VOL. XVII. No. 5

MAY 1932

MECCANO MAGAZINE

AVIATION OF THE FUTURE
(see page 330)

6D.

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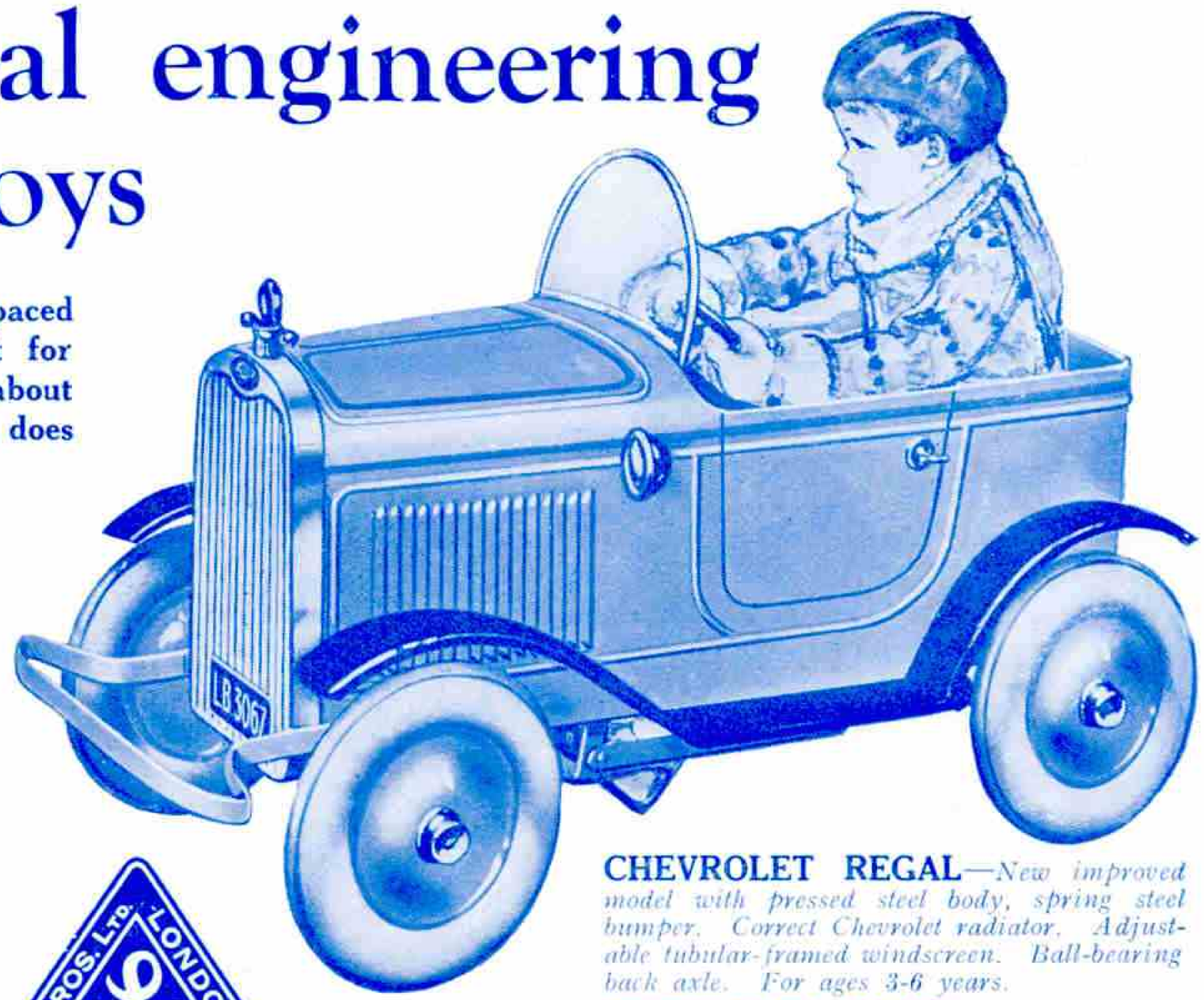
Tri-ang Toys are thorough-paced engineering jobs. Made not just for show, but for work. Everything about them that can be made to work, does work. For their makers, Lines Bros. Limited, very well know that nothing less than that is enough for the stern young realists of the rising generation. Consider these cars, for instance. Pressed steel bodies, adjustable windscreens, ball-bearing back axles, half-elliptic springs—bonnets that open, lamps that light: isn't this the sort of thing the young idea talks in his sleep about? Get in touch with the Tri-ang agent and hear all about the whole Tri-ang range.



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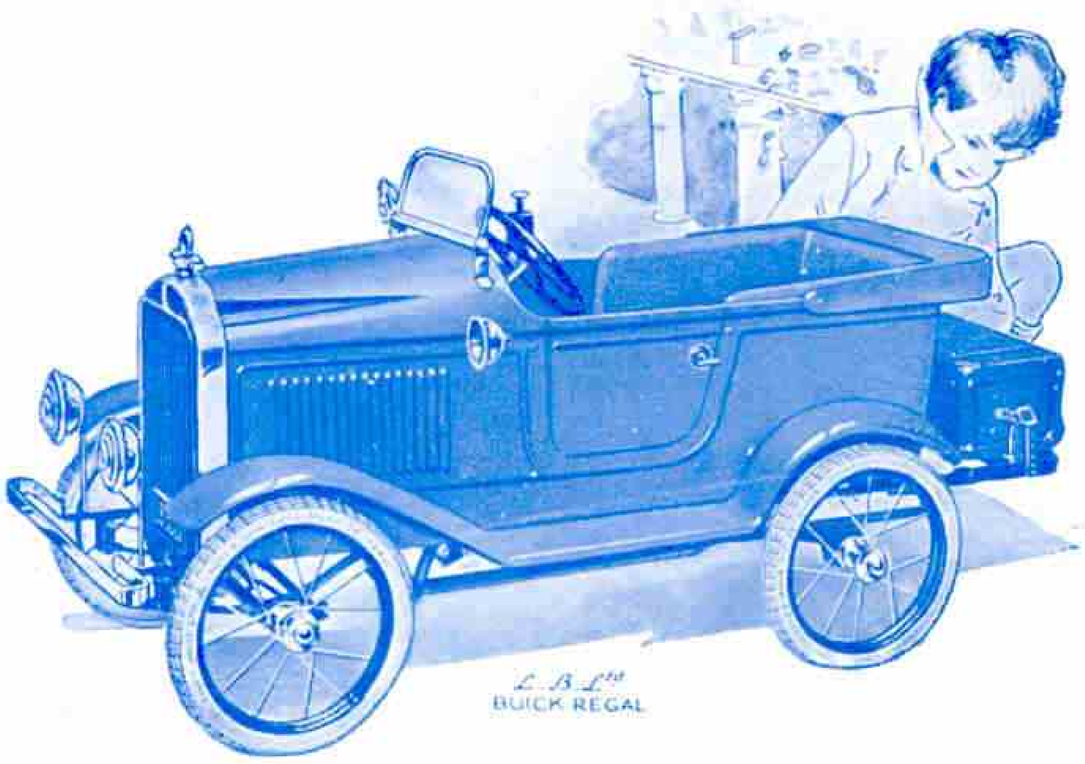
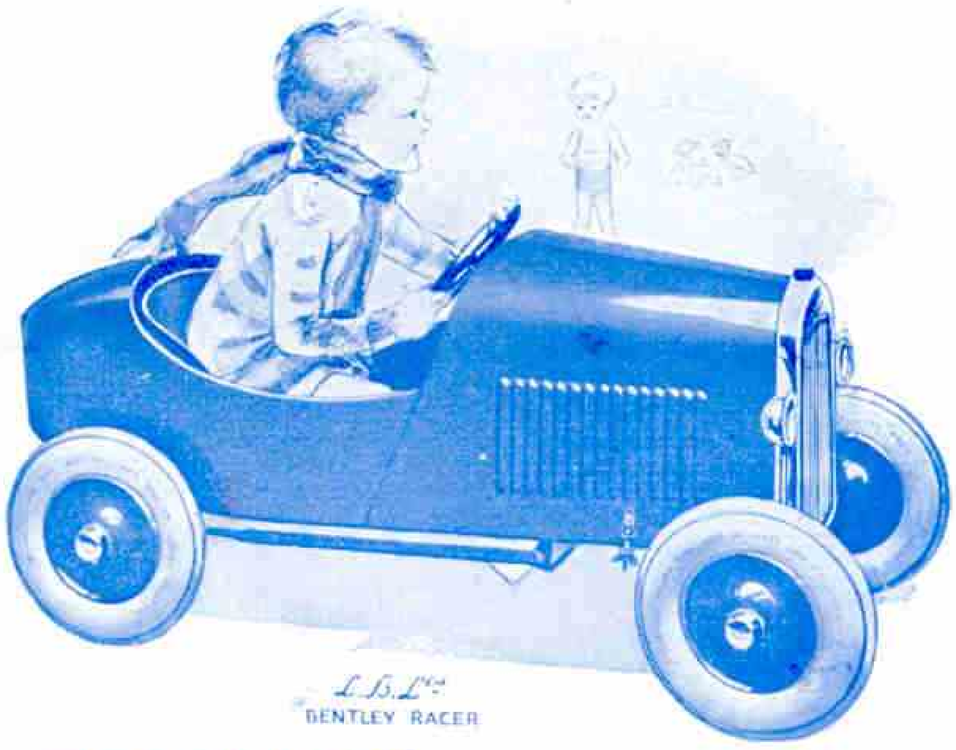
CHEVROLET REGAL—*New improved model with pressed steel body, spring steel bumper. Correct Chevrolet radiator. Adjustable tubular-framed windscreen. Ball-bearing back axle. For ages 3-6 years.*

CHEVROLET MAJOR *is longer. For ages 4-8 years.*



BUICK REGAL—*Pressed steel body on half-elliptic springs. Ball-bearing back axle. Adjustable tubular-framed windscreen. Fitted for two electric lights. $1\frac{1}{16}$ in. white auto tread tyres on tangent spoked wheels. Luggage grid and trunk. For ages 4-8 years.*



BENTLEY RACER—*All steel body, lift-up bonnet. Adjustable seat. Plated model Bentley radiator. 9 in. steel balloon wheels, $\frac{3}{8}$ in. rubber tyres. Rubber pedals. For ages 3-6 years.*

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NEXT MONTH: "ARTISTS OF PREHISTORIC TIMES." PUBLISHING DATE: 1st JUNE

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With the Editor

Age-long Secrets Revealed

Recently I have had an interesting correspondence with a reader, only 14 years of age, who has had the distinction of discovering the fossilised remains of a prehistoric crocodile. This is W. B. Harland, who lives at Scarborough, but is a pupil at Bootham School, York. During a holiday last year he decided to visit the shore of Runswick Bay, a few miles north of Whitby, in order to search for fossilised shells of small molluscs, known as zonal ammonites, that flourished in that locality millions of years ago. At that time great tracts of England were sunk at the bottom of immense stagnant lakes, and the climate of the parts of the country remaining above water was warmer and more genial than it is to-day.

While Harland was eagerly looking for ammonites, he unexpectedly came upon traces of a larger creature. The first indication was the discovery of the fossilised femur of a prehistoric reptile, and on looking round he found a practically complete set of bones of the right hind leg, together with a portion of the spine. In great excitement he continued the search, and after a few hours' work succeeded in tracing 35 bones on or near the surface. The most prominent discovery was a well-preserved tooth 5 in. in length. This was found about 6 ft. from the first leg bone, while an isolated rib and numerous vertebræ, or sections of backbone, were scattered about.

Expert workmen preparing the fossilised bones of a prehistoric crocodile for exhibition in the Natural History Museum, South Kensington. The remains were found at Runswick Bay by W. B. Harland, Scarborough, and our photograph is reproduced by permission of "The Yorkshire Evening Post."

Harland was careful not to disturb the bones, but he made sketches of them as they lay. Eventually his drawings and description were sent to the Natural History Section of the British Museum, South Kensington, where the bones were recognised as those of an interesting extinct variety of crocodile known to scientists by the formidable name of *Steneosaurus brevior*. A further search revealed the skull and other bones, and these have now been cut out of their limestone casing, in which they probably have spent about 150 million years, and fitted together in order to reveal the skeleton of the crocodile that came to an untimely end at what is now Runswick Bay.

Harland is to be congratulated on the keenness that led to his discovery, and the story is an interesting incident in the work of unravelling the history of the earth and of the amazing creatures that have inhabited it. Our knowledge is gained literally by digging, for the bones of such giant reptiles as saurians, and those of the prehistoric mammoths, mastodons and other extinct creatures, have been unearthed by spade work. The remains of ancestors of our own race also have been discovered in this manner, and in an early issue of the "*M.M.*" I hope to tell the fascinating story of the earliest human beings thus revealed.

Bible Story Verified

Digging also has re-created the vanished civilisations of Egypt, Mesopotamia, and other ancient lands, for the ruins of the buildings erected in these countries thousands of years ago have been covered with sand and soil that has had to be removed in order to enable us to examine them. It is interesting to find that work of this kind has verified for us many of the incidents recorded in the Bible. For instance, a deep, mysterious layer of clay discovered during digging in the tombs of the kings of Ur, the ancient Chaldean city, was eventually recognised as the work of the great flood of Bible times. More recently the well-known story of the fall of the walls of Jericho also has been verified. Ancient Jericho had two walls, and careful digging has shown that both fell, the stones of the outer wall actually being scattered on what once was a slope outside the city. The western wall appears to have been damaged by an earthquake and, as the district is subject to movements of this kind, an earthquake may well have been the cause of the downfall of Jericho.

The excavations at Jericho have had an interesting development, for they have shown that the city was taken by the Hebrews about 1407 B.C., and urgent letters written about the same time have been discovered in Egypt in which the governors of cities in Palestine asked the Pharaoh for protection against the "Habiru." These letters, which are inscribed on tablets of clay, almost certainly refer to the Hebrews. The appeals were made to Amenhotep III, who became Pharaoh in 1413 B.C.; and the date of the letters is almost exactly 40 years later than that at which his predecessor, Amenhotep II, the Pharaoh of the Exodus, came to the throne. Thus the discovery of the clay tablets that have been hidden in the earth at Tel el Amarna for nearly 3,500 years seems to confirm the tradition that after leaving Egypt the Hebrews wandered 40 years in the wilderness before they appeared in Palestine.

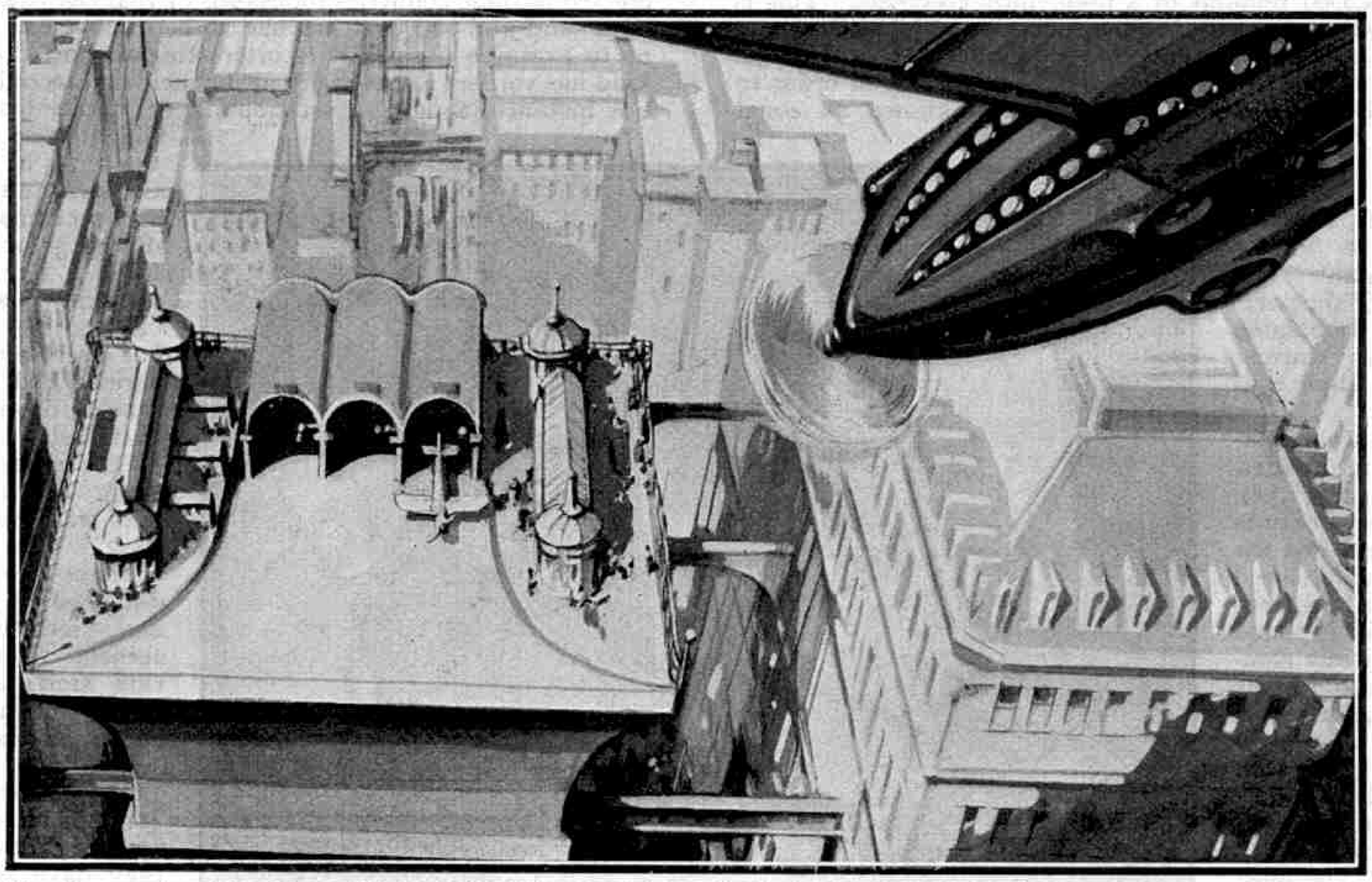
Earthquakes are frequently experienced in the valley of the Jordan, and in 1927 a severe shock caused a great part of a cliff to fall bodily into the river, where it dammed the flow of water, so that for nearly 24 hours it was possible to pass on foot from one bank to the other. This may explain why the Israelites, led by Joshua, appeared suddenly on the west bank of the river just before the siege of Jericho. If an earthquake dammed the waters of the Jordan, exactly as in 1927, the invading Hebrews would be able to cross without difficulty, and the psalmist described the event almost literally when he said that "the mountains skipped like rams and the little hills like lambs" when the waters of Jordan were driven back.

Aviation of the Future

Aeroplane Landing Grounds on City Skyscrapers

ALL who are interested in aeroplanes and airships have probably tried at some time or other to imagine what life on the earth will be like in the days when aircraft will be as familiar and as largely used as trains and motor vehicles are to-day. There is no doubt that in the future giant aeroplanes and airships will fly regularly to all parts of the world on definite air routes, and will be used as a matter of course for passenger traffic of all kinds, as well as for the carriage of goods. There is room in the air for enormous fleets of machines, and no limit need be imposed upon their speeds.

In trying to form a picture of the aviation of the future, the first thing naturally is to visualise the type of aircraft that will be used. Will these be aeroplanes or airships? There is no doubt that greatly improved aeroplanes will be employed on an ever-increasing scale, for they climb more swiftly than lighter-than-air machines, and are more easily manœuvred. The airship has the advantage that its natural buoyancy enables it to fly and to remain aloft even when its engines are out of action, whereas an aeroplane depends entirely on its speed for its support. On the other hand the great bulk of the airship is a source of weakness, and recent events have suggested that it is not sufficiently reliable to make it useful in all weather conditions. It is probable that the airships of the future will be larger and stronger than those of to-day; but they will not necessarily be much heavier, nor will they require much additional gas to lift them, for they will be made of strong but extremely light alloys. These alloys may contain aluminium, which is largely used in modern aircraft construction, but lighter metals, such as magnesium, also may be employed, and others now regarded as chemical curiosities may become available. For instance, ores of beryllium are abundant, and eventually it may be found possible to extract this metal easily and cheaply, and to use it to advantage in aircraft construction.



The air passenger of the future will be rushed swiftly upward in an elevator to the flat roof of a giant building, where he will find a completely-equipped aerodrome with air liners leaving for, or arriving from, all parts of the world.

Light alloys will be used also in building aeroplanes, and a second development that will lead to wonderful advances in aircraft design will be the production of more powerful engines. At first the petrol engine will be replaced by one of the Diesel type, and refinements in design, together with the use of light alloys, will lead to the production of engines developing far more power for their weight than those of to-day. The fuel employed will be burned more completely and there will be less waste of both oil and air. At present engines simply admit the air itself to the cylinders, along with the fuel, but in time this important agent in combustion may be as carefully refined for use as the oil itself, and either pure oxygen, or carefully prepared mixtures of oxygen with nitrogen or some other diluting gas, may be employed.

Petrol or oil engines will not be installed in the aircraft of the distant future, however, for the supplies of oil available are by no means unlimited. This is already realised, and suggestions have been made that when the earth's underground stores are exhausted, a suitable fuel may be made by distilling coal. A similar difficulty arises, however, for although unworked coal is more abundant than is generally realised, it will not last for ever, and when it is finished a new source of power must be looked for. As far as we can see, it will then be necessary to make use of the direct heat of the Sun. In all probability enormous power plants will be established at suitable places in the tropics, and there the Sun's rays will be concentrated by means of mirrors upon enormous boilers in order to produce steam, or to vaporise some other liquid than water, for the purpose of driving electric generators.

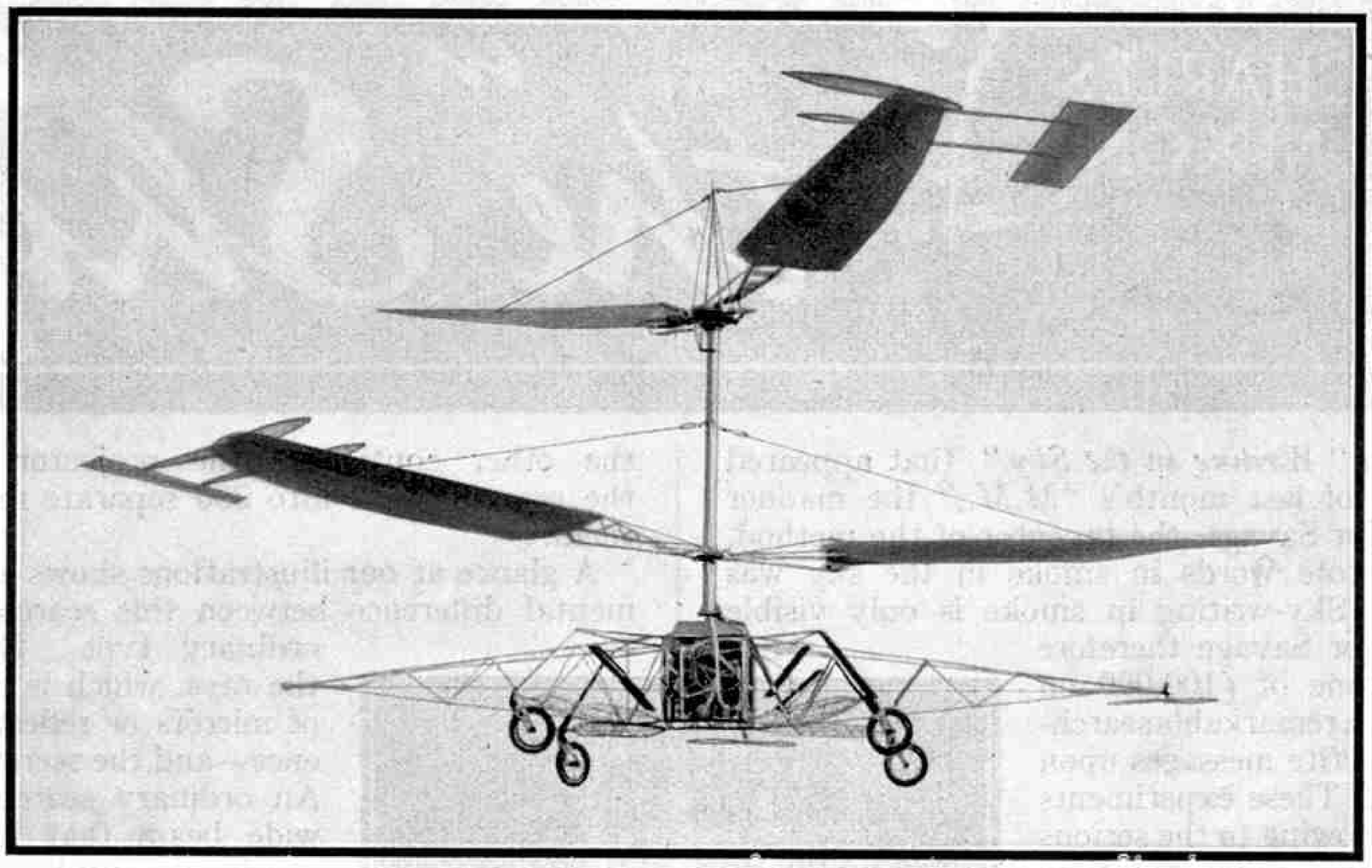
An interesting possibility is the direct development of electric power from the Sun's rays. When light falls upon certain metals, such as sodium, potassium and rubidium, electrons or tiny particles of negative electricity are shot off from them. If an electrode in a glass bulb containing an inert gas under low pressure is coated with one of these metals, or a suitable compound of it, and a second electrode is given a positive charge, the electrons expelled under the influence of light flow between the two electrodes and constitute an electric current that may be made to pass through circuits outside the bulb.

An arrangement of this kind is called a photo-electric cell. Only minute currents have been generated in the calls so far constructed, but it is reported that a German engineer has invented one giving a current that is strong enough to drive a small motor. The photo-electric cells of the future may be even more powerful, and the power stations built in tropical lands to make direct use of the Sun's rays may have no boilers or alternators, but may consist only of gigantic photo-electric cells that transform the light falling upon them into electricity.

Even a development of this kind may not be the end of the wonders of electrical science. It would have been practically impossible for anyone living about 150 years ago to have foreseen Faraday's discovery of the principle of the dynamo, and to have imagined the changes this was to bring about. It is quite possible that discoveries of an equally unexpected character will change completely the progress of science and engineering, and also will affect aircraft design.

The power from the great tropical power stations will be distributed to different parts of the earth through enormous cables,

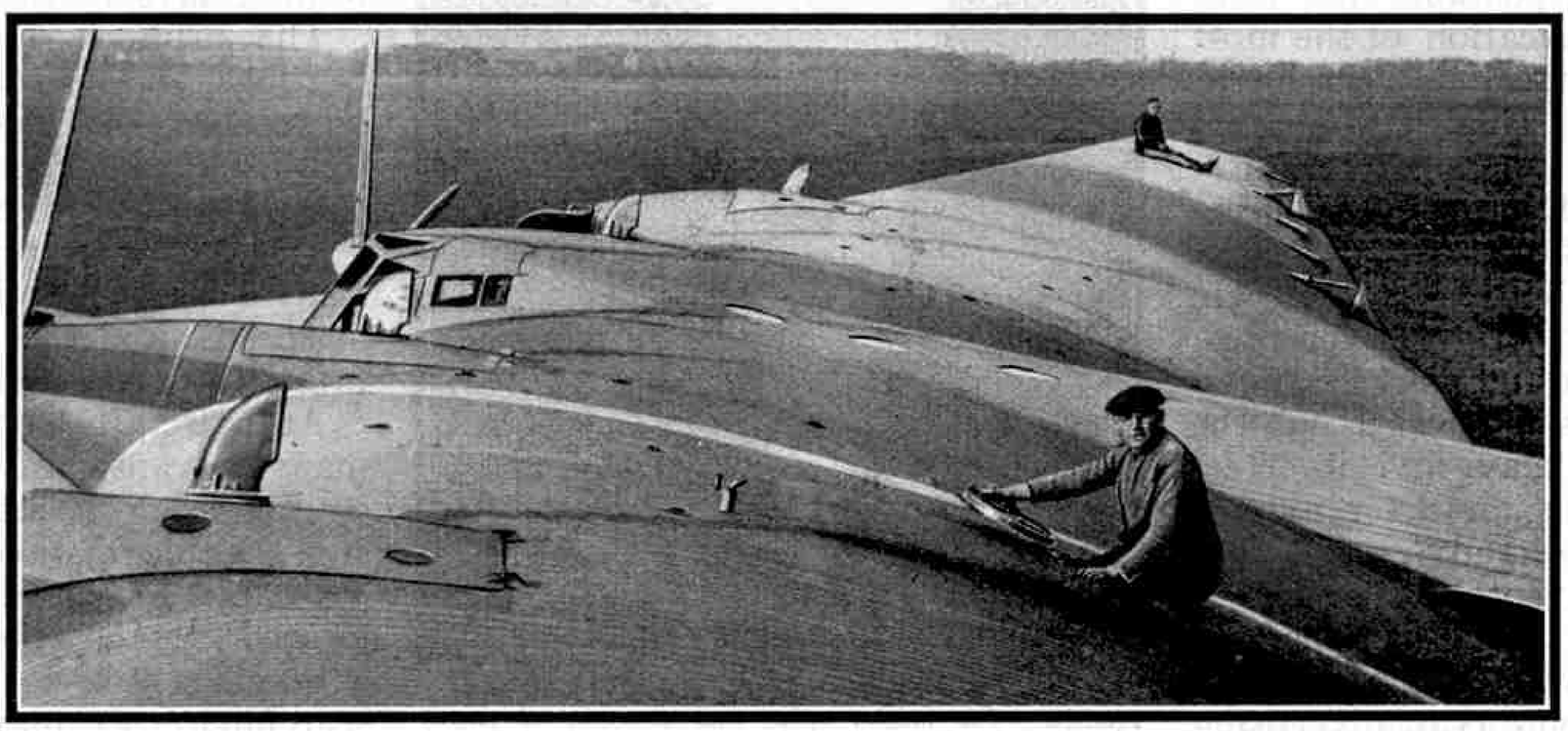
or perhaps radiated from aerials as wireless signals are to-day. Power radiated through the ether could be employed to drive electric motors. If transmitted by cable it could not be used directly in airships or aeroplanes, of course, but could be applied indirectly through accumulators. Installing these would lead to an unwelcome increase in weight, however, and it seems more probable that other means would be devised. For instance, the power developed may be used at the generating stations for liquifying air or some other convenient gas. The liquid may be stored under pressure in cylinders of standard size and shape that may be mounted on aircraft, where the opening of valves will transform the machines into rockets that develop their power continuously, instead of in one gigantic burst as is the practice with ordinary firework rockets of to-day. Engines of this kind would give out no poisonous fumes, and the gas employed as the source of power would not be destroyed, but would be returned to the atmosphere.



The D'Ascanio helicopter, a machine that has made successful flights in Italy. Its design suggests the lines on which aeroplanes may be developed. Photograph by courtesy of Lt. Col. P. F. Bitossi, Air Attaché to the Italian Embassy.

It is not difficult to visualise the form of the flying machines of the future, for these certainly will develop on well-recognised lines, and in particular, efforts will be made to ensure perfect streamlining in order to reduce head resistance to a minimum. A bulky airship cannot be so effectively treated in this manner as an aeroplane, and it seems likely that these vessels will be used for work at comparatively low levels. They will be of giant size and will be roomy and comfortable, and the engines and the accommodation for passengers will be within the envelope. The gas employed probably will be helium, for this gas is safer than hydrogen, and the development of light alloys will compensate for the loss of lift that its use involves.

The aeroplanes of the future will not have the heavy fuselages and cumbersome tail units of present-day machines, but will realise the ideal of the all-metal all-wing monoplane, or a machine in which every surface contributes to the lift. Except the "Pterodactyl," or tail-less aeroplane, designed by Captain Hill, the nearest approach to this ideal at present is the Junkers G.38 machine described on page 972 of the "*M.M.*" for December, 1931. The wing of this aeroplane is thick, and the engines and part of the passenger accommodation are contained within it.



The upper surface of the gigantic wing of the Junkers G.38, a monoplane that has passenger accommodation inside the wing. This photograph is published by the courtesy of Junkers-Flugzeugwerke, A.-G.

A machine of the future designed on the "all-wing" principle will be much larger than those of to-day, and its wing will be sufficiently deep to provide accommodation equal in luxury and comfort to that obtainable to-day on the greatest Atlantic liners. Passengers will be cut off from the cold and rarefied atmosphere at the heights at which the aeroplane will fly and will be supplied with clean air at a comfortable temperature and normal pressure. Such a machine will travel through the upper reaches of the atmosphere in much the same manner as a submarine traverses the depths of the ocean, but with far more comfort, for voyages through the air will be made in brilliant sunshine above the clouds. It is impossible to suggest the limit to the speeds attainable, but these may approach 1,000 m.p.h., and a journey by air round the world may be possible in 24 hours. Travelling to Australia then will be a mere 12 hours' trip, and will be less fatiguing than a journey from London to Paris is to-day. A curious feature of the high speeds to be attained is that it will be necessary to cool the machines, for when aeroplanes fly at more than 360 m.p.h. the rush of air ceases to have a cooling effect, and the machines are heated.

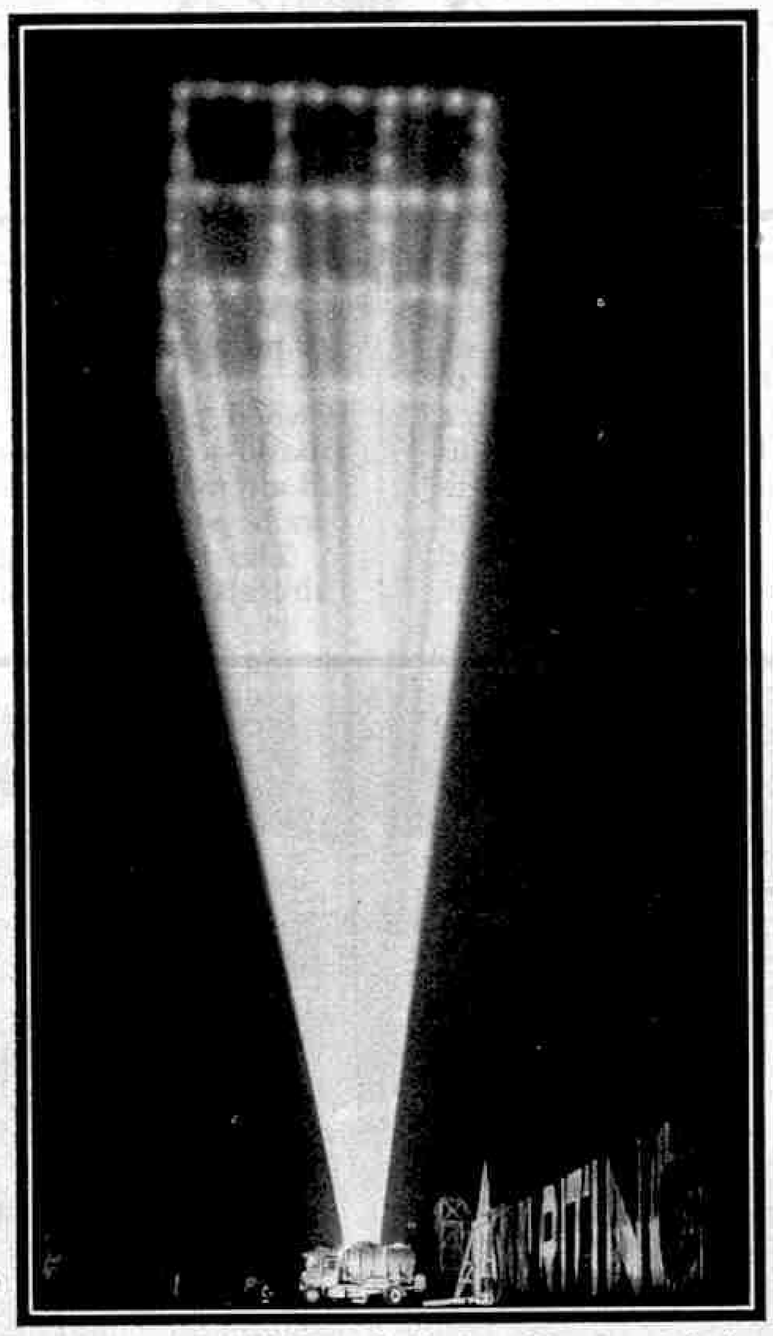
Aeroplanes on the regular long-distance air routes of the future will be fitted with superchargers and propellers of variable pitch to enable them to fly at tremendous heights in order that they may overcome the handicap of the resistance of the denser air. At heights of 10 miles or more they also will keep clear of the lower air routes, which will be reserved for machines on local services, airships and privately owned aeroplanes. It is probable that the atmosphere will be marked out in zones, each devoted to the use of a particular type of aircraft, or kept for special services, and strict regulations for air traffic will be framed in order to avoid accidents.

The landing grounds, or stations of the air necessary when aircraft are in full use, will be established in all populous centres and not at considerable distances, as at present. Open spaces suitable for this purpose can scarcely be laid out in the heart of London, Paris, New York or any similar city, and the roofs of the gigantic buildings of the cities of the future therefore will be employed. Express lifts will give easy access to these aerodromes and it will be less difficult to start a journey by air than it is at present to begin one by train.

The establishment of air stations in the hearts of great cities is not an idle dream, for similar proposals already have been made. A mooring mast has been erected on the Empire State Building, the highest building in New York, in order to enable American airships to anchor themselves above the very centre of New York instead of being compelled to descend at a distant aerodrome, leaving passengers to travel to their destination by rail or road. Proposals also have been made to level the roofs of large stations in order to provide landing grounds for aeroplanes. The shock of landing with a machine of present day design is considerable and the provision of roofs of sufficient strength to withstand it would be costly; but the aeroplanes of the (*Continued on page 388*)

IN an article on "*Writing in the Sky*" that appeared on page 254 of last month's "*M.M.*," the manner in which Major Savage, the inventor of the method, and his pilots wrote words in smoke in the sky was fully explained. Sky-writing in smoke is only visible by day, and Major Savage therefore has spent a fortune of £100,000 on experiments with a remarkable searchlight that would write messages upon the sky at night. These experiments became necessary owing to the serious restrictions imposed upon day-time sky-writing by our unfavourable climate. In this country nights offer suitable conditions for sky-writing more often than days, and it is thought that four nights out of five may be relied upon.

A remarkable result of the experiments is that, while they have made night sky-writing possible, they have also led to the creation of the most powerful and ingenious searchlight in the world. This has aroused greater interest amongst technical men for its usefulness in detecting aircraft flying at night than for its sky-writing possibilities, and as there has been an outcry against the prospect of seeing our night sky exploited as a vast advertising background, the new searchlight may find its chief application in our air defence force rather than among advertising contractors. The inventor believes that it has a future in both directions, and as he is fully aware of the nuisance that it might become as an advertising medium if used recklessly, he therefore proposes to allow nobody the liberty of abusing it.



The Savage searchlight projecting a grid pattern of nine squares. The height, speed and direction of enemy aircraft revealed by the network may quickly be worked out.

Much of the detailed design of the new searchlight is the inventor's secret, but the writer is permitted to give a general description. The intensity of the source of light used in no less than 3,000,000,000 candle power, and the supply of current is obtained from the standard Tilling-Stevens petrol-electric chassis upon which the searchlight is mounted. This supply also drives the unit. The searchlight itself consists of a drum of large diameter that has two main compartments, one containing the means for generating the light, and the other containing the projector that breaks up the mass of light into 300 separate rays and transmits them.

A glance at our illustrations shows at once the fundamental difference between this searchlight and one of ordinary type. The separation of the rays, which is caused by a series of mirrors or reflectors, is the difference—and the secret of the invention. An ordinary searchlight throws one wide beam that loses intensity towards its peak, but the Savage searchlight projects each of its 300 rays in the form of a parallel beam. Collectively these form a range of grid patterns on the sky. They lose no intensity at their maximum altitude of 16,000 feet, and thus the Savage beam widens out without losing power, whereas an ordinary beam tapers to nothing, as it were.

The drum is mounted on roller bearings, and in spite of its size may be rotated very easily, and the projector end elevated from a distant control box. This control is obtained with electrical power, while the control switch permits of a wide range of speeds, and the projector may be rotated and elevated at the same time.

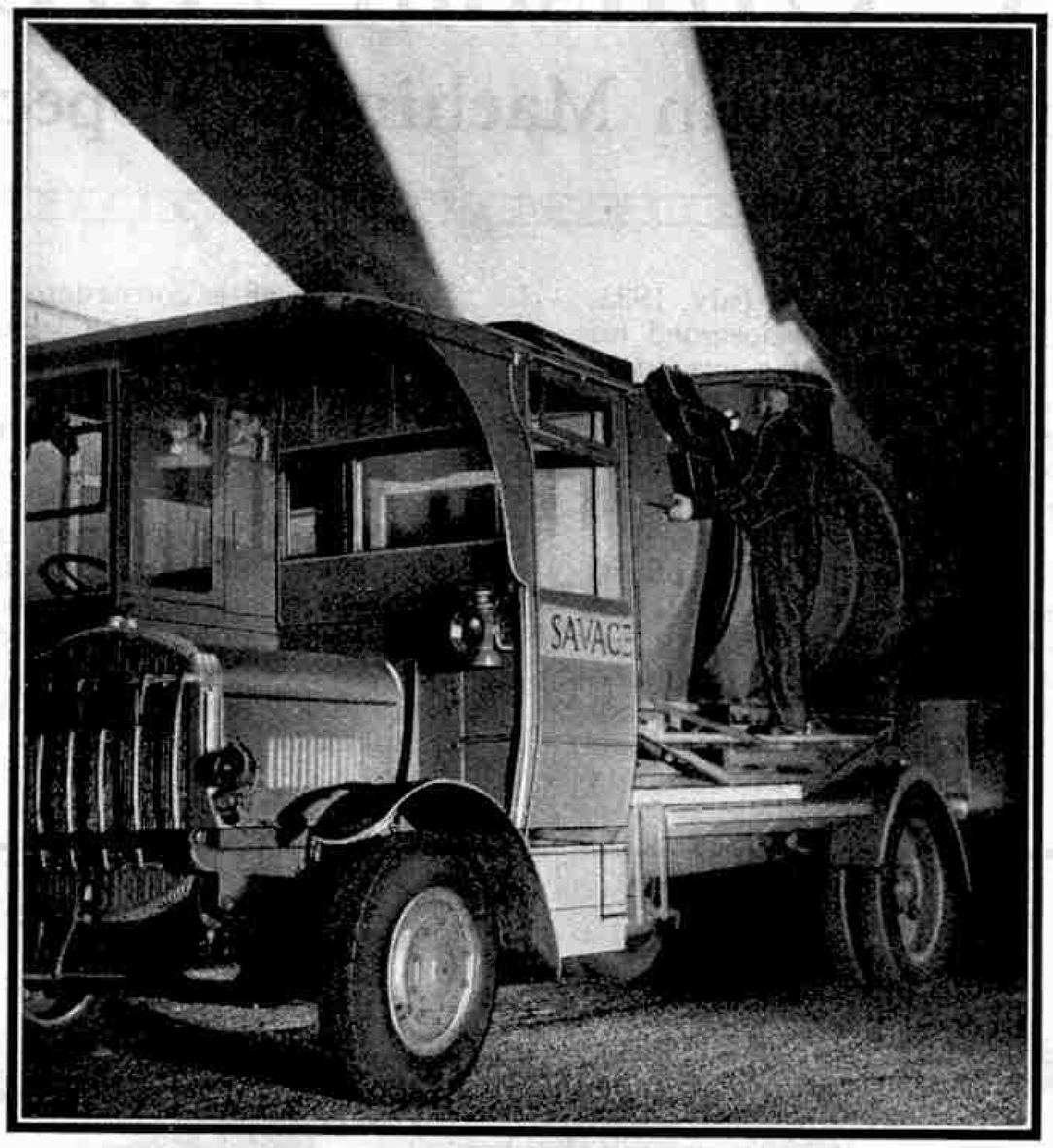
Anti-aircraft batteries would find many advantages in being able to control such a searchlight from a considerable distance, for it is not advisable for the searchlight to be located close to the guns.

Coming now to the uses of this searchlight, we may first discuss its special advantages for detecting enemy aircraft. It is at present designed to be effective at a height of 16,000 ft., and with this range the beam should reach any bombing aircraft or airship that is not content with dropping its bombs haphazardly. We may reasonably assume that our own bombers are not inferior in performance to those of foreign powers, and the Handley Page twin-engined all-metal bomber "Hinaidi," an example of a modern British machine, can reach a ceiling of 14,500 ft. with a useful load of bombs. It therefore may be said that in a contest between the Savage searchlight and an enemy raider,

only foggy conditions would give the latter a decided advantage. And even then, although fog would permit a low approach over a town, it probably would prevent the bomber from attaining the best objective. Fighting aircraft can operate at far greater heights than 16,000 ft., of course, but then could not carry bombs of great destructive force.

For detecting raiders, the Savage searchlight can throw upon the sky a grid of light that will trap them and also enable the battery to work out their height, speed and direction very quickly. This grid pattern, may consist of various numbers of squares, and our illustrations show a grid of 16 squares and one of nine squares.

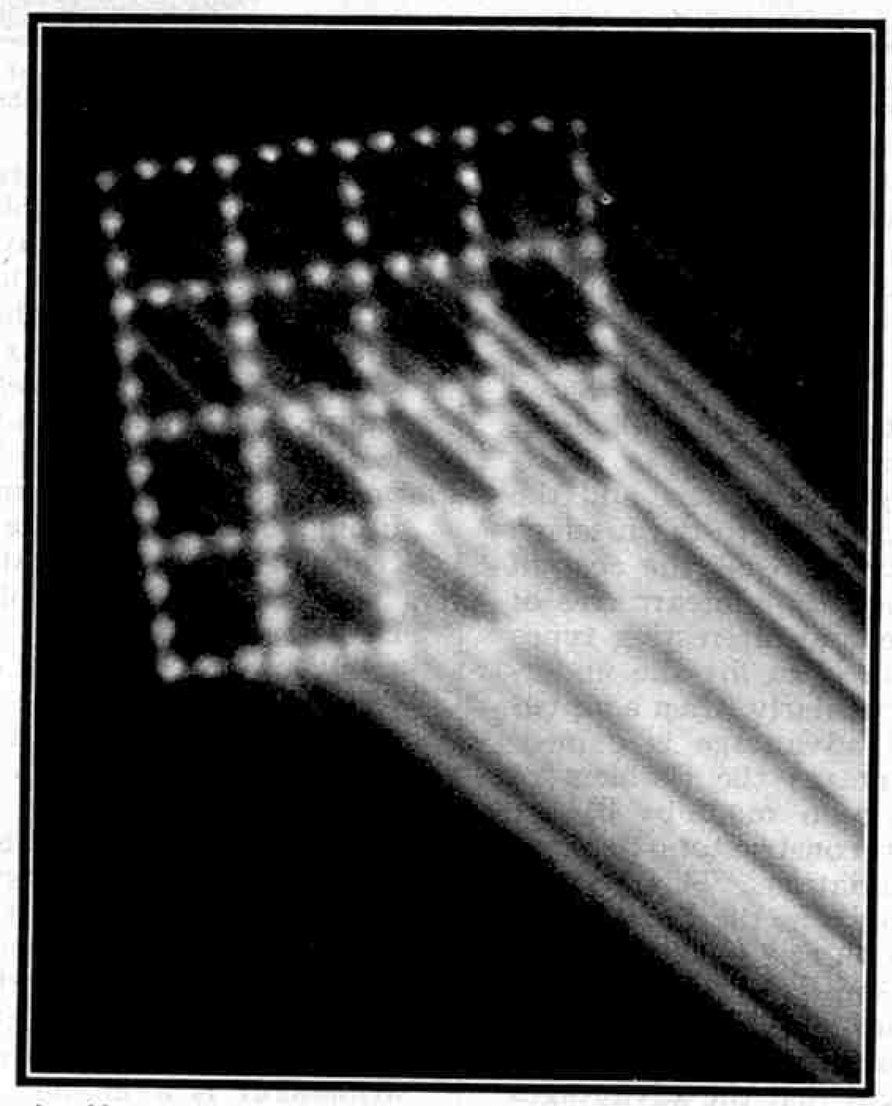
The 16-square grid covers one square mile at a height of 16,000 ft., and in a second it may be contracted to the size of one of its squares, measuring 1,000 ft. each way. It then looks like a set of illuminated squares separated by a set of dark squares. The contraction also results in an increase in the intensity of the light, thus making it more effective.



The Savage searchlight mounted on a petrol-electric chassis from which the necessary current is obtained. The movements of the beam may be controlled from a distant point by means of remote control apparatus.

A raider would come into view every time he crossed a line in the grid, and he would not see the lines of light until he was actually in them. The perplexity of the first raider caught in this net of light may be imagined, for whichever way he turns a mysterious beam of light will reveal him. If he seeks cover in the dark areas of the grid he will have to circle, and then a slight movement of the whole grid will again expose him so quickly that he will begin to think that the whole sky is a network of rays! It may be assumed that he will not be able to escape, and the guns will end his predicament.

Another use of the searchlight is for guiding aircraft down at night. It can throw a horizontal beam, only 5 ft. 6 in. in height, that will reveal the landing ground without dazzling the pilot. Airmen have already confirmed its superiority in this respect over other means of illumination, and it may be added that a newspaper can be read with ease when held in the horizontal beam five miles away. Although the light will not illuminate fog, the infra-red rays in it will pierce fog when it is necessary to let an approaching aeroplane know that the concealed aerodrome is beneath.



A grid pattern of 16 squares projected on unseen clouds. This can be contracted in a second to the size of one square, and it would be almost impossible for an enemy machine caught in the beam to escape.

Sometimes aircraft are recalled at night by a searchlight beam directed vertically into the sky in the shape of a fan. As this recall signal can easily be copied by an enemy, however, the Savage searchlight has been designed to project rays that will form a code message.

The invention may be used as a naval searchlight, and this leads us to conjure up the wonderful spectacle of a battleship illuminating the complete circle of the horizon and much of the intervening water, thus becoming practically the pin centre of a vast wheel of blinding light. Such a spectacle is possible with six Savage searchlights. Each can project a beam covering an angle of 60°, so that six mounted on a battleship would cover the full 360° of the circle. Every vessel within view would be revealed and trapped, unless it had enough speed to get beyond the battleship's horizon. This would be a very simple searchlight system, and its introduction would do away with the present necessity of sweeping the seas with single beams in order to keep an enemy in sight.

For its final purpose, that of sky-writing at night, the Savage invention requires no fundamental change in its mechanism. The written word is merely one of the many patterns that it can throw upon the sky. We have referred to the grid pattern, but patterns taking the shape of ovals, arcs and straight lines are very simply obtained if considered more suitable for certain classes of detection work.

A word may be written letter by letter or projected immediately as a whole. So far the longest piece of sky-writing at night has contained 16 letters, but it is already possible to use 24 letters, while a bigger projector, or two used in conjunction, would be able to write even longer sentences. A message has been read clearly from a distance of seven miles, and one night when the operator projected the beam on a cloud retreating over the horizon, the word spelled out was read 15 miles away.

The writing does not take up much space in the sky. For instance, the word "SAVAGE," only measures 1,700 ft. in length at a height of 5,000 ft. Curiously enough, a clear night does not provide the necessary conditions for casting a message. A curtain in the form of cloud or mist is required, and the best

(Continued on page 350)

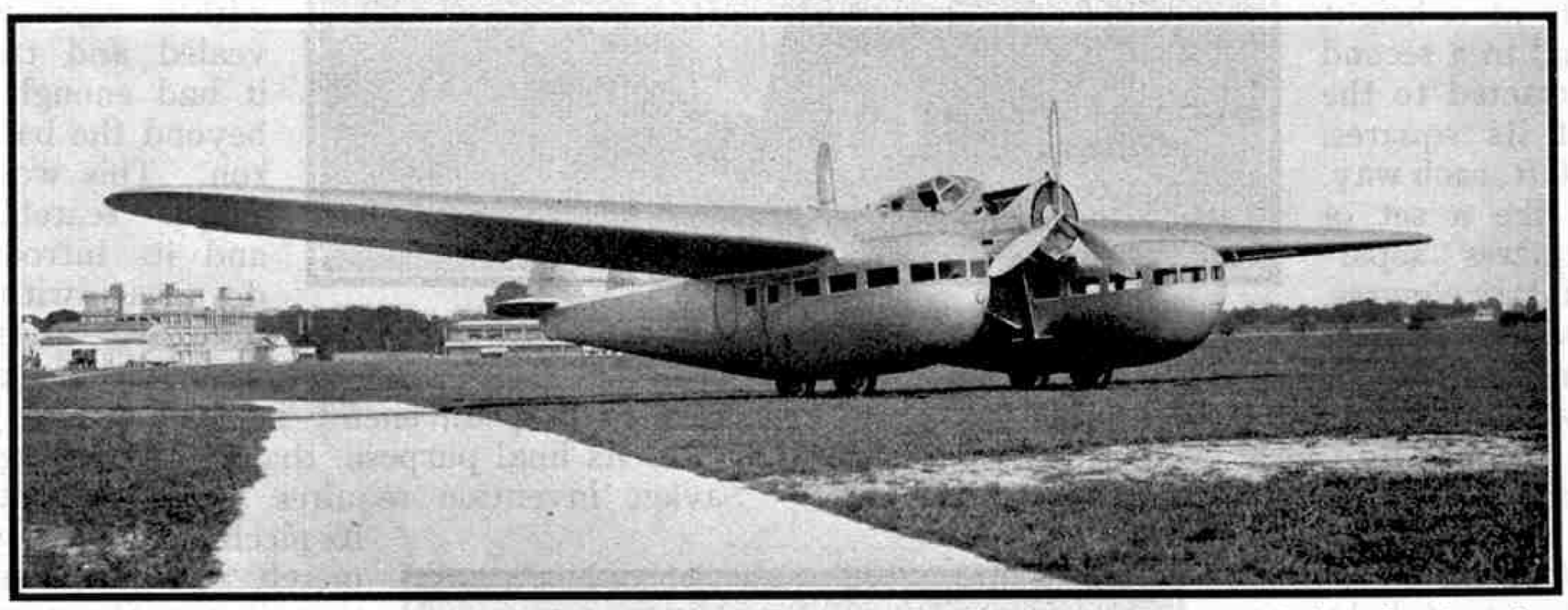
More Unusual Aircraft

French and American Machines of Special Design

IN an article published on page 558 of the "*M.M.*" for July, 1931, we described unusual types of aircraft that were designed for the purpose of making flying safer. Interesting machines differing in appearance from ordinary aeroplanes have been designed for other purposes, however, and in the present article we intend to deal with aircraft in which unusual methods have been employed in order to improve their performance or to fit them for special work.

In the early days of flying the constructor considered his efforts sufficiently rewarded if his machine was able to rise from the ground and maintain flight under its own power. Designers now require aircraft to fulfil many special conditions. For instance, a military machine must be capable of attaining very high speeds and of carrying out intricate manœuvres, the amount of fuel consumed, and the cost of operation generally, being of secondary importance. On the other hand, while speed and endurance are desirable qualities in a civilian machine, expense is a very important consideration.

Fortunately the ends of designers of both types of aircraft may be gained by a close study of streamlining, or the science of shaping the fuselage, struts and other parts of a machine to offer the least possible resistance to the flow of air past them. An efficiently streamlined fighting machine is able to take full advantage of the power of the engine fitted to it, while an aeroplane designed for use in civil aviation in which due attention is paid to this problem requires an engine of lower power than otherwise would be the case.



The two boat-like hulls of the Blériot 125, which give the machine such an unusual appearance, almost completely enclose the undercarriage and thus reduce air resistance. Our photograph of this interesting aeroplane is published by permission of Blériot-Aéronautique.

The ordinary type of undercarriage fitted to an aeroplane is responsible for about 15 per cent. of the machine's drag, or resistance to the airstream. This is a very large proportion, and the use of an undercarriage that could be withdrawn into the fuselage when not required therefore should greatly decrease the cost of operation of a machine or increase its range. Undercarriages of this kind are said to be retractable, and several interesting types have been designed. The machinery required to lift the undercarriage usually is so weighty, however, particularly when adapted for use in large aeroplanes, that no real advantage is gained.

A striking attempt to solve by other means the problem of reducing drag due to the undercarriage has been made by Blériot Aéronautique, the French firm of aircraft constructors directed by M. Louis Blériot, one of the pioneers of aviation. The interesting machine designed for this purpose is known as the Blériot 125. It is a high wing monoplane and is fitted with two fuselages, each of which is shaped like the hull of a boat. As will be seen from our illustration of this machine, this form of construction gives a very large frontal area, but the wheels of the undercarriage only just protrude below the fuselages, and it is thought that the advantages thus obtained will more than compensate for the drag induced by the size of the surface presented to the airstream.

Two engines mounted in tandem are employed in the Blériot 125, and these are carried in a housing that is placed between the fuselages, the pilot's cabin occupying a similar position. Two pairs of tandem wheels are provided. Naturally the bottoms of the hulls are very close to the ground, and it seems probable that a forced landing on a rough surface would cause damage.

The machine is constructed throughout of wood and is a cantilever monoplane with a wing span of 96 ft. 5 in. It may be fitted with any two engines developing a total of 1,000 h.p. and has a tare weight of 8,640 lb. and a gross weight of 13,860 lb. The estimated maximum speed of the machine is about 127 m.p.h. and it is capable of carrying 12 passengers, six being accommodated in each hull.

The Blériot 125 was first exhibited at the Paris Aero Show of 1930. Many engineers were frankly sceptical as to its value, but its novel shape was a great attraction to most visitors and details of its performance under all conditions will be awaited with interest It has been suggested that the use of a single large hull would lead to greater efficiency, but this is a problem that can only be solved by practical trials.

In another unusual type of aircraft, also French in origin, the customary long tapering fuselage is replaced by a shorter one that provides accommodation for the pilot and the engine, and is connected to the empennage, or tail unit, by a short girder. This type of machine is made by the company directed by M. Louis Breguet, and the purpose of the designer has been to reduce air resistance. The form of construction adopted enables flying wires to be eliminated, and in addition the pilot is given a better view than may be obtained from most French machines.

So far only two machines of the new type have been produced and these are known as the Breguet 27 and the Breguet 41 respectively. The Breguet 27 is a two-seater biplane in which any engine developing 450 h.p. to 600 h.p. may be fitted, and probably is the only French machine that has been designed as a general purpose aeroplane, for machines of this type are not in use in the French Air Force. The Breguet 41 is a larger machine and is a twin-engined multi-seater fighter.

The Breguet 27 was illustrated on page 971 of the "*M.M.*" for December of last year. It is a biplane, and its lower wing is very small, having a span of only 24 ft. 11 in., while that of the upper wing is 59 ft. 9 in. The wings are joined at their tips by two spars arranged in the shape of a V, and the lower one is of the cantilever type and requires no external bracing. Duralumin sheeting covers both planes.

The steel girder that is the most unusual feature of the Breguet 27 is about 32 ft. in length, and extends from the engine mounting in front to the tail unit at the rear. The short fuselage is built round it and this method of construction has enabled the designer to provide very comfortable cockpits. These are provided with adjustable seats in addition to wind-screens and arm-rests, while dual control apparatus is fitted and accommodation for the usual armament is available. The engine mounting forms a separate unit and a fireproof bulkhead intervenes between it and the cockpits. The fuel is carried in the lower wing.

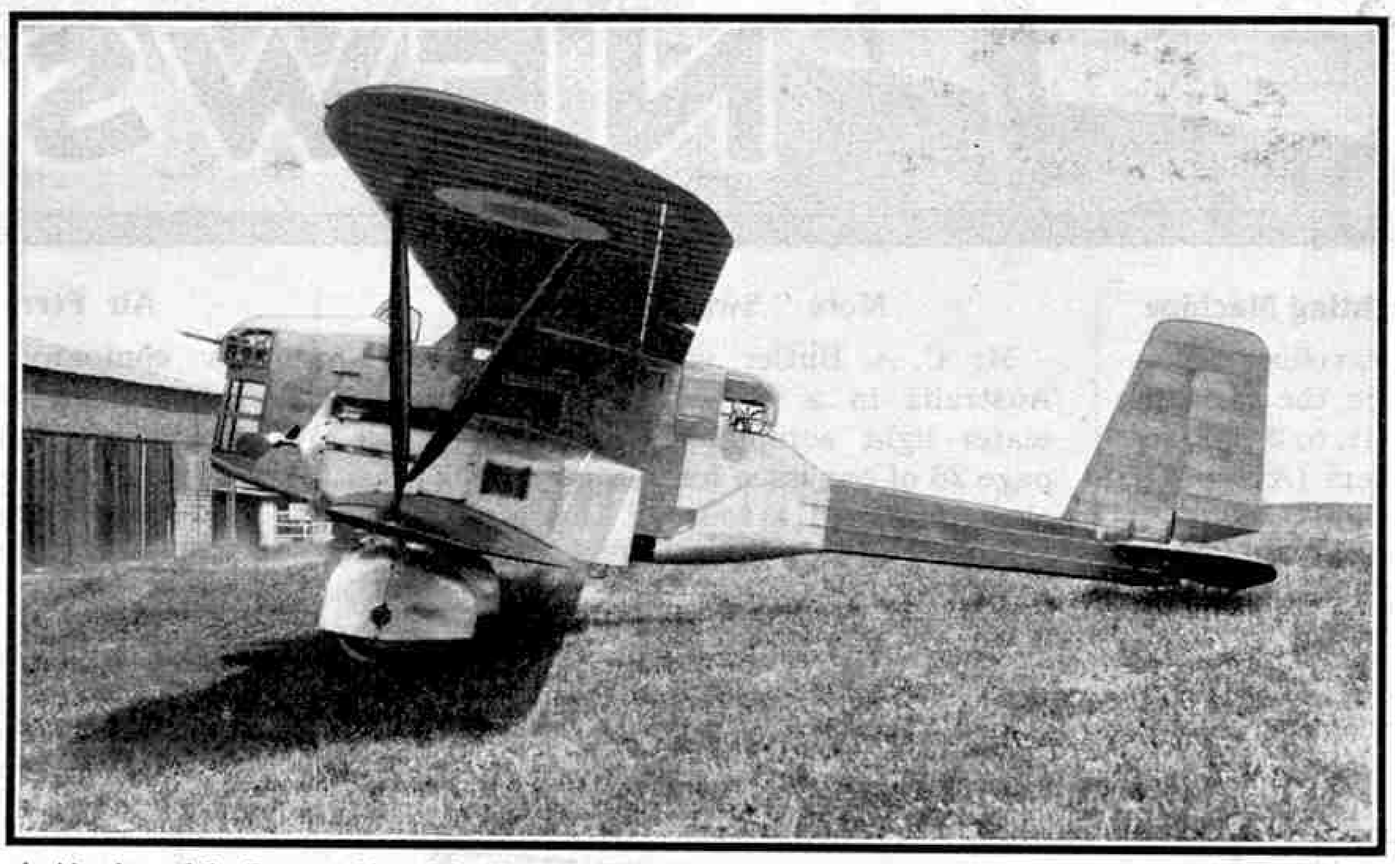
Oleo-pneumatic shock absorbers are employed in the undercarriage. The two wheels are carried in separate steel forks and are provided with brakes, while a swivelling tail wheel fitted with a shock absorber is used instead of the usual skid.

The Breguet 27 has a maximum speed at sea level of 134.5 m.p.h. when fitted with a Hispano-Suiza 12 Hb. engine equipped with

silencers, and at a height of almost 20,000 ft. this is reduced to 124.5 m.p.h. The machine has a ceiling of 25,900 ft. It takes off after a run of about 323 ft. and when the brakes are employed its landing run is 344 ft.

The Breguet 41 has the characteristic construction already described in connection with the Breguet 27, and as our illustration of the larger machine shows, the fuselage is short and the tail unit is carried on the rear end of a girder protruding from its rear. The fuselage is constructed in two sections. The forward member consists of a number of built-up bulkheads connected by four longerons and a number of diagonal members, and the rear section is built round four longerons and a number of transverse frames. The whole of the fuselage is covered with sheet aluminium alloy.

The machine is provided with an enclosed gunner's cockpit in the nose, while the pilot's cockpit, which is open, is situated immediately below the leading edge of the wing. A navigation room also is provided, and the machine carries an internal bomb rack operated from a special compartment. A trap door is provided in the left wall of the fuselage in order that the aeroplane may be used for photographic purposes.

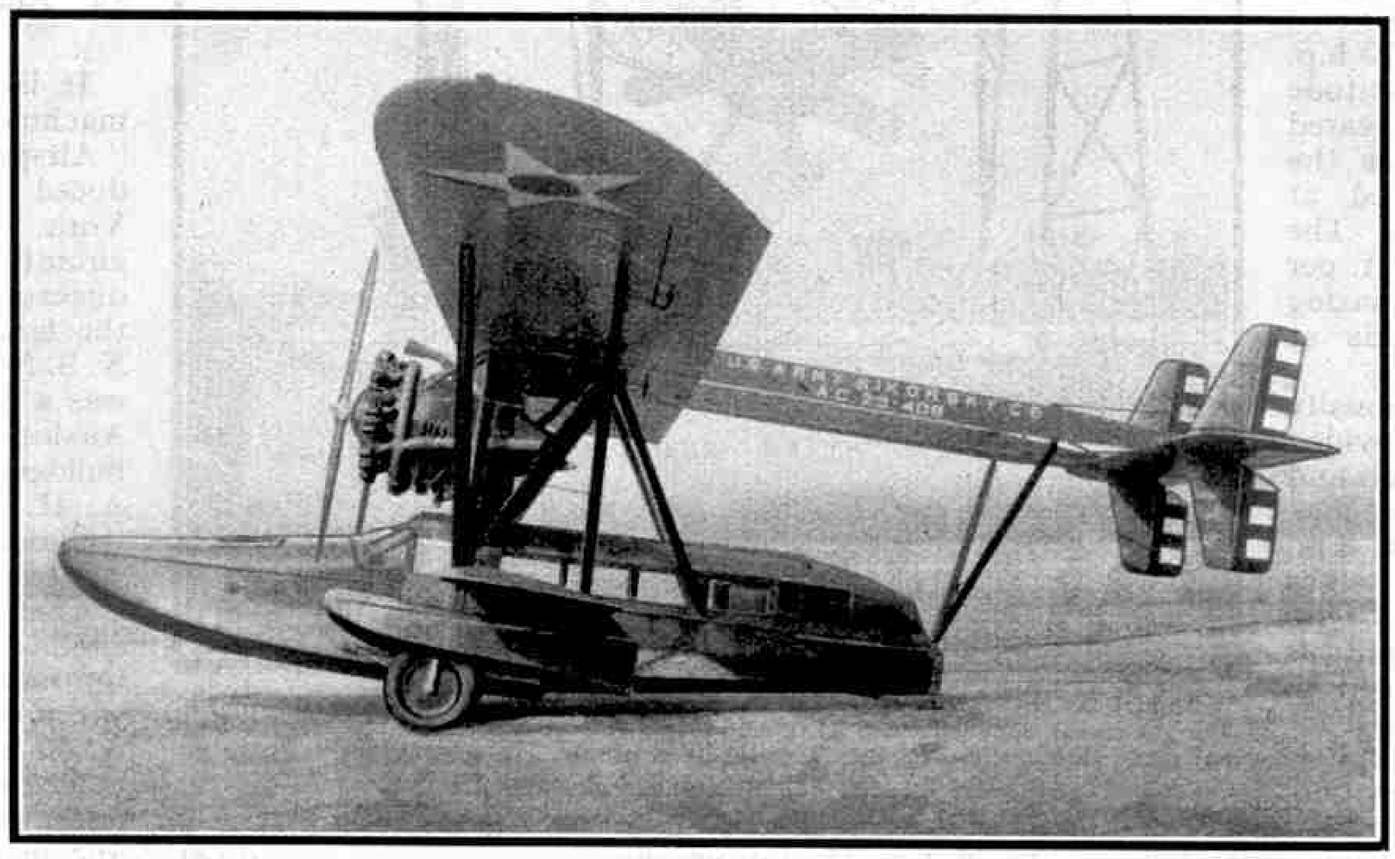


A side view of the Breguet 41 multi-seater fighting, or night bombing, machine. ¡For this photograph we are indebted to the Société Anonyme des Ateliers d'Aviation Louis Breguet.

The Breguet 41 is 37 ft. in length and 16 ft. 8¼ in. in height. Its upper wing has a span of 66 ft. 3 in., that of the lower wing being 41 ft. The machine itself weighs 6,358 lb. and with full load for service as a multi-seater fighter its weight is 8,435 lb. When intended for use as a night bomber the all-up weight is 10,244 lb.

There is a choice of power units for this aeroplane, which may be used with either 500 h.p. Hispano-Suiza 12 Hb. engines or 650 h.p. Hispano-Suiza 12 Nb. engines. When fitted with the 500 h.p. engine, the machine has a speed of 149 m.p.h. at an altitude of 13,120 ft., and this altitude may be attained in 12 min. 3 secs. The absolute ceiling is 25,256 ft., and the range 440 miles. When equipped with the 650 h.p. engine, the speed at a height of 13,120 ft. is 159.6 m.p.h., and the machine climbs to this altitude in 11 min. It has a ceiling of 27,880 ft. and a range of over 400 miles.

Another series of interesting machines produced for special purposes is the range of amphibians built in the United States by the Sikorsky Aviation Corporation. These machines are designed for service on the routes operated by the Pan-American Airways and other airline companies, and also for the use of the United States Army Air Corps.



The Sikorsky C.6 amphibian. Our illustration shows the short hull and the high wing, with outrigger carrying the tail unit, that are characteristic of these machines. Official photograph, U.S. Army Air Corps.

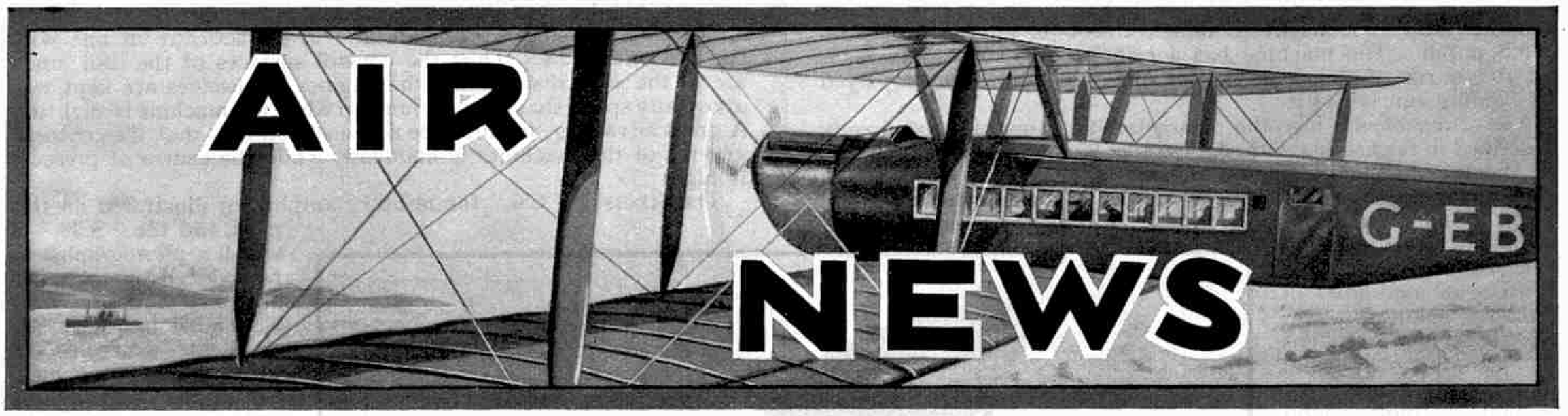
The machine of this type illustrated in this article is an army transport amphibian. In appearance this is characteristic of the type and differs considerably from most flying boats. The tail units of machines of ordinary design are carried on the hulls, which rise considerably aft in order to be well above the surface of the water when the machines are taxi-ing. The Sikorsky amphibians have short hulls, and the monoplane type of tail unit employed on them is carried on outriggers running aft from high upper wings. The engines are carried in mountings suspended by struts from the top wing spars and are practically in line with the tail outriggers. Thus the control surfaces of the tail units are in the slipstream, while the engines themselves are kept well above any spray that may be flung up when the machine is alighting. A great advantage of this type of construction is that the centre of gravity of the machines is kept low, while the centre of pressure is high.

The Sikorsky "C.6," the military amphibian illustrated on this page, and the "S.38," of which a photograph was reproduced on page 885 of the "*M.M.*" for November last year, are excellent examples of this type of machine. Both are sesquiplanes and in each case the lower wing is on a level with the windows of the hull, while the upper wing is carried on slightly splayed-out "N" type struts.

The S.38 is fitted with two 420 h.p. Pratt and Whitney "Wasp" radial air-cooled engines, and these give it a maximum speed of 125 m.p.h. and a cruising speed of 110 m.p.h. The machine can take off from land in 12 seconds, while 18 seconds are required for a take off from water. The initial rate of climb is 750 ft. per minute. The machine has an empty weight of 6,500 lb. and when carrying a pay load of 1,700 lb. and sufficient fuel and oil to cruise for 600 miles, its all-up weight is 10,480 lb. It is capable of accommodating nine passengers in addition to a pilot and a mechanic.

Other machines of similar type produced by the Sikorsky Aviation Corporation include the S.39, a high wing monoplane. The wings of this machine are of all-metal construction, with fabric covering, and the outer sections are quickly detachable, the total width of the machine when dissembled being only 18 ft. 2 in. The normal span of the wing is 52 ft. and the length of the machine is 32 ft. 2 in. The machine is provided with a short single-step hull similar to that of the S.38, and a retractable undercarriage. It is a much smaller machine, however, weighing only 2,500 lb. when empty, and 2,700 lb. when fully loaded, and one 300 h.p. Pratt & Whitney "Wasp Junior" is fitted. The maximum speed of the machine is 122 m.p.h. and its cruising speed is 100 m.p.h. The enclosed cabin in the hull seats four persons, the two front seats being separate and fitted with dual controls, while the two passengers are accommodated on a single seat occupying the width of the cabin.

A more powerful machine of this type is the Sikorsky S.40. This amphibian is equipped with four 575 h.p. Pratt and Whitney "Hornet" engines and with fuel tanks that enable flights lasting for nine hours to be carried out without refuelling. Ordinarily the machine possesses accommodation for between 16 and 24 passengers together with 1,000 lb. of mail, but when short journeys only are to be undertaken, 41 passengers and a crew of four may be carried. Duralumin has been extensively employed in the construction, but the hull is covered with "Alclad" stainless steel. The machine has a maximum speed of 129 m.p.h. and cruises at 108 m,p.h. and with one engine out of action its speed is 90 m.p.h.



Four Miles a Minute in a Fighting Machine

A machine capable of travelling at a speed of nearly 240 m.p.h. in the rarified air at a height of from 13,000 ft. to 20,000 ft. has been produced by Vickers (Aviation) Ltd. It is known as the Vickers "Jockey" and is an interceptor fighter that can climb to a height of 20,000 ft. in 11 minutes. Its ceiling is 36,000 ft. or 7,000 ft. higher than the summit of Mt. Everest.

The new Vickers machine is a low wing monoplane and with the exception of the fabric coverings of the fin, the tail plane, rudder and elevators, it is of all-metal construction, duralumin being largely employed. The fuselage is in two sections, the forward portion consisting of a steel tube framework covered with aluminium panels, while the rear section is of the monocoque type, being built up of a number of circular "formers" covered with sheet duralumin. The undercarriage is of the divided type and is fitted with Oleo-pneumatic shock absorbers.

The Bristol "Mercury" engine with which the "Jockey" is fitted develops its maximum of 530 h.p. at 2,000 r.p.m. and an altitude of 15,800 ft. The engine is geared and supercharged and gives the machine a maximum speed at ground level of 182 m.p.h. The initial rate of climb is 1,450 ft. per minute. In spite of its amazing speed, the "Jockey" lands at only 62.5 m.p.h.

The machine is exceptionally clean in design, being provided with "spats" over the wheels and a Townend ring over the engine. It has a wing span of 32 ft. 8 in. and length of 23 ft., and weighs 2,377 lb. when empty and 3,270 lb. when fully loaded. Flying controls and instruments are arranged to provide the utmost comfort for the pilot, and the open cockpit is equipped with oxygen-breathing apparatus, and is warmed by radiators in order that the machine may be operated at great heights, where the air is rarified and the temperature is very low.

Famine Avoided by Air Transport

A short time ago one of the heaviest snowstorms ever experienced in New Mexico isolated many Indian villages, and about 20,000 of their inhabitants were in danger of starvation. Food could not be taken to them by ordinary means, and aeroplanes proved their value in these circumstances, six United States Air Corps bombing machines being despatched from Arizona with the urgently-needed supplies. About five tons of food were dropped.

More "Swift" Flights

Mr. C. A. Butler, whose recent flight to Australia in a Comper "Swift" single-seater light aeroplane was described on page 26 of our issue for January, 1932, has also completed a tour of Australia in his machine. During this tour Mr. Butler covered a distance of 12,260 miles. Thus after leaving Croydon the machine flew about 22,950 miles in less than eight weeks, a striking demonstration of the reliability of this little aeroplane, believed to be the smallest in the world, and also of its 75 h.p. Pobjoy engine.

Another excellent flight has been made in a Pobjoy-engined Comper "Swift," this time in South America, where Mr. C. Taylor flew a machine of this type across the Andes from Mendoza, in the Argentine, to Santiago, in Chile, in 1 hr. 50 min. The mountains were crossed at a height of 18,000 ft.

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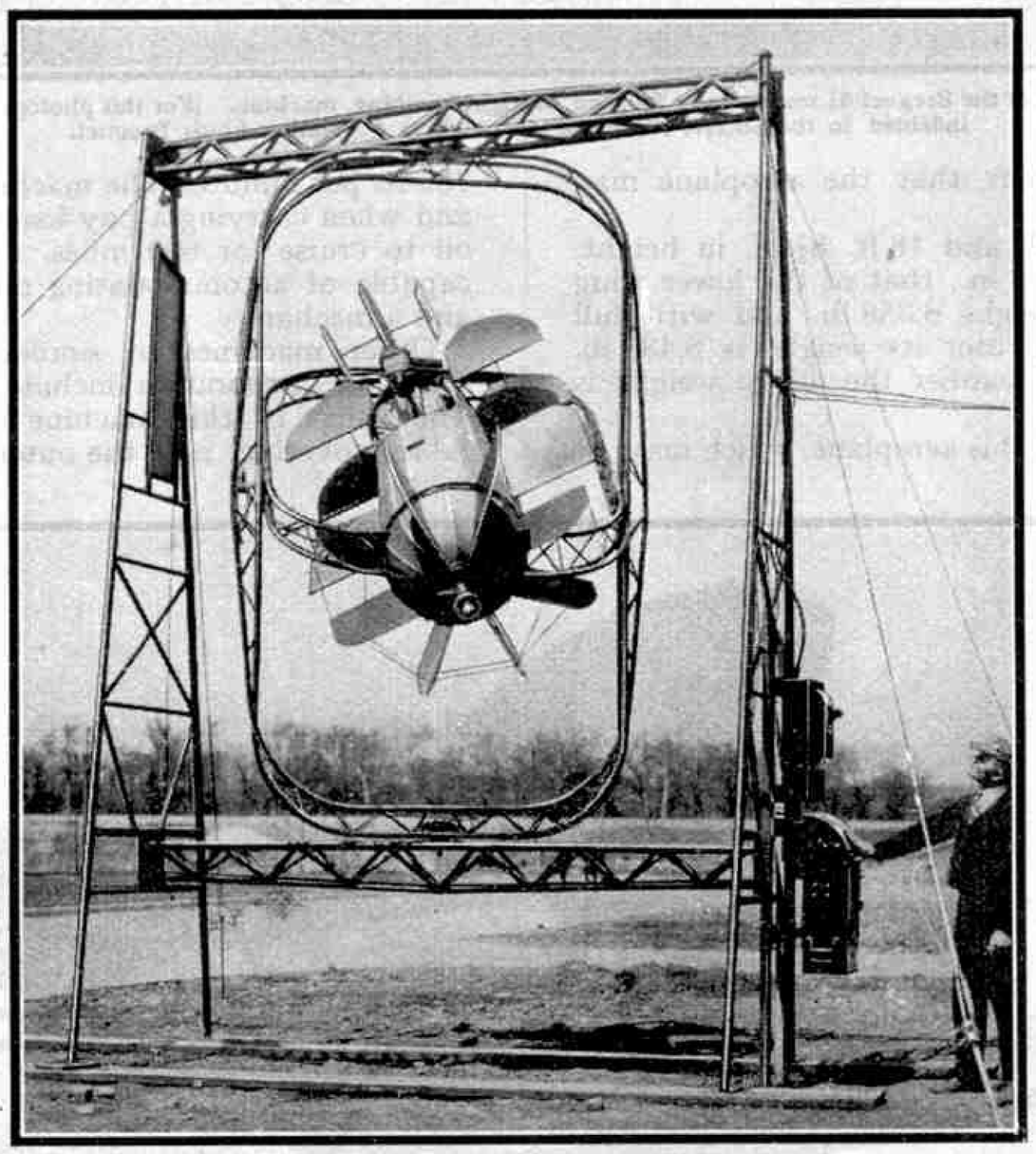
In order to assist the development of long distance flying, Prince George Bibesco, President of the Fédération Aéronautique Internationale, has offered a Challenge Cup for a round-the-world flight. The cup is for open competition.



A flight tutor on which recruits to the United States Army Air Corps are tested. The car in the apparatus can be moved into any position, and if the recruit does not come through his test satisfactorily he is usually not suitable for training as an airman. Official photograph, U.S. Army Air Corps.

Air Ferry Across The Solent

A company has been organised to maintain an air ferry service between Portsmouth, and Ryde in the Isle of Wight. The ground required for an aerodrome has already been secured near Ryde, and it is expected that this will be ready for use next month, although the necessary constructional work will not be completed until Autumn.

The present plans provide for hourly flights during the day time. Each flight will occupy seven minutes and the fare will be 5/–. Multi-engined aircraft will be employed, and as most of the journey will be made over water the aeroplanes used will be capable of flying with one engine out of commission.

The company's machines also will undertake pleasure flights round the Isle of Wight. These will occupy about 45 minutes and the price will be about the same as that usually charged for similar tours by motor coaches.

Sir Alan Cobham and a New Aeroplane

It has been announced that a machine to be known as the "Airspeed Ferry" is to be produced shortly by Airspeed Ltd., York. This is a new firm of aircraft manufacturers, and its directors include Sir Alan Cobham, the famous pioneer airman; Mr. N. S. Norway, who for many years was a designer on the staff of the Airship Guarantee Company, the builders of "*R.100*"; and Mr. A. H. Tiltman, formerly of the technical staff of the de Havilland Aircraft Company.

The "Ferry" will be a double-engined biplane accommodating ten passengers. A special feature will be the excellent view afforded to the pilot, for the cockpit will be placed in the nose of the machine, the middle engine being mounted on the upper plane in order to allow this to be done. The airscrew driven by this engine will just clear the fuselage.

Air Mail Service Across Iceland

It is reported that an air mail service between Europe and North America by way of Iceland is to be started by a company known as the Transamerican Air Lines Corporation. Permission to establish a base in Iceland is to be applied for, and if this is obtained a modern airport will be constructed.

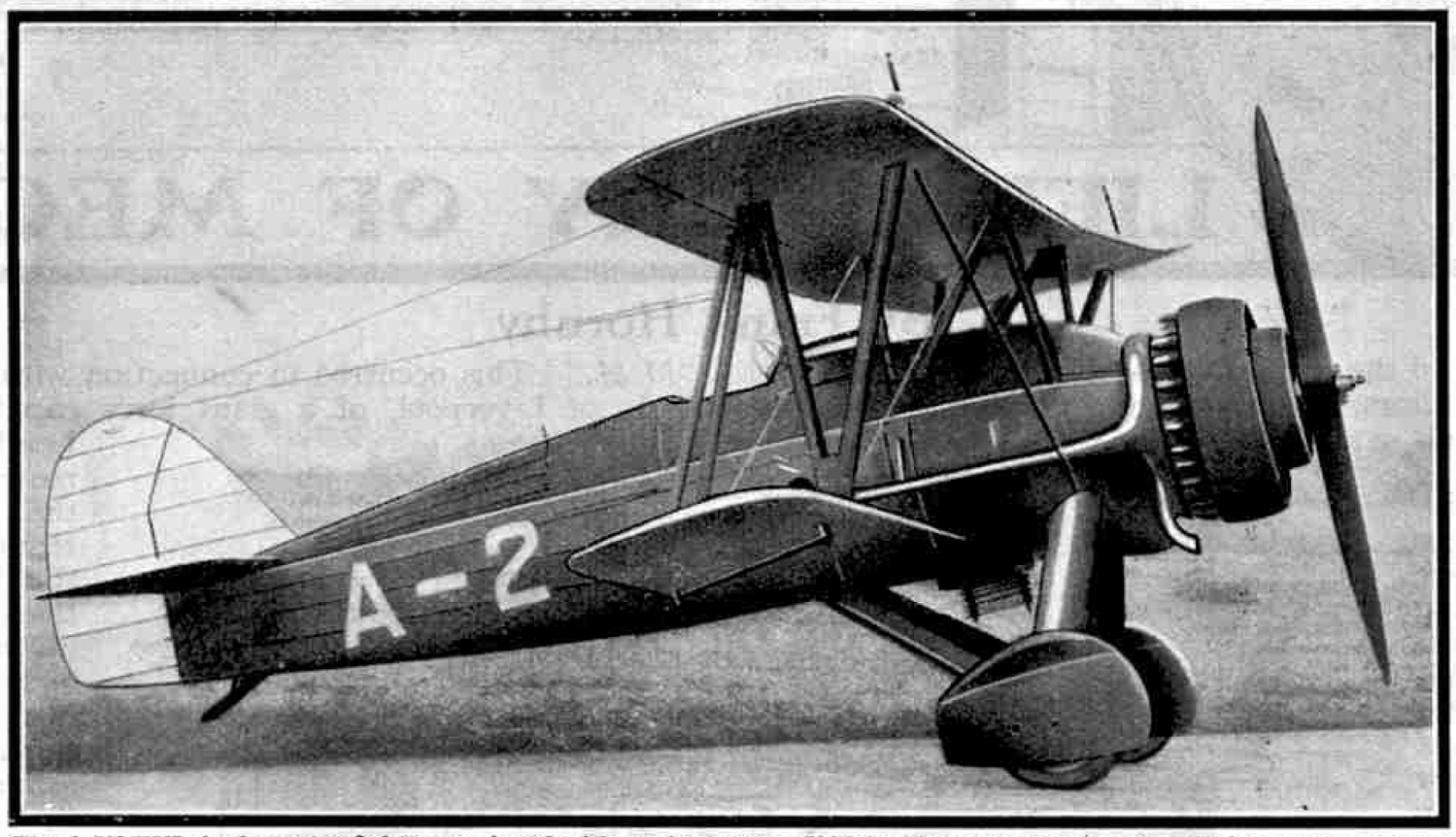
When the proposed service is established, it is expected that machines will leave London daily throughout the year.

A French Pioneer of Aviation

The pioneers of flight by means of heavier-than-air machines included many enthusiastic experimenters who never achieved real success, and whose names are apt to be forgotten. Among these less fortunate pioneers was a Frenchman, Clement Ader, whose portrait appears on this page. Like many other early experimenters, Ader at first made use of artificial wings manipulated in imitation of the motions of a bird in flight. His first machine, built in 1872, had flapping wings, and was intended to be propelled by man power. The inventor soon found that this scheme was impracticable, however, and turned his attention to power-driven aeroplanes.

After travelling abroad and studying the soaring flight of large vultures, Ader returned to France in 1886 and built another machine, which he named the "*Eole.*" This aeroplane had bat-like wings and was equipped with a light steam engine. It was tested in 1890, and according to friends of the inventor it rose to a height of 1 ft. and flew a distance of 164 ft. This success, if confirmed, would establish Ader as the first man to navigate in the air a heavier-than-air machine; but all that is definitely known of the trial is that the aeroplane proved unstable and almost uncontrollable, and was wrecked. Ader rebuilt the machine, and in the following year demonstrated it before the French military authorities at Satory. It is claimed that on this occasion the machine rose to a height of 3 ft. and flew 328 ft.; but again all that is definitely known is that it was wrecked during the demonstration. Ader's efforts seem to have impressed the authorities, however, for they granted him funds to continue his experiments.

In 1897 Ader constructed a power-driven aeroplane named the "*Avian,*" which had two four-bladed propellers driven by two 20 h.p. steam engines. The machine was tested on a specially prepared circular track in the presence of General Mensier, and succeeded in hopping off the ground several times. A second trial was subsequently carried out, and on this occasion the machine was beginning to lift into the air when a sudden gust of wind accelerated its progress. Ader found himself unable to steer the machine round the circular track, and hastily shut off steam, with the result that the aeroplane plunged to earth. The inventor's friends state that the machine reached a height of nearly 5 ft. and had travelled through the air 984 ft. before the wind terminated the flight. This unfortunate ending to the trial made a bad impression on the French military authorities who were present, and the subsidy granted to Ader was discontinued. The inventor afterwards abandoned his experiments, presented the "*Avian*" to a Paris museum, and retired to the Pyrenees.



The A.W.XVI single-seater fighter, equipped with an Armstrong Siddeley "Panther" engine. This machine, which has a speed of 200 m.p.h. at a height of 15,000 ft., was described on page 715 of the "M.M." for September, 1931. Our photograph is published by courtesy of Sir W. G. Armstrong Whitworth Aircraft Co. Ltd.

Surveying British Canals from the Air

A number of canals in the Midlands recently were surveyed from a Westland "Wessex" triple-engined monoplane, the work being carried out successfully in spite of very bad weather.

The "Wessex" employed for the work was equipped with three seven-cylinder "Genet-Major" engines in place of the five-cylinder "Genets" usually employed in this machine. The change increased the power available from 330 h.p. to 447 h.p. and this led to an increase in speed from 108 m.p.h. to 118 m.p.h., although the fuel consumption was increased by only 6¾ gallons per hour. The "Wessex" also is able to climb higher when the more powerful engine is fitted, the ceiling then being at a height of 14,900 ft. instead of 12,300 ft.

Clement Ader, one of the lesser-known pioneers of aviation, whose experiments with a steam-powered aeroplane are described on this page.

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One of new Handley-Page air liners of Imperial Airways is now making a tour of England and Scotland. The tour will occupy six weeks, and will include visits to Birmingham, Edinburgh, Glasgow, Leeds, Liverpool and Manchester.

The Avro Mail Aeroplane in Canada

On page 794 of the "*M.M.*" for October, 1931, we included a description of a special aeroplane constructed by A. V. Roe & Co. Ltd. for fast air mail work. A machine of this type fitted with a geared Armstrong Siddeley "Jaguar Major" engine recently was sent to Canada, and there it has carried out experimental flights on regular air mail services.

On one of these trials, the Avro mail aeroplane flew from Toronto to Detroit, a distance of 237 miles, at a speed of 136.5 m.p.h., although there was a head wind of 20 m.p.h. The return journey was made during darkness in order to test the night flying equipment and the machine then maintained an average speed of 143 m.p.h., this being much greater than that attainable by any other aircraft employed on this route.

A long distance test between Winnipeg and Ottawa was equally satisfactory, the distance of 1,042 miles being covered in less than seven hours, the average speed being 152.3 m.p.h.

To the Riviera by Air

London and the Riviera are now linked by air, for a "Golden Ray" machine of the French Air Union leaves Croydon daily at 9.0 a.m. for Lyons, where passengers are transferred to a "Rapid Azur" machine in which they fly to Cannes, arriving at 4.30 p.m. The new service enables the Mediterranean coast to be reached from London in much less time than is possible by surface transport, for even the famous express known as the "*Blue Train*" requires 24 hours for the part of the journey between Calais and Cannes. The cost of flying also is much less than that of the journey by boat and train.

British Airways in 1931

During 1931 the aircraft of Imperial Airways flew a total of 1,510,867 miles, carrying 30,581 passengers and 1,664,970 lb. of mail and freight. In December alone 1,048 passengers crossed the Channel by air in Imperial Airways machines, this being nearly double the number of passengers carried during the same period in the previous year.

A feature of the year's traffic was the growth in the volume of air mails. On the England-India route loads increased to more than 45,000 letters a week, while on the new African air line traffic also showed a brisk and satisfactory growth. Altogether during 1931 more than 52 tons of letters were flown out of this country in Imperial Airways machines. This represents an increase of 29 per cent. over 1930, and of 74 per cent. over 1929.

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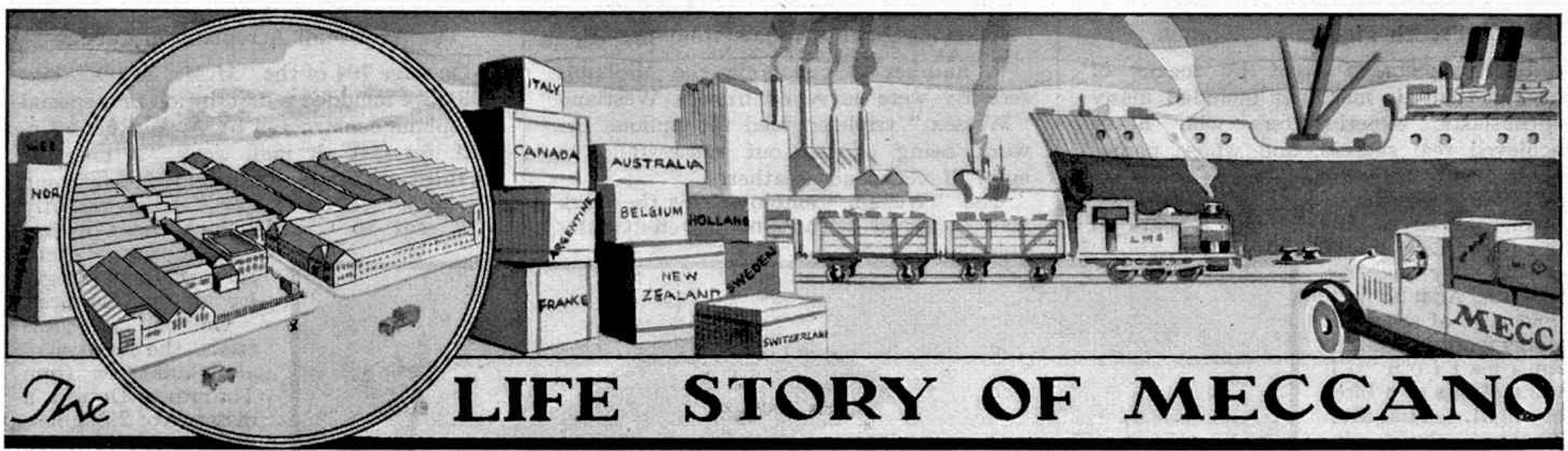
A loud-speaking apparatus for advertising purposes has been tested over Milan in a Caproni machine. The amplifiers used increase the volume of the normal human voice more than 1,600,000 times.



The LIFE STORY OF MECCANO

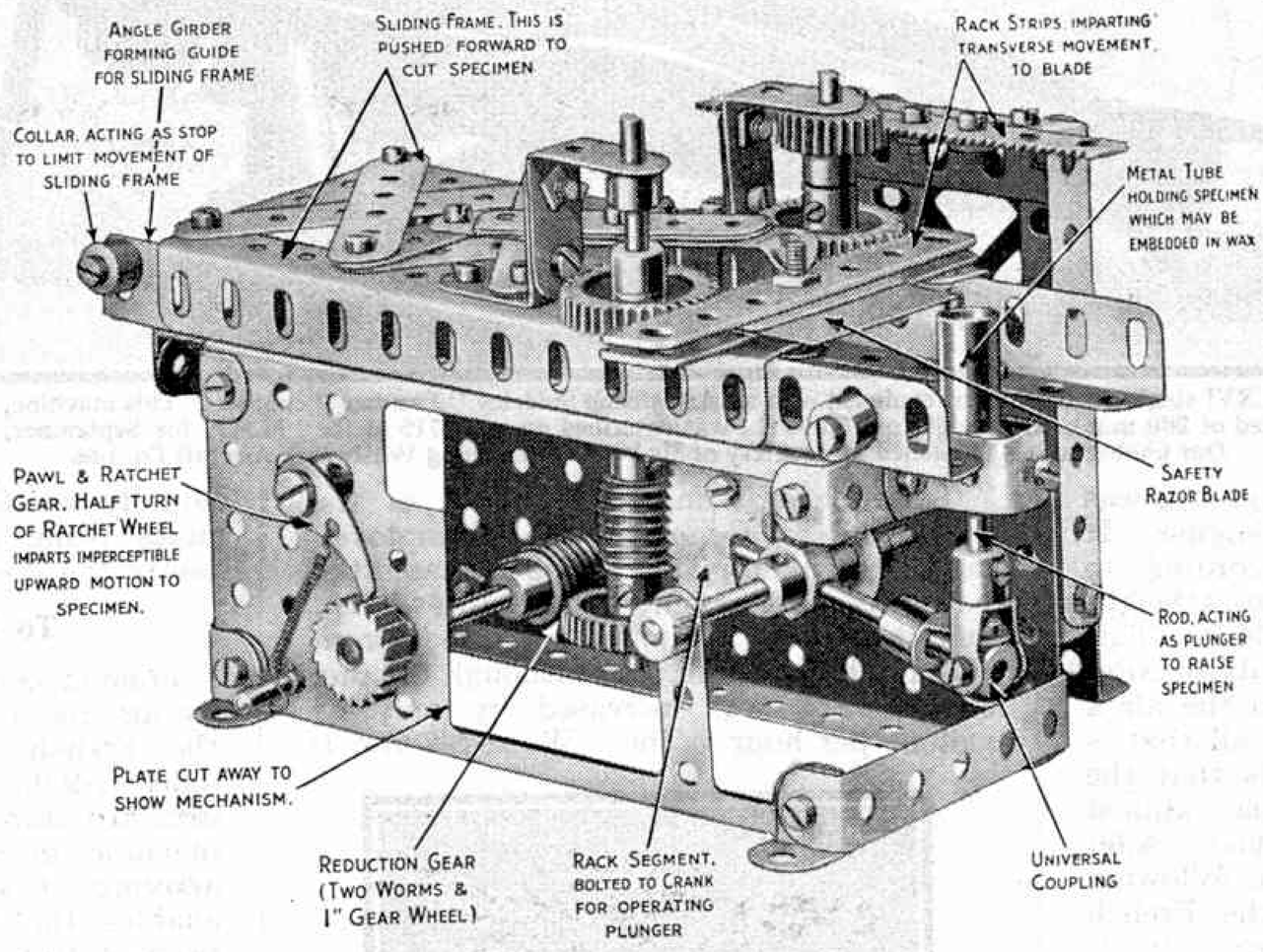
By Frank Hornby

LAST month I referred to the increasing use that is being made of Meccano by inventors, engineers and engineering firms, scientists and schoolmasters, and I promised to refer to a few notable instances in which Meccano had proved of service. There are so many of these, and they are so varied in character, that I find it difficult to know which to select for the purpose. In one respect all are alike—they show how rapidly and effectively Meccano is replacing the older methods of model-making.

Formerly an inventor or an engineer who wished to try out in miniature form a new idea had only two possible courses open to him. He must himself go through the laborious process of making special parts in wood or metal, as I had to do before I invented Meccano; or he must have these parts made for him, which necessarily involved considerable expense. In very few cases was the model thus built quite satisfactory. Almost always many changes had to be made, involving the preparation of new parts, for it was seldom that the existing parts could be modified to suit the purpose. Frequently, too, the idea ultimately turned out to be impracticable, and then all the time and money spent on the model were wasted. Meccano has opened up entirely new possibilities in this direction. In the first place it provides ready-made parts with which any mechanical movement can be reproduced. Then, if the result is not at first satisfactory, almost endless modifications may be made by substituting here and there larger or smaller parts, or parts of a different type. In the end, if the scheme is sound Meccano will enable it to be demonstrated in practical working form; or if it proves unsound, the parts all remain available for further experiments, nothing being lost or wasted.

More than this, inventors have told me how Meccano has actually given them new ideas when they were at a loss as to how to produce certain results. While pondering over the problem they have suddenly caught sight of a part that immediately suggested the solution, and very soon the desired end was achieved. This is not in the least surprising, for with a large Meccano outfit an inventor has spread out before him in miniature almost all the resources of modern engineering.

One of the most recent uses of Meccano by engineers has already been described in the "*M.M.*" This occurred in connection with the design by M.R.S. Ltd., of Liverpool, of a giant lorry capable of carrying across London the huge girders required in the erection of the Cumberland Palace Hotel now being built near the Marble Arch. Among these girders was one weighing 99¼ tons, and measuring 68 ft. in length, 10 ft. 4 in. in depth, and 2 ft. 4 in. in thickness. The designing of a lorry capable of handling such a load presented great difficulties, and the problem was solved only after many experiments with models built from Meccano parts, which ultimately led to the discovery of a new principle of steering. In addition, a Meccano scale model of the lorry and its trailer was used to work out in Liverpool on a miniature course the details of the journey through London streets. Illustrations and details of the remarkable Meccano model of this huge lorry appear elsewhere in this issue.

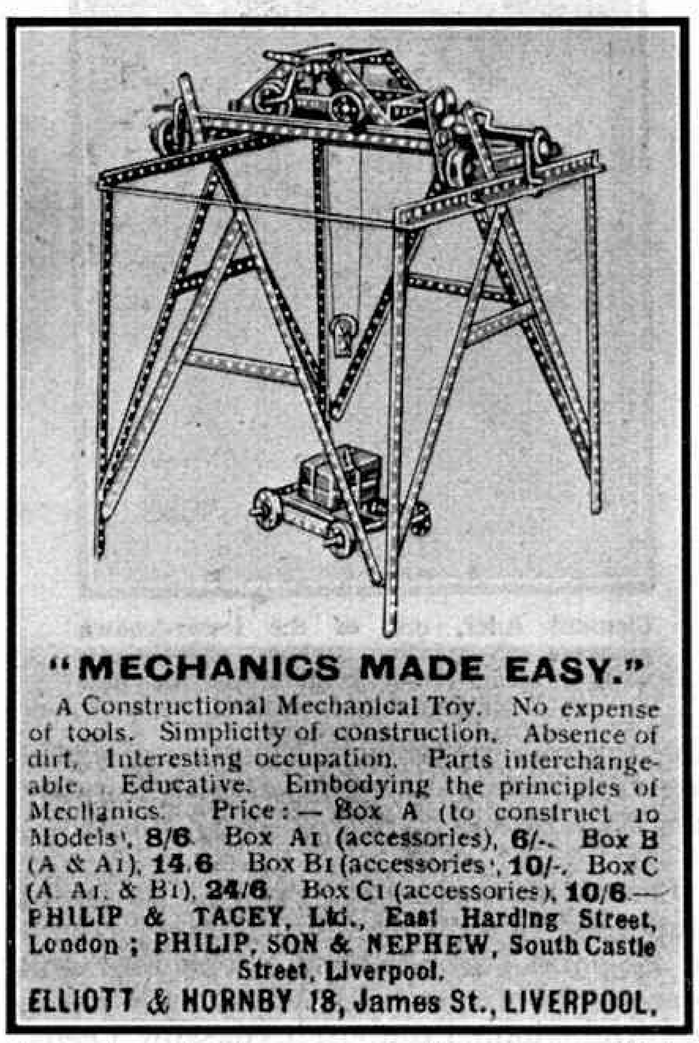


A wonderful microtome built in Meccano by Dr. Ernest Bade, a United States scientist. This remarkable instrument cuts sections of tissue as thin as two thousandths of an inch.

Going back a few years, Meccano enthusiasts who visited the Amusement Park at the British Empire Exhibition at Wembley, will remember the wonderful "Golden Glide" constructed by A. & F. Pears Ltd., the famous soap manufacturers. This Glide consisted of a journey of nearly a quarter-of-a-mile through alternate scenes of beauty and of horror, and at speeds varying from a gentle glide to a swift downward rush. The apparatus, which has been described as a masterpiece in engineering, was designed by Mr. C. E. Cannon, and the original model of it was worked out entirely with Meccano.

Mr. F. Dutton, Superintendent of Signals and Motor Transport of the South African Railways, developed the Stronach-Dutton locomotive tractor from models in Meccano. This tractor was designed specially for use in thinly-populated countries like South Africa, the idea being to utilise the low tractive resistance of vehicles running on rails and the high tractive effort of solid rubber tyres on roads. In a letter expressing his appreciation of the Meccano parts Mr. Dutton says: "I think their adaptability and accuracy are astonishing. They furnish not only 'Engineering for Boys,' but apparatus of the most useful description for designers, inventors and experimenters. I think that the Meccano System is simply wonderful, and the interchangeability and precision of the various items are indeed extraordinary."

By way of contrast to this I may mention

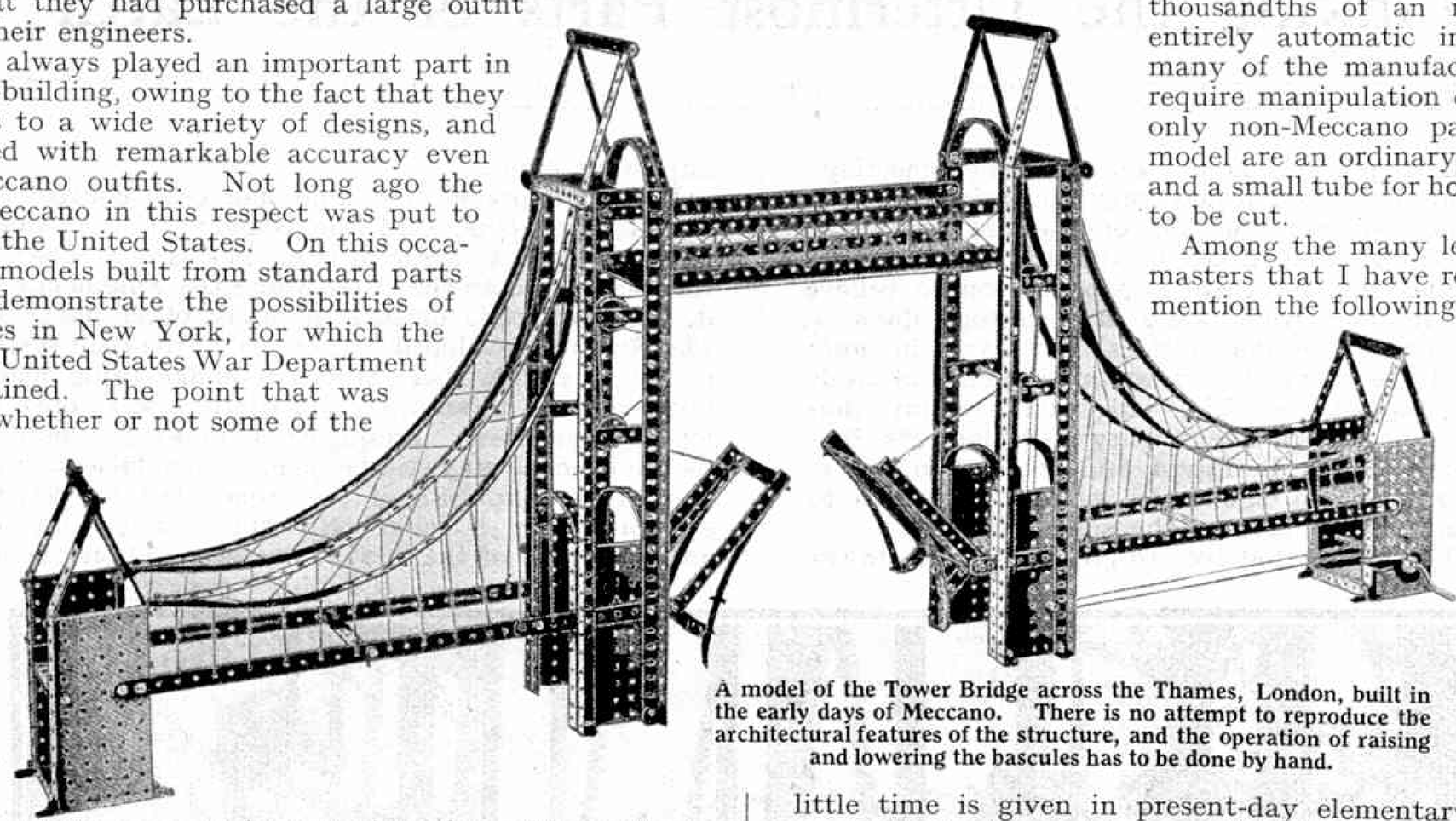


An early advertisement of "Mechanics Made Easy."

that Mr. W. R. Dunlop, the inventor of an egg-grading machine for use in connection with the Ministry of Agriculture Egg Marketing Scheme, worked out his ideas with the aid of Meccano parts.

I was particularly interested some time ago to learn that the Mersey Docks and Harbour Board, of Liverpool, had worked out in Meccano, with complete success, a new type of bale-lifter, and had found Meccano of such value in developing machines in model form that they had purchased a large outfit for the use of their engineers.

Bridges have always played an important part in Meccano model-building, owing to the fact that they lend themselves to a wide variety of designs, and can be produced with remarkable accuracy even with small Meccano outfits. Not long ago the capability of Meccano in this respect was put to practical use in the United States. On this occasion large-scale models built from standard parts were used to demonstrate the possibilities of proposed bridges in New York, for which the sanction of the United States War Department had to be obtained. The point that was in dispute was whether or not some of the piers of the proposed two bridges, one at Elizabeth and the other at Perth Amboy, across the "Arthur Kill" channel, might prove to be serious obstructions to river traffic. At the request of a committee formed by authorities in favour of the scheme, scale Meccano models were built and placed on exhibition during the hearing of the case before the War Department. The models, one of which was 21 ft. in length, were placed on wooden bases covered with plate glass to represent water, and the depths of the river at various points were plainly marked. In addition, scale models representing various types of vessels were placed on the glass river. These models proved of great assistance in demonstrating that the objections to the bridges were not well founded, and ultimately construction was sanctioned by the War Department, the engineers of which commented very favourably on the models and the purpose they had served. After the hearing, one of the model bridges was displayed at the Staten Island Ferry House, where it was inspected by many thousands of people.



A model of the Tower Bridge across the Thames, London, built in the early days of Meccano. There is no attempt to reproduce the architectural features of the structure, and the operation of raising and lowering the bascules has to be done by hand.

Turning now to scientific applications, Professor C. V. Boys, F.R.S., has used Meccano in making apparatus and instruments. In a paper read before the Society of Gas Engineers he described the particular application of Meccano to his work, and in the course of his remarks said: "This is the third time recently within my knowledge where the admirable fittings of the Meccano firm, made and sold for toys, have found a place in a highly-refined scientific instrument."

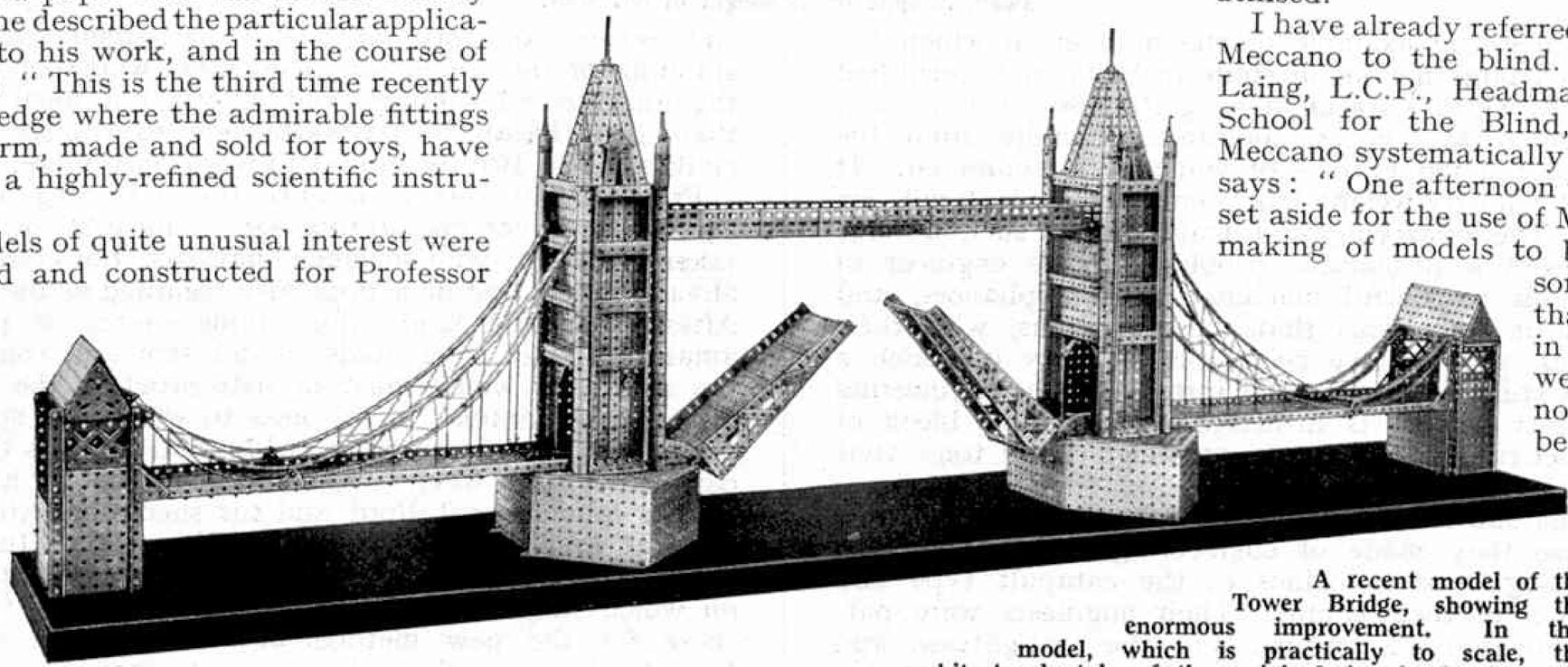
A series of models of quite unusual interest were specially designed and constructed for Professor E. N. da C. Andrade, D.Sc., for use in connection with the Christmas Lectures that he delivered at the Royal Institution of Great Britain, London, in December, 1927, and January, 1928. These models included a "Baltic" tank locomotive with Walschaerts valve gear, and demonstration models of Stephenson's link motion and Joy's valve gear. In referring to these models Professor Andrade wrote: "The locomotive model is magnificent, and will certainly ensure the success of my third lecture." On another occasion Professor Andrade wrote: "Meccano is the finest toy not only that I know, but that I can imagine, and fully deserves all the success it has had."

Further afield, Dr. Ernest Bade, the well-known United States expert in microscopical work, has constructed in Meccano, with perfect success, a variety of devices for use in scientific work in connection with the microscope. Some of these devices have been described in past issues of the "*M.M.*," and among them one of the most interesting is a microtome, an instrument for cutting extremely thin slices of plant and animal tissue, a view of which I illustrate here. Instruments of this type are costly to buy on account of the great precision they must possess; yet the Meccano model not only cuts with perfect accuracy sections as thin as two thousandths of an inch, but also is entirely automatic in action, whereas many of the manufactured instruments require manipulation of the blade. The only non-Meccano parts in the whole model are an ordinary safety razor blade and a small tube for holding the specimen to be cut.

Among the many letters from schoolmasters that I have received I will only mention the following two from masters at London County Council Schools. Mr. Percy L. Blackman, Surrey Square School, S.E.17, writes: "It may interest you to know that I often make use of Meccano in the ordinary science lessons in which I specialise. I am sure that far too little time is given in present-day elementary science teaching to mechanical principles; and in the teaching of these I find Meccano an unrivalled assistant. The last hour on Friday afternoons I often use in allowing boys to bring their Meccano sets and make models, and display the working to the less fortunate boys."

The other interesting letter comes from Mr. W. F. Abrahams, science teacher, Boys Department, Mawbey Road School, S.E.1, who says: "You will perhaps be interested in the photograph enclosed illustrating a turbine wheel constructed by the older boys in order to encourage the younger boys in the study of science. The smaller boys are encouraged to construct simple models with their Meccano parts, and at periods a little competition is held at school, when all their constructed models are seen by them working for an hour or so on the home-made shafting. The older boys find Meccano parts most useful in constructing their own models to illustrate scientific principles; indeed, there are few of our lessons in which some Meccano parts cannot be utilised."

I have already referred to the value of Meccano to the blind. Mr. R. Elton Laing, L.C.P., Headmaster, Yorkshire School for the Blind, who employs Meccano systematically in his teaching, says: "One afternoon per week is now set aside for the use of Meccano and the making of models to be employed in some of the lessons that will fall due in the following week. This afternoon has come to be called 'Meccano afternoon,' and I think I am right in saying that it is the busiest and happiest afternoon of the whole week. The whir of the motor is a never-ending source of delight to the younger boys, and excitement runs high when the eager hands have brought a model to completion and, by means of the motor, set it to work just like the real thing. I am now thoroughly convinced that Meccano is indispensable for the teaching of the blind along practical and at the same time interesting lines. Nowadays when our school prize day comes round and I ask what sort of prize the winner would like, the answer in very many cases is certain to be—'A Meccano outfit, please, sir.'"



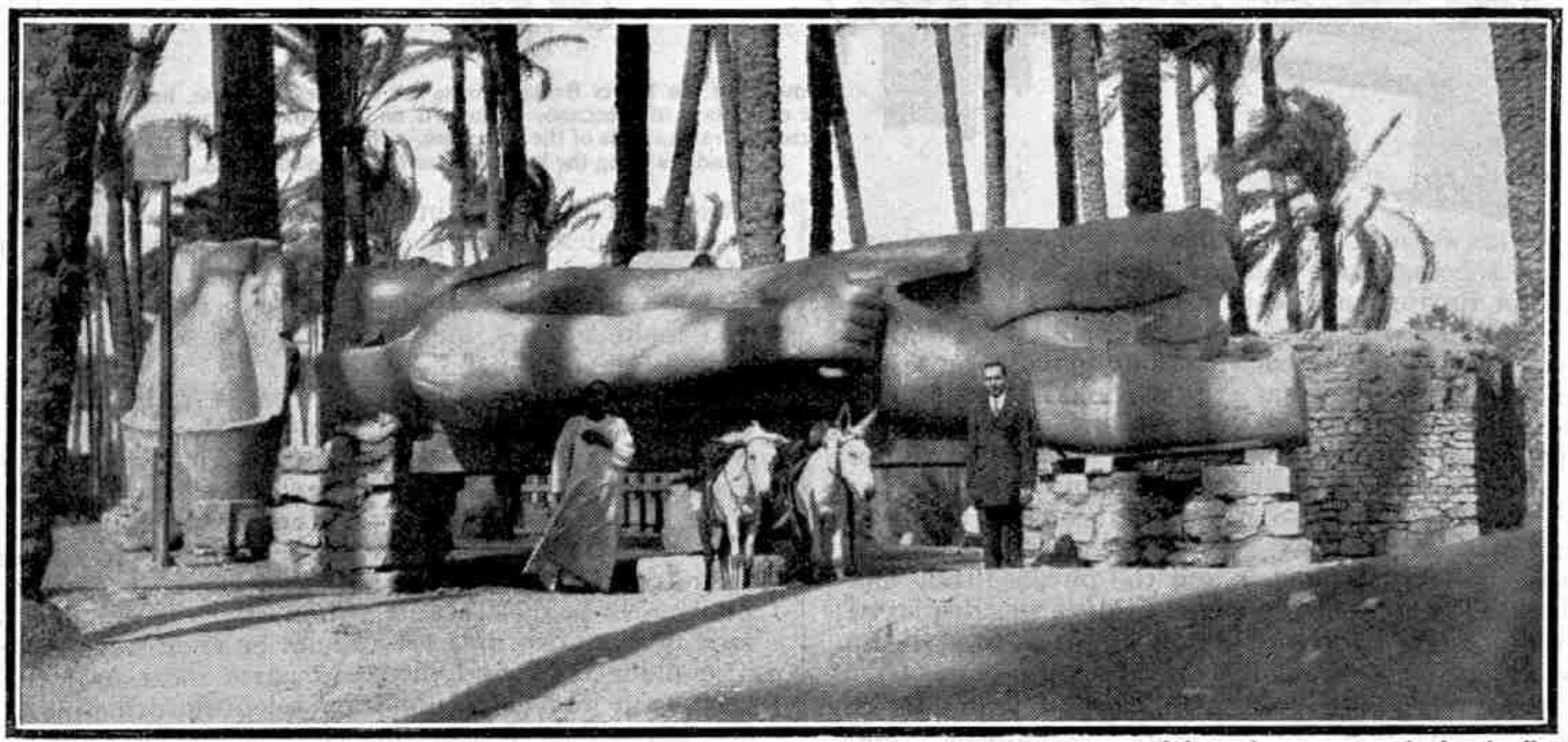
A recent model of the Tower Bridge, showing the enormous improvement. In this model, which is practically to scale, the architectural style of the original is closely followed, and the bascules are raised and lowered continuously by an electric motor concealed in one of the towers.

The Engineer and Civilisation

Linking the Uttermost Parts of the Earth

THE story of civilisation is very largely the story of engineering; in fact it is not too much to say that no nation has ever become civilised without the aid of the engineer. The very earliest beginnings of civilisation appear to have been associated with engineering, for there is good reason to believe that crops of grain for food were raised in prehistoric days on terraces that were cut out on the hillsides near rivers in order that they might easily be supplied with water by means of crude lifting or pumping appliances. The irrigation systems thus set up were the beginnings of the mighty developments that are seen at their best to-day in Egypt and the Sudan, where huge dams have been built to enable the waters of the Nile to be used for renewing the fertility of the soil.

At later periods the nations that rose to greatness were always remarkable for some form of engineering skill. The pyramids and the temples of ancient Egypt show that their builders had engineering ability of a very high standard. The largest of the pyramids indeed still has the distinction of being the greatest mass of masonry ever erected.



The statue of Rameses II found at Thebes. It was carved from a single block of granite transported from Assouan, hundreds of miles away, in spite of its weight of 887 tons.

An even more surprising example of the manner in which the Egyptians handled large masses of stone in building is furnished by the stone out of which a statue of King Rameses II was hewn. This was discovered at Thebes, hundreds of miles from the nearest quarry of the red granite of which it is composed. It is 60 ft. in length and its weight has been calculated at not less than 887 tons. The quarrying and transport of such a huge mass would present a formidable problem to the engineer of to-day with all his wonderful machinery and appliances, and it is little short of marvellous that the Egyptians, with their crude mechanisms, should have been able to carry out such a gigantic task. A still more remarkable instance of the engineering capacity of ancient peoples is furnished by the huge block of stone, 69 ft. in length and estimated to weigh 1,500 tons, that has been uncovered at Baalbek, Syria.

The Romans undoubtedly owed a great part of their supremacy to the skilful use they made of engineering principles in the construction of large war machines of the catapult type and in the fortification of their camps. Their engineers were particularly successful in road making, and the straightness and the enduring qualities of a Roman road are now proverbial. Every country they conquered and occupied was quickly covered by a network of splendid roads, many of which still exist or have become the sites of modern roads. Other signs of Roman occupation are to be seen everywhere in the ruins of the magnificent buildings, bridges and aqueducts that they constructed.

Roads and bridges provided the engineers of early days with their chief opportunities. Both have always been of vital importance in making communication easier and in assisting the development of trade and the opening out of the natural resources of a country. The Romans realised this fully and the road engineer of a province of their vast empire was a very important official.

In Britain roads of a kind had been constructed even before the Romans conquered the island. In Cornwall, for instance, there were tracks made of stone blocks over which most probably tin was carried to the coast where the Phœnician traders awaited it. Similar roads existed in many other parts of the country. The Romans developed and extended the road system extensively, partly to enable their armies to make rapid marches from one fortified camp to another, and partly also to open up the country for trade purposes. Examples of the roads constructed in Britain by the Romans may still be seen, as the efficient drainage provided and the hard nature of the stone used for paving made them extraordinarily durable. No finer roads were built, in fact, until the time of the famous engineer Telford, nearly 2,000 years later.

After the Romans left Britain the wonderful buildings they had erected were treated as quarries, the stone being removed for use in the erection of meaner buildings, and most of the roads fell into disuse and gradually became covered with earth. The partial abandonment of these products of engineering skill was due to the barbarism and lack of understanding of the Anglo-Saxon invaders who soon descended upon the unprotected country, and it was not until these people in their turn began to pay attention to similar necessities that civilisation in Britain moved forward once more.

Progress was very slow until the beginning, about 150 years ago, of the great engineering age. The first important step was taken by Watt, who so much improved the crude steam engines already in use that he is popularly regarded as the actual inventor. After Watt had made this ample source of power available, amazing strides were made in industry and commerce, most of the credit for which must be attributed to the great engineers.

The most familiar of the uses to which the steam engine was put was in the construction of locomotives. As this development came at a time when a splendid road system had been created by the labours of Telford and his successors, steam locomotives were at first planned to run on the roads. In the meantime, however, railroads had been made in various parts of the country, on which wagons were drawn by horses; and the suitability of these for the new method of haulage soon became evident. Largely through the labours of George Stephenson and his associates in the north of England, and of the pioneers of the Baltimore and Ohio Railway in America, railways as we know them to-day came into existence, and thus the engineer took a great step forward in the work of making communication easy.

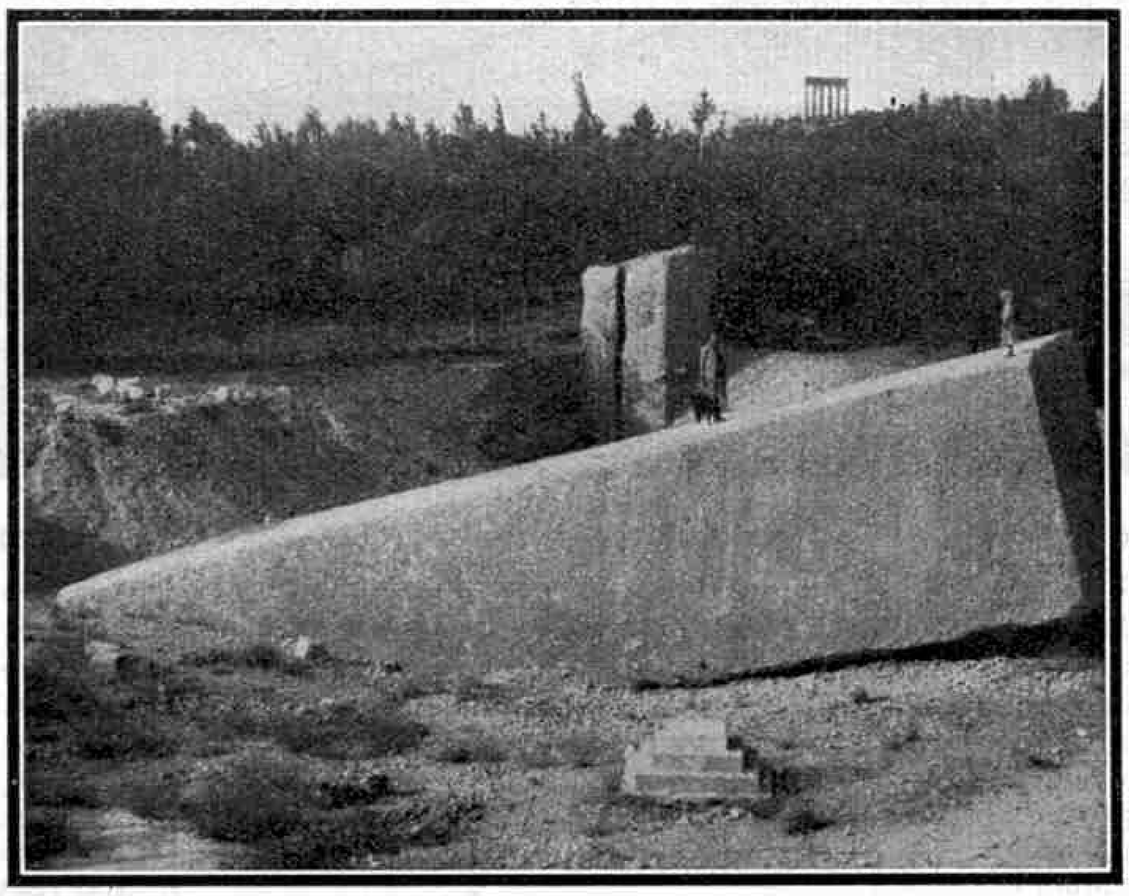
Steamships also became of commercial importance. They grew more numerous and progressively larger, until their greater speed and capacity for carrying cargo, together with their comparative independence of weather conditions, enabled them to displace sailing vessels almost completely.

These great engineering developments were productive of results in all parts of the world almost immediately. The steamship

brought the old world and the new into closer contact and knitted the various parts of the latter together. Britain especially benefited by the change, as the times required for the journeys to Canada, South Africa, Australia, and New Zealand were greatly shortened. This led to a more rapid development of the resources of these great countries, as the rate of settlement was greatly increased.

Railways also played a great part in the exploitation of the natural wealth of these and other partially developed countries. This was particularly noteworthy in Canada, where far-seeing minds called on the engineer to construct a line to stretch across the prairies to the Pacific Coast. A similar scheme had already been carried out further south, and it was thought that the new road would at least make communication between the settlements on the east and west coasts of Canada easy, as the earlier road had already done for those of the United States.

Actually the successful completion of the Canadian Pacific Railway, as the new line was called, did far more. Prior to its construction the easiest route to Winnipeg and the Western Provinces of Canada led through the territory of the United States, while British Columbia was also more closely in contact with the latter country than with the rest of Canada. The railway opened out an easy route north of the Great Lakes and bridged the Rocky Mountains, thus making Canada for the first time a really compact and self-contained territory.

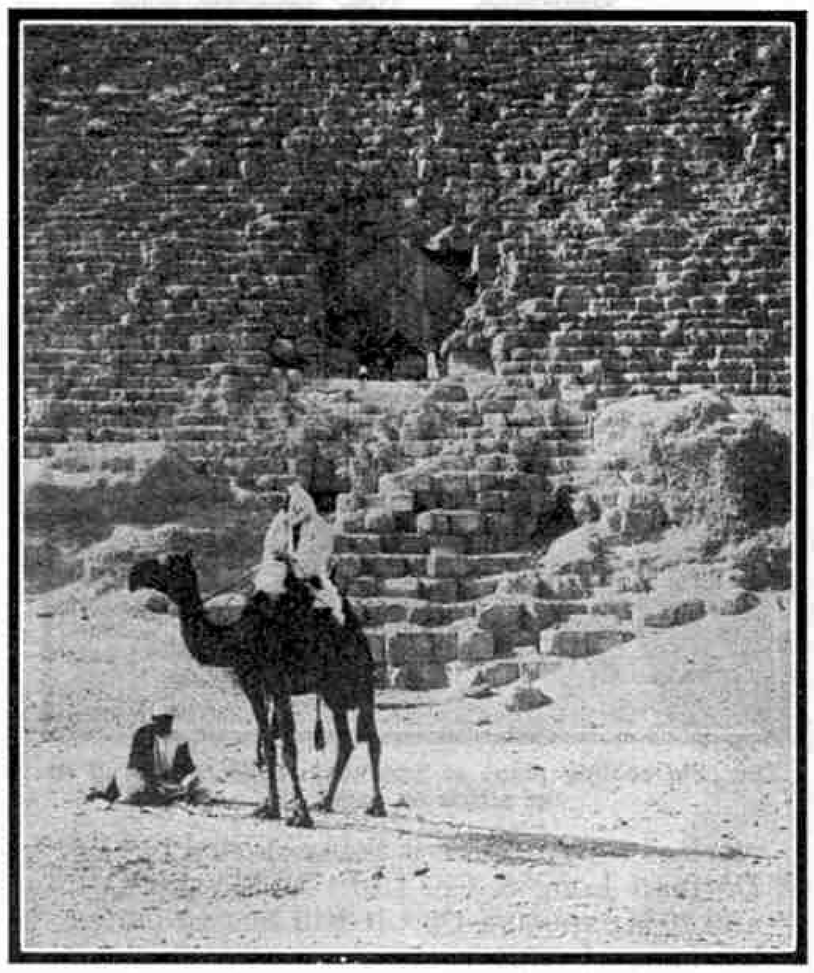


The largest block of stone ever quarried. Its estimated weight is 1,500 tons, and we can only surmise how it was handled by the ancient people of Syria, where it was found.

In addition the railroad increased the rate of settlement enormously by providing access to the rich prairie lands and a means whereby the grain that they produced could be exported. The process has since been continuously accelerated by the construction of a second trans-continental railroad and of numerous branch lines. It is no exaggeration to say that Western Canada has been made by engineering, for it could not have become the thriving region that it now is if the railroads had not been constructed.

Examples of the immensely important part played by railways in the development of the new countries could be given from almost all quarters of the earth. The first question raised by any country desiring to bring new regions within the sphere of civilisation is invariably that of the construction of a railroad. This holds good in all climates. Kenya in the tropics, and Manchuria in the extreme north of China, are both undergoing development along newly constructed railroads, and into the dense forests of the Congo and of Brazil, the northern prairie lands of Canada, the fertile valleys of China, and the ancient and productive countries in the hinterland of West Africa, railways are being pushed forward as heralds of civilisation.

The extension of railroads to hitherto inaccessible parts of the earth has not been carried out easily and it has been necessary to learn many new methods of bridging rivers and boring tunnels through mountain ranges. Some of the greatest feats in this direction deserve mention as important agents in the engineer's conquest of the world for civilisation. An outstanding example of a bridge that opened an enormous field for exploitation is that over the Zambesi River near the Victoria Falls. It made possible the extension of the railroad to the valuable gold and copper mines of northern Rhodesia and the borders of the Congo Free State.



This photograph of the entrance to the Great Pyramid gives a good idea of the immense size of the structure. It has been calculated that it contains 2,300,000 blocks of stone.

Other instances of the influence of the engineer are provided by the Suez and the Panama Canals. Until the former was opened the most convenient route from Britain to India was around the Cape of Good Hope, and Calcutta was reached as easily as Bombay. The shortening of the journey benefited Indian trade and commerce considerably, a fact that was made evident by the phenomenal growth of the port of Bombay. This city displaced Calcutta as the principal port of entry, but nevertheless Calcutta continued to grow and flourish. The Suez Canal in fact made Bombay in exactly the same way as the Canadian Pacific Railway made Western Canada, but in neither case did any other district suffer from the development.

The Panama Canal is proving equally well that the work of the engineer is one of the chief factors in developing and extending civilisation. The mere fact that it is no longer necessary to make the dangerous voyage around Cape Horn is sufficient justification for the existence of the canal, and marks the engineers who constructed it as benefactors to humanity. Beyond this, in the comparatively few years of its existence the canal has already led to a great increase in the importance of the countries on the western slopes of the Andes and of the Rocky Mountains. The astounding growth of Los Angeles is a striking example. This is due almost entirely to its growing value as a seaport. In the United States it actually ranks second to New York, a position that it owes to its favourable situation as the nearest port in California to the Panama Canal.

Along with the development of the railway and the steamship during last century came the application, on a continually increasing scale, of steam power in industry. Spinning and weaving in all their branches benefited greatly by this, while production in iron and steel-works increased enormously in attempts to cope with the demands occasioned by new applications of machinery. In addition, the coal industry witnessed an almost unprecedented increase in output, as the possession of cheap and abundant fuel became the foundation of national prosperity.

The early attempts to introduce steam-power into industry were received with hostility, but the greater output made possible by the use of machinery led to increased prosperity in which all classes shared, and the prejudice against machinery has almost completely disappeared.

The civil and mechanical engineers of the last century placed resources hitherto undreamed of at the disposal of mankind, with the result that there has been a great improvement in the general conditions of life in those quarters of the globe where their influence has been exerted. These two were joined later by the electrical engineer. The latter introduced a new power medium that is easily generated at central points, and transmitted over enormous distances for use as required.

More recently the motor engineer and the aeronautical engineer have brought about a revolution in the means of transport as great as that due to the introduction of the steam locomotive. Motor-propelled vehicles have given the roads a new lease of life and raised them to a position of incalculable importance. Such vehicles are not confined to roads, however. When fitted with suitable caterpillar track they are able to traverse almost any kind of country, even the great African desert. They thus enable communication to be opened up with places that are far beyond the reach of the railway. The aeroplane has brought about an amazing speeding-up of transport for passengers, mails and light goods. It is now possible to travel from London to Karachi in six days, or about 15 days less than are taken when the journey is made by fast mail steamer. From London one may reach Paris or Brussels in 4 hr. 5 min.; Cologne in 5 hr. 50 min. Amsterdam in 3 hr. 30 min., and Berlin in 8 hr. 5 min.

Proposed Tunnel Between Italy and Sicily

It is proposed to connect Italy and Sicily by means of a tunnel under the Straits of Messina, which vary in width from 2½ miles to 14 miles. A design for such a tunnel has been prepared by two Italian engineers for submission to Senor Mussolini. If the proposal is approved, and a tunnel is constructed, tourists will be able to reach Sicily from the mainland more easily than at present, and fruit and agricultural products grown in the island will be transported more readily and cheaply to Italy. The estimated cost of the tunnel is £45,000,000.

Steel Pylon 352 ft. in Height

What is claimed to be the highest tower in England has been erected at Barking Creek, near Barking, Essex. It is a steel structure with a height of 352 ft., or only three ft. less than that of St. Paul's Cathedral, and has been built for the purpose of supporting four electric cables carrying current at 66,000 v. The cables are to be employed in the transmission of current from the generating station at Barking, which they will connect with the main grid cable system in the eastern section of the inner London electricity area.

Later it will be necessary to carry the cables across the Thames and two larger supporting towers then will be required. These towers will be 487 ft. in height, and probably will be the highest structures of their kind in the world. The distance to be spanned by the cables they will support will be 3,060 ft.

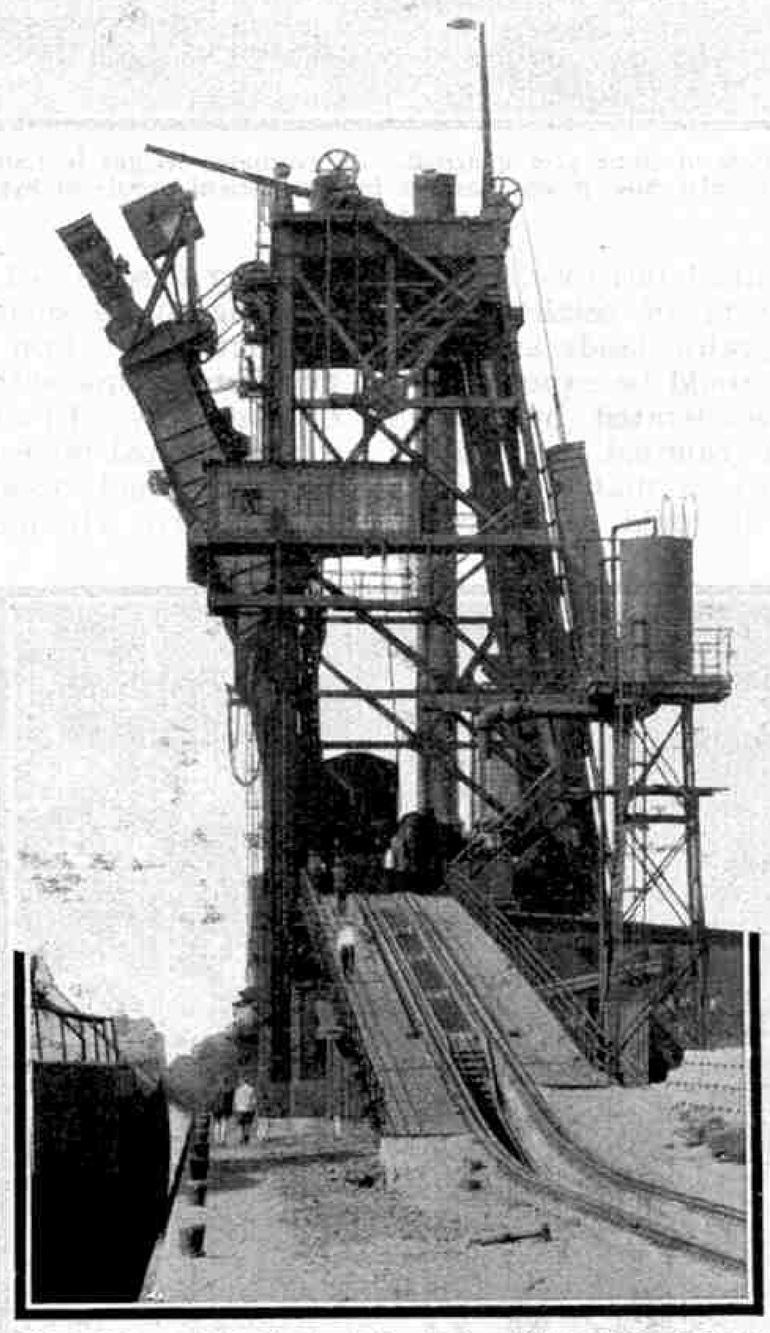
Omnibus with Sound-Proof Bodywork

A new omnibus has been designed in which passengers are unable to hear engine and transmission noises. This result has been achieved by employing special sound insulating material below the floor covering, on top of which coconut matting is placed in order to avoid any resonance. The front bulkhead also is constructed of sound-proof material to prevent sound waves from passing through it, and the windows do not rattle.

An interesting feature of the new omnibus is that it is panelled with armoured plywood, thus reducing the risk of injury to passengers in the event of a collision; and thermostatic heating is provided, together with a system of indirect lighting. A vehicle of this type is already in operation between London and Reading and it has proved to be very popular among the many regular travellers on this route.

New Bridge Across the Nile

There was laid recently the foundation stone of a new bridge across the River Nile at Cairo, to connect the city with Gezira Island, a residential quarter. The work of construction is being carried out by Dorman Long & Co. Ltd., Middlesbrough, and it is expected that it will be completed by June of next year.



The ship coaling plant at Sandusky, Ohio, described in the article on page 345.

The bridge is to have a total length of 1,250 ft., and will be 66 ft. in width. It will have six spans in addition to a double swing span that when opened will leave two channels, each 66 ft. in width, for navigation purposes. About 4,000 tons of steel will be used in building the bridge, and the total cost will be about £300,000. This includes the cost of constructing paved terraces on each side of the Nile, and a number of ornamental staircases.

Largest British Motor Fire Escape

A motor turntable fire escape that is believed to be the largest in this country has been constructed by John Morris & Sons Ltd., Salford, for the London Fire Brigade. When fully extended the ladder reaches a height of 104 ft., and it can be raised to this height in 20 seconds. Three men usually work at the top of the ladder, and they may be given orders from officers on the ground by means of a telephone fitted with a loud-speaker attachment. The machine is built of steel and weighs 8½ tons.

Improved Omnibuses for London Services

An improved type of omnibus is now being constructed for service in London. The new vehicles probably will be introduced in June. They will be equipped with spiral staircases and will carry more efficient route indicators than those now running, but their most remarkable feature will be the use of cellular rubber upholstery. The cellular rubber employed in this is made by whipping the liquid extracted from the rubber trees into a froth and pouring it into moulds to set. Thick pieces of this material may be regarded as pneumatic cushions in which the air is contained in tiny pockets distributed throughout the rubber. They are very resilient, and seats provided with them are lighter, and yet more comfortable, than those containing springs and the various types of stuffing that are usually employed for this purpose.

Salvage Work in Canada

An interesting piece of salvage work has been completed in Canada, where a large dredger has been raised from the bed of the St. Lawrence at a point about two miles east of Three Rivers, Quebec. The vessel was sunk in August, 1931, and has been raised only after many months of hard and continuous work. It was lifted to the surface on three occasions, when it turned over on its port side and sank to the bottom again. The total cost of the salvage operations was approximately £20,000.

Danube Bridge Completed

A new bridge has been constructed across the River Danube between Belgrade and Pancsova. The bridge is 4,950 ft. in length and 56 ft. in width, and has cost approximately £1,250,000 to build. The new structure is believed to be the longest bridge spanning the Danube.

Reservoir Building in Malay Peninsula

Four gigantic dams have been erected across rivers in the state of Johore, in the Malay Peninsula, in order to provide Singapore with an increased water supply. Two of the dams are of concrete and have been erected across a stream flowing southward, where they enclose a great artificial lake, known as the Sultan Ibrahim Reservoir, that is capable of holding 1,220,000,000 gallons. The lower dam is 600 ft. in length and 120 ft. in height, while the upper one is 340 ft. in length and 40 ft. in height. Water from a second river is brought to this reservoir by means of a tunnel driven through the intervening hills. This tunnel pierces material ranging from solid granite to quicksand, and in rocky sections it is lined with concrete, while steel segments provide the necessary strength where it passes through soft ground.

The reservoir will provide an average daily supply of 6,500,000 gallons, taken to a new service reservoir at Singapore through a steel pipe 33 miles in length and 3 ft. in diameter. The conduit passes through extensive swamps and there it is supported on concrete piers resting on piled foundations.

The remaining dams are built of earth over concrete cores and impound the water of a stream flowing south-westward. One of them is 450 ft. in length and 65 ft. in height; the second, a subsidiary dam, is 2,900 ft. in length, but only 45 ft. in height. The reservoir enclosed between them has an area of about 558 acres and a capacity of 3,200,000,000 gallons, and will be capable of supplying about 9,000,000 gallons of water daily. A steel pipe line 3½ miles in length and 2 ft. 6 in. in diameter connects it with the Sultan Ibrahim reservoir. The subsidiary dam was built on swampy ground, and it was necessary to use 2,000 tons of steel piling in order to obtain a satisfactory foundation.

The completion of the work provides Singapore with an additional daily water supply of about 15,500,000 gallons, bringing the total supply up to more than 30,000,000 gallons per day.

Telephone Line Across Canada

A telephone system from coast to coast has been established in the Dominion of Canada. The new line extends from Halifax, Nova Scotia, to Vancouver, British Columbia, a distance of 4,363 miles, and its completion makes it unnecessary to rely upon lines in the United States for long distance calls between east and west.

In providing this Canadian service, duplication of pole routes has been avoided as far as possible, the line being carried on the poles of the Canadian Pacific Railway Company through part of the Rocky Mountains section, and also along the north shore of Lake Superior. About 2,000 miles of line were rebuilt, most of this work being required in the prairie provinces and 22 repeater stations were established in order to ensure good reception. The cost of construction was about £1,000,000. Work on the line was not commenced until 1930.

New Excavator Record

A new record for the amount of spoil excavated in one day was set up a short time ago during work on the Hoover Dam in America, more than 16,000 c. yds. of rock being removed in 24 hours. This rock was obtained from tunnels that were enlarged by 256 linear feet in a single day. The speed of the work was maintained for a long period, and during one week about 1,700 linear feet of heading measuring 41 ft. by 56 ft. were excavated.

It is interesting to note that the dam is expected to be completed at least a year before the date contracted for.

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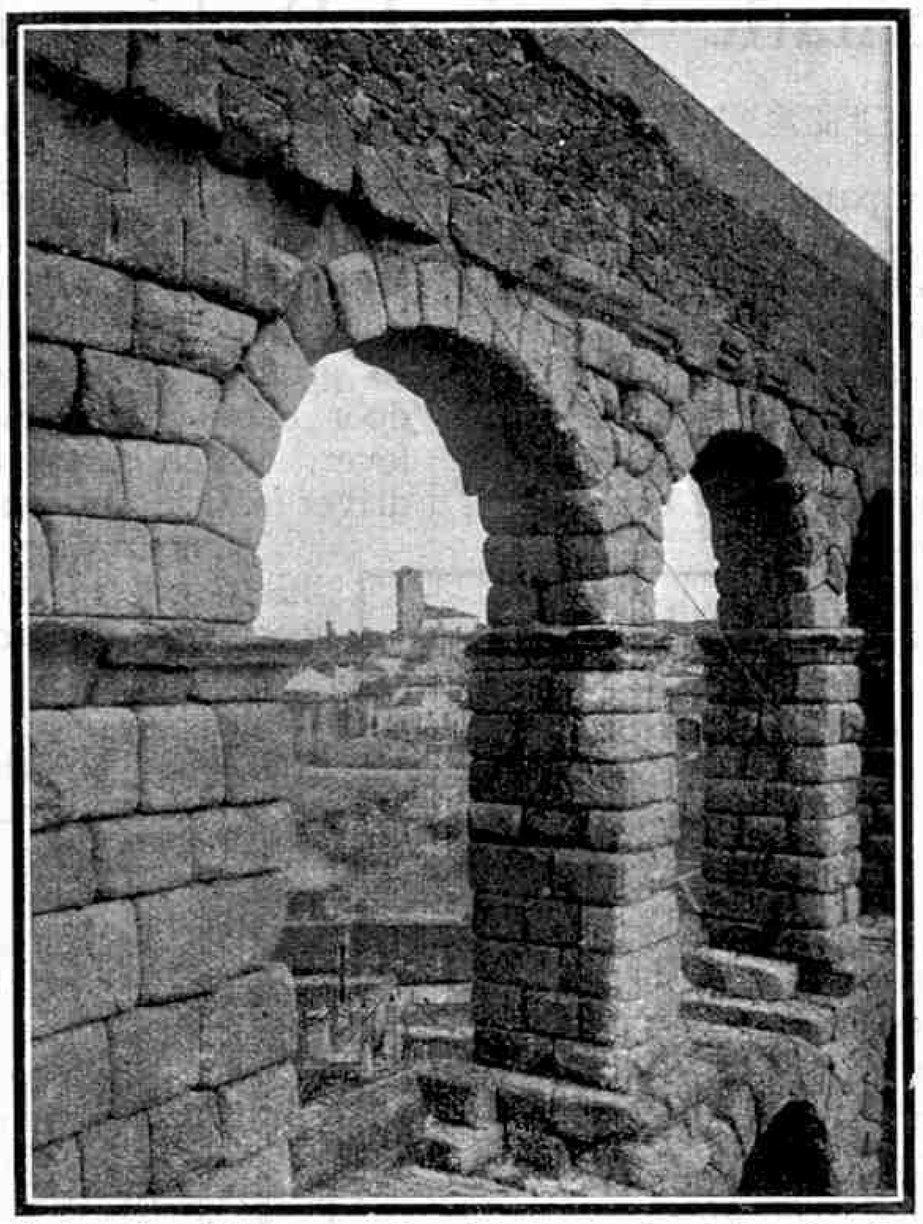
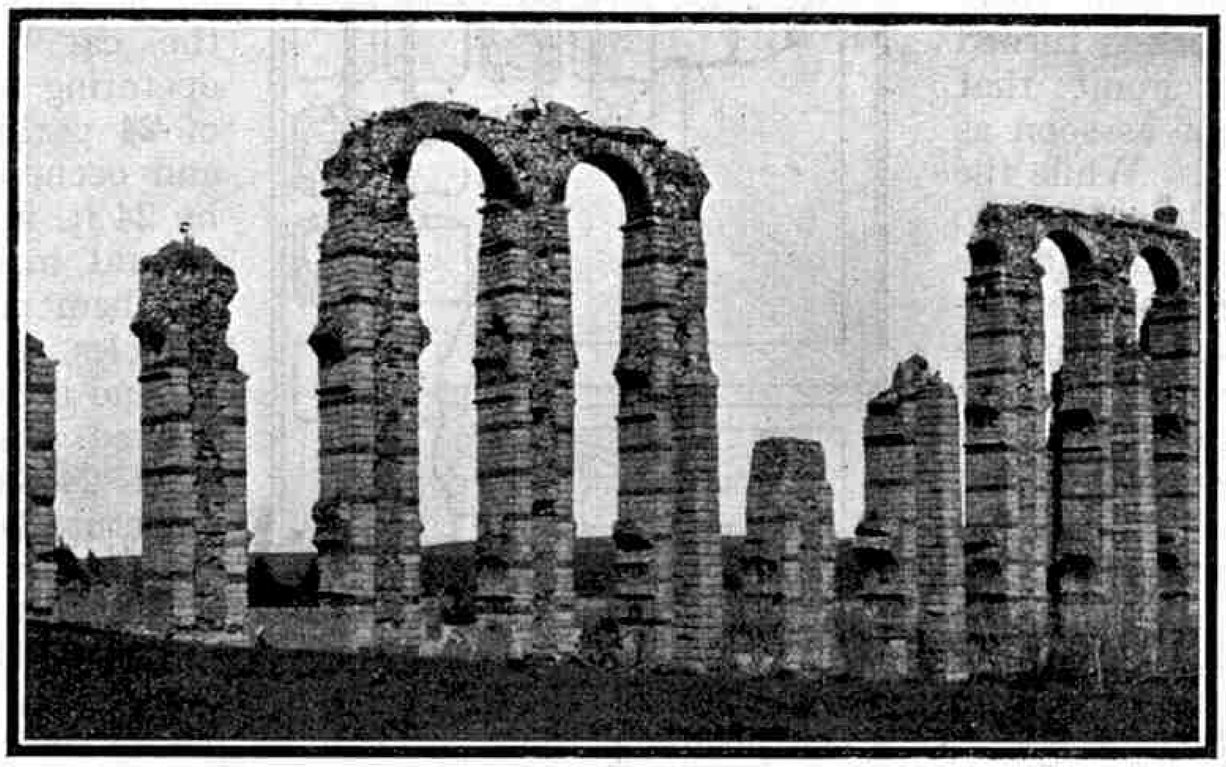
Omnibuses with wide central entrances and twin staircases leading to their upper decks have been supplied to the Burnley Corporation. The two staircases in each vehicle are placed opposite the entrance.



A close view of the upper arches of the Roman Aqueduct at Segovia, Spain, described in "The Story of Water Engineering," on page 346 of this issue. The structure was built about 109 A.D.



Ruins of a great Aqueduct at Merida, Spain, that also was built by Roman water engineers. The illustrations on this page are reproduced by courtesy of Mrs. Aubrey Le Blond.

Prospecting for Gold by Motor Lorry

An interesting six-wheeled lorry has been specially designed by Scammell Lorries Ltd., London, for the purpose of transporting oil pipes across undeveloped country. The four rear wheels are carried on oscillating axles, and thus the lorry is unaffected by inequalities of the ground passed over. During trials it travelled without difficulty over large heaps of earth and stone, and even with a test load of 10 tons of logs to represent oil pipes, it ascended with ease gravel heaps 20 ft. in height. Swampy areas also formed no obstacle to its progress, and in one interesting test it extricated itself without difficulty from a position in which the wheels on one side were sunk deep in mud.

The new lorry has a rigid frame and only one rear axle, from which the drive is transmitted to the rear wheels. The engine is a standard four-cylinder model developing 53 b.h.p. at 1,000 r.p.m., and a maximum of 80 b.h.p. at 2,000 r.p.m.

It is interesting to note that three lorries of this type are to be used in exploring an Australian goldfield that so far has been practically inaccessible. The area to be prospected is about 300 miles from the nearest railway. The leaders of the expedition will reach it by aeroplane, leaving the other members of the party and the equipment to be brought on the lorries, while supplies of food and fuel also will be carried by air.

A New Belgian Power Station

A large power station has been constructed at Schelle, Antwerp, on the right bank of the River Scheldt, from which water for the condensers will be obtained. The station is equipped with three generating sets, each of 30,000 k.w. capacity, and a larger one to produce 80,000 k.w. also has been ordered. This will run at a speed of 3,000 r.p.m. and will be one of the largest in the world to work at that speed.

The boiler house is 354 ft. in length, and in it are six Babcock and Wilcox multitubular boilers of the semi-marine type. These are able to supply 78 tons of steam per hour at a pressure of 610 lb. per sq. in. and are fired with pulverised fuel. The station eventually will be enlarged to have a capacity of 630,000 k.w. and the five additional boilers of similar type then to be installed will be capable of producing from 100 tons to 125 tons of steam per hour.

The power generated is transmitted at a pressure of 70,000 volts over four cables, two of which run towards the power station at Malines, the remaining two feeding a transforming station at Schelle, where the voltage is reduced to 15,000. The new station is linked with large generating stations at Alost, Sweveghem, Liège and other places in Belgium by means of high voltage transmission lines. More lines are being constructed, however, and the station will be connected shortly with another one at Langerbrugge, West Flanders.

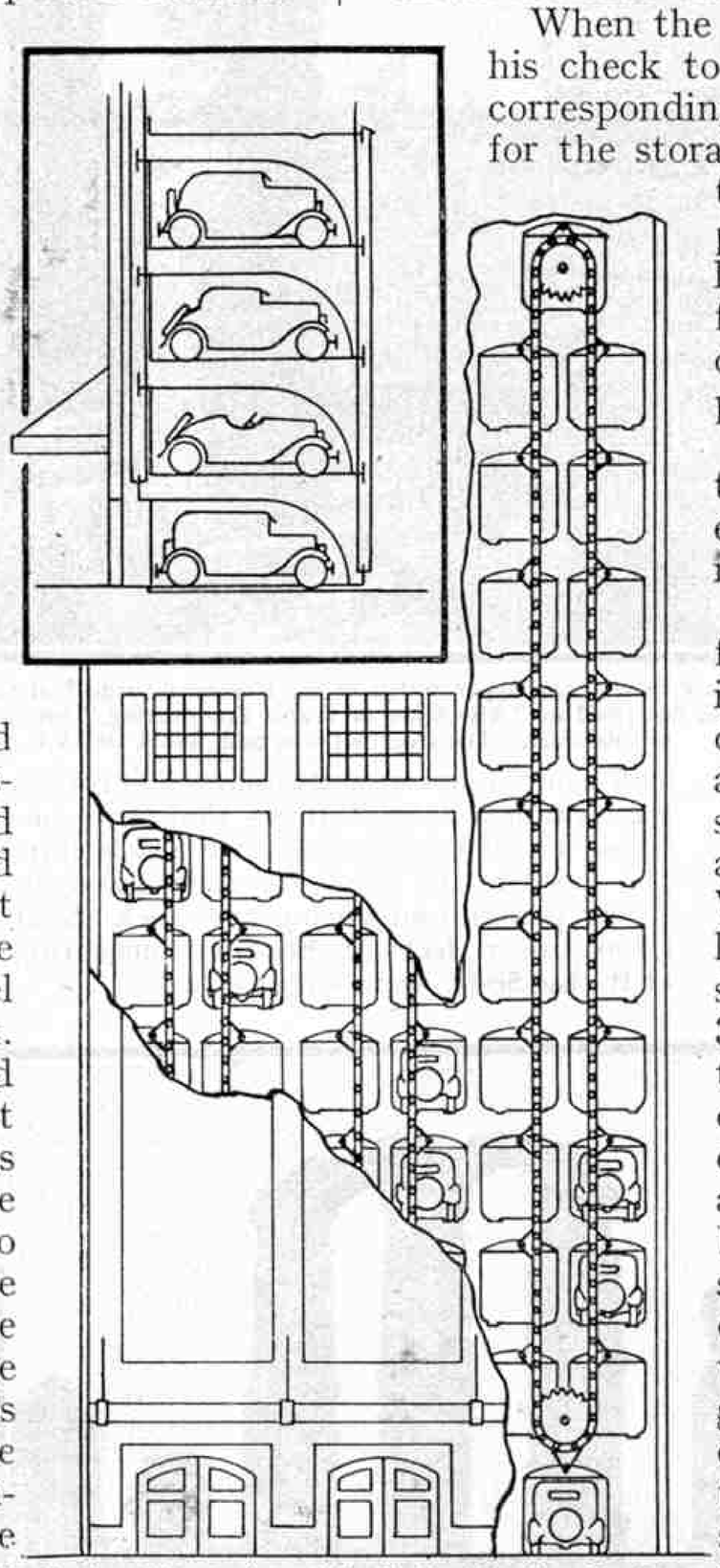
Interesting Car Storage System

An Automatic Vertical Parking Machine

THE Westinghouse Electric Company, East Pittsburgh, Pennsylvania, U.S.A., have recently devised an interesting automatic parking machine, which enables 24 cars to be parked on a ground space little larger than that required by an ordinary double garage. The general arrangement of the scheme is shown in the accompanying figure. The machine consists of cradles, one for each car, supported between two endless chains that pass over sprocket wheels at the top and the bottom of travel. The chains are driven by two electric motors, and by means of a push-button control, or its equivalent, any cradle can be brought quickly to ground level for receiving or discharging a car.

There are three chief methods for operating the machine, all of which use practically the same control, but in different ways. First there is the key system, which is used at the Westinghouse Company's parking garage at the East Pittsburgh works. Outside the garage is a panel having several numbered locks, one for each parking space, and a lock for opening and closing the door. Each tenant is provided with a key which, when inserted in the lock for his particular space, and turned at right-angles, dispatches that cradle to ground level and allows the tenant to remove his key from the panel lock and insert it in the door lock. When the key in the door lock is turned sideways it completes a circuit that automatically opens the door as soon as the cradle is at ground level. While the driver is engaged in driving his car on to or off the cradle, the key remains in the door lock, thus preventing anyone else from operating the machine. When the tenant is ready to leave, the key is turned to the vertical position to remove it from the lock, which results in completing another circuit that closes the doors and leaves the machine ready for use by the next tenant.

Another method of operating the machine is by push-button control. This method is specially suitable for a public garage, where the push-button can be placed in the cashier's office. When a customer wishes to park a car, a dispatcher directs him to a vacant place and opens the door to the parking space. Alternatively the customer may drive close to the opening of a machine showing a "vacant" signal, such as a green light, where a light-ray operated relay or a track switch causes the doors to open. In either case the driver then places his car on the cradle. When he has stepped out of the enclosure he operates a lever to get his check, which is stamped with the position of the car and the time of parking. The lever completes a circuit for closing the door, and sets up another circuit for dispatching an empty cradle to ground level ready for the next customer. The door cannot be closed until the driver operates the lever, which prevents accidental closing while the driver is inside the enclosure.



Sectional front view of the Vertical Parking Machine. (Inset) Side view of the machine showing how the cars are carried on individual cradles. By courtesy of the Westinghouse Electric Company.

When the driver returns for his car he presents his check to the cashier, who pushes the button corresponding to the check, and receives payment for the storage. By the time the driver reaches the machine on which his car is parked, his parking space is at ground level and the doors are open ready for him to drive out. The act of driving the car off the cradle completes a circuit that closes the doors.

The third method of operation is the same as the push-button system, except that a coin machine is used instead of push-buttons.

It is stated that the average time for parking a car, or delivering it, is only one minute. The present design of the machine operates at a chain speed of 100 ft. per minute, so that the average time for bringing a cradle to ground level is 30 seconds. When a cage is required at ground level the machine automatically selects the shortest route. Another 30 seconds are occupied in driving the car "on" or "off" and in operating the doors. Each machine of 24 parking spaces is 105 ft. high, and occupies a ground area of 16 ft. by 24 ft. for a car 18 ft. long. Where several machines are installed, most of them may be made for shorter vehicles, thus reducing the required ground area and the first cost. When desired a smaller or greater number than 24 cradles may be used, the structure being changed 8 ft. in height for each pair of cradles omitted or added.

In addition to the saving in time and space, other advantages are claimed for the system. The car can be placed on the machine and taken off by the driver, no attendant need handle it; there is no danger of the car being bumped or injured, and no one but the driver has access to it while it is on the machine. Operation of the machine without attendants is possible by having it controlled and supervised from an adjacent office, or by the use of a coin-collecting machine. The machine has been developed as the result of several years close study of car parking problems by Westinghouse engineers.

Coaling at 5,000 Tons an Hour

A Remarkable American Plant

DURING the past 100 years remarkable developments have been made in the coaling of ships. The early steamships were so small and required so little coal that the problem of filling their bunkers was not serious; and coaling by hand labour, in spite of its slowness, fulfilled all requirements. As the size of vessels and the length of their voyages increased, however, the old coaling methods became inadequate. By degrees various mechanical appliances were brought into use to speed up operations, and these have been improved and developed until to-day hand-coaling methods exist only in a few parts of the world where there is an ample and cheap supply of native labour.

An interesting ship coaling plant at Sandusky, Ohio, U.S.A., owned by the Pennsylvania Railroad, is shown in the accompanying illustration. This plant is designed to handle 120-ton wagons fully loaded, but it has sufficient reserve capacity to deal with 150-ton wagons when necessary.

The ship coaling plant at Sandusky, Ohio, in operation. In the foreground is shown a loaded wagon being pushed up the inclined gangway by a mechanical arm.

When the plant is in operation the loaded wagons are shunted to a point conveniently near, and pushed one at a time towards an inclined gangway that leads up to the "cradle" or platform of the hoist. At the foot of the incline each wagon passes over a pit, from which immediately appears a small contrivance known as the "barney-car." This consists of a mechanical arm attached to a small trolley running on a narrow-gauge track placed inside the track for the coal wagons, and it pushes each wagon up the incline to the cradle, where it is brought to rest ready for the next wagon. The barney-car then returns to its pit.

The hoist carries the loaded wagon upward for a distance of about 30 ft., and then the tipping mechanism comes into operation and the wagon is slowly tilted on to its side. With a roar the 100 or more tons of coal are dumped into a great pan, from which the coal gravitates down a long tapering chute lowered into the hold of the ship. Before the noise of the descending coal has ceased, the tipping mechanism has righted the wagon and the hoist has returned it to the top of the gangway. Immediately the cradle comes to rest the wagon descends an inclined gangway on the opposite side of the plant to the one on which it approached.

The whole of the operations just described are carried out in the remarkably short time of 90 seconds, and by the time that an empty wagon has begun to descend one gangway the barney-car is already pushing another loaded wagon up the other gangway. The empty wagon travels a distance of 400 ft. to the "kick-back," a steep incline on which it reverses its direction. It then runs through a switch and down into the "empties" yard.

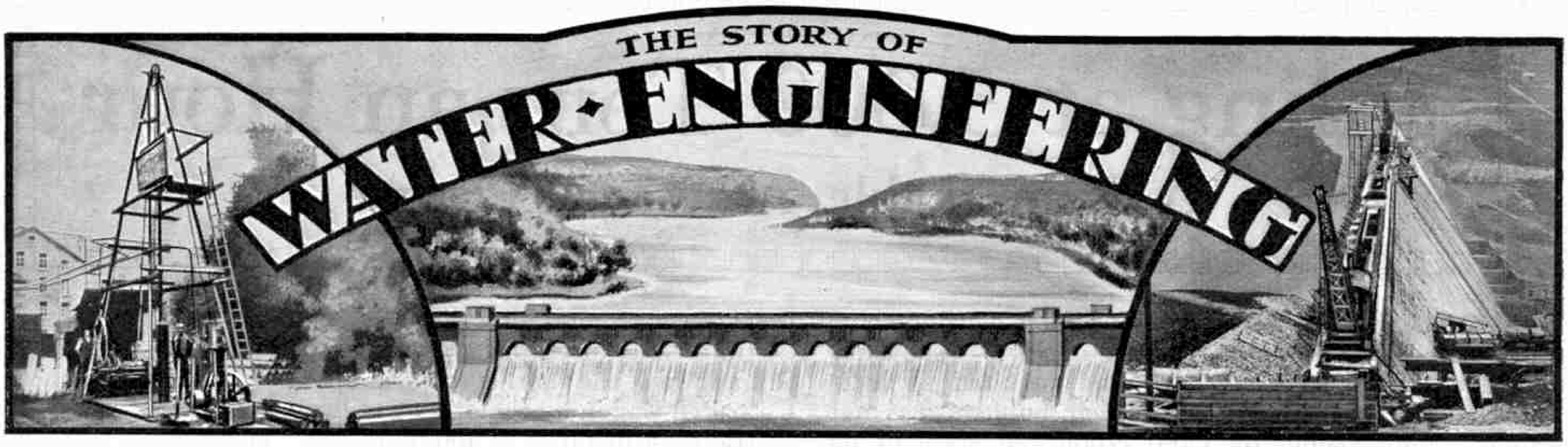
The coaling plant structure is supported on 11 piers tied together with cross girders and beams, and a 4-ft. concrete slab over the entire area forms the engine room floor. The four piers on the water side carry the heaviest loads, and extreme care was taken to ensure that these piers rested on solid rock with ample bearing areas. The piers on the land side rest on clay, through which rail anchors are driven down to the solid rock.

The approach track rises on a 12 per cent. gradient, and the haulage pit for the barney-car extends for 215 ft. at the foot of the approach.

The plant is equipped with direct-connected slow-speed engines. Over 40 cars per hour can be handled by the cradle hoisting engines with engine speeds not exceeding 60 r.p.m.; but if required the operator can run the engine as slowly as 3 r.p.m. The engine for hauling the barney-car is provided with an automatic slow-down and stop at each end of the haul, and an interesting feature of the plant is that the car is controlled, during its return to the pit at the foot of the incline, by slightly spreading the gauge of the wheels, thus producing the necessary braking effect. The mechanism for hoisting the cradle and for hauling the barney-car is operated by steam engines, but all other movements of the plant are operated electrically.

A complete electric lighting system is installed and two 90-ft. steel towers carry floodlights for illuminating the dock and yards, where operations are carried on at night during practically the entire operating season.

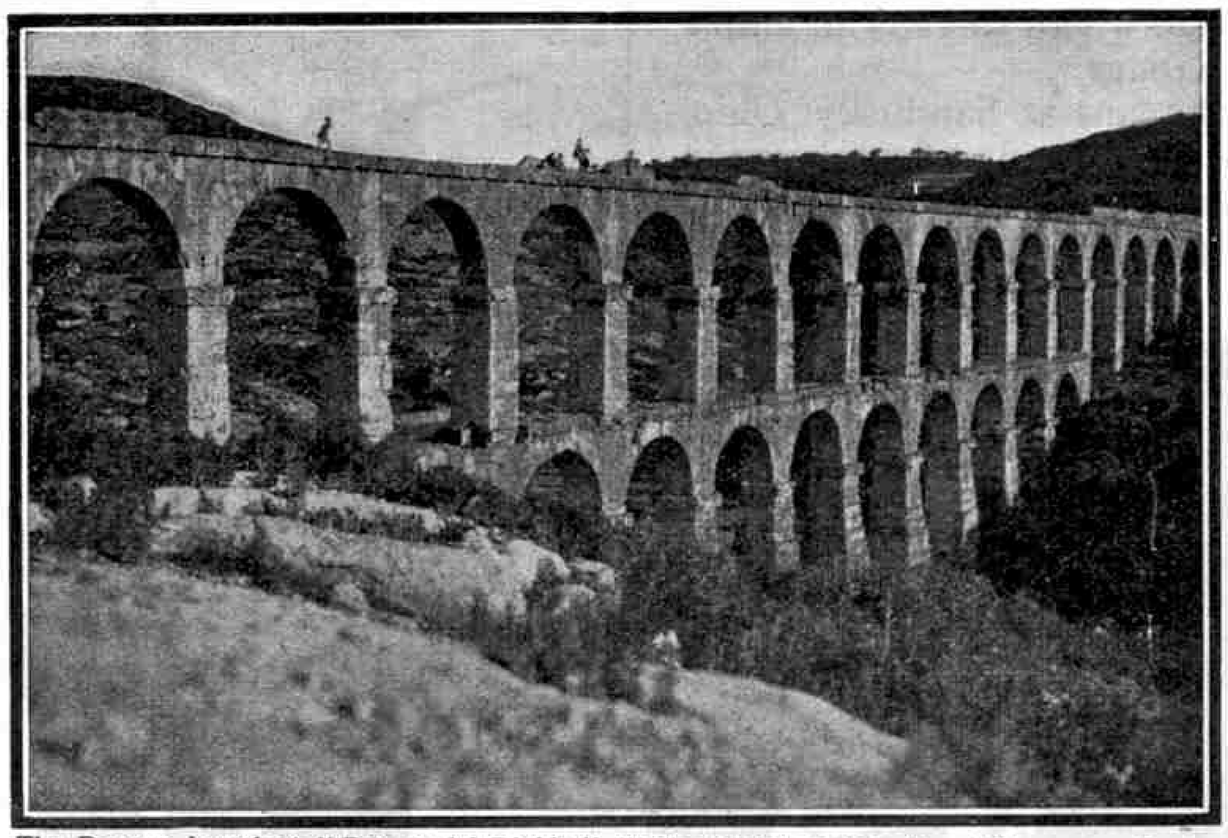
A reinforced concrete subway, 105 ft. long, 6 ft. wide and 7 ft. high, has been built under the railway tracks, so that pedestrians can pass to and from the docks without crossing the tracks. Ducts in the subway walls carry the power, light and telephone cables to t e docks.



I.—THE GREAT ROMAN AQUEDUCTS

WATER is a necessity to the existence of Man, and its presence or absence has always determined the sites of his encampments, villages and towns. Early Man availed himself of the water supplies that were ready to hand, and families or tribes established themselves in the neighbourhood of springs or streams and rivers. Later it was found that water could be obtained in times of drought, when springs and streams failed, by digging wells deep into the ground. The beginnings of well sinking and drilling are lost in antiquity, and it is not known which country was the first to make use of this means of procuring water, China and Egypt perhaps having the strongest claim. Records exist of ancient Chinese wells as much as 3,000 ft. in depth and from 5 in. to 6 in. in diameter.

It is probable that for a very long period the ancient communities simply took from the nearest available source the water they required, and allowed the rest to run to waste. As the size of these communities increased, however, it became necessary to find some means of storing up water for use during periods of drought, and reservoirs of various kinds came into existence. After a time local water supplies became inadequate to meet the needs of the ever-growing settlements, and additional water had to be brought from distant lakes by means of aqueducts and pipelines. From these beginnings has developed the modern practice of damming up whole valleys to create enormous artificial reservoirs from which the water is conveyed great distances through immense underground pipelines.

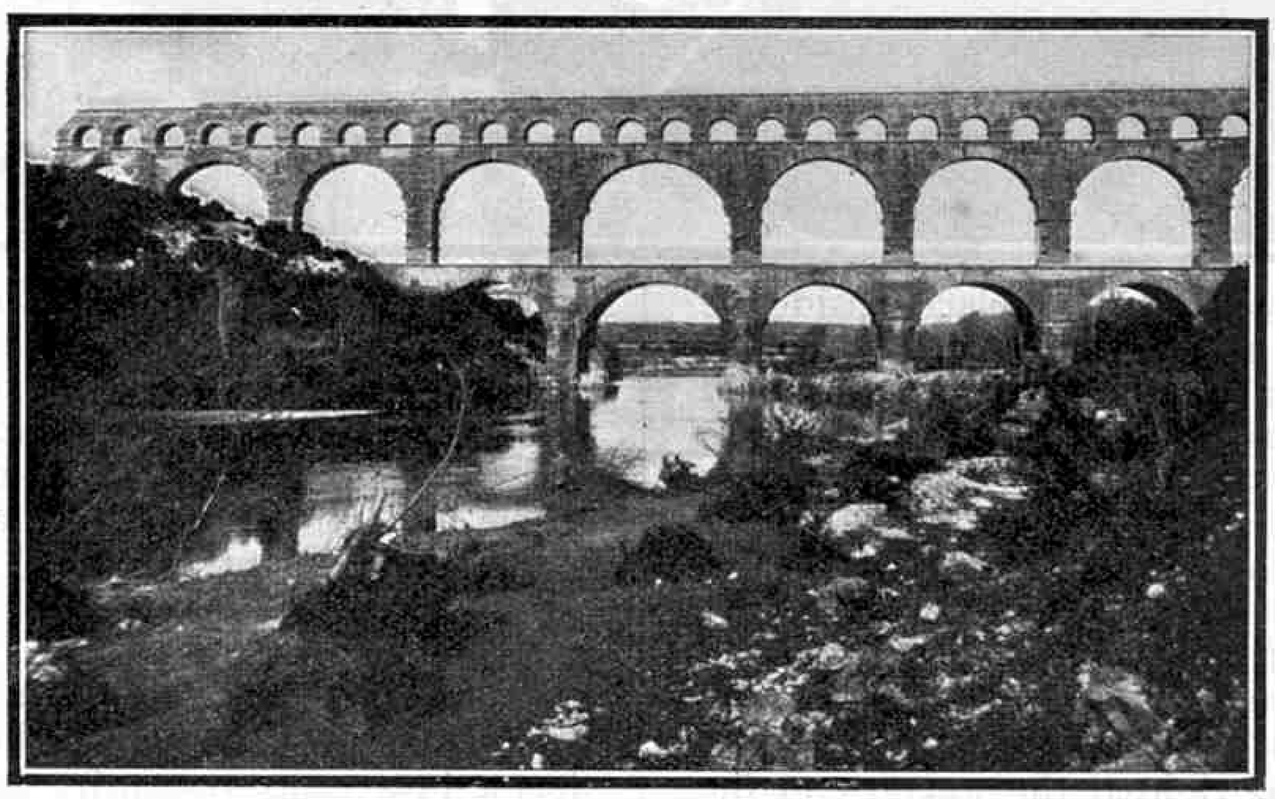


The Roman Aqueduct "Puente del Diablo" ("The Devil's Bridge"), at Tarragona, Spain. For this and the other illustrations to this article we are indebted to the courtesy of Mrs. Aubrey Le Blond.

The Greeks and the Romans paid a great deal of attention to securing abundant supplies of pure water for their cities. The Greek engineers noted how water collected in the hills and descended by underground courses to the coast, where it emerged cool and fresh; and they adopted a similar principle in the system of channels or conduits that they built to collect the water and convey it from the hills to the cities. These conduits sloped downward at a carefully calculated gradient that ensured the water flowing steadily by gravitation. Some of them were of considerable length, and their construction involved boring tunnels through hills, and cutting extensive canals to avoid the bridging of valleys. When the water reached the end of its journey through a conduit it passed into a large reservoir outside the city, from which it was distributed to various parts of the city by means of an extensive system of underground channels. A conduit built about 625 B.C. to convey water to Samus, Greece, passed through an intercepting hill, the tunnel being 2,400 ft. long, 8 ft. wide and 8 ft. high.

The Romans followed the Greek plan of constructing conduits at a steady gradient from one end to the other, but where a valley intercepted the route they boldly carried the conduits across it on a stone structure known as an aqueduct. The name aqueduct is derived from the Latin words *aqua*, meaning water, and *ducere*, meaning to lead. It is applied to the bridge-like structures that carry the conduits across valleys, and also to a conduit system in its entirety.

The Roman aqueducts were not solid walls of masonry, which would have completely obstructed traffic through the valleys, but consisted of series of pillars and arches. Some of the valleys bridged in this manner were very deep, and the aqueducts were built up to the required height by constructing a second, and in some cases a third row of arches above the first tier. Many of these aqueducts were colossal structures, and although they were built nearly 2,000 years ago, some of them are still in use.



The ruins of the Pont du Gard Aqueduct, near Nimes, France. The greatest height is 180 ft.

The first aqueduct was built by the Censor Appius in the year 312 B.C. and was known as *Aqua Appia*. It was seven miles in length, and led water from the hills to the poorer quarters of Rome. Another and much greater aqueduct, the *Anio Vetus*, was built about 40 years later. It commenced above Tivoli and was 43 miles in length. Then followed in rapid succession the *Aqua Marcia*, 61 miles in length, in 144 B.C.; *Claudia*, 50 miles, and *Anio Novus*, 46 miles, built between A.D. 28 and 50; and *Trajara*, 42 miles, A.D. 109. The total length of these aqueducts was 346 miles, and they supplied the city of Rome with 350,000,000 gallons of water per day—more than the present supply of Greater London.

This enormous quantity of water is the more remarkable when we remember that the population of Rome at that time was only about 1,500,000.

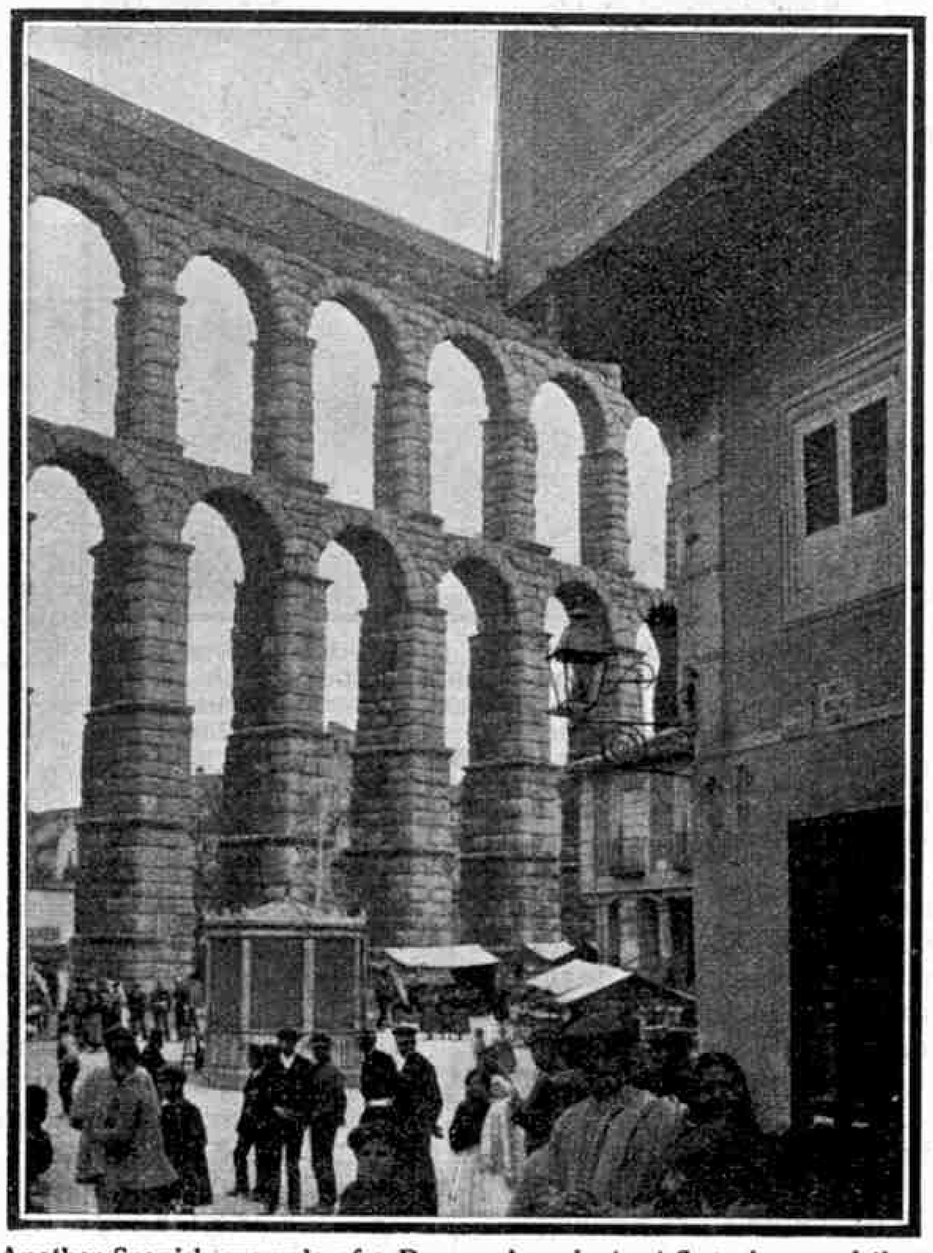
The abundant supply of water with which Rome was thus provided was not by any means used entirely for domestic purposes. Enormous quantities were used in the palatial public baths of which Rome possessed 800 or more. The baths of Caracella, for instance, were 1,840 ft. in length and 1,476 ft. in width. On every side were temples. The main building included a spacious vestibule that gave access to four halls on each side, where cold, tepid, warm and steam baths could be obtained. Beyond a huge inner quadrangle, where physical exercises were taken, was a hall with seating accommodation for 1,600 bathers, and flanked at both ends by libraries. Dressing rooms, lecture and music rooms were also a part of the building.

In addition to baths there were many magnificent and elaborate fountains, of which the Romans were very fond. Great quantities of water were used also to produce artificial lakes in the amphitheatres. Some of these lakes were of great size, and on them were fought miniature but none the less fierce naval battles for the amusement of the excitement-loving populace.

The water channel, or conduit, on the Pont du Gard.

The water was conducted through the aqueducts on a uniform gradient to great storage reservoirs at Rome, and distributed by a system of high-pressure mains and lead pipes to all parts of the city. Some of the stopcocks used in connection with this distribution network are now to be seen in the British Museum. A celebrated Roman writer on architecture, Marcus Pollio Vitruvius, who flourished under Julius Cæsar and Augustus, describes the use of the pressure pipeline for crossing a valley. He points out the need for care in this work, and the necessity for using air vents. The skill of the Roman engineers in dealing with high water pressures is shown by the fact that in 115 B.C. a siphon was constructed at Alatri to withstand a head of 340 ft. of water, which is equivalent to a pressure of 146 lb. per sq. in.

Workmen engaged in excavating in the streets or cellars in Rome and other ancient Roman cities dig up from time to time lead pipe laid down from 1,800 to 2,000 years ago, and still in a perfect state of preservation. An interesting piece of pipe was dug up in 1907 by workmen excavating for a cellar beneath a large hotel in Rome. This piece of pipe, which was taken to the United States and now belongs to the National Lead Company, bears an inscription which, freely translated, reads: "(Manufacture of the) Emperor Cæsar Augustus Vespasian under the charge of Callistus, freedman of the emperor, manager." The age of this pipe can be calculated from the fact that Vespasian reigned from A.D. 69 to 79. Another interesting piece of pipe, now the property of Columbia University, carries the inscription of the Roman plumbing firm of Aurelius Philetianus & Aelia Marciana, the latter being a woman. Sections of Roman lead pipe have been dug up also at various places in England.



Another Spanish example of a Roman Aqueduct, at Segovia, consisting of two tiers of arches. The illustration gives a good idea of the height of the structure.

The fact that these pipes have been preserved through so many centuries is due to the fact that lead is an extraordinary durable metal. If it is exposed to the action of the atmosphere, a coating of rust forms on it just as rust forms on iron, but there the similarity between the two metals ends. Whereas rust gradually penetrates deeper and deeper into iron, and finally destroys it, lead is protected by the first thin coating of rust that is formed, and provided that this coating is not scraped away, no further corrosion takes place. It is for this reason that the lead roofs of many buildings erected several centuries ago are still in excellent state of preservation.

By the end of the first century Rome was receiving water from nine systems of conduits, and eventually the number was increased to fourteen. Probably the best known of these aqueducts is *Porta Maggiore*, which formed part of a conduit system that was begun in A.D. 38 and completed 10 years later. This aqueduct, which at one place reaches a height of 109 ft., carried two conduits that converged about six miles from the city, and from that point onward were carried one above the other. These conduits carried water to the city from places 45 miles and 62 miles away respectively.

Reservoirs were built at regular intervals along the course of a conduit, so that water could be run off for the needs of the people of the districts through which the conduit passed, and also to enable repairs to be made at any point. According to Roman law, the material required for any repairs had to be provided by the owner of the property nearest to the damage, and this owner also had to convey the material to the site at his own cost. In the large reservoirs outside the city wall the collected water was allowed to purify itself before being distributed throughout the city, and salt was utilised to assist the process. These purifying reservoirs were often imposing structures. One of them was two storeys in height, each storey containing two or three large basins connected to each other. The structure was covered with a vaulted roof supported by pillars and provided with apertures through which foul air could escape. Smaller reservoirs were built in many parts of the city to aid in the distribution of the water supply.

In almost every country that the Romans occupied they left enduring evidence of their engineering skill, and some of the most striking of their aqueducts were built outside Italy. Probably the most remarkable of those still in existence is the *Pont du Gard* at Nimes in France, which was built in the year 19 B.C. during the time of Augustus. This aqueduct carries a conduit 4 ft. in width over the River Gardon, and at one place is 180 ft. in height. It is built up in three tiers of stone arches, of which the top tier is 28 ft. in height, while the two lower ones are each about 65 ft. in height. The bottom tier consists of six arches, above which is a row of twelve arches, topped by 35 arches having a total length of 882 ft. It will be seen from the accompanying illustration that the arches of the top row are not placed symmetrically with those of the two lower tiers. No mortar was used in the construction of the aqueduct, the large stone blocks being laid "dry"; but the conduit carried on top of the aqueduct was thickly lined with cement, and the tops of the conduit sides were covered with stone slabs. This aqueduct is regarded as being unrivalled for lightness and boldness of design.

One often hears it said that the Romans made use of a secret cement, the making of which still remains a mystery. This is not the case, however. The ancient Egyptians built their pyramids and other structures with a mortar consisting of calcined or burned lime, incorporated with partly-burned gypsum or calcium sulphate. The Romans improved upon this by mixing volcanic ash with the burned lime. This mortar would (*Continued on page 350*)

XXX.—A FARMER

WHEN the subject of careers is under discussion it is remarkable how seldom agriculture is mentioned alongside industry, commerce and the professions; and yet the number of people who annually take up farming must be large. The last published returns, for the year 1930, gave the total of agricultural holdings above one acre in area in England and Wales as nearly 400,000, and it is probable that every year about 10,000 boys and young men take up agriculture in order to provide for the succession of farmers. The chief reason for the fact that agriculture comes so little into the reckoning is the tendency for sons to follow fathers. This tendency has always been marked in farming and it seems to be intensified with the passing years. The great mass of boys now living in Great Britain see very little of the countryside, and to them the means of entering upon an agricultural career seem so remote that in practice farming appears to be open only to the sons and relatives of farmers.

It is only natural that boys living in the country should have an easy entrance into the agricultural industry. They are brought up in the atmosphere of farming, and although their education is not directed to farming, they learn as they work and live in it. Boys of this class do not wish to know how to take up farming, but rather to learn how to make the best of their adopted calling. Fortunately they are now able to study agriculture in all its aspects, for within the last 30 years excellent facilities for education in agriculture have become available at farm institutes, universities and agricultural colleges. On the whole, farmers have been slow to send their sons and daughters to these institutions, which were primarily provided for them. This is perhaps because hard times have reduced farmers' incomes, for keeping a son at home means that a labourer's wage is kept inside the family.

The value of science is being increasingly recognised by farmers, however, and country boys and their parents and guardians should bear in mind that its lessons may best be combined with practical experience in farm management by taking advantage of the further education available in various forms. These forms range from the short farm-institute courses of a term's duration, to those at agricultural colleges and universities at which are awarded diplomas and degrees in general agriculture, and in specialised studies such as dairying, horticulture and poultry keeping. Details of these institutions are given in publications of the Ministry of Agriculture and Fisheries and in agricultural journals. Full information also may be obtained from the Editor of the "*M.M.*," while details of the courses provided in the colleges themselves may be obtained from the secretaries.

Next we must consider the case of the boy who is strongly attracted by farming, but does not live in the country, or for some other reason has no natural and easy means of taking up farming. In most occupations a period of apprenticeship may be served, but this is scarcely the case with agriculture. The majority of farms in Great Britain are of medium size, on which a few labourers are employed, but no sub-managers or skilled assistants above the rank of bailiff or foreman, that is, a specially experienced man of the labourer class. Only exceptionally are farms on a grand enough scale to offer opportunities of apprenticeship in a subordinate position of responsibility, and there is no regular ladder of promotion.

For this reason the boy who wants to farm at home on his own account has to take the plunge without extended preliminaries, and must have command of capital, say £15 an acre for ordinary farming. The old way of learning farming certainly was to pay a premium and become a "pupil," but in many cases the pupil got little more for his money than his board and lodging and the run of the farm. To-day it is better to combine a practical training with a course of technical instruction.

Sir E. J. Russell, O.B.E., D.Sc., F.R.S., is Director of the Rothamsted Experimental Station of the Lawes Agricultural Trust. He was appointed lecturer and demonstrator in Chemistry at the Victoria University, Manchester, in 1898, and three years later became head of the Chemistry Department of the Agricultural College, Wye. In 1907, he joined the staff of the Rothamsted Experimental Station, of which he became Director in 1912, and was knighted in 1922.

It is difficult to say whether a course of training in agriculture should go before a period of one or two years' work on a farm or should follow it, and the best plan to adopt depends largely on individual circumstances. The matter can best be settled by means of a talk with the head of the selected college or institute. The break between school and the technical course probably should not be too long, for a young man desiring to become a farmer must gain experience after study at his college before he can set up in business for himself.

During his period at college the youth will get some idea of what kind of farming he wants to follow, and this will determine the sort of farm to which he should go for practical work. The head of his college or institute will be able to help him to find the right farmer, and his best plan is to put in a year or two's work as a labourer, for this experience will be helpful to him in learning how to deal with men and to gauge a reasonable day's work. After a year or so on his first farm he may seek a more responsible place that will give him touch with management and marketing, and in due course he should be able to take a farm of his own.

It is more difficult to give advice to a boy without capital, and who does not come of farming people, than to one who has been associated with agriculture. Before such a boy can make enough to start on his own account he must expect to spend a long period in such assistant and managerial posts as the industry offers. To begin with, his pay will be that of a labourer, or little better, and in the later stages of responsibility he will receive less than is earned by those who hold similar positions in ordinary walks of commerce and industry. Although it is a comparatively unremunerative business many boys and young men choose farming as their occupation. A training to suit them should be on much the same lines as those indicated for the intending farmer with capital, but more emphasis must be laid on the value of systematic college instruction as a means of qualifying for something more than labourer's pay. A young man in this position should aim at securing a diploma, preferably the National Diploma in Agriculture. This means taking a two years' course at the shortest; and during that time he should specialise in dairying, horticulture, poultry-keeping or book-keeping and cost-accounting. These subjects are so valuable as a means of finding openings for special work at better pay that, if at all possible, the period spent at college should be extended to allow them to be studied.

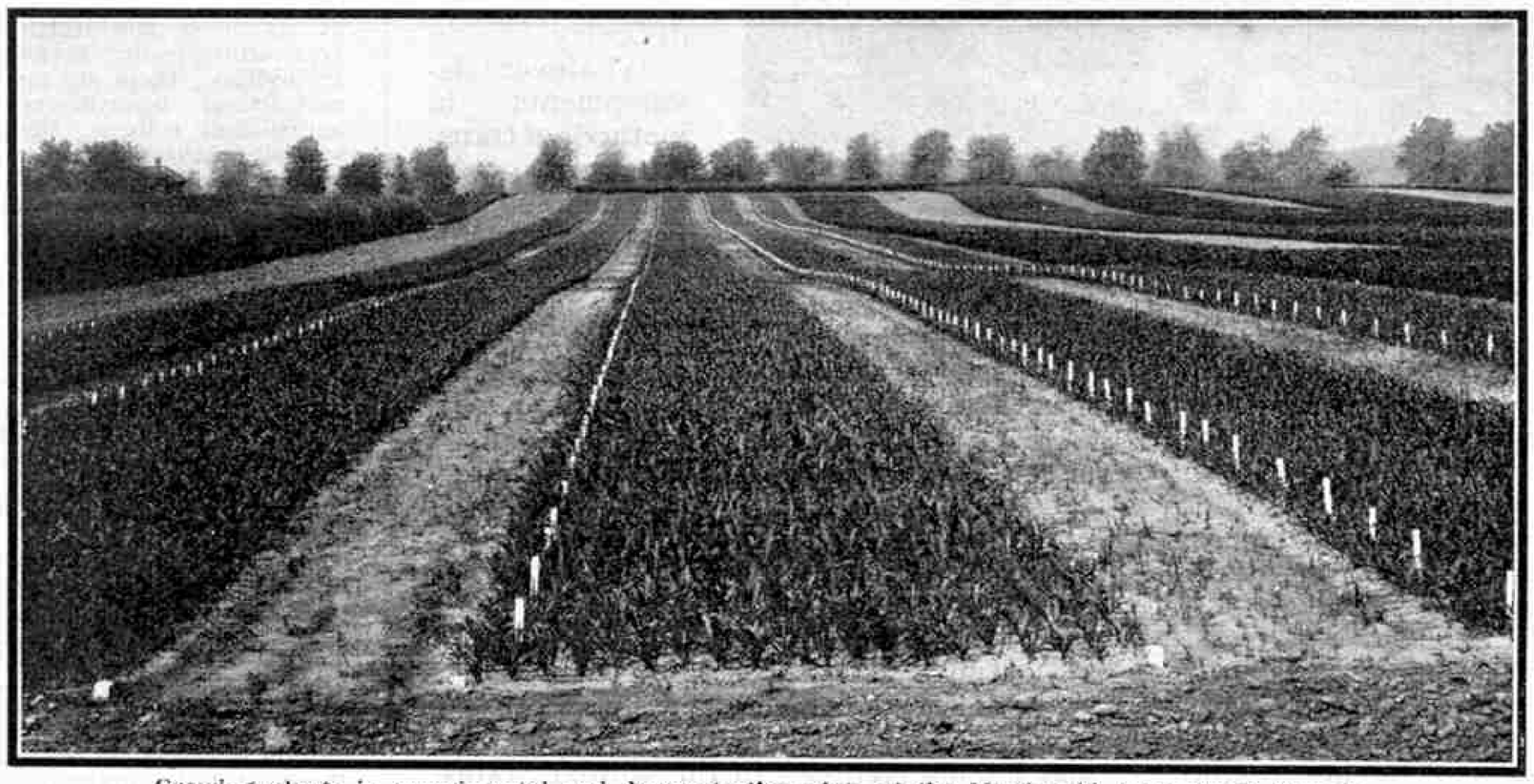
Unfortunately the present depressed condition of agriculture and the comparatively small returns obtainable may deter many parents, and the boys themselves, from looking to farming as a livelihood. In addition, it may be pointed out that changes in the nature of farming have occurred in the years since the War. Ideal considerations of good husbandry have had to go under stress of circumstances, and to-day it is unsafe to work otherwise than on cash results, as shown by a close system of accounting. The result is that there has been a considerable modification of the old advantages of farming as a "life," although many of its pleasant features remain. The agricultural outlook has become more hopeful within recent months, but it is still necessary to adopt a cautious attitude.

Some of the difficulties attached to entry into farming are less marked overseas than in England. There farm work is relatively of greater importance than in this country, and as a rule capital goes farther and the earnings of labour are greater, while money may be put by more quickly. A point that should be borne in mind by those who are attracted by farming overseas is that agricultural colleges and training centres have been established in the Dominions, and boys and young men born and brought up there also are taking up this calling.

One of the hostels of the Macdonald Agricultural College, Quebec, Canada. For the two photographs on this page we are indebted to the courtesy of the High Commissioner for Canada.

It is not necessary or even desirable that a boy should go through a grounding in the routine of an English farm before going overseas, for farming conditions in such countries as Australia and Canada are different from those in Great Britain, and the quality most valued is adaptiveness. His school may be able to give him experience in rough constructional work and a saddler will instruct him in the simple working of leather for harness. He may go on a farm long enough to know the handling of horses and cattle, ploughing and milking, and he should learn to ride and to drive a tractor.

Boys and young men who have been brought up in rural districts, and especially those who have already acquired some practical knowledge of farm life, are most likely to succeed overseas as farmers. This does not necessarily mean that all those who have only had experience of city life will fail, but they must either possess or develop those characteristics that will enable them to adjust themselves to agricultural conditions. These are determination or tenacity of purpose, good character and physical development, and industry, thrift and adaptability. In addition, they should have sufficient mental discipline or development to observe and to absorb a sound practical knowledge of every branch of agriculture.



Growing plants in experimental and demonstration plots at the Macdonald Agricultural College.

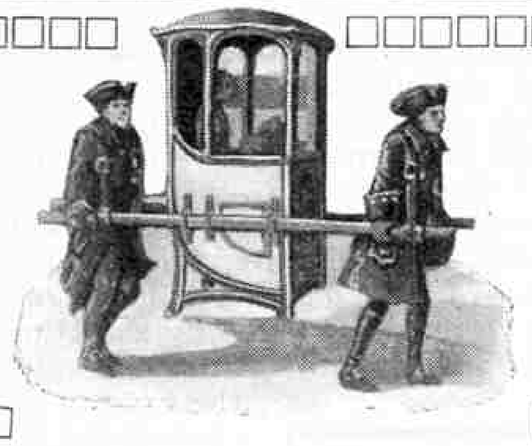
Before going to one of the Dominions in order to take up an agricultural career, full enquiry in regard to conditions of entry into the country chosen and the general conditions and prospects should be made. Full information on these points may be obtained from the representatives in this country of the Dominions concerned. On proceeding overseas when the necessary preliminaries have been settled, the first step is to acquire a sound practical knowledge of actual farming practice, and this can best be accomplished by obtaining employment with a successful farmer who keeps in touch with the latest agricultural methods or developments. This plan gives a keen young man the opportunity of gaining knowledge of marketing and land values, in addition to actual agricultural experience.

Farming is not the only career open to those who have been able to afford a sound training in agriculture, for young men possessed of expert knowledge of agriculture itself, or of the sciences connected with it, are recruited at home by the Ministry of Agriculture, the research stations, the universities and colleges, the County Councils and the industries concerned with the supply of farmers' requisites and disposal of produce; and for overseas, by the Indian and Colonial Services and the planting industries and corporations. These appointments fall into two classes—agricultural and scientific. In the first class come administrators, teachers of agriculture, agricultural organisers and estate managers of business corporations. To the second class belong the research workers who introduce new breeds of plants and investigate farming problems generally, and the teachers of such subjects as agricultural chemistry and biology.

Those who wish to take up appointments of this kind should make sure of matriculation or its equivalent, taking in their course as much science, especially on the biological side, as the school permits. From school the intending agriculturist must pass on to the agricultural department of a university or to one of the resident colleges in order to take a course leading to a degree or a diploma. A degree is preferable, but the qualifying course extends over three years instead of the two usually required for a diploma. In certain cases the qualification is not obtained until the student has previously put in a year's practical work upon a farm, and the majority of counties assist by offering scholarships, particulars of which may be obtained from the Education Office of the county in which the student resides.

After graduation it is only natural to look for an appointment, but if a period can be devoted to consolidating knowledge by further practical work in a responsible capacity, the time will be found to have been profitably spent. Of course this is more necessary for the town-bred student than for the man from the farm who has early acquired a background of experience. Both will have to add a working knowledge of agricultural economics and book-keeping.

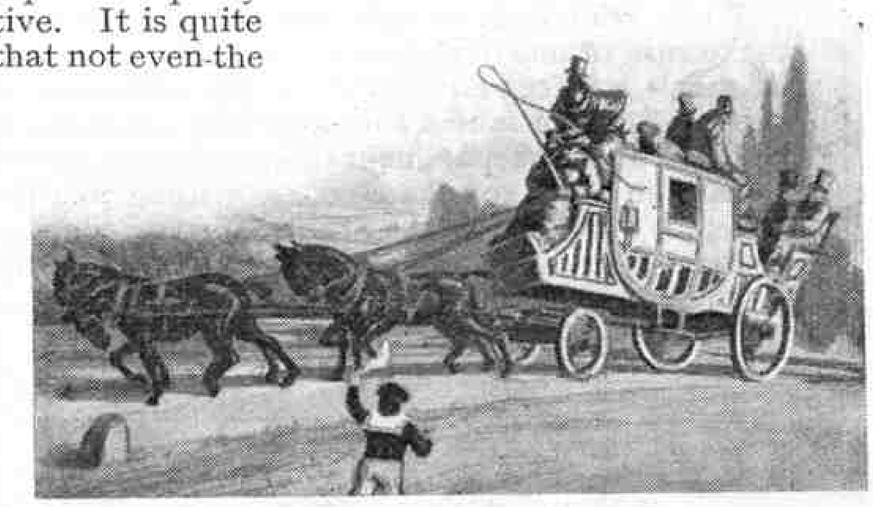
The scientific officer, as distinct from the agriculturist, must set out for a degree in pure science. His school course should be scientific in character, and biology with a background of chemistry should figure prominently in it. His university course should be similar, the sciences included in his degree examination being those related to agriculture. He will have no time to take a specific course of instruction in agriculture, but since his later work will deal with the problems of farming he must take steps to know the ordinary routine of the business. *(Continued on page 350)*



Early Coaching Days

Although the Stockton and Darlington Railway was the first public railway to carry passengers under Parliamentary sanction, it was not the first railway to be constructed under Parliamentary powers. This honour belongs to the Surrey Iron Railway opened in 1804. The Surrey railway was intended only for goods traffic, however, whereas the Stockton and Darlington line was not only organised for public goods traffic of all kinds, but also had definite rights with regard to the conveyance of passengers.

The opening of the Stockton and Darlington Railway on 27th September 1825, is a landmark not only in the history of transport, but also in the history of the world; and the progress that has taken place during the past 125 years is a high testimony to the foresight and thought of our early railway engineers. A large proportion of those who witnessed this event attached no importance to it, and indeed treated it with ridicule; but there must have been a few who dimly realised the possibilities opened up by the steam locomotive. It is quite certain, however, that not even the most imaginative of those spectators could have foreseen the stupendous changes that the railway was destined to bring about in the conduct of the world's affairs.



The bad old coaching days! How people travelled a century ago.

At the dawn of the 19th century men moved about very much in the same manner as they had been doing for generations past. The poor man walked; while those of sufficient means travelled on horseback, by Sedan chair, or by stage coach. People who lived in Edinburgh and who wished to travel to London had the opportunity of making the journey by stage coach once a month. This journey required ten days in summer, and in winter twelve or even more days were required on account of floods that frequently made the badly constructed roads of that period almost impassable. At the best of times the coach was a most uncomfortable vehicle, and the slow speed, and the necessity of having to stop for the night at inns that were not always of the best, made the journey extremely tedious for travellers. In addition to the discomfort there was always the possibility of an encounter with highwaymen, and altogether it is no matter for surprise that travelling in those days was regarded as a risky and adventurous undertaking. To most of the people of that period the country outside a radius of 20 miles or so of their homes was almost as remote as a foreign land.

All this has been altered by the coming of the railway, and to-day every town in the United Kingdom is linked to a vast network of lines. British railways now have a total mileage of single track, including sidings, of 51,000. The passenger stations number 6,809; there are 11,059 signal-boxes and 1,092 tunnels; the locomotives total 22,168, and the passenger carriages 45,525 with a seating capacity of 2,573,000. The freight wagons owned by British railways number 665,134, and their total carrying capacity is 7,500,000 tons. We now travel at high speeds in comfort and safety, and eat and sleep on board the train. A journey from London to Edinburgh is accomplished in the short space of eight hours, instead of the ten or twelve days necessitated just over a century ago.

The "iron horse," as the early locomotive was quaintly named, has overcome every obstacle, mechanical and geographical. It travels across valleys; crosses gaping chasms; tunnels through great mountain ranges; penetrates jungles, and safely traverses dangerous swamps and bogs—even wide rivers fail to check its progress. The building of the great railways of the world forms a wonderful story of engineering skill, courage and dogged perseverance in the face of every conceivable obstacle and difficulty.

Whatever developments in methods of transport may take place in the future, it is unlikely that the railway will be superseded for fast, large-scale transport; but it is very probable that the steam locomotive will be replaced by some type of electrically-propelled giant. British railways already have 1,320 miles of electrified track, and the electrified sections of line have been so successful commercially that there is little doubt of their steady extension. The application of electricity to long main line journeys has not yet been attempted in this country, but the possibilities in this direction have been proved by the success of the 660 miles of electrified track of the Chicago, Milwaukee, St. Paul and Pacific Railroad in the United States, which is the longest stretch of electrified line in the world.

The ease with which the trains on the electrified section of this railway are handled shows that electricity gives smoother, more reliable and quicker running than steam. The great transcontinental trains are started, operated, and brought to a standstill, both up and down the severe mountain grades, with a precision that only electric power can supply. In addition the 61 electric locomotives now in use in the electrified zones have released for service elsewhere on the system, no less than 162 steam locomotives.

Water Engineering—(*Continued from page 347*)

harden and set under water, and it made possible the Roman aqueducts and maritime works of various kinds. The volcanic ash was obtained from a place named Puzzuoli. In some remarkable manner the method of making this cement, simple as it was, became lost; and for something like ten centuries the Roman cement did actually remain a mystery. We now know all about it, however, and we are able to produce cements that are quite as good, and in many respects better.

The ruins of several fine Roman aqueducts are to be seen in Spain, the best known of these probably being the one at Segovia. This aqueduct is nearly 2,400 ft. in length and 102 ft. in height, and it contains 159 arches which, as is shown in the illustration, were ranged in two tiers. We illustrate also the aqueduct at Tarragona, which is 876 ft. in length and 83 ft. in height. The poet Swinburne makes an interesting reference to this aqueduct in his "*Travels in Spain*." He writes: "This aqueduct is not only an admirable monument of antiquity for its solidity and good mason's work, which have withstood the violence of so many barbarities and the inclemencies of the season during so many ages, but also wonderfully beautiful and light in design."

Long before the building of the aqueducts the Romans had constructed a remarkable system of drains to carry away water from the swamps surrounding the Seven Hills on which ancient Rome was built. These drains consisted of semi-circular tunnels strongly built of great stone blocks weighing as much as three tons, fitted together in the most skilful manner. The main drain of this system, into which the others discharged their contents, remains, after some 2,500 years, in good condition, and still carries water into the River Tiber. It is 13½ ft. in width, and is lined with three concentric arches of stone blocks, 5 ft. in length and 3 ft. in thickness, jointed so perfectly that no cement was necessary.

After the decline of the Roman Empire the aqueducts were allowed to fall into decay, and it was not until after the middle of the 18th century that aqueduct-building was resumed to any great extent.

What Shall I Be?—(*Continued from page 349*)

After obtaining his degree he should continue with specialised post-graduate training.

It may be pointed out that the veterinary profession is closely connected with agriculture, and in the article on veterinary surgery as a career that appeared on page 968 of the "*M.M.*" for December, 1931, special attention was given to practice in rural districts.

Official appointments are offered by various public bodies. The Ministry of Agriculture recruits men and women, mainly with the agriculturist type of qualification, at the grade of inspector, carrying a commencing salary of £200, exclusive of the cost of living bonus. The County Councils employ large staffs of organisers and instructors in science, dairying, horticulture, poultry keeping and other special subjects. In addition, there are openings on the staffs of the agricultural departments of the universities and agricultural colleges, these also being centres for specialist investigators and officers who advise on farming problems. Salaries vary, ranging from £200 to £300 at first entrance to £1,000 or more for the best posts.

Appointments of a wide range of type are at the disposal of the Colonial Office. Vacancies in the colonial agricultural departments are filled through post-graduate scholarships offered annually. It is intended that these scholarships should be available at any rate till 1933 and about fifteen probably will be awarded this year. Appointments in the Colonial Service are not guaranteed to holders of these scholarships, but they may expect to be retained for the service if their work and conduct are satisfactory. The initial salary, with allowances, usually is not less than £500 per annum. Further prospects vary according to the colony in which an appointment is held, the best posts carrying salaries of from £1,000 to £1,600.

Writing in the Sky—(*Continued from page 333*)

curtain is a range of solid cloud at a height of several thousand feet. Preferably the cloud should have a straight base, and even on fine nights there is usually enough mist within reach to suit the purpose.

If one stands beside the searchlight the end of the beam cannot be seen until it strikes a cloud or layer of mist, when the written message can be read even from brilliantly lighted streets.

Many foreign powers are interested in this searchlight and a German firm has already purchased one for advertising purposes, while the German authorities have allowed their admiration of the searchlight as a technical achievement to overshadow any consideration of its effect as an advertising intruder upon their night skies. Although the experiments have cost a lot of money, the fact that night sky-writing does away with the costly maintenance of an aircraft fleet suggests that as an advertising medium it should be cheaper than daytime sky-writing.

In view of the objections that have been raised to advertising by means of sky-writing, a committee of the House of Commons has been appointed to consider the use of appliances for this purpose.

Scientific Prophecies in Fiction

The Career of Jules Verne

JULES VERNE occupies a unique place in the history of literature. He was one of the first writers to make systematic use in fiction of accurate scientific knowledge, and in many respects he still remains the most successful. His most famous books are not only based on scientific ideas, but in addition the incidents that unfold themselves in the course of the story are natural scientific developments of the main idea. His vivid imagination led him to describe achievements that seemed wildly improbable at the time he wrote, but it is remarkable how many of them have been realised either completely or to a considerable extent. Perhaps the most striking book in this respect is "*Twenty Thousand Leagues Under The Sea,*" in which are vividly described the exploits of "Captain Nemo" in his submarine "*Nautilus.*" It is an interesting fact that this was one of the author's most cherished works. It has been translated into a host of languages—as indeed have all his books—and it has been read with keen delight by both children and "grown-ups" of every nation.

Jules Verne was born in 1828 at Nantes. From the balcony of the old house the boy watched with ever-growing interest the busy life on the river, accompanying in imagination the sailing ships to far-off and mysterious destinations. His younger brother Paul was his constant companion, and Jules used to thrill him with wonderful stories of travel and adventure. At school Jules was by no means a model pupil. His exercise books were covered with drawings of ships and flying machines, and we are told that on one occasion he drew on the blackboard, before a group of excited schoolmates, a wonderful picture of an elephant worked by steam!

After his schooldays Jules went to Paris to study law, but he gave more attention to writing plays than to his legal work. Presently his father insisted that he should return to succeed him in his lawyer's office, but the youth replied: "The only career that suits me is the one I am following—writing—so please forgive your affectionate son." This was his final decision. For a long time he had a hard struggle, and indeed he passed through a period of semi-starvation. He wrote essays, and obtained a post as temporary clerk in a lawyer's office, and by these and other expedients managed to exist. Later some of his plays had a small amount of success, but he seemed no nearer to fame as a writer. A change came when his book "*Five Weeks In A Balloon*" was accepted by the prominent Paris publisher Hetzel, and achieved immediate success. This book still remains one of the most widely read of all his romances. His next two books, "*The English At The North Pole*" and "*The Ice Desert,*" were equally successful, and by this time his reputation was made.

Jules Verne

In 1859 Verne made a tour of Scotland, followed by a visit to London, where he saw the "*Great Eastern*" in course of building. This huge ship made a strong impression on his mind, and years afterwards he and his brother Paul crossed in her from Liverpool to the United States. Some of the incidents of this trip are told in "*A Floating City.*"

One day an advertisement of a Cook's tour attracted his attention, and immediately his imagination conjured up a personality in check tweeds, suitcase in hand, determined to go round the world in the shortest possible time. Not long afterwards this idea took form in "*Round The World In Eighty Days,*" which is in many respects his masterpiece. Scarcely had this story begun to appear in instalments in a Paris newspaper than the famous bet of Phileas Fogg produced a crop of similar bets. American journalists in Paris cabled daily to New York the incidents of the undertaking, and agents of shipping companies called repeatedly on Verne to offer him large sums of money if he would arrange for his hero to travel by one of their ships and arrive quicker than by a rival company's vessel! Needless to say, all these offers were promptly refused. A clever dramatist, Adolphe D'Ennery, who, starting life in a garret, had reached in 20 years the stage of a big theatre in the Avenue du Bois—now the Avenue Maréchal Foch—was introduced to Verne, and together they dramatised the story. The play was produced in a setting of unprecedented brilliance. Verne, rather uneasy about the tremendous expense involved, asked the theatre manager during a rehearsal if he thought the play was a success. "No," was the reply, "it's a fortune." The far-sighted manager was right, for the play had a run of over two years, bringing a fortune to its authors and the theatre.

The success of "*Round The World In Eighty Days*" was followed by another almost as great, that of the extraordinary adventures of the Czar's courier, "*Michael Strogoff,*" which as a play ran for 400 consecutive performances.

In their youth the brothers Jules and Paul had often watched with longing eyes the vessels building in the shipyards at Nantes, and had determined that if ever they could earn enough money to buy a vessel for themselves they would sail round the world together. Their opportunity came, but their voyages in the yacht "*Saint Michael*" were of more modest extent, being confined to the Mediterranean and the Channel, with a trip to Scotland, Germany and the Baltic, on the return from which Verne produced his surprising book "*The Begum's Millions,*" in which he predicted long-range guns such as bombarded Paris in the Great War. The Mediterranean cruises produced "*Mathias Sandorf,*" in which the minor incidents of the voyages became transformed to the most fantastic adventures.

When the French Revolution broke out in 1870 Verne was mobilised and sent as a coastguard to Crotoy. There he found time to continue his writings and produced his most serious work, "*The Story of Three Englishmen and Three Russians.*" He had hardly completed this before he was hard at work on another novel, "*In the Country of Furs.*" In 1872 he produced his famous book "*Twenty Thousand Leagues Under the Sea,*" which secured for him one of the greatest honours bestowed on authors, the prize of the French Academy. At the presentation ceremony Verne received a remarkable reception and his address of thanks was enthusiastically applauded.

At the height of his success Verne left Paris to live at Amiens, where he spent his last years quietly in a delightful old-fashioned house. News of the illness that finally proved fatal was received with sorrow throughout the world. All the newspapers gave reports of his condition, and the Havas Agency published bulletins every hour. The last bulletin that was posted up in the Paris Stock Exchange on the morning of 24th March 1905, said: "The illustrious author is succumbing quietly"; and at four o'clock on the same day he passed away. The cemetery of the Madeline at Amiens contains a monument bearing the names of Jules Verne and his wife, and a life-like effigy of the author by the sculptor Rose. This shows Jules Verne casting aside his tombstone, and bears underneath the words: "Towards Immortality and Eternal Youth."

In 1928 the centenary of the death of Jules Verne was celebrated throughout the world and one newspaper in Denmark sent a reporter round the world in imitation of Phileas Fogg. Probably the most touching tribute to the memory of the famous author was paid by the French Minister of Marine who marked the occasion by naming two submarines, then under construction, "*Jules Verne*" and "*Nautilus*" respectively. This thoughtful act brought the Minister a letter of thanks from the grandsons of Jules Verne.

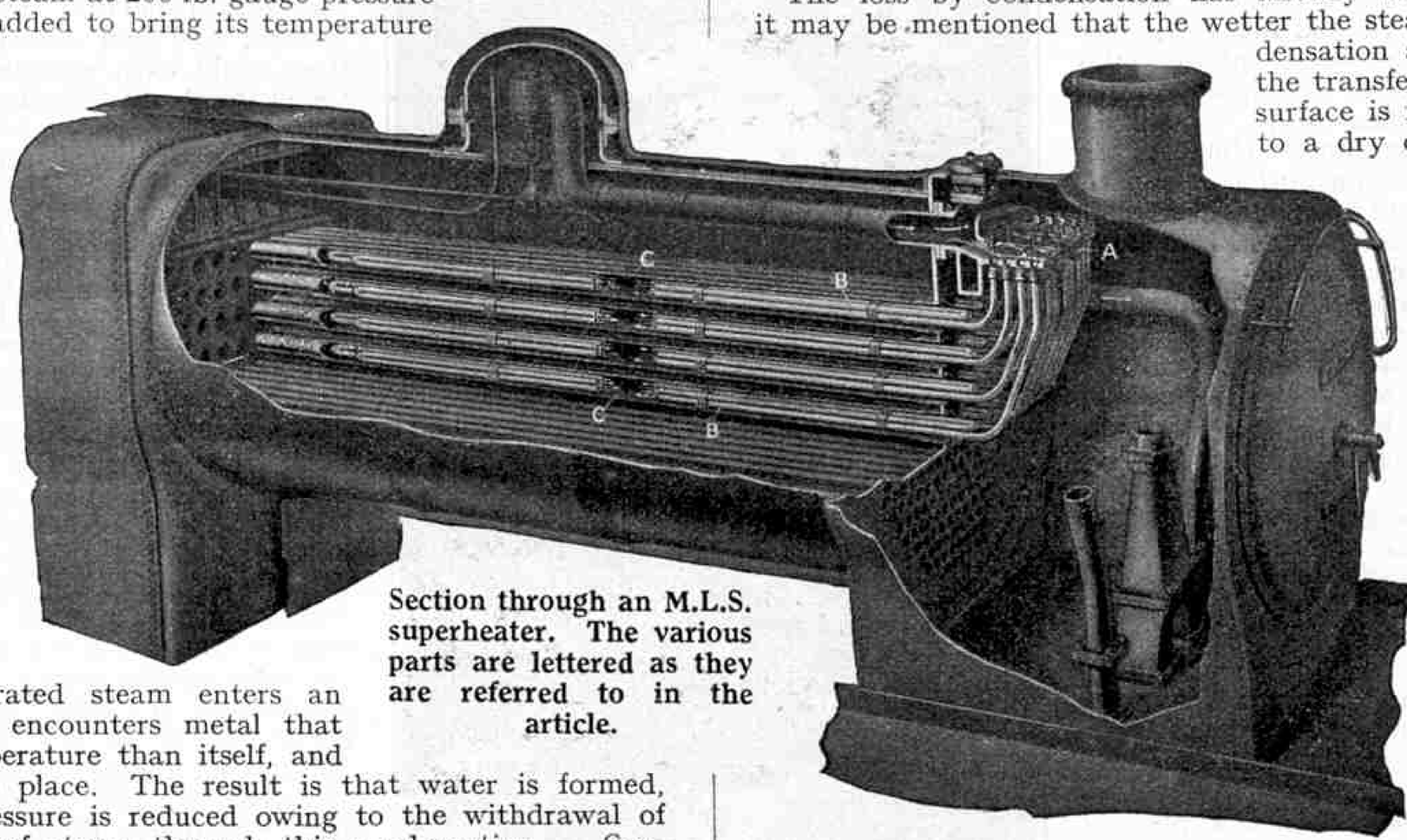
How and Why Steam is Superheated

The Modern Locomotive Boiler

NEARLY all modern locomotives are fitted with superheaters and the steam supplied to the cylinders is superheated. This means that extra heat, over and above that required to produce steam at a certain pressure, has been added.

The steam generated in a boiler is termed "saturated," and has a definite temperature corresponding to its pressure. For instance, steam in a boiler at 100 lb. pressure above atmosphere (known as gauge pressure), or 115 lb. absolute, always has a temperature of 338° Fahrenheit, while at 200 lb. gauge pressure the temperature is 388°F. The volumes per pound of water evaporated into steam are also in definite relations to the pressure and temperature, being in the two examples just given 3.88 and 2.14 cubic ft. respectively.

If the saturated steam be taken from the boiler and subjected to further heating it will expand, or increase in volume, but its pressure will remain constant. If sufficient heat is added to steam at 100 lb. gauge pressure to increase its temperature to 438°F., then it is said the steam has 100°F. superheat. As a further example, if steam at 200 lb. gauge pressure has sufficient heat added to bring its temperature up to 588°F., then it has 200°F. superheat. The volume of the steam in each case has been considerably increased, however, that at 100 lb. gauge pressure with 100° superheat being 4.51 cubic ft. per lb., an increase of 16.25 per cent., and that at 200 lb. gauge pressure with 200° of superheat being 2.84 cubic ft. per lb., an increase of 32.7 per cent.



Section through an M.L.S. superheater. The various parts are lettered as they are referred to in the article.

When the saturated steam enters an engine cylinder it encounters metal that is at a lower temperature than itself, and condensation takes place. The result is that water is formed, and the steam pressure is reduced owing to the withdrawal of a certain amount of steam through this condensation. Consequently, in order to enable the engine to do its proper work, further steam has to be added to compensate for loss due to condensation.

When superheated steam is used, however, the whole of the superheat can be taken away without affecting its pressure, and it will thus be realised that cooling may take place in steam pipes and cylinders *up to the amount of the added heat* without condensation and its attendant losses taking place.

As an example, we will take an engine cylinder using 2 cubic ft. of steam at 200 lb. gauge pressure at each stroke, the cut-off, or point at which the valve admitting steam to the cylinder is closed, taking place when the piston has made 32 per cent., or one-third, of its travel. With saturated steam about 20 per cent. of the steam is condensed, so that to compensate for this a further .4 cubic ft. has to be supplied. This 2.4 cubic ft. represents 1.12 lb. of water evaporated into steam at 200 lb. pressure, and as approximately 1,200 heat units (known as British Thermal Units or "B.T.U's") are required to generate each pound of steam at this pressure, a total of 1,344 B.T.U's is used for the steam supplied.

If steam at the same pressure, but superheated 200°F., is used, it probably will be cooled about 150°F. by the cylinder walls, so that there is still 50°F. superheat left in it, and at this temperature (438°F.) it has a volume of 2.33 cubic ft. per lb. Thus only .86 lb. of steam superheated 200°F. is required, and as the heat content per lb. is 1,310 B.T.U's, the net amount of heat expended is 1,127 B.T.U's.

It will thus be seen that, by using superheated steam at the above pressure and temperature, only .86 lb. must be used, as compared with 1.12 lb. of saturated steam, showing a saving of 23 per cent. of water. The heat expended is only 1,127 B.T.U.'s as compared with 1,344, showing a saving of 16 per cent. of fuel.

The following table enables ready comparisons to be made :—

		Saturated	Superheated
Volume of steam used per cylinder stroke	...	2.4 cu. ft.	2.4 cu. ft.
Weight " " " " "	...	1.12 lb.	.86 lb.
Heat Units Used " " "	...	1,344 B.T.U.'s	1,127 B.T.U.'s
Water saved " " "	...	—	.26 lb.
Heat " " " "	...	—	217 B.T.U.'s

Saturated steam always contains a proportion of water in suspension. That is to say, it is not perfectly dry, and with some boilers the amount of moisture carried over with the steam is quite large. This moisture represents a direct loss of heat, as it is at the same temperature as the steam. At the same time it is inert in so far as its capacity for work is concerned.

The loss by condensation has already been considered, and it may be mentioned that the wetter the steam the more is condensation accelerated, because the transfer of heat to a moist surface is far more rapid than to a dry one. When steam is superheated all moisture is evaporated and turned into useful working fluid. Boilers that "prime" badly—or pass water over with the steam in fairly large quantities—are made more economical, and the danger of damaged pistons and cylinders—always existing when water is present—is eliminated.

Many types of superheater were tried in the early stages of development. At first it was thought that the necessary heat could be obtained by placing a superheater in the smoke-box, to be heated by the smoke and gases from the fire after these had played their part in the boiler. It was found, however, that only a very moderate amount of heat could be obtained in this manner, and all modern superheaters are of what is known as the "smoke-tube" type. This form of superheater was evolved and patented by the late Dr. Schmidt of Cassel, Germany.

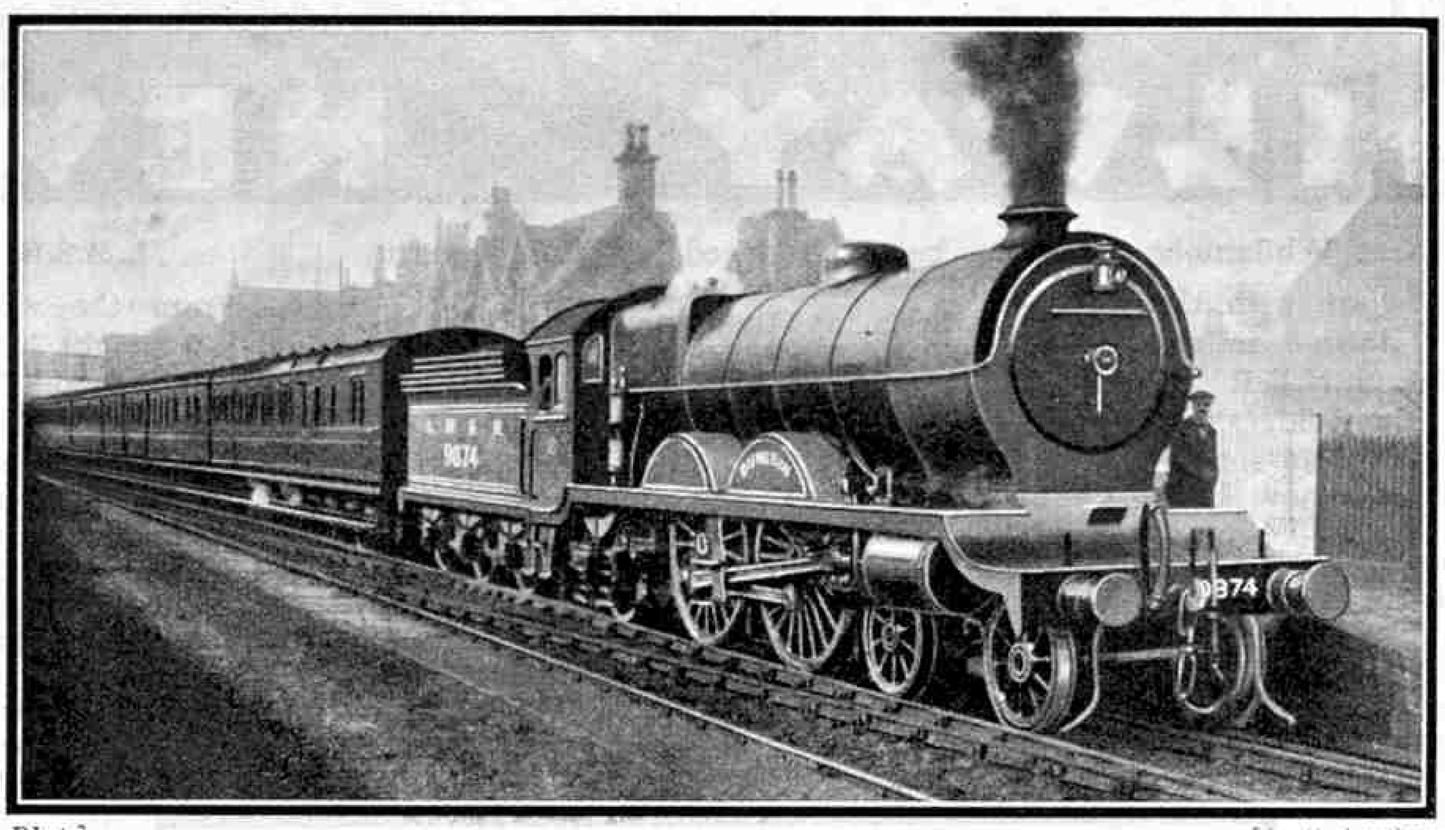
Difficulties were experienced with the earlier superheaters in regard to lubricating the slide-valves and pistons, on account of the comparatively low vaporisation temperature of the animal or vegetable oils then used. This trouble has been surmounted by the use of mineral oils capable of withstanding very high temperatures. The introduction of metallic packing for cylinder glands has abolished the other early trouble experienced with the fibrous packings then employed.

The year 1900 saw the adoption of superheating for locomotives with practical success and to-day there are throughout the world nearly 100,000 locomotives fitted with superheaters, the different designs varying only in detail.

The saving in fuel and water resulting from the use of superheaters enables locomotives fitted with them to run longer distances without replenishing their supplies. This is of particular advantage in the case of tank engines, which can carry only a very limited amount of fuel, and in districts where water is either

scarce or bad. The superheater does practically nothing to increase the starting power of an engine, but it enables a larger horse-power output to be maintained, with a consequent increase in hauling power when running. In many cases engines that have become obsolete as a result of the increase of train loads have been given a new lease of useful life by the addition of a superheater.

The accompanying illustration shows the usual type of superheater now fitted to locomotives. In place of the ordinary small boiler tubes, a number of larger tubes, C, are substituted. The saturated steam generated in the boiler goes to a "header," or steam collector, A. This is divided into separate compartments, some of which are supplied with saturated steam. Connected to the header A are several superheating pipes, or elements, B. Each of these consists of four runs of pipe situated in each large boiler tube. They are connected together so as to form one continuous passage for the steam, the inlet end of each element B being connected to one of the saturated steam compartments of the header A, and the outlet end of each to one of the other compartments of the header that receive superheated steam. From these latter compartments the steam proceeds through the smoke-box steam pipes to the steam chest and thence through the ports to the cylinders.

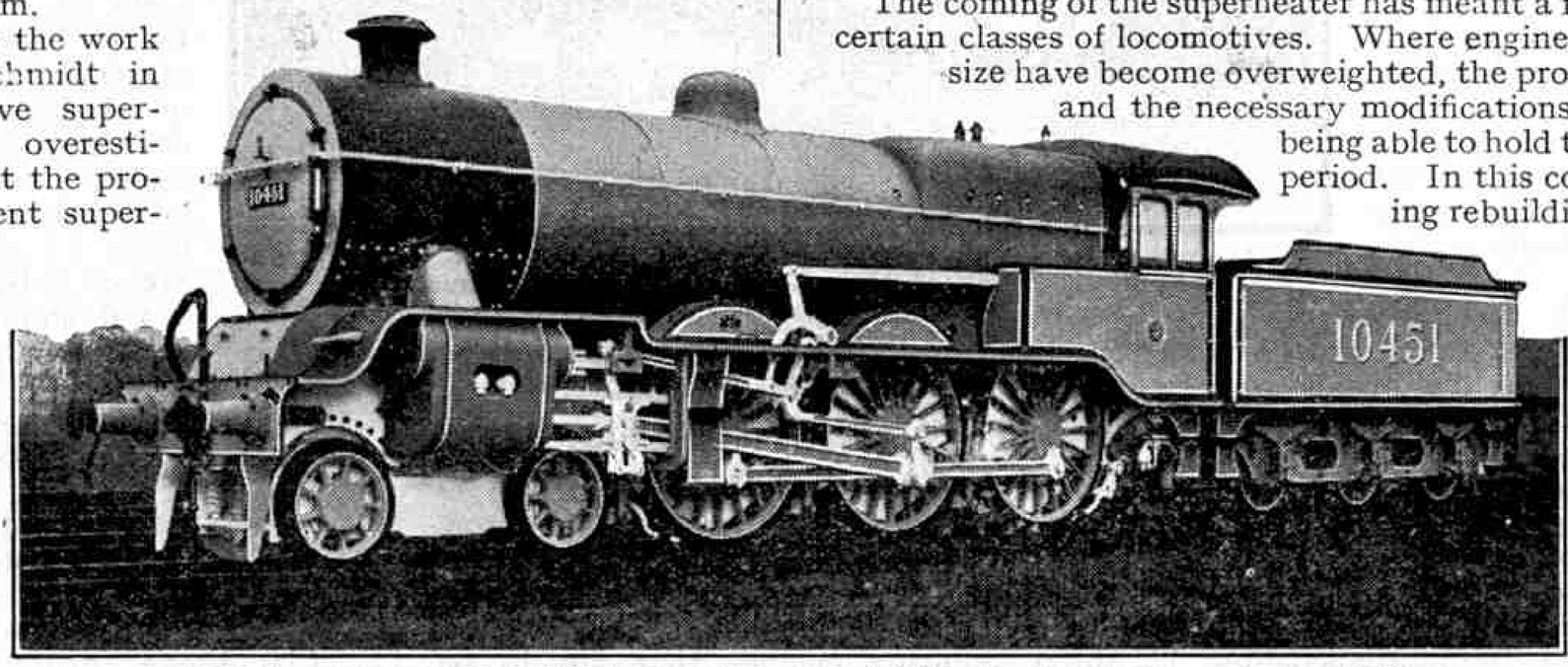


Photo] [*L. R. Lindsay*

L.N.E.R. locomotive No. 9874 "*Dunedin*." This is one of the original North British "Atlantics," built in 1906 and subsequently fitted with a superheater.

It will thus be seen that the steam, after being taken from the boiler, proceeds to the header, from which it travels through the elements, passing four times backwards and forwards in the large flues in its course, and then back again to the header (but to the superheated compartments thereof) and thence to the engine. As furnace gases at a very high temperature are passing through the large flue tubes from the fire-box to the smoke-box and chimney, the steam is heated to a temperature very much higher than its saturated temperature, and in ordinary locomotive practice about 300°F. superheat is added to the steam.

The importance of the work of Dr. Wilhelm Schmidt in regard to locomotive superheating cannot be overestimated. Attempts at the production of an efficient superheater had been made at intervals from as early as 1839. In that year R. and W. Hawthorn devised a superheater that was partially successful, and in 1852 and 1859 J. E. McConnell, of the London and North Western Railway, brought out two different types embodying various improvements. Mention must be made also of the work of M. Moncheuil, a French engineer, who proposed a superheater that foreshadowed the principle of the modern smoke-tube type. It is very doubtful, however, whether the Frenchman's ideas ever passed from paper to actual construction.



L.M.S.R. superheated 4-6-0 locomotive No. 10451, built at Horwich in 1923.

For various reasons these early superheaters achieved only small success and it was left to Schmidt to find the solution to the problem and to devise a superheater that was sound both from the mechanical and the commercial standpoint. Schmidt devoted over 30 years to experimental work. His first superheater was fixed in the smoke-box and supplied with heat from the fire through a flue passing along the base of the boiler. This design was partially successful and was fitted to a number of German locomotives.

It is interesting to note that in 1898 Sir John Aspinall fitted superheaters of the smoke-box type to six express locos on the Lancashire and Yorkshire Railway.

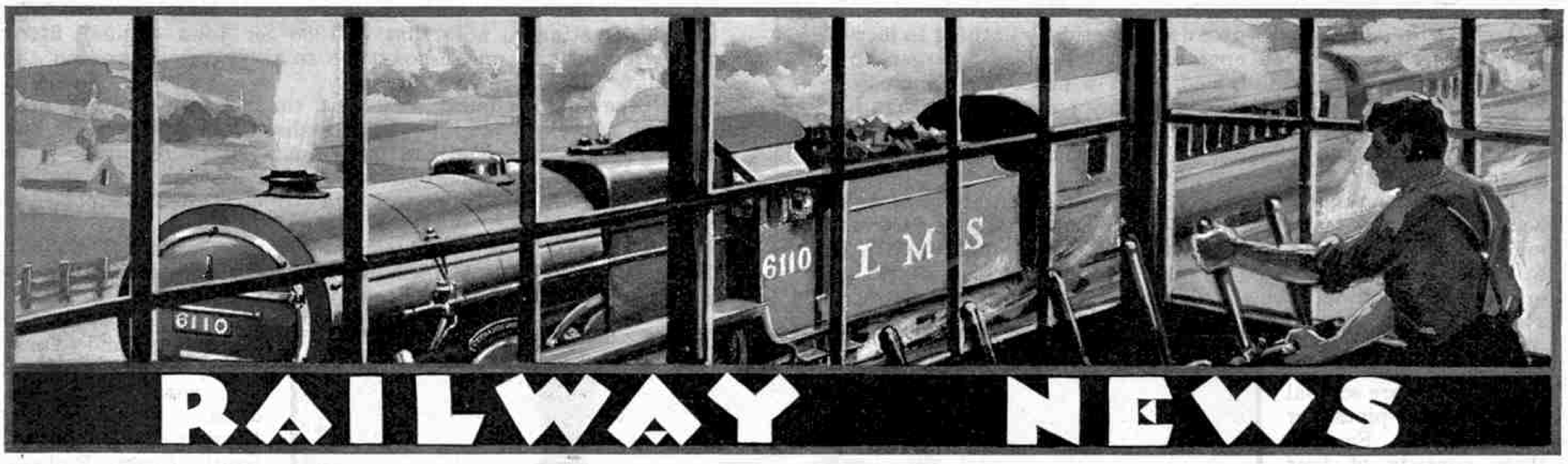
From the first Schmidt aimed at the attainment of a high degree of superheat and he soon realised that the smoke-box type of superheater could not give him what he required. He therefore turned his attention to the smoke-tube type and in 1902 introduced his famous design which rapidly superseded all other forms.

In 1906 the G.W.R. fitted a Schmidt superheater to a 4–6–0 locomotive, and later Mr. Churchward, then Chief Mechanical Engineer, evolved his well-known "Swindon" superheater. Shortly afterwards the Lancashire and Yorkshire Railway followed suit with two 0–6–0 locos. In 1908 the London, Brighton and South Coast Railway adopted the superheater, followed by the Great Northern, London and North Western and Great Central Railways in 1910, and by the North Eastern and Great Eastern lines in the following year. Its adoption on the L.N.W.R. in the well-known "George the Fifth" class of locomotive was largely due to the surprising performance in regard to fuel and water consumption of a large 4-4-2 tank locomotive of the London, Brighton and South Coast Railway. This engine had exchanged duties in the previous year with a L.N.W.R. locomotive of the "Precursor" tender class, and they worked turn and turn about on the "*Sunny South Express*" between Rugby and Brighton. Thus the "George the Fifth" class locomotives were practically superheated versions of the earlier "Precursors." When in their prime, these fine locomotives regularly hauled train loads of over 400 tons on long non-stop runs on fast schedules. The performance of the G.N.R. "Atlantics" and of numerous other classes of locomotives was greatly improved by the provision of superheaters.

The coming of the superheater has meant a further lease of life for certain classes of locomotives. Where engines of a relatively small size have become overweighted, the provision of superheaters and the necessary modifications has resulted in their being able to hold their own for a further period. In this connection an interesting rebuilding was carried out by Mr. R. E. L. Maunsell with certain 4-4-0's on the former South Eastern and Chatham Railway. Owing to the weight restrictions on the route upon which they ran, it was impossible to provide larger locomotives. By skilful designing, however, these engines were provided with new boilers and superheaters and brought thoroughly up to date without increasing the total weight to any appreciable extent.

The extension of the practice of superheating undoubtedly tended to divert the attention of British locomotive engineers away from the question of compounding, which previously had been well to the fore.

More recently the increased cost of fuel and the necessity for economies in operation have caused locomotive engineers in this country to consider the possibility of improving the thermal efficiency of their engines. Large numbers of compound express locomotives, also fitted with superheaters, have been built for the L.M.S.R. closely following the general design of the previous well-known Midland engines originated by S. W. Johnson in 1902.



Eddy Current Rail Brakes at Whitemoor

Good progress is being made with the construction of the new "down" freight marshalling yard on the L.N.E.R. at Whitemoor, near March, Cambridgeshire. The sorting yard will comprise 40 sidings and about 30 of these have now been completed.

The "up" marshalling yard, which has been in use since 1929, has proved an unqualified success, substantial economies having been secured, and traffic greatly speeded up. The provision of the steeply-graded hump with rail-brakes, or retarders, at its foot, enables the trains to be sorted very quickly, and during 1930 no less than 792,427 wagons passed through the yard. It is usual for trains to travel steadily over the hump at about four miles an hour and, in passing, each "cut," consisting of a wagon or group of wagons, is sent into its correct siding. As many as seven trains, consisting of 357 wagons with 232 cuts, have been shunted in one hour, and recently 13 trains, totalling 846 wagons with 578 cuts, were shunted in three hours.

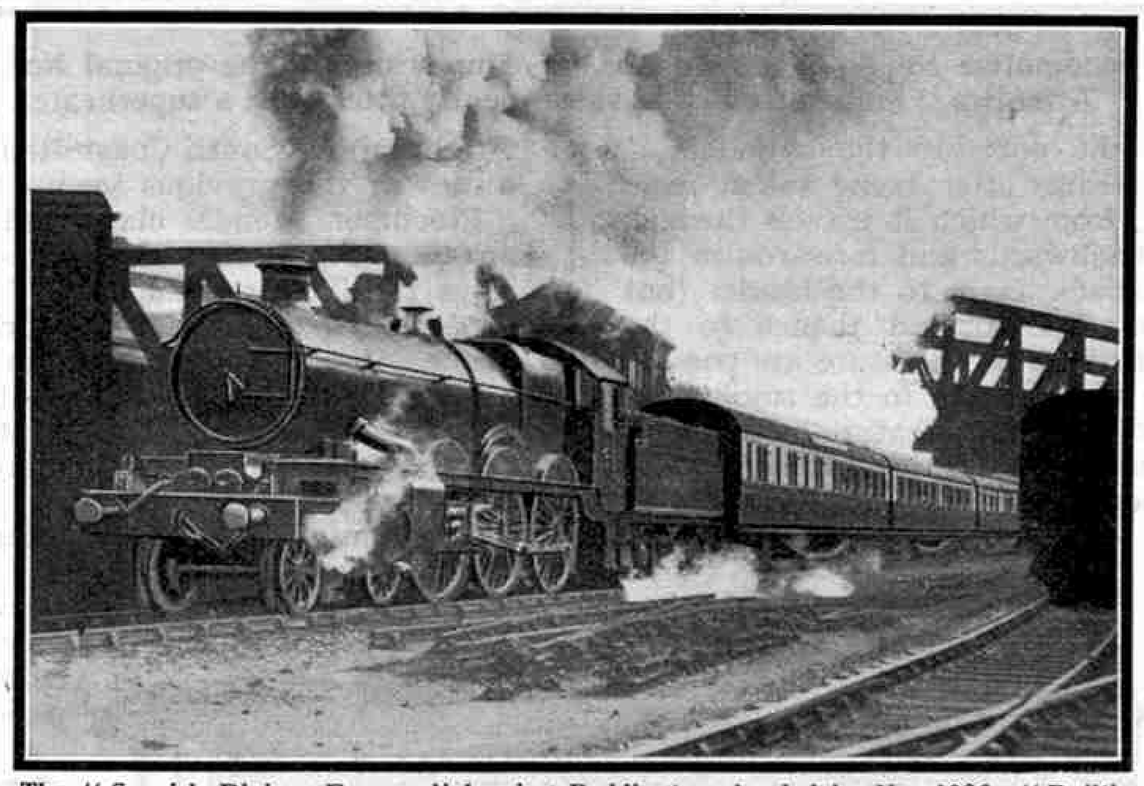
Traffic for shunting is received in the 10 reception sidings at the north end of the yard. The trains for sorting are usually made up to 70 wagons, but experiments have lately been made with trains made up to 80 wagons each.

At present, trains are being pushed over the hump by tender engines of the 2–8–0 G.C.R. type, these being used in preference to tank engines because their larger water capacity enables them to work longer without stopping to replenish supplies.

The importance of March as a traffic centre will be realised when it is stated that 280 locomotives are now stationed there. A mechanical locomotive-coaling plant has been installed to enable the more rapid coaling of engines to be carried out.

It may be added that the new "down" shunting yard is being equipped with a new type of rail brake. The "up" yard is fitted with Froelich retarders, which are worked by hydraulic power and exert pressure on the rims of the wagon wheels. In the "down" yard, the Eddy Current Rail Brake is to be used. A brief account of this invention appeared on page 36 of the "*M.M.*" for January last. Its action is electro-magnetic, and only a small percentage of the total braking force is obtained by friction, the main retarding effect being produced by the powerful "pull" of electro-magnetic force upon the wheels as they pass through the retarder. An additional advantage of this use of electro-magnetic attraction is that it tends to bind the wheels to the brake and to hold the wagon down on to the track, thus obviating any danger of derailment due to the squeezing of the wheels by the retarder.

Other information concerning this wonderful mechanised marshalling yard at Whitemoor will be found in articles published on page 851 of the "*M.M.*" for November, 1930, and page 544 of the issue for July, 1931. Further developments at the yard will be awaited with interest.



The "Cornish Riviera Express" leaving Paddington, hauled by No. 4086, "Builth Castle." Additional engines of this capable class are being constructed at Swindon this year. (Photograph, Railway Photographs, Liverpool.)

Novel L.N.E.R Shunting Engine

Further 0–6–0 goods engines of the J.39 class have been completed at Darlington works. They bear the numbers 2973, 2974, and 2975.

A novel feature in the two eight-coupled hump shunting engines that are to be built this year—as stated in last month's "*M.M.*"—is that the wheels of the booster-fitted bogies will be coupled. This will give a wheel notation of 0–8–4–0.

A Remarkable Derailment

An unusual accident occurred recently on the S.R. line between London and Maidstone. As a down goods train was leaving the triangle siding at Hoo Junction, the fourth wagon from the engine became derailed and ran three-quarters of a mile to Higham, where it re-railed itself at the angle of the crossover and then ran without incident over the eight miles to Snodland. The wagon broke more than 300 chairs.

L.M.S.R. Locomotive News

From the works at Crewe, standard 0–8–0 freight locomotives continue to be turned out, and Nos. 9645 to 9652 are now in service. At Derby, further 4–4–0 passenger engines of Class 2 have been built and are numbered 666 to 677. Surprise has been expressed in some quarters that the L.M.S.R. should be building so many of these comparatively small engines, of which 33 were built last year and further batches are to be added this year. The L.M.S.R. authorities are convinced that there are still many trains on their system with which these Class 2 engines are fully capable of dealing, however, and they believe that it is more economical to build new engines of this standard type than to continue to rebuild the many different types of 4–4–0s that were included in the locomotive stock of the various companies at the time of the amalgamation in 1923.

The engines now building at Crewe and Derby are the last of a long-term programme of construction. When that is finished, as it will be shortly, a new short-term programme will be put in hand. This provides for the construction of 75 new locomotives all of which will be of the present standard classes. These will include twenty 0–8–0 freight locomotives; twenty 4–4–0s of Class 2; fifteen 2–6–4 tanks; fifteen 2–6–2 tanks; and five 0–4–0 shunting tanks.

This new programme is planned to employ the works at Crewe and Derby until the end of the present year, after which further developments may be expected. These will be awaited with unusual interest in view of the recent appointment of Mr. W. A. Stanier, formerly of the G.W.R., as Chief Mechanical Engineer.

It has been decided that all the rebuilt "Claughtons" of the "5X" class shall be fitted with side sheet smoke deflectors and most of them are now running with that equipment.

Two "Royal Scots"—Nos. 6125 and 6151—are running with smoke deflectors of a more elaborate design and not with the usual side sheets.

Two more of the 2–4–0 "Jumbos" have been scrapped. These are No. 5023, "*Dagmar*," and No. 5032, "*The Queen*."

A London reader reports that on Thursday, 31st March, at Brondesbury, on the North London line, he saw an eight-coupled goods engine of the L.N.W.R. type, which was fitted with an eight-wheeled tender.

New Locomotives from Swindon

The second 10 of the new batch of 20 2–6–0 "Mogul" locomotives have just been finished at Swindon and are being put into traffic. They are numbered 9310 to 9319. Work has been continued on the two series of 0–6–0 tank engines. Of one series, No. 6400 to 6409 have been completed, and of the other—numbered 5400 to 5419—all will be out by the end of May. The 10 new "Castles" have reached an interesting stage of construction and the first will probably be ready for service by the beginning of June.

Fastest Train on L.M.S.R.

Since 1st April the 4.50 p.m. L.M.S.R. express from Birmingham (New Street) to Euston has had an additional stop at Coventry included in its schedule, and only 87 minutes are now allowed for the run of 88¾ miles from Coventry to Willesden. This involves an average speed of 61.2 m.p.h. and makes this train the fastest express on the L.M.S.R. Despite the introduction of the extra stop at Coventry, no extension has been made to the overall time of the train, which thus covers the 112¾ miles from Birmingham to Euston, with two intermediate stops, in two hours.

Smoke Deflectors for S.R. "Schools"

Engine No. 1915, a 2–6–4 tank of "W class," has been turned out from Eastleigh works and put into traffic. This completes the first batch of five engines of this class.

All the 4–4–0 express passenger engines of the "Schools" class are being equipped with smoke deflector sheets of similar design to those fitted on the engines of the "King Arthur" class. The three "Schools" stationed at Ramsgate—Nos. 900, 901 and 902—have already been fitted with them; while of the seven stationed at St. Leonards, Nos. 904, 908 and 909 have so far received them.

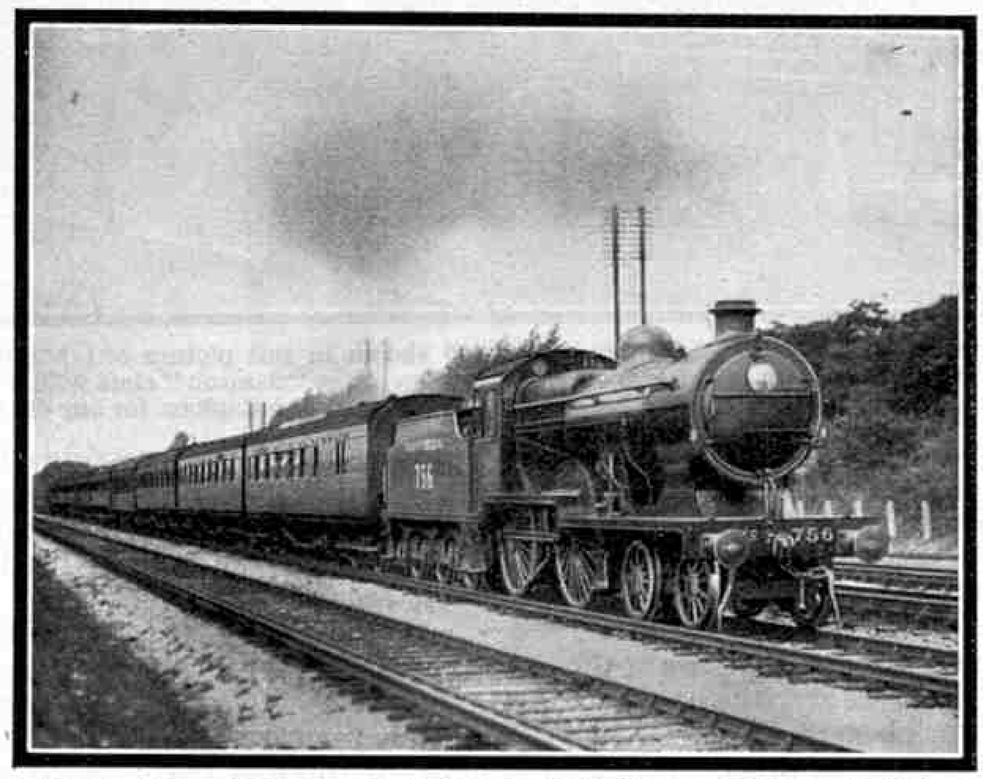
New Turntable at Euston

A new giant 70 ft. turntable has just been installed at Euston. It weighs 36 tons, but one man can rotate it easily when an engine of the "Royal Scot" class, weighing about 127 tons, is stood on it.

Progress of S.R. Electrification Scheme

The electrification of the S.R. main line between London and Brighton is so far advanced that, commencing on 17th July, electric services will be operated as far as Three Bridges, to be followed by through services to Brighton and Worthing early in 1933. The new schedules provide for a greatly improved service. In addition to a number of semi-fast trains, there will be an hourly service of non-stop expresses performing the journey in each direction between London and Brighton in 60 mins. This, of course, is the same time as is now taken by the fastest expresses hauled by steam locomotives.

It is of interest to recall that the record run between London (Victoria) and Brighton was made as long ago as 26th July, 1903, when the 4–4–0 engine No. 70, "*Holyrood*," with a train made up of three Pullman cars and two brake vans, covered the distance of 51 miles in 48 min. 41 sec., start to stop. The 50 miles from Grosvenor Bridge to Brighton goods shed were covered in 46 min. 11 sec. and a maximum speed of 90 m.p.h. was attained near Haywards Heath. Will an electric train presently break that record?



The illustration at the top of this page shows the giant C.N.R. 2-10-2 or "Santa Fe" locomotive No. 4100. The "Vanderbilt" type tender fitted to this engine was the first of its kind to be used in Canada. The lower illustration shows S.R. "Folkestone Flyer," hauled by "L1" class locomotive No. 756. (Photograph, Railway Photographs, Liverpool.)

Non-Stop Freight Trains

Notable improvements have been made of late in the freight train services of this country and some lengthy non-stop runs are now included in the schedules of these trains. For instance, on the G.W.R. the freight express that leaves Paddington at 11.35 p.m. for Newton Abbot runs non-stop between Acton and Taunton, a distance of 152½ miles. The record for operating the longest non-stop freight service in this country is claimed by the L.M.S.R., however, the 7.45 p.m. express freight train from London (Camden) to Liverpool (Edge Hill) covering the 191 miles between these centres without an intermediate stop.

Two other non-stop journeys of exceptional length made daily by L.M.S.R. freight expresses are from Crewe to London (Broad Street), 162¾ miles, and from London (Camden) to Crewe, 153¾ miles. The greatest distance covered by a through express freight train on the L.M.S.R. is the 545 miles from Aberdeen to London (Broad Street), the 9.35 a.m. express freight train from Aberdeen arriving at the London terminal at 11.25 p.m. the same day. The longest freight service provided by the L.M.S.R. in through wagons is between Thurso and Bournemouth, a distance of more than 850 miles.

L.N.E.R. Branch Line Closing

Owing to the increasing competition of road motor coaches and buses, the Railway Companies are closing one after another of their smaller branch lines to passenger traffic and, in some cases, to traffic of all kinds. Since the end of 1928 more than 750 route miles of line have been thus closed. The L.N.E.R. now announce that all train services on the Port Carlisle branch will be withdrawn on and after Wednesday, 1st June.

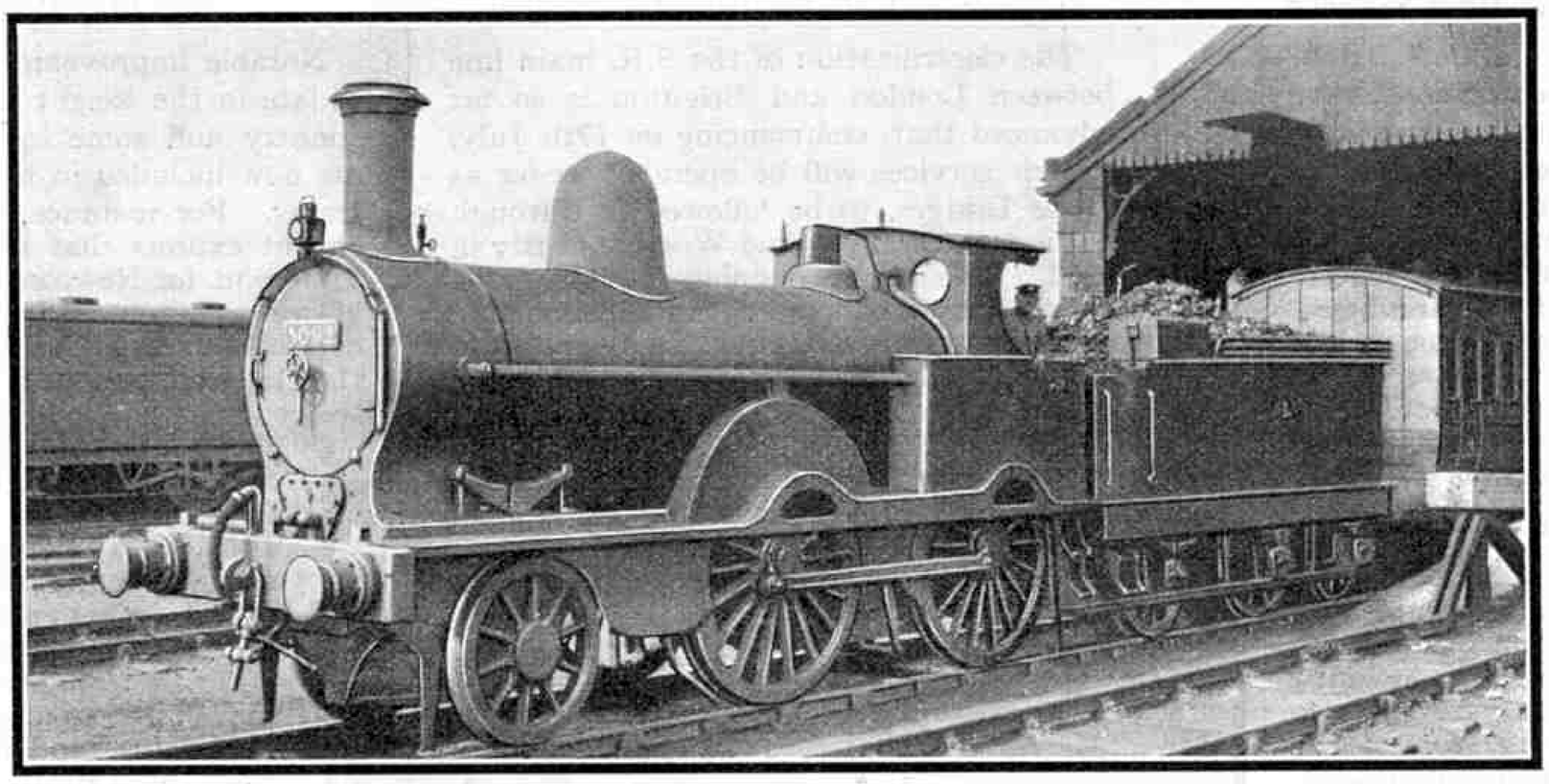
This branch, which starts from Drumburgh Junction on the Carlisle and Silloth line of the former N.B.R., is only 2½ miles in length and has two stations—Glasson, and Port Carlisle on the Solway. The traffic has been light for many years past and it was on this branch that the last horse-drawn "Dandy" or rail-coach, to be operated in England was run. The horse-drawn passenger service was discontinued in April, 1914.

An Interesting Locomotive Class

The Story of the L.N.W.R. "Jumbos"

A RAILWAY enthusiast of to-day would be greatly astonished if he were to see an express train bound for Scotland hauled by two locomotives similar to those illustrated on this and the following page. Yet even as recently as 10 years ago such a sight was not unknown, owing to the shortage of locomotive power due to the arrears of maintenance caused by the difficult conditions existing during the war period and for some time afterwards. The sound of the approach of two such small engines on a heavy train would be characterised by noisy determination in the sound of their exhausts, and would form a strong contrast to the purposeful ease that marks the progression of the up-to-date locomotive.

The 2-4-0 wheel arrangement to which the engines shown belong is a very old one, and it was a great favourite for express work for a considerable number of years. The North Eastern, Midland, Great Eastern, Great Western and London and North Western railways employed it extensively. Indeed, bogie express locomotives of the 4-4-0 type did not appear on the two last-named systems until quite late, the engines introducing them being the former "Armstrong" class in 1894 on the G.W.R., and the 4-4-0 "Jubilee" compounds of 1897 on the L.N.W.R. The locomotives illustrated belong to two classes that for many years, even after the introduction of larger and nominally more capable locomotives, were the mainstay of the express services of the former "North Western." The two classes referred to are the "Samsons," illustrated by L.M.S.R. No. 5092, "*Violet*," and the "Precedents," of which "*Charles Dickens*" and "*Hardwicke*" earned the greatest fame. The almost identical appearance of "*Violet*" and the other two engines is clearly shown, and practically the only difference between the classes was that the "Samsons" had driving wheels 6 ft. in diameter, while those of the "Precedents" were 6 ft. 6 in. Both classes therefore are always considered together and are known as "Jumbos," though the reason for this nickname has never been satisfactorily explained. On other railways there have been instances of classes of locomotives referred to by this name.



The characteristic features of the L.N.W.R. "Jumbos" are well shown in this picture of L.M.S.R. locomotive No. 5092, "Violet," on a Penrith to Workington train. This was one of the last few of the "Samson" class with 6 ft. driving wheels, and is now withdrawn from service. We are indebted to Mr. J. J. Cunningham for our photograph.

The history of these L.N.W.R. "Jumbos" is interesting, and the tracing of their development from the beginning carries us back to 1863, or nearly 70 years ago. In that year Mr. John Ramsbottom, the inventor of track water troughs, then in charge of Crewe Works, turned out the first ten of a class of 2-4-0 tender locomotives. These were the first four-coupled main line passenger locomotives built for the L.N.W.R., although both four-coupled and six-coupled engines were in use for goods traffic. "Single-drivers" had been employed up till that time for express work. Two notable classes of "singles" more or less contemporary with these coupled engines were the outside cylinder "Problems" built at Crewe, and the inside cylinder "Bloomers" developed at Wolverton on the Southern division. The increase of loads, coupled with the heavy gradients encountered between Crewe and Carlisle and between Manchester and Leeds, made some increase of locomotive power necessary, hence the appearance of four-coupled engines for main line duties.

The "Samsons" were steadily multiplied until in 1866 there were 50 in service. In 1871 Mr. F. W. Webb succeeded Mr. Ramsbottom, and between 1873 and 1879 he added 40 more, so that the total reached 90. They were diminutive engines in their early state, and had cylinders with a bore and stroke of 16 in. by 20 in., the driving wheels, as already mentioned, being 6 ft. in diameter. The boilers were small, having a total heating surface of 1,083 sq. ft., and worked at a pressure of 120 lb. per sq. in., although the later Webb engines had a pressure of 140 lb.

As express engines the "Samsons" in their original form do not appear to have achieved any great success, but as secondary passenger locomotives they were useful, and were employed nearly all over the system. Although they were satisfactory for the time at which they first appeared, the building of them as late as 1879 is difficult to understand. In common with most locomotives of their period the earlier members of the class had no cabs. The splashers had radial oval slots pierced in them, and the chimneys had ornamental caps of Mr. Ramsbottom's design. Those turned out by Mr. Webb had the form of chimney and cab associated with his locomotives, and both these features remain either wholly or in part on practically all locomotives of L.N.W.R. design. The chimney, of course, has decreased in length to suit modern boilers, and the cab has become enlarged with corner pillars supporting the roof at the rear of the splashers; but the general design is substantially the same. The cut-out splashers common to Mr. Ramsbottom's locomotives were retained in those of the class turned out by Mr. Webb, but in later years the splashers were closed.

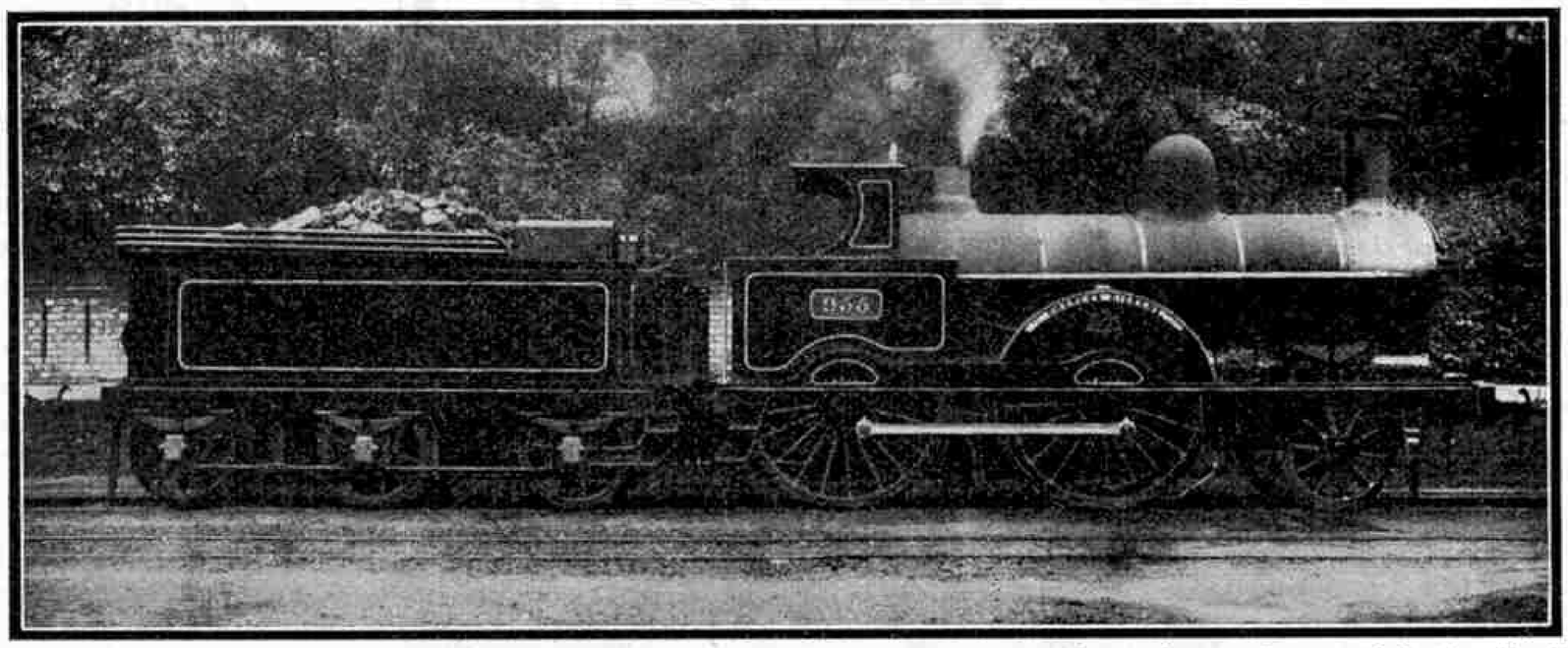
Three years after the introduction of the "Samsons," another class of locomotives of generally similar design appeared. These were the "Newtons" with larger driving wheels, 6 ft. 6 in. in diameter, and 96 of them were built. The last 40 appeared after Mr. Webb had taken office at Crewe, and in fact the first passenger engine turned out by him was one of them, named after his predecessor "*John Ramsbottom*." These 40 engines had Webb's pattern of chimney and cab. No special reputation seems to have been achieved by them in their earliest condition, but at any rate they were equal to the demands made upon them at the time of their introduction. They were intended for use on the Scottish expresses between Crewe and Carlisle, and up to 1874 they almost monopolised the services over that route. Most of them were stationed north of Crewe, but several were at Rugby and at Birmingham. Their dimensions were moderate, their weight in working order being only 28 tons 3 cwt. Between 1879 and 1882 they were fitted with new boilers working at a pressure of 140 lb. per sq. in., and as in the case of the "Samsons" the splashers were closed. As thus rebuilt they were similar in appearance to the "Precedents" that came after them, but their boilers were somewhat smaller.

We will now turn to the "Precedents," so called after the first engine, No. 2175, that left Crewe Works in December 1874. These were a development of the "Newtons," and in fact the cylinders, wheels and wheelbase were identical. The "Precedents" had larger boilers, however, and Allan straight-link motion in place

of the Stephenson link motion of the "Newtons."

Successive batches of these engines were turned out until February 1882 when they reached a total of 70. Their cylinders had a bore and stroke of 17 in. by 24 in. and their driving wheels were 6 ft. 6 in. in diameter. The boilers had a total heating surface of 1,083.6 sq. ft., and the working pressure was 140 lb. Subsequently locomotive policy at Crewe as far as express engines were concerned was directed largely towards the "Compound" principle devised by Mr. Webb, first on the three-cylinder and later on the four-cylinder system.

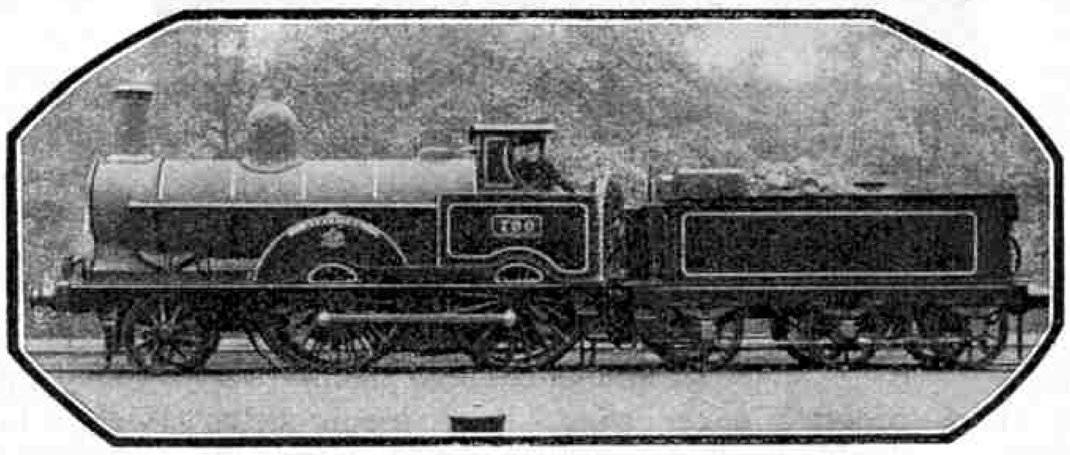
In 1887 there began the conversion of the "Newtons" to "Precedents." This conversion was purely nominal, for in the new engines practically all that remained of the originals was the name and number plates and the wheels. In this process the boiler pressure was increased to 150 lb. and subsequently the earlier "Precedents" were similarly reboilered, so that the 6 ft. 6 in. "Jumbo" class numbered 166 engines. The renewed "Newtons" soon showed their mettle, for in August 1888, when the first "Race to Scotland" took place, No. 275 "*Vulcan*," covered the distance from Preston to Carlisle at an average speed of 60 m.p.h.



L.N.W.R. No. 955, "Charles Dickens," a locomotive that ran more than 2,000,000 miles, and created a record for length of main line service. Our photograph is reproduced by courtesy of the L.M.S.R.

By this time the diminutive "Samsons" were distinctly out of date, so in a similar manner to the "Newtons" a renewal process was instituted by which the "Samsons" became practically "Precedents" with 6 ft. wheels. The first engine to be dealt with in this manner was No. 1045, "Whitworth," so that this class has been variously referred to as the "Samson" or the "Whitworth" class. In these renewals also Allan motion replaced the original Stephenson gear, and new cylinders and new frames with a longer wheelbase were provided. Once again only the wheels and the name plates belonging to the original engines formed part of the new ones.

The company now possessed 256 locomotives of the same general type for express work, and for a long period these filled a useful place in the locomotive stock. The "Compound" policy already referred to gave very variable results, so that a great deal of work fell upon these "Jumbos." They were reliable little engines, and frequently performed work far in excess of their designed capacity, for the loads to be dealt with were steadily increasing as a result of the introduction of more luxurious coaching stock and the provision of restaurant facilities on the principal trains. The renewed "Samsons" or "Whitworths" were employed principally as secondary main line engines, and therefore were found on such routes as the Liverpool and Leeds line, which is a difficult one to work. Several of them were employed on main line duties, however, the first renewed engines, for instance, being stabled at Preston. Over the line between Crewe and Carlisle it was frequently necessary to use two engines for the heavy trains that were then becoming general, and it was the usual practice to run a 6 ft. 6 in. and a 6 ft. engine together in this manner. Thus united they formed a formidable combination, and many notable speed records have been made by them in the past, rates of 87 and even 88 m.p.h. being attained on occasions.



The "Hardwicke," a famous locomotive of the 6 ft. 6 in. "Jumbo" class. In 1895 this locomotive ran from Crewe to Carlisle at an average speed of 67.2 m.p.h.

In 1895, when another "Race to Scotland" developed, this time with Aberdeen as the goal instead of Edinburgh, another of the renewed "Newtons," No. 790, "*Hardwicke*," ran from Crewe to Carlisle at the amazing average speed of 67.2 m.p.h. Considering the size of the engine and the heavy gradients over that section, this was a very fine performance, and it has not been equalled since on that line. It must be remembered, however, that there has been no need to equal it owing to the general slackening of times that followed the agreement between the East Coast and West Coast routes to refrain from cutting their times. This agreement was brought about largely by the Preston accident in 1896.

The engine best known to the travelling public was the last built of the 70 original "Precedents," No. 955, "*Charles Dickens*." This engine was turned out of Crewe on 6th February, 1882, and was stationed at Longsight. For many years she performed the double trip from Manchester to Euston and back on the 7.45 a.m. "up," which later became the 8.15, and from 1889 the 8.30; the return journey being made on the 4 p.m. from Euston. By 12th September, 1891, "*Charles Dickens*" had covered a million miles, and in August 1902, before the finish of her 5,312th trip from Manchester to London and back, two million miles had been covered.

So regular a performer was this engine that the punctuality of the train she drew became a byword quite early in her existence; and it is said that instead of referring to these trains by their times passengers were in the habit of calling them the "Charles Dickens." Later on the weight of the trains proved too much for her and she was replaced on her arduous duties by a more modern locomotive. She was finally withdrawn in November 1912. Her name has become proverbial for regularity of running and for mileage covered in a given time, two million miles being covered in 20 years and 181 days. During that period the engine consumed 204,771 tons of water and 27,486 tons of coal.

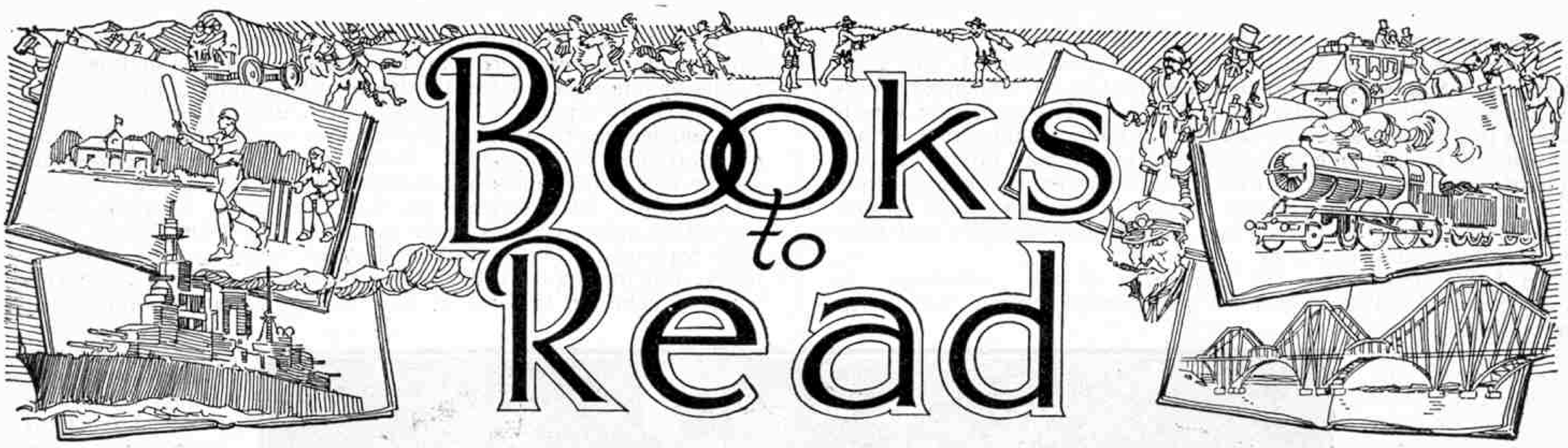
A second "*Charles Dickens*" appeared in January, 1913, this being of the well-known L.N.W.R. "George the Fifth" class. It was originally numbered 82, and is now L.M.S.R. No. 5380.

The "*Hardwicke*" became L.M.S.R. No. 5031 and remained in service until 30th January of this year, its total mileage then being 1,326,470. There were rumours that it would be scrapped, but the L.M.S.R. have recently announced their intention of preserving the famous engine, together with the "Single-Wheeler" No. 123 of the Caledonian Railway, a veteran of the races to Scotland that is still in service as L.M.S.R. No. 14010. Both are certainly worth preservation in the same manner as "*Cornwall*," "*Gladstone*," the "Stirling" single-wheeler No. 1, "*City of Truro*" and other famous locomotives of the past.

Several constructional features of the "Jumbos" are of interest as compared with the practice of to-day. Simplicity in design and appearance is noticeable, and this feature, except perhaps for the various Compound engines, has always been maintained on L.N.W.R. locomotives. A primitive characteristic that was not discontinued on Crewe-built engines until quite late was the wooden buffer beam, clearly shown in the picture of "Violet." This was faced with a steel plate, and mounted on it were the somewhat clumsy buffers used by Mr. Webb. In a number of cases on his locomotives these have been replaced by the conical pattern buffers used with a few exceptions on more up-to-date Crewe designs.

In the illustration referred to the front cover of the valve chest also can be seen below the smoke-box door, and it gives us an idea of the form of the chest. This was V-shaped with sloping valve faces, so that there was plenty of space in it. The free steaming of the engines, and the ability to get rid of the exhaust quickly, no doubt accounted for the many notable performances made by them.

The tenders used on these engines were of the light and simple pattern standardised by Mr. Webb. These are a definite link with the practice of quite early days, for the frames are of timber with the axle-guards bolted to them. Again, the general shape of the tender and the "horse-shoe" shape of the water tank round the coal space is a survival of old design.



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Orders should be addressed to the Book Dept., Meccano Limited, Old Swan, Liverpool, and 1/- should be added to the published price of the book to cover the cost of postage. The balance remaining will be refunded when the book is sent, as postages on different books vary according to the weight and destination.

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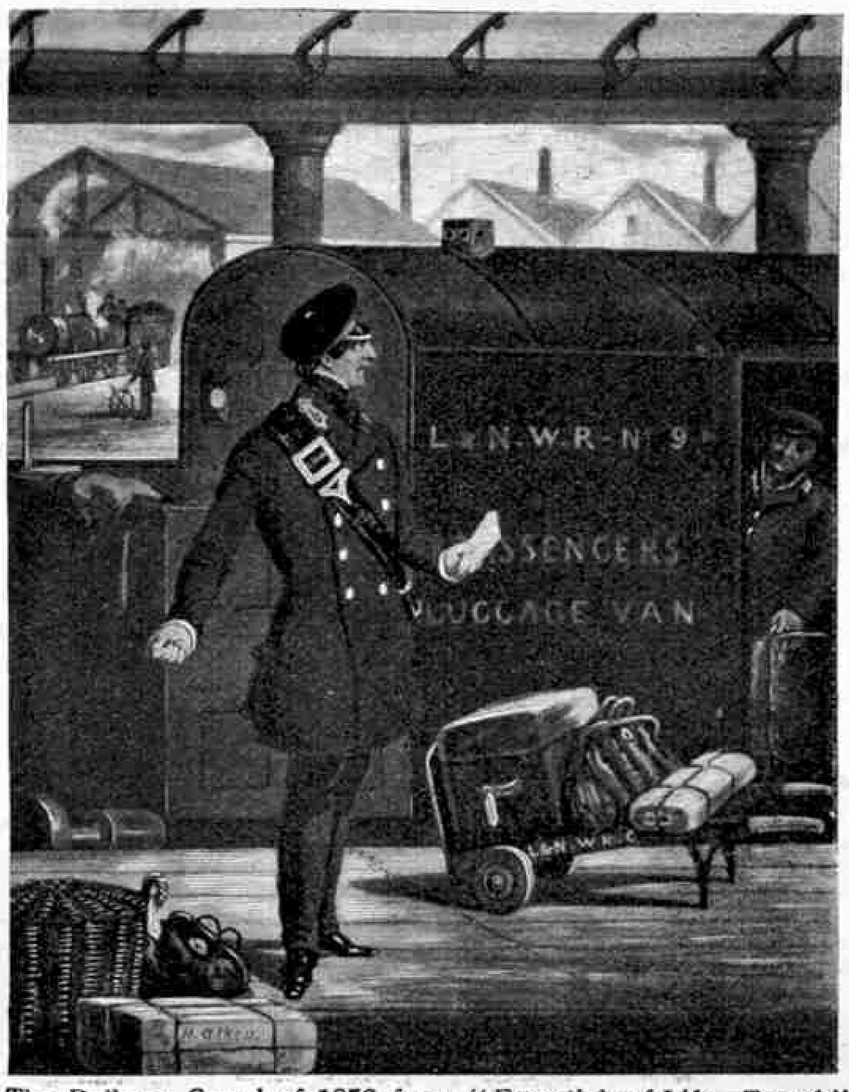
By Lieut.-Col. F. S. Brereton, C.B.E.
(Batsford. 4/- each)

These volumes are two of the "Essentials of Life" Series, the object of which is the dissemination of geographical facts and general knowledge, and the endeavour to show in a readable manner the "why and the wherefore" of matters of common interest. In each case the books deal with their respective subjects from the earliest times down to the present day. They are well illustrated with plates and sketches that add greatly to the value of the books.

In the volume on clothing we have an interesting account of the various types worn through the ages, and of the methods of manufacture of flax, cotton, wool and silk. We learn how the processes of spinning and weaving are carried on, and how greatly the machinery of a modern clothing factory has helped in the production of low-priced clothes. Leather and tanning; the making of boots, hats, and gloves; dyeing, washing, and dry cleaning, all find their place in the story. The final chapter, dealing with fastenings, covers the ground from ancient pins to modern machine-made buttons.

We are brought into contact with many foreign countries, strange peoples, and unexpected processes; and with workers far and near, who each in his own way is a cog that keeps the wheels of progress turning. As the author tells us in his Preface, "a vast number of individuals strive that we shall be clothed. From the raw material to the finished article is often quite a long and complicated journey. Yet there will be many of us, perhaps, who accept the huge variety of articles and materials that combine to adorn and clothe us, and give scarcely a thought to their creation, nor trouble to compare the crude skin garments of ancient peoples with the finished articles of to-day." From the available store of valuable material Colonel Brereton has made a most interesting volume.

In the second volume, we learn about travel through the ages—trading routes, coaching, roads, the coming of the steam-engine, the development of steamships, the bicycle, and the aeroplane and similar subjects. We realise the contrast between the old post-chaise and mail-coach and the locomotive with its comfortable coaches, and as it races along its steel track we remember that this has developed out of the crude tramways laid down near the collieries in the north of England. We learn, too, how the ancient bone-shaker has improved to its present elegant and useful form; how the petrol engine, the pneumatic tyre, and the aeroplane have developed along with the motor car to such an extent that we may almost think there is no further room for improvement. As the author points out, however, we know quite definitely from past experience that progress never stops—there seems little doubt, for instance, that the thousands of inventors who are attempting to improve the petrol engine and other power units are not labouring in vain. With the author, "we sit back and wonder what marvellous new inventions the years to come will bring; and we may rest assured that means of travel will develop yet further, and will form closer relations between the various peoples of the world, and knit them into closer intercourse and a wider understanding."



The Railway Guard of 1852 from "Essentials of Life—Travel" reviewed on this page.

"Model Aeroplanes, Airships and Kites"

(The Boy's Own Paper. 1/6)

Kite flying is by no means only a pastime, for there are many scientists who fly kites for purposes other than amusement, as they can teach us a great deal about air currents. There is a peculiar thrill in getting a kite up and flying it on the end of a couple of thousand feet of string, and in sending "telegrams" up the string, or in releasing miniature parachutes from a great height. Kite flying is not as easy as it looks, and not everyone has the knack of understanding the why and the wherefore of the subject, which, of course, is closely allied to aeronautics. A popular handbook on kites and kite flying has long been wanted, and this little book goes far to filling the vacant space in our literature.

The first part is devoted to model aeroplanes, in which subject we know many of our readers are intensely interested. Instructions are given for making a small aeroplane, and also for making model flying machines, gliders, hydroplanes and airships. The second part deals with scientific kite flying and gives instructions for the building of different forms of kites. There is much interesting information to be found in addition to the technical details of construction. The writer of the chapter that deals with kite flying in Hong Kong lived there for some time when a boy. There "kite-cutting" is a popular pastime, the object being, of course, to cut the string of your opponent's kite by sawing across it at some considerable height with your own string. Careful preparation of the string is necessary beforehand, by making a paste that contains glass reduced to an extremely fine powder by means of a pestle and mortar. To ensure it being fine enough it is sifted through a handkerchief! A teacup full of this glass powder is required, and it is applied to the string by holding a lump of the paste when cool and carefully running it along the string. To treat a string properly in this way may take the best half of a day, for it is a long and tedious job.

The kites used, which are light and flimsy compared with English kites, are made of tissue paper and split bamboo; and flying them is an art that takes some time to learn, but once learned is never forgotten. "When the strings have been crossed both flyers 'let out' as fast as possible, and the better string wins the day. The cut kite floats out to sea, or on to the hill-side where it is eagerly scrambled after by hordes of Chinese boys who have been watching the contest." Sometimes the strings of the two kites become entangled, and then the thing is to pull in as fast as you can if you want to get your kite, as no mercy is shown and the fastest "puller-in" gets both kites.

The writer remarks that he thinks this game of kite-cutting "is of Indian origin. It certainly is not Chinese, and the better-made kites flown in Hong Kong come from Calcutta, I believe. The game is gone in for much more largely by Portuguese, Chinese, and Indian residents than by the English, although some English boys do take it up with ardour. Indeed, I have heard of an

Englishman, who spent his early life in Hong Kong, taking it up again with enthusiasm on his return to the colony, after a stay of some years in Europe."

We are inclined to agree with the writer "that kite-cutting is a most fascinating game and would be worth while introducing into England."

"The Standard Natural History"

Edited by W. P. Pycraft, F.L.S. (Warne. 15/-)

This wonderful book of over 900 pages, with 12 coloured plates and over 900 illustrations in the text, is one that will delight the hearts of all animal lovers and students of nature. Experienced writers, each an authority on his own subject, have contributed to make it one of the most important works of its kind that have appeared for some time. Attention is drawn to the fact that it is "on their anatomical structure, even more than on external characters, that we must depend in our efforts to trace the blood-relationship of the various types of animals, one to another, for no classification that has not this aim for its basis is of any value."

Full attention is paid to the most primitive forms of animal life—Protozoa, Mollusca and Arthropoda, etc. From the worm-like animals, a group that covers a variety of creatures including earthworms and leeches, whose continual struggle for existence is treated in detail, we pass to a host of remarkable marine creatures—lamp shells, starfishes, sea-urchins, etc.—from a study of which much light has been thrown on the evolution of species. Particularly interesting is the description of Crinoids (sea-lilies), which resemble plant life so closely. The section dealing with Mollusca traces the changes of structure, both internal and external, imposed by environment. We are shown the links between coat-of-mail shells, limpets, snails and slugs, mussels, oysters, squids and cuttle-fishes. This is followed by an account of fossil Trilobites, and Crustacea, including shrimps, barnacles, crabs, and lobsters.

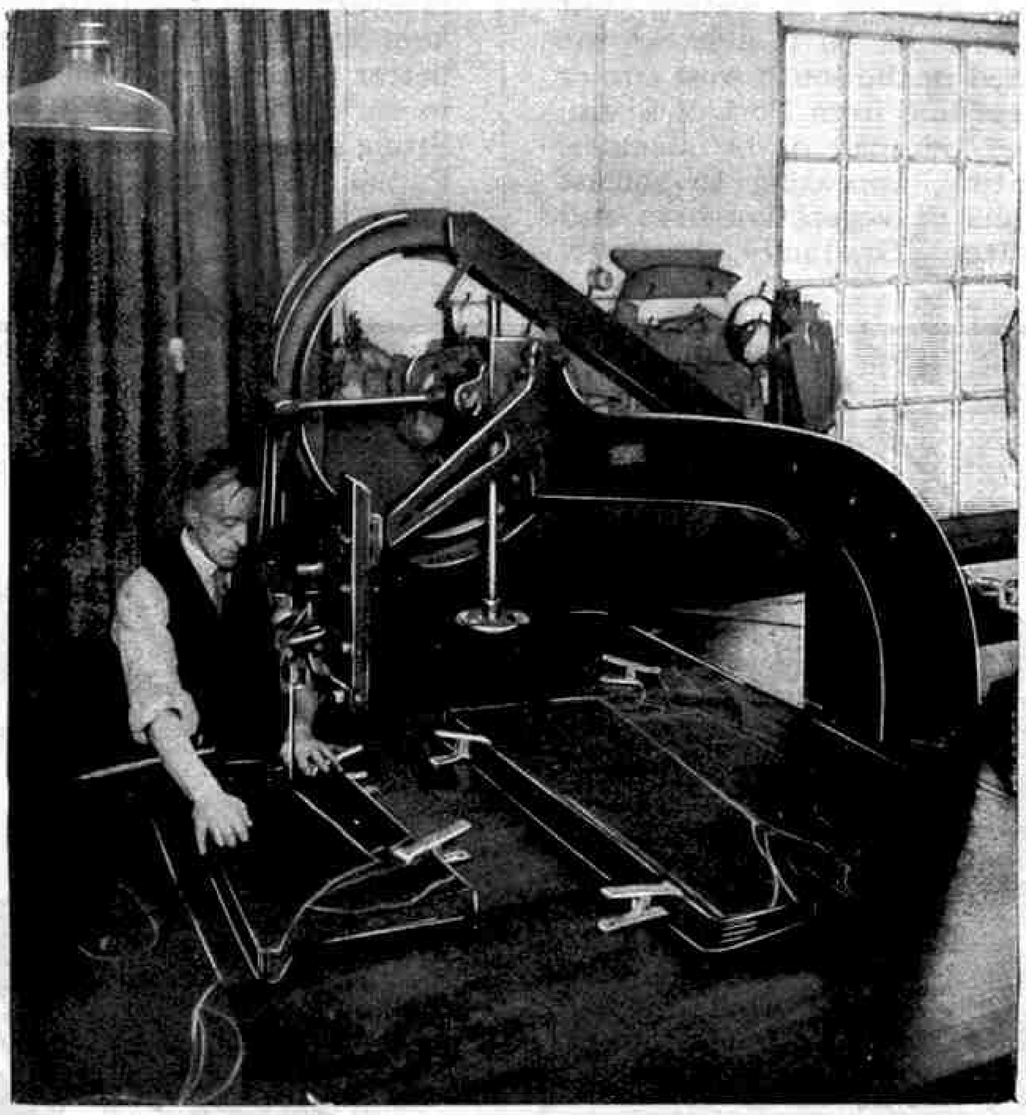
In that part of the book dealing with insects there is the interesting statement that "butterflies of the genus Cephenomyia can fly at a speed of six hundred miles an hour, and outstrip even Flight-Lieutenant Stainforth in his Schneider Trophy seaplane." Considerable space is devoted to the subjects of mimicry and protective devices among butterflies, moths, and other winged creatures, and some popular misconceptions are corrected in regard to protective coloration. For instance, the chameleon has long been credited with the ability to change colour according to variation of surroundings, but we now learn that these changes are primarily due to such influences as the emotions and the rise and fall of temperature. Everyone has heard of the angler-fish with his waving line and bait, but how many people know that in one species of this fish "the flexible line is placed at the end of a stiff, long rod, and is itself extended beyond the bait and ends in a series of hooks—a Complete Angler, indeed!"

In the second part of the book the Vertebrates are considered at length. We learn of the many developments in fishes, and the curious adaptations in their form and coloration induced by special conditions of life. The chromid of the Lake of Galilee is said to have formed part of the miraculous draught of fishes recorded in the Gospels, and a black spot on its side is said to commemorate the touch of St. Peter—a legend that has been transferred in Cornwall to the mackerel. The belief that the sword-fish uses its formidable snout as a weapon of attack is said to be very questionable.

The part played by the Amphibia and the Reptilia in the evolutionary history is described at length, and it is shown how, through the fossil link of Archæopteryx, we may trace the development of Birds from ancestral reptilian forms. Structural changes, as revealed by anatomical research, are strikingly exemplified in the study of land and sea-birds, while the picturesque subject of plumage coloration and adornment is not overlooked.

The final section of the book is devoted to the Mammals, and naturally in so exhaustive a work the whole field of the higher form of animal life is adequately covered.

The "Standard Natural History" is undoubtedly the most exhaustive and up-to-date work of its kind offered to the scientist and student. In accordance with its valuable revision of classification it contains the results of the latest research work by the anatomist and microscopist, yet at the same time the general reader has been kept in mind. Wherever possible, the popular name of every creature is given, with an entertaining account of its surroundings, habits, etc. The wealth of illustration further assists to make this a Natural History with an appeal of absorbing interest.



Cutting the "lay" at a factory where British mackintoshes are made. From "Clothing" reviewed on the previous page.

"The Enchanted Spectacles"

By T. A. N. Nash. (Toulmin. 2/6)

These twelve fine stories of adventure in bygone times, in which a boy and a girl actually take part, show us something new in story-telling. Ben and Emily are twins, and they discover that their spectacles have the power of transporting them to the thrilling times of other days and other countries. We cannot but be thrilled when Ben sees the figures walk out of a school-room picture of Raleigh's boyhood, and actually joins them in stirring adventures. We are nearly as much thrilled when Emily sees her gym slip change into a dress of gold and her suburban home into a mediæval castle. Amongst their best adventures are "Eldorado," "The Blind Dervish," "Pistols and Lampoons," "Spanish Honour," and the "Vizier's Cheetahs."

"A Register of Civil Aircraft"

By W. O. Manning and R. L. Preston
(Sir Isaac Pitman & Sons Ltd. 2/6 net)

All boys who are interested in aviation try to decide the make of every aeroplane they see. Unfortunately, however, it is usually impossible for them to check the results of their observations, and thus they are not able to learn from their mistakes. The "*Register of Civil Aircraft*" will assist them greatly in their efforts to distinguish different types, for by noting the identification letters of the aeroplanes, and then looking them up in the register, they will be able to determine whether they have named the type correctly.

The book contains a complete list of all civilian aircraft registered in this country, together with the names and addresses of their owners, and thus it is a valuable reference volume. Its small size makes it convenient for slipping into the pocket to take to air meetings.

"Bill of Billabong"

By Mary Grant Bruce
(Ward, Lock & Co. 3/6 net)

Stories of life on an Australian stock farm, with a background of bush and hilly country to provide opportunities for adventure, are almost always interesting, and the story of Bill of Billabong is no exception. Bill began life as Percival, and the ridiculous combination of this name with red hair led to many misunderstandings and fierce conflicts. Fortunately for Percival, he was transferred from the care of relatives who did not understand him to the bracing conditions of Billabong, an up-country cattle station; and there friendly hands helped to turn him into a good little sport, full of grit and readiness.

Sectional Chart of 4-8-2 Locomotive of the S.A.R. (1/6 post free)

This is a particularly useful addition to the series of Locomotive Charts issued by the Locomotive Publishing Company. It shows that although built to run upon a narrower gauge—3 ft. 6 in.—than the British standard, the South African engine depicted is a notable example of locomotive construction. Its massive proportions are fully evident from a study of the end elevation and section. Stout bar frames are employed as on American engines, and the springs of the driving wheels are connected by compensating beams. The fire-box, which contributes 201 sq. ft. toward the total heating surface, is of the wide variety and is provided with brick arch water tubes.

From the brief details above readers will have gathered that there are a number of notable features about the locomotive, which, however, will be grasped more clearly by a study of the actual chart.

The Asphalt Lake of Trinidad

Sir Walter Raleigh's Great Discovery

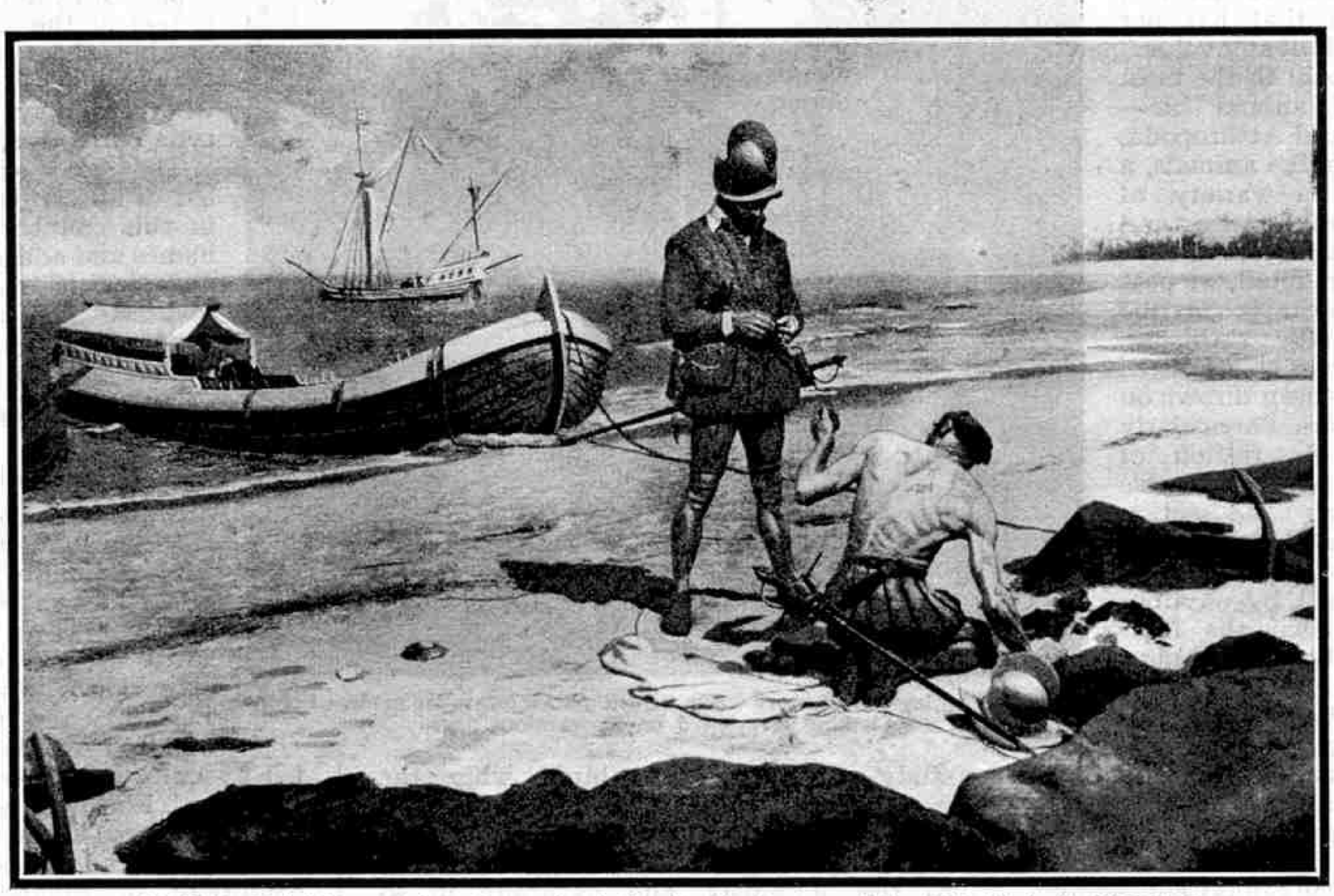
ONE of the wonders of the world is the "Pitch Lake" in the tropical island of Trinidad, British West Indies, where in the space of a few acres Nature produces millions of tons of asphalt. The name "Lake" has been given to this area because it consists of an expanse of more or less mobile character resembling in some respects a similar expanse of water: but it is sufficiently solid to enable men to walk on it even at the hottest period of the year. It is situated in the south west corner of the island, about 28 miles in a direct line from Port of Spain, the capital, and can be reached either by road or by steamer. At first sight the Lake is disappointing, appearing to consist only of a greyish black mass, with bits of vegetation here and there and an occasional pool of water. Gradually, however, the contrast between this "Dead Sea" and the rest of the beautiful island creates an extraordinary and unforgettable impression of weirdness.

The legend of the Lake is interesting. Centuries before the Spaniards came to the New World, Trinidad was "The Land of the Humming Bird," which was worshipped by the natives of the island, Carib Indians. On the actual site of the Pitch Lake there then stood a flourishing Indian village situated in a fertile valley. The tribe that inhabited this village, after defeating all its enemies, celebrated its success by killing and eating the sacred humming birds. This action roused the wrath of the Great Spirit. As a punishment he caused the earth to open out, so that the village and its inhabitants perished. The beautiful green valley vanished, and in its place appeared a dark lake of black semi-fluid mud. Even up to the time when commercial operations were first commenced the legend still persisted that the village lay beneath the Lake.

It is impossible to doubt that the Lake must have attracted the attention of the early explorers, among them Christopher Columbus, who discovered the island in 1498, and took possession of it in the name of Spain. It was not until 1595, however, that mention of the Lake was made, when Sir Walter Raleigh landed at a spot on the coast where an overflow of asphalt from the Lake reached down to the sea.

Sir Walter had been attracted by stories of El Dorado, the wonderful city of gold then believed to exist in the interior of South America. He thought this city could be reached by travelling up the Orinoco, the great river that enters the Caribbean Sea through a delta nearly opposite the island of Trinidad, and after sending out a preliminary expedition in order to acquire information about the country, Raleigh himself sailed westward in 1595 with five ships. Landing on the island he attacked the Spanish settlements, and burned the principal town, before starting to build boats in which to ascend the Orinoco. It was then that he found the Asphalt Lake, and he describes his discovery in the following words:—

"Besides our vessels were no other wherries, but one little barge, a small cockboate and a bad Galiota which we framed in haste for that purpose at Trindidado, and these little boates had nyne or ten men apiece with all their victuals and armes. I myself coasted in my barge close abord the shore, and landed in every cove the better to know the Island, while the shippes kept the chanell. I left the shippes and kept by the shore the better to come to speack with some of the inhabitantes and also to understand the rivers, watring places, and portes of the Island. From Curipan I came to a port and seat of the Indians called Parico. From thence I rode to anchor port, called by the natives Piche and by the Spaniards Tierra de Brea. At this point called Tierra de Brea or Piche there is that abundance of stone pitch that all the shippes of the world may be therewith laden from thence, and we made triall of it in trimming our shippes to be most excellent good, and melteth not with the Sunne as pitch of Norway, and therefore for shippes trading South partes very profitable."



Sir Walter Raleigh examining a lump of asphalt, after his discovery of the "Pitch Lake" of Trinidad.

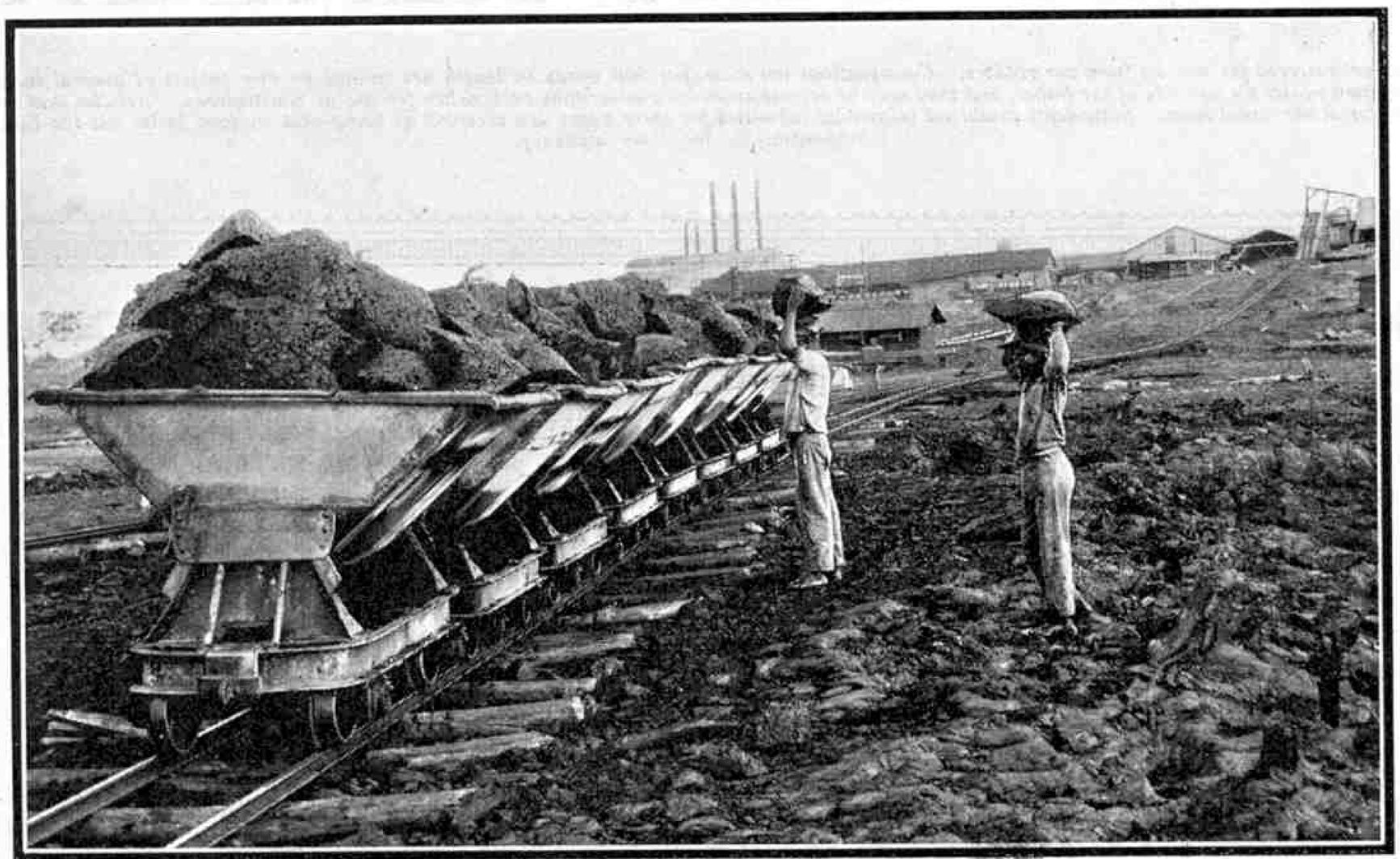
Although Raleigh may have employed the pitch in building the vessels in which he intended to explore the Orinoco and its tributaries, he does not appear to have made any effort to develop its use. He had come to the Spanish Main for gold, and in every expedition his chief aim was to penetrate the South American jungle in search of the mythical El Dorado.

From this time little is heard of the Lake, and it was not until the latter part of the 19th century that the coming of the bicycle and the motor car created a demand for smooth and dustless roads that its appointed destiny was established. In 1851 the tenth Earl of Dundonald leased a large portion of the Lake for 20 years, and since then it has played an increasingly important part in the history of the island. When this lease expired in 1871 special regulations were passed regarding the sale and lease of Crown Lands for the purpose of exploring and taking pitch, as the asphalt was then called. The entire Lake came under the control of four lessees, and the present holders of the concession are the Trinidad Lake Asphalt Co. Ltd., who pay a royalty to the British Government for every ton of crude asphalt taken from the Lake, totalling to-day many millions of pounds.

It is now generally accepted that the Pitch Lake had its origin many thousands of years ago during a period of general earth movement in this vicinity. One or more of the fractures that resulted was of sufficient depth to reach a large reservoir of oil and gas below the earth's surface, thus providing a channel of escape to the surface. The agitation caused by the escaping oil and gas gradually scoured away the surface clays and earth until eventually a large basin was formed into which the escaping oil collected in great quantities. In course of time the more volatile portions of the oil evaporated, leaving only the residue that forms the native lake asphalt of to-day. During this period

the inflow of oil from underground sources was sufficient to replenish that lost through evaporation, and to keep the basin full to overflowing.

The deposit is contained in a large circular depression covering approximately 114 acres, and the whole mass is in a constant state of movement as the result of the evolution of gas in the centre and the continuous inflow of new material. The nature of this remarkable movement is shown by the fact that pieces of wood that slowly rise above the surface of the asphalt in the centre are gradually carried towards the edge of the Lake, where they appear to be slowly sucked down and finally disappear. The formation of the so called islands on the Lake is accounted for by the fact that there is a kind of scrub tree that grows on the asphalt in places where leaves and other vegetable matter carried by the wind have lodged. This vegetable matter gives the necessary protection to the young plants while they are developing, and the roots gradually seek their way into the asphalt. The trees ultimately reach a height of from 15 to 16 ft.



Native labourers loading the asphalt into cars for conveyance to the refinery adjoining the Lake.

In Sir Walter Raleigh's time the Lake was surrounded by jungle; now it has been transformed into a busy industrial centre. A large pier has been erected alongside which ships drawing 30 ft. of water can load, and an aerial ropeway delivers crude asphalt from the Lake and refined asphalt from the refineries direct into the ships. A great factory by the side of the Lake is at work day and night refining the crude material and preparing it for transhipment to all parts of the world. The factory is equipped with steam-heated tanks, each producing from 85 to 90 tons of refined material in 24 hours. This is drawn off through a large screen, heated with steam coils to prevent the asphalt from cooling and sticking, and allowing only the clean material to pass through into the barrels. The asphalt tanks or driers are charged every day. The men on the Lake start work at about 3 a.m. At 8 a.m. this shift goes off duty and a second shift takes up the work and continues until the tanks are completely charged. The reason for starting so early in the morning is to avoid as far as possible working during the hot hours of the day, which are from noon to 4 p.m.

View in the refinery giving some idea of the immense number of barrels that are used for containing the refined asphalt ready for shipment.

Approximately 1,000 native British labourers are employed on this part of the work engaged at the tanks, pouring sheds, storage sheds, barrelling plant and power station, and on the pier. From 200 to 300 men are employed in the mining operations. They are organised in gangs, each made up of one digger or pitch cutter, and about five loaders. Each of these gangs has its own particular little spot somewhere along the line of one of the tracks, and each has its own car for hauling the asphalt from the digging pit to the tanks. The pitch cutter breaks the pitch out in large lumps, and his five loaders load these into cars.

It will be realised that there are many difficulties in keeping the railway track even approximately straight on a moving base like the surface of the Lake, and the rails have to be relined daily. The three railways used for mining operations on the Lake are of 24 in. gauge, two being used for loading asphalt for charging tanks, and the third, which forms a long continuous loop, for loading crude material direct to ships. Cars are run in trains of eight for tank charging, and of from two to four for direct crude shipments. Cable haulage is provided for the trains. On the loop track used for crude shipments it is an endless cable, the loaded trains being provided with a device for gripping the cable. The trains used for charging tanks alternate, one going up and dumping, while the other is loading. Haulage is provided by a single cable that pulls the train up the steep incline to the tanks, and after the cars are dumped the train runs back by gravity, pulling the cable with it. At the end of each day large-sized pits are left in the surface of the Lake, from which the pitch has just been taken. These gradually fill up, and in a short time all traces of them disappear.

The material thus obtained from the Pitch Lake is used to an enormous extent in the great cities of the world, and on the main highways. There, may be seen the counterpart of the gangs working on the Lake in Trinidad; but instead of digging up the material and loading it into trucks these gangs remove it from vehicles, steaming and hot, and place it once more on the earth. Shovellers, rakers, tampers, experts at their work, and then the final consolidation by the roller, all form part of a great industry built up by the unique qualities of the material produced in the space of a few acres in a distant part of the Empire.

An interesting and valuable feature of the asphalt from the Trinidad Lake is its consistent quality, the nature of the material never having varied since records were first taken more than 50 years ago.

For the information contained in this article, and for the photographs, we are indebted to the Trinidad Lake Asphalt Co. Ltd.

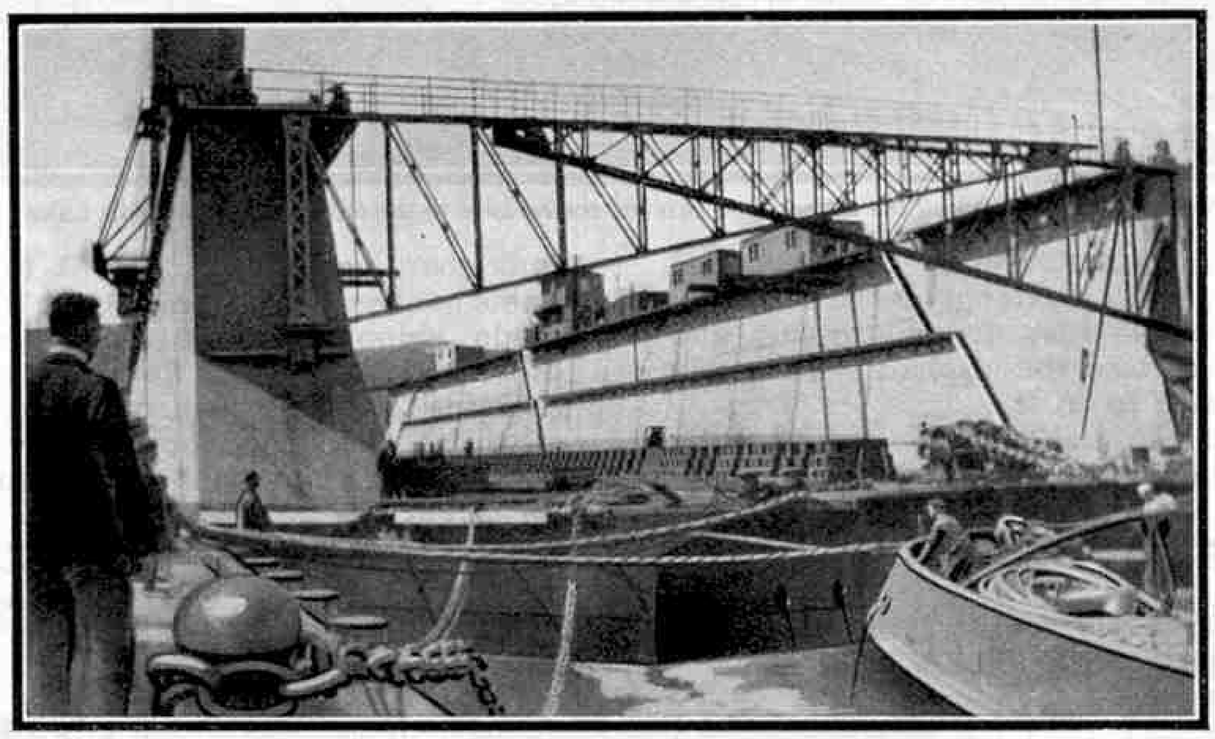
FROM OUR READERS

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, 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 Jubilee Dock at Wellington

I was fortunate enough to see the arrival in Wellington Harbour of the great floating dock built by Swan, Hunter & Wigham Richardson Ltd., Wallsend. This has been named the Jubilee Dock to commemorate the 50th anniversary of the constitution of the Wellington Harbour Board, and is the only floating dock in New Zealand. It is 584 ft. in length and 117 ft. 6 in. in width, the entrance being 88 ft. across. The bottom part, or pontoon, covers an area of more than 1½ acres, and is divided into seven sections, which are flooded when the dock is to be sunk and pumped dry to raise vessels requiring examination or repair.

The dock reached Wellington after being towed 13,600 miles from England by the "*Zwarte Zee*" and the "*Witte Zee*," two Dutch tugs. This was the world's record tow and occupied five months, the distance being covered at an average speed of four knots. During the voyage, the members of the crew of the dock itself were housed in a special structure on the port wall, and no untoward incident occurred although huge seas occasionally swept along the floor of the dock. The structure proved extremely seaworthy, and rolled only slightly. Its voyage across the Indian Ocean was planned to occupy the period of the year when the weather there was most favourable, and practically the only discomfort was caused by the high temperature experienced while passing through the Mediterranean and Red Seas, for this section of the voyage was made in summer and the effect of the Sun's rays was increased by reflection from the steel plating.



The Jubilee Dock temporarily moored at Wellington at the conclusion of the voyage of 13,600 miles from England. On the right is the stern of the "Zwarte Zee," one of the two Dutch tugs that towed the dock to New Zealand. This photograph was taken by our reader, H. Sharp, Wellington.

To watchers on the shores of Wellington Harbour, the dock looked like a rectangular grey island as it was pulled slowly along by the tugs. It had been met at the Heads, a few miles south of the Harbour, by the ferry steamer "*Muratai*," which was crowded with passengers; and as it neared its destination launches and yachts sailed round it, and two aeroplanes flew backward and forward over it. A special wharf has been constructed for it, and there it is now permanently moored by means of huge steel booms that leave it free to rise and sink when in use for raising large vessels. H. SHARP (Wellington, N.Z.).

A Visit to an Electric Cable Factory

When I visited a cable factory, I was surprised by the extent of the works, which cover many acres. The various shops are so arranged that copper rod, lead and other raw materials enter at one end of the factory, and cables wound on the familiar wooden drums leave it at the other end. During my visit I followed the course of the operations by which the transformation is effected.

On arrival, the copper is immersed in acid and carefully washed in order to remove scale and dirt. It is then passed to the wiredrawing shops, where the rods are reduced to the required size by drawing them through a series of dies, each slightly smaller than its predecessor. I was interested to learn that very fine wires with a diameter of only about a thousandth of an inch are produced by drawing through dies made from diamonds.

The next operation is stranding. This consists of twisting several wires together in order to form the cores of the cables, and like all cable twisting and wrapping operations is carried out by means of complicated machines. These consist of enormous rotating frames carrying bobbins of the wire that forms the conducting part of the cable, or of the covering material wound over it. As they leave the machines the stranded cores are rolled to give them the required section, and insulating paper is wrapped round them, as many as 30 layers being used for cables intended for high voltage work. Finally two or more cores are stranded together in order to form the centre of a cable.

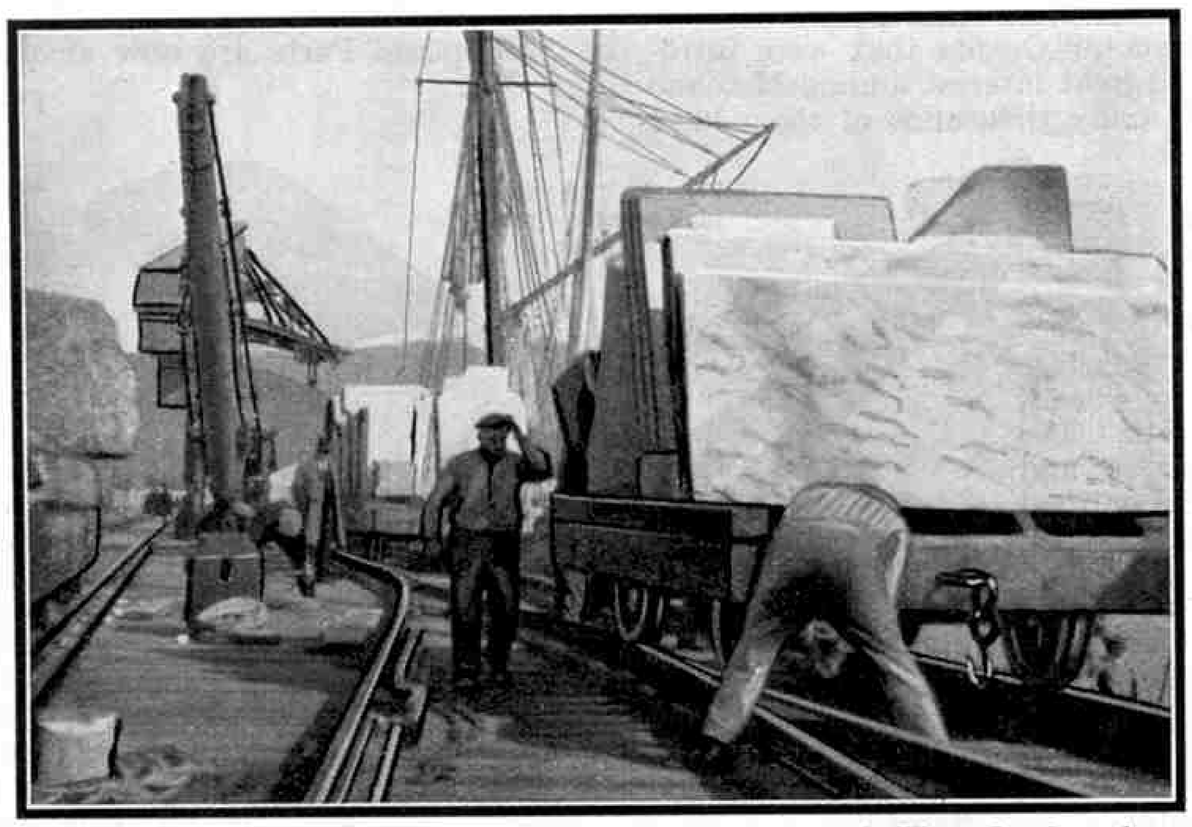
The partly-finished cable is thoroughly dried in a vacuum and is impregnated with oil forced in under pressure. It is then passed through a die fed with semi-molten lead at very high pressure. This metal forms a protective sheet for the cable, which also is covered with layers of jute or steel tape armour.

Cables are carefully tested before leaving the works, and I was greatly interested in the laboratories, in which the necessary trials are carried out. These are equipped with transformers by means of which electrical pressures as high as 500,000 volts may be applied in leakage tests, in addition to apparatus for chemical analysis of raw materials. R. T. GILLAMS (Ilford).

The Marble Quarries at Carrara

The marble quarries at Carrara seem to contain an inexhaustible supply of beautiful white marble, for they have been a famous source of this material for more than 2,000 years. The product is so pure in colour that the uncovered masses in the quarries on the sides of the mountain glisten like snow, and as it is also hard and durable it is an ideal medium for sculpture.

The marble is quarried by means of explosives, and only flawless blocks are used. These amount to about one-third of the quantity extracted, and the rest of the material is discarded, the debris of centuries being strewn about the extensive quarries. The selected pieces are roughly squared and then are lowered down the slopes on sledges held steady by means of ropes passed round posts. At the bottom they are loaded on bullock carts for transport to the saw mills.



Our photograph, for which we are indebted to our reader, A. K. Quilliam, London, shows marble from the quarries at Cararra being loaded on to sailing vessels for transport by sea.

The blocks are ready for despatch when they have been sawn to the required shape. Most of them are loaded on railway trucks, slab-shaped pieces being placed in an upright position in order to prevent damage during transport. Other slabs and blocks are transported by water. The vessels employed are wooden sailing boats and the marble is placed deep in their holds. Occasionally pieces of extraordinary size are wanted and special means of conveying them are then devised. Thus when an enormous obelisk was required for a statue of Signor Mussolini to be erected in Rome, the block selected was shipped in a specially built barge-like boat.

About 15,000 workmen are employed in the quarries themselves, in the saw mills and in the loading depots. An interesting feature is a school where principles of sculpture are taught free of charge, the only cost to the pupils being the very low price of the blocks of marble they use. Statues, tombstones and other works executed at Carrara by sculptors may be seen in a large museum.

The staircases and steps of modern Italian houses are built of marble, which is comparatively cheap and plentiful in Italy. Many shop fronts also are made either of the Cararra stone or of the coloured marbles from the Aosta Valley, and the use of marble in the construction of both shops and houses gives them a refreshingly cool appearance during the hot days of the summer months. A. K. QUILLIAM (London).

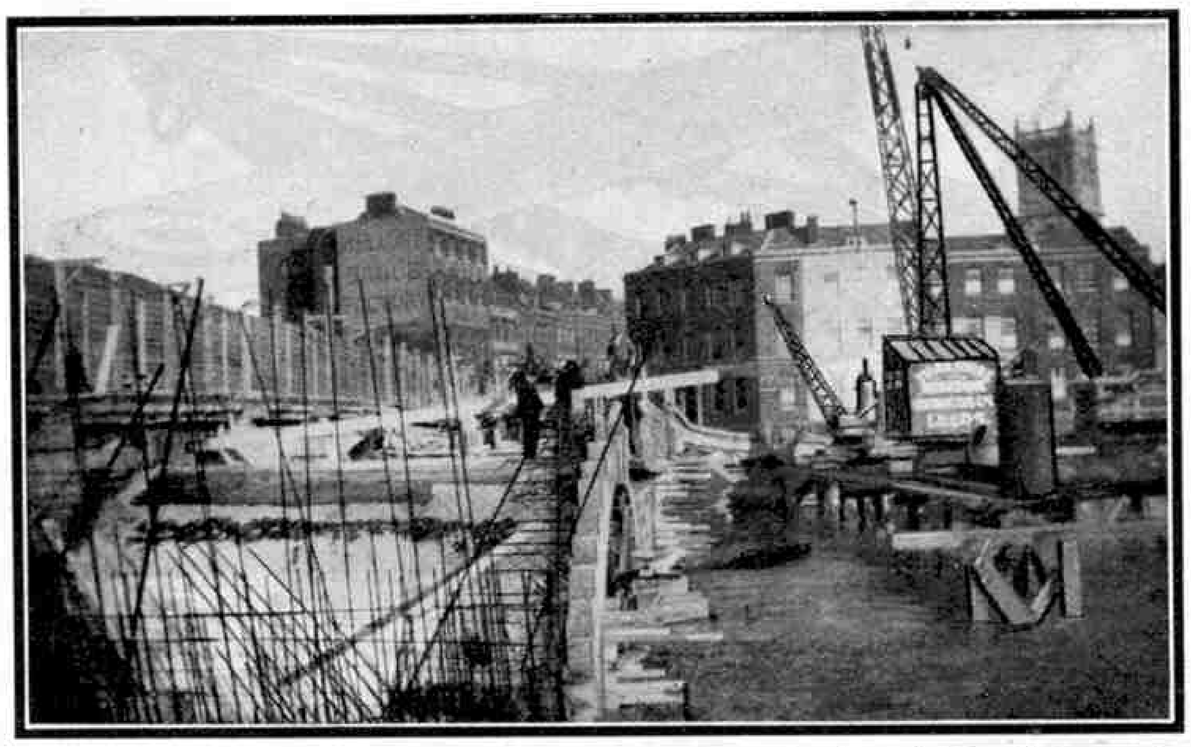
Building the New Bridge at Worcester

The quaint old bridge that until recently spanned the Severn at Worcester was only 32 ft. in width, and the great volume of traffic that passed over it daily made reconstruction necessary. It is therefore being entirely rebuilt, and when the work is completed, probably at the end of the year, a handsome reinforced concrete structure 60 ft. in width will be available.

Although the bridge had been toll free since 1828, the quaint toll-houses used before that date still remain, and will have to be removed. The historic buildings probably will be re-erected on another site in order to preserve them. It is interesting to note that some of the material of the quay walls of the bridge now being reconstructed probably is more than 600 years old, for a proportion of the stonework of a bridge erected as early as 1313 was used in its construction.

I have watched the building of the new concrete arches with great interest since the first of the supporting piles were driven. At one stage of the work a crane employed in pile-driving toppled into the river, unfortunately carrying its driver with it in spite of his efforts to jump to safety as the crane fell. The crane was completely wrecked, and I was present a few hours later when the dangerous task of raising the tangled mass of steel from the river bed into which it had fallen was undertaken.

G. GOODALL (Worcester).



The reconstruction of Worcester Bridge. The steel rods employed to reinforce the concrete are clearly shown in our photograph, taken by our contributor, G. P. Goodall, Worcester.

Harry, the Hedgehog

When I first saw Harry, the hedgehog, he appeared to be only a small bundle of prickles, for he had rolled himself into a ball in order to resist the attacks of an excited fox-terrier. I drove the dog away, and after Harry had unrolled himself I picked him up very gingerly, for his prickles were very sharp, and took him home. He quickly became tame and learned to answer readily to his name, particularly at feeding time!

One day Harry disappeared, and repeated efforts to find him were in vain. Shortly afterwards I was awakened one night by loud scufflings and cacklings in the hen-coop. Thinking that a fox or a stoat had made its way in, I roused my brother and after arming ourselves with stout sticks we sallied out to investigate. To our great surprise we found the intruder to be our lost friend Harry! He had grown so accustomed to his usual diet of bread and milk that he had returned in order to eat up that provided for the chickens. T. SLEIGHT-HOLME (Ripon).

A New Type of Meccano Model

Aeroplane Parts and Standard Parts Combined

THE Meccano Aeroplane Constructor Outfits that were introduced last year have aroused great interest among Meccano enthusiasts, and as a result many thousands of them have become model aeronautical engineers!

The separate Aero Parts of which the No. 1 and No. 2 Aeroplane Outfits are composed are copies of actual aircraft units such as main planes, tail planes, fuselage sections, rudders, propellers, landing wheels, radial engines, struts, floats, etc. The parts are finished in aluminium lacquer and glossy enamel, and therefore the finished models possess a remarkably high degree of realism and beauty.

All the separate aero parts are interchangeable, and what is of particular interest to the Meccano model-builder is that all the parts are designed on the standard Meccano equidistant hole system. All perforations and slots cut in the parts are of standard Meccano size, as are all bosses and Rods; and therefore they may be used freely with the standard Meccano parts in the construction of special types of aeroplane models. Model-builders will find the standardisation of the Aeroplane Parts with the original Meccano system of great assistance in many instances. For example, if the aeroplane constructor runs short of Bolts when building a special model with his Aeroplane Outfit, he can quite easily fall back on the Bolts in his standard Meccano Set.

It is not, however, essential to be the owner of a complete Aeroplane Outfit in order to take advantage of the increased realism given by the use of the special parts, and in this article we intend to show how constructors owning small Meccano Outfits, Nos. 00, 0 and 1, may build realistic model aeroplanes by merely adding a few Aero Parts to their standard Sets.

The first three models shown are built with the parts contained in a standard Meccano No. 00 or No. 0 Outfit, with the addition of various Aero Parts and a few extra nuts and bolts; while the remaining three models make use of the standard parts contained in the No. 1 Meccano Outfit, together with a number of Aero Parts. The No. 00 Outfit models are arranged to show how, by gradually increasing the number and variety of the Aero Parts, the realism of the models may be increased. The No. 1 Outfit models are also arranged in progressive order, the models ranging from a simple monoplane to a realistic biplane amphibian. It should be borne in mind that the models shown in this article are merely representative of what can be done in this direction, and they in no way indicate the limits of construction. By arranging the Aero Parts and standard Meccano Parts in different combinations it is possible to build hundreds of different models, and a splendid new field is thus opened for the Meccano boy. Before going further we would mention that the complete range of separate Meccano Aeroplane Parts are now stocked by all Meccano dealers.

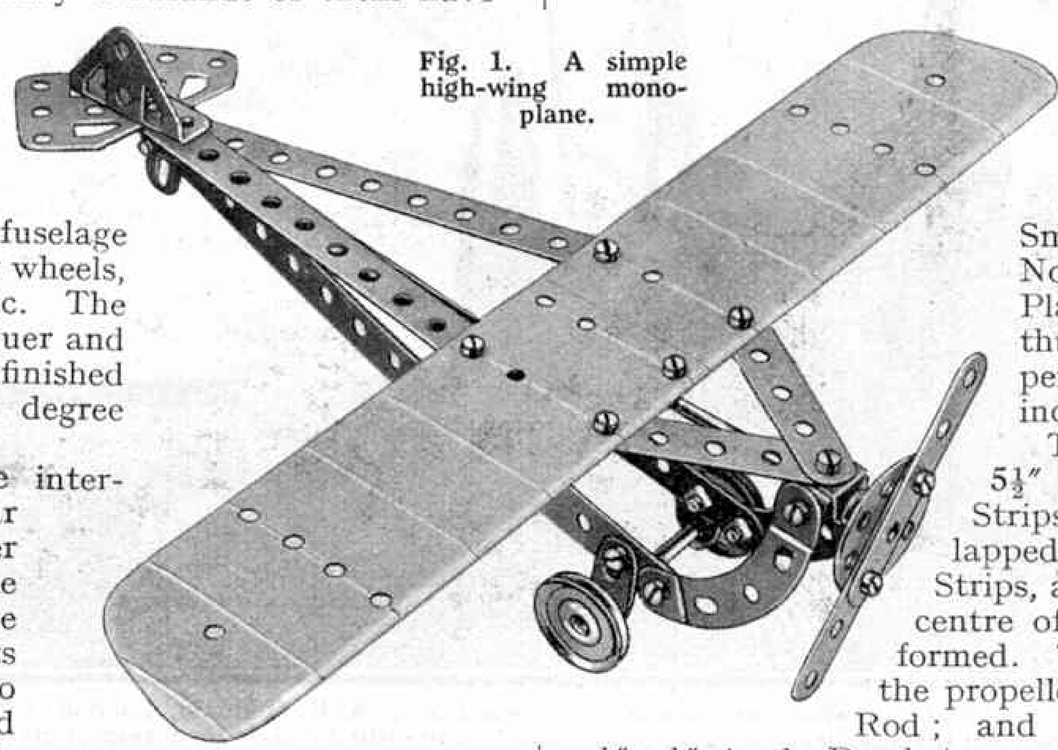


Fig. 1. A simple high-wing monoplane.

The Simple Monoplane Model

The first model illustrated is of a very simple nature, and makes use of the minimum of Aero Parts in addition to the Standard Parts contained in the No. 00 Outfit. The Aeroplane Parts used consist of one Small Right-hand Main Plane (Aero Part No. P3) and one Small Left-hand Main Plane (Aero Part No. P4). The model thus serves to show how by the expenditure of a few pence a remarkable increase in realism may be effected.

The fuselage of the model consists of 5½″ Strips and 2½″ Straight and Curved Strips. The Small Main Planes are overlapped and bolted in position to the top Strips, and an Angle Bracket is secured to the centre of the lower surface of the wing thus formed. This Bracket forms one bearing for the propeller shaft, which consists of a 3½″ Axle Rod; and this Rod is supported in a second ½″ × ½″ Angle Bracket secured to the nose of the machine. The propeller is a Bush Wheel fitted with two 2½″ Strips. The landing wheels (1″ Pulleys) are mounted on a 3½″ Axle Rod secured in Flat Brackets bolted to the fuselage. The tail unit consists of a Trunnion and two Flat Trunnions, and a Flat Bracket is secured to the rear of the fuselage of the model to provide a tail skid.

By making use of additional Aero Parts, the realism of the model may be still further increased. A Small Propeller (Aero Part No. P35) may be substituted for the built-up propeller shown. Rubber Tyres (Aero Part No. P44) may be fitted to the wheels, and Small Identification Discs (Aero Part No. P37) secured to the wing. A more realistic tail unit assembly may be devised from three Fuselage Sides Front sections bolted in position in place of the Meccano Trunnions shown.

The standard Meccano Parts used in this model are:—4 of No. 2; 6 of No. 5; 3 of No. 10; 4 of No. 12; 2 of No. 16; 2 of No. 22; 1 of No. 24; 1 of No. 35; 16 of No. 37; 2 of No. 90a; 1 of No. 126; 2 of No. 126a. Aeroplane Parts used:—1 of No. P3; 1 of No. P4.

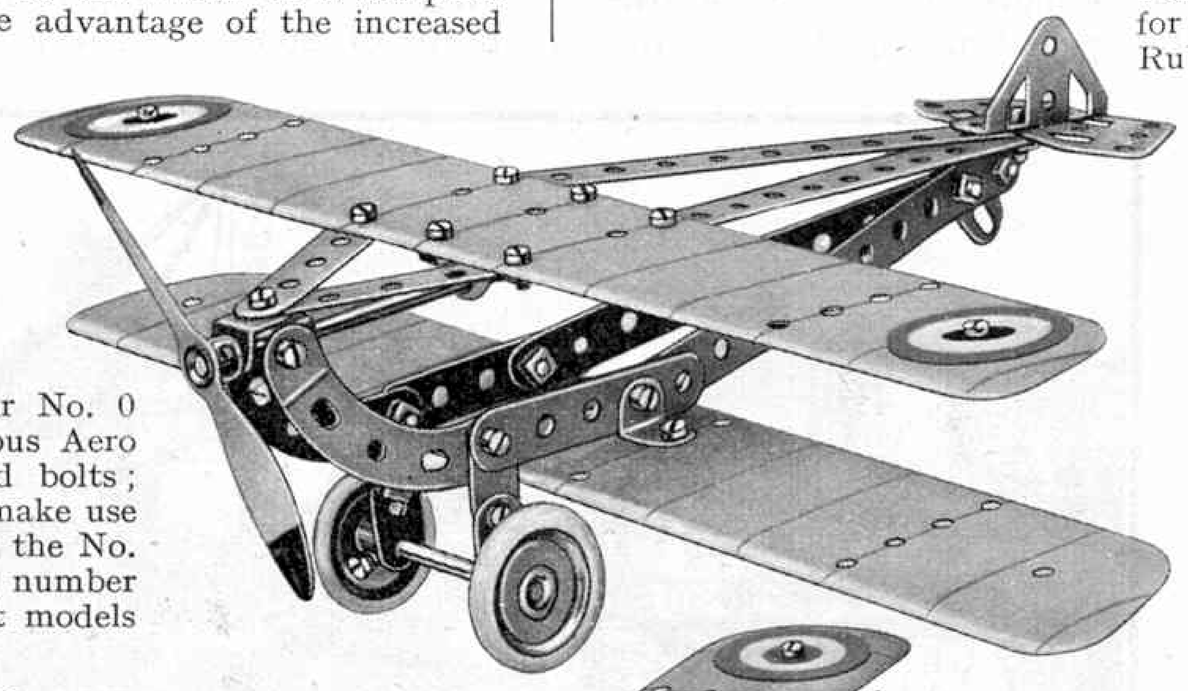


Fig. 2. Model military biplane.

A Military Biplane

The model shown in Fig. 2 is more elaborate than the monoplane just described. It represents a Service biplane, and is fitted with Identification Discs, Rubber-tyred landing wheels, and a Small Propeller (Aero Part No. P35) in place of the built-up Meccano propeller that is used in the model shown in Fig. 1.

The construction of the fuselage of the model is similar to that of the monoplane just described, with the exception that a second pair of Small Main Planes (one Right and one Left-hand) are bolted to the lower side of the fuselage by means of Angle Brackets. Each strut of the undercarriage in the model is built up from two Flat Brackets, so that the landing wheels will clear the lower plane. A further improvement in the appearance of this model can be made by using three Fuselage

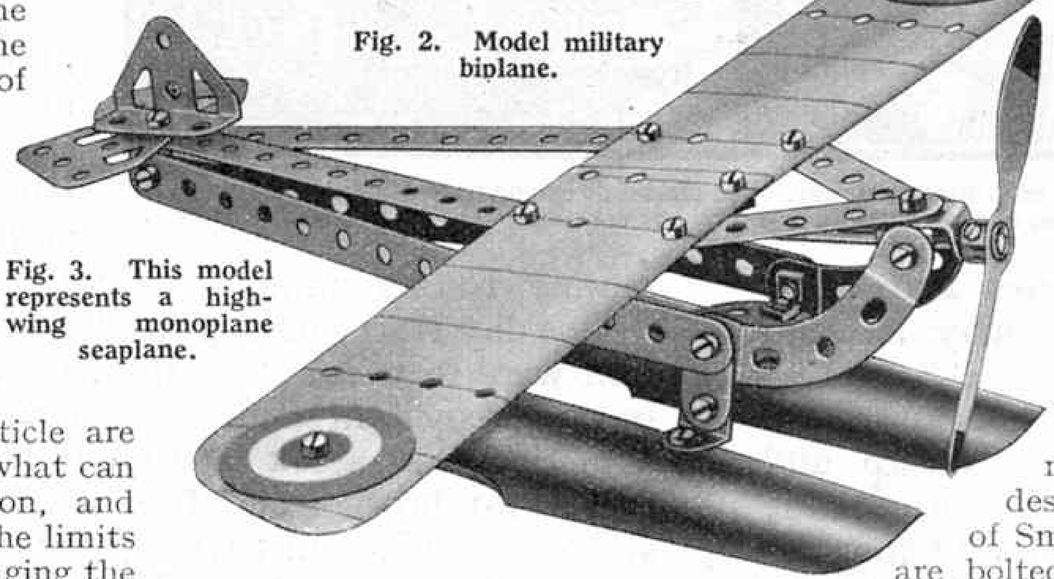


Fig. 3. This model represents a high-wing monoplane seaplane.

Sides Front (Aero Part No. P16) for the tail unit in place of the Trunnions shown fitted.

The model Military Biplane contains the following Meccano Parts :—4 of No. 2 ; 4 of No. 5 ; 5 of No. 10 ; 7 of No. 12 ; 2 of No. 16 ; 2 of No. 22 ; 1 of No. 35 ; 22 of No. 37 ; 2 of No. 90a ; 1 of No. 126 ; 2 of No. 126a. Aeroplane Parts used :—2 of No. P3 ; 2 of No. P4 ; 1 of No. P35 ; 2 of No. P37 ; 2 of No. P44.

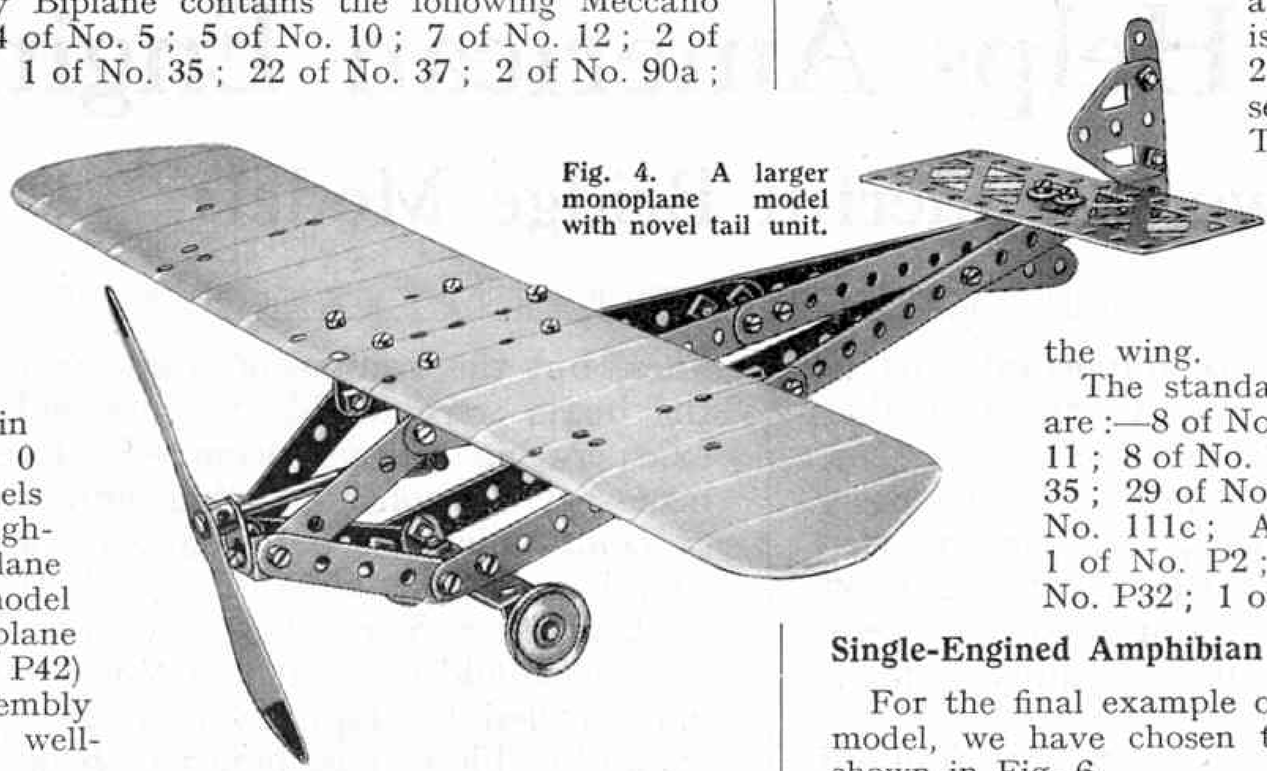


Fig. 4. A larger monoplane model with novel tail unit.

High-Wing Seaplane Model

The final example in the No. 00 or No. 0 Outfit range of models is the neat model high-wing monoplane Seaplane shown in Fig. 3. The model makes use of the Aeroplane Floats (Aero Part No. P42) and the complete assembly forms a particularly well-proportioned model.

The assembly of the Meccano Strips forming the fuselage of the model is similar to that of the model shown in Fig. 1, the method of securing the Floats only requiring any explanation. A Flat Bracket and an Angle Bracket are secured at each side of the lower portion of the fuselage and a Bush Wheel is bolted to the lugs of the Angle Brackets. Further Angle Brackets are now secured to the Flat Brackets and the Floats themselves are attached to these Angle Brackets. A Bolt is passed through the lug of each Angle Bracket and is screwed into the threaded bore that is provided in the top of each of the two Floats.

The standard Meccano Parts used in this model are :—4 of No. 2 ; 6 of No. 5 ; 2 of No. 10 ; 6 of No. 12 ; 1 of No. 16 ; 1 of No. 24 ; 1 of No. 35 ; 18 of No. 37 ; 2 of No. 37b ; 2 of No. 90a ; 1 of No. 126 ; 22 of No. 126a. Aeroplane Parts :—1 of No. P3 ; 1 of No. P4 ; 1 of No. P35 ; 2 of No. P37 ; 2 of No. P42.

From the Aeroplane models built with the No. 00 and 0 Outfits we turn to those that are constructed from the parts contained in the standard Meccano No. 1 Set. The increased number of Strips available in a No. 1 Outfit enable larger models to be built, and the Large Aeroplane Main Planes, Tail Planes and Rudder consequently may be employed.

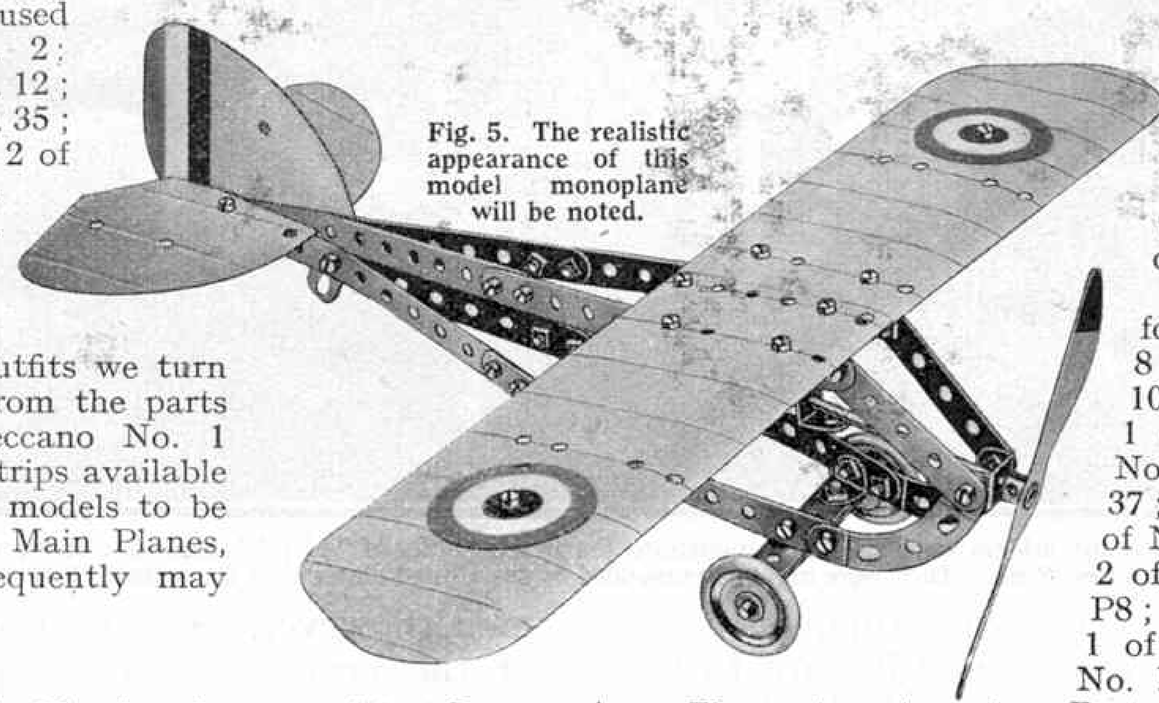


Fig. 5. The realistic appearance of this model monoplane will be noted.

High-wing Monoplane

The model monoplane shown in Fig. 4 makes use of two Large Main Planes (Aero Parts Nos. P1 and P2) and a Large Propeller (Aero Part No. P34).

The fuselage of the model is built up from eight $5\frac{1}{2}''$ and five $2\frac{1}{2}''$ Strips. The Large Right and Left-hand Main Planes (Aero Parts Nos. P1 and P2) are held to the fuselage by means of Angle Brackets and Flat Brackets, and a $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip is secured to the under side of the wing in the centre. This Angle Strip supports the propeller shaft, which is mounted in a Flat Bracket at the front of the fuselage. The tail plane consists of a $5\frac{1}{2}''$ Braced Girder held to the fuselage by means of two Angle Brackets. The Bolts holding the Girder to the lugs of the Angle Brackets are passed through the lattice openings in the Girder, and washers are placed under the heads of the Bolts so that the Girder is held rigidly. The landing wheels are mounted in a $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip secured to the fuselage by means of Angle Brackets.

In the High-wing Monoplane the following standard Meccano Parts are used :—8 of No. 2 ; 6 of No. 5 ; 5 of No. 10 ; 1 of No. 11 ; 8 of No. 12 ; 2 of No. 16 ; 2 of No. 22 ; 1 of No. 35 ; 35 of No. 37 ; 2 of No. 38 ; 1 of No. 48 ; 1 of No. 48a ; 1 of No. 100 ; 1 of No. 111c ; 1 of No. 126a. Aeroplane Parts used :—1 of No. P1 ; 1 of No. P2 ; 1 of No. P34.

A Further Monoplane Example

A second model of the monoplane type is illustrated in Fig. 5. The Aero Tail Planes and Rudder have been used to form the tail unit assembly in the model, and Identification Discs, Rubber Tyres and the Large Propeller have been fitted so that the complete model has a remarkably realistic appearance. The fuselage of the model is built up from $5\frac{1}{2}''$ and $2\frac{1}{2}''$ Strips and $2\frac{1}{2}''$ Curved Strips. The Rudder is secured to the rear $5\frac{1}{2}''$ Strips, and the Tail Planes (Right and Left-hand) are held in position by means of Angle Brackets. The propeller shaft is carried in a Double Bracket and a $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip secured to the lower side of the wing.

The standard Meccano Parts used in the model are :—8 of No. 2 ; 2 of No. 5 ; 1 of No. 10 ; 1 of No. 11 ; 8 of No. 12 ; 2 of No. 16 ; 2 of No. 22 ; 1 of No. 35 ; 29 of No. 37 ; 1 of No. 48 ; 1 of No. 48a ; 1 of No. 111c ; Aeroplane Parts used :—1 of No. P1 ; 1 of No. P2 ; 1 of No. P10 ; 1 of No. P11 ; 1 of No. P32 ; 1 of No. P34 ; 2 of No. P36 ; 2 of No. P44.

Single-Engined Amphibian

For the final example of this new type of Meccano aeroplane model, we have chosen the single-engined amphibian machine shown in Fig. 6.

The hull of the model is built up from $5\frac{1}{2}''$ and $2\frac{1}{2}''$ Strips, and the lower wing, which consists of one Right and one Left-hand Large Main Plane, is secured to the hull by means of Angle Brackets. A $2\frac{1}{2}''$ Strip is secured to the lower portion of the hull by means of Angle Brackets for bracing purposes. Six $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips are secured to the lower wing, and these support the upper wing, which consists of one Right and one Left-hand Large Main Plane and one Extension Plane (Aero Part No. P8). The Large Propeller is carried on a $2''$ Axle Rod mounted in a $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip bolted to the top wing. A Rudder (Part No. P32) is secured to the tail of the hull, and a Tail Plane is bolted to each side of the Rudder by means of Angle Brackets. The landing wheels are mounted on a $3\frac{1}{2}''$ Axle Rod that is journalled in the hull of the model.

The Amphibian incorporates the following standard Meccano Parts :—8 of No. 2 ; 3 of No. 5 ; 1 of No. 10 ; 1 of No. 11 ; 6 of No. 12 ; 1 of No. 16 ; 1 of No. 17 ; 2 of No. 22 ; 1 of No. 35 ; 41 of No. 37 ; 2 of No. 38 ; 1 of No. 48 ; 6 of No. 48a. Aeroplane Parts used :—2 of No. P1 ; 2 of No. P2 ; 1 of No. P8 ; 1 of No. P10 ; 1 of No. P11 ; 1 of No. P32 ; 1 of No. P34 ; 2 of No. P44.

The various Aeroplane Parts that have been used in the models illustrated in this article by no means comprise the full range of Meccano Aeroplane components, and many of the other parts in the range may be used to increase the realism of the models.

The Radial Engines (Aero Parts Nos. P43 and P46) are particularly suitable for fitting to models where radial air-cooled engines are to be represented.

In certain models the water-cooled type of engine must be represented, and in these instances the Aeroplane Engine Casing unit may be used. This unit consists of two parts, the Engine Casing Base (part No. P40) and the Engine Casing Top (part No. P41). When it is required to fit the unit to a model, the Engine Casing Base is bolted in the required position, and a small Propeller (part No. P35) is secured to the end of the Casing Base by means of a Pivot Bolt and two Nuts. The Engine Casing Top is next placed over the base piece, and a $\frac{3}{4}''$ Bolt is passed through the holes in the sides of the Top and through the perforated lug in the base piece. A Nut is then screwed on to the projecting shank of the $\frac{3}{4}''$ Bolt so that the complete Engine unit is held rigidly.

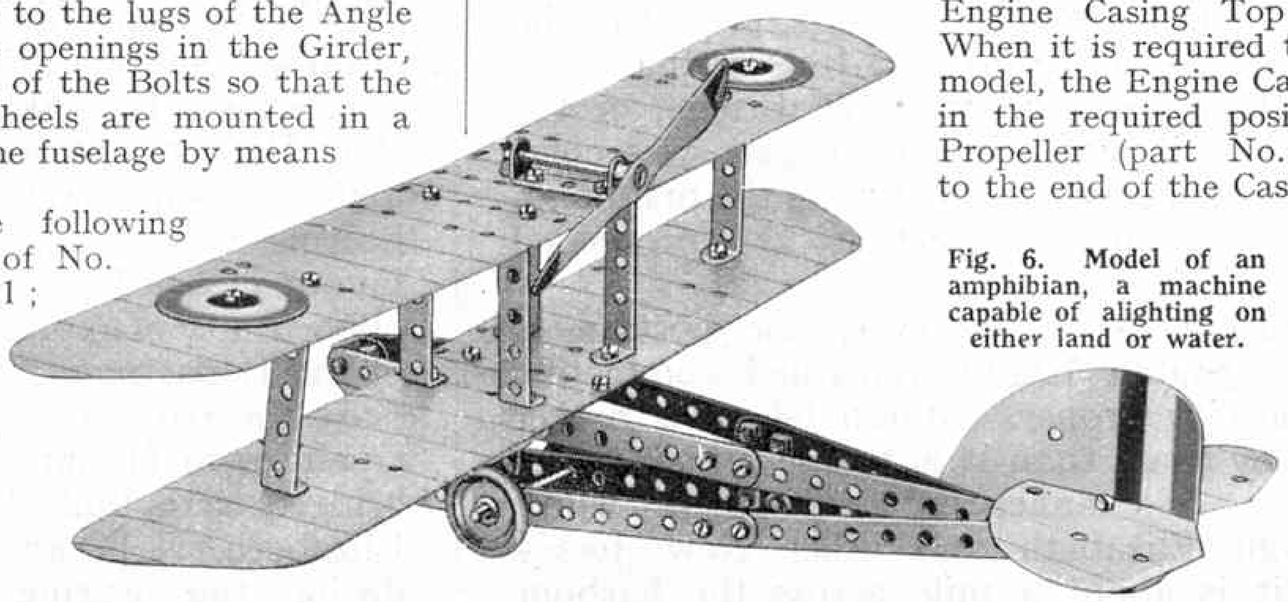


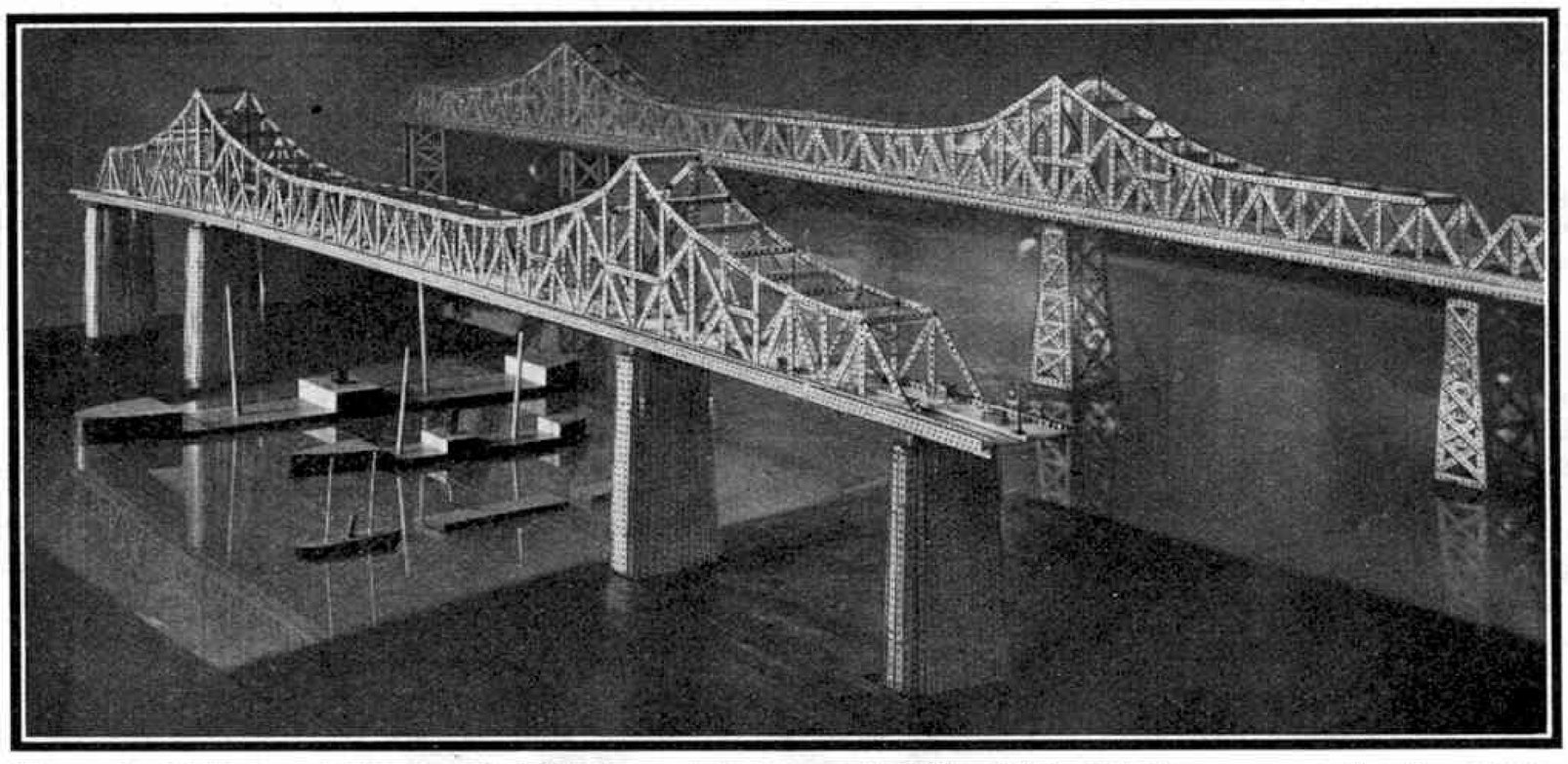
Fig. 6. Model of an amphibian, a machine capable of alighting on either land or water.

Meccano Helps American Engineers

Two Wonderful Bridge Models

BRIDGES have always played an important part in Meccano model-building, owing to the fact that they lend themselves to a wide variety of designs, and may be reproduced with remarkable accuracy even with small Meccano outfits. Among modern bridges are to be found some of the finest and most beautiful structures designed by Man, and the main features of their construction can be readily demonstrated in Meccano.

The remarkable adaptability of its parts has often led to Meccano playing an important part in real engineering, and a striking instance of the practical value of the system occurred in the United States. On this occasion large-scale models built from standard parts were used to demonstrate the possibilities of a proposed bridge in New York, for which the sanction of the United States War Department was required. The story of how this demonstration came about is very interesting.



These splendid Meccano bridges were built to demonstrate the practicability of "pier" bridges across the "Arthur Kill" Channel, New York. They were highly commended by the United States War Department Engineers.

Within the boundaries of New York City are to be found more great examples of the art of the bridge-builder than exist anywhere else in the world in a region of equal area. The municipality of New York controls no less than 44 bridges and three viaducts; and in addition there are in the city six bridges owned by railway companies. This large number is due to the fact that the central portion of the city is built on an island, cut off from the mainland by rivers on the north, east and west, some of these rivers being a mile in width. Until 1883 ferry boats provided the only means of cross-river transport, but in that year the first of the huge bridges, Brooklyn Bridge, or the "Great Bridge" as it was originally called, was completed, giving direct access to Brooklyn on the mainland. Since that time bridge construction has proceeded rapidly.

Until quite recent years, however, one portion of New York City, Staten Island, remained completely severed from the city proper. Staten Island is nearer to the New Jersey coast than it is to the remainder of New York City. A channel only 700 ft. in width separates it from Elizabeth and other New Jersey cities, whereas it is about a mile across the harbour to the nearest point in New York. Access from the island to New Jersey was provided by two ferry boat lines, but the volume of traffic increased so much that the boats were unable to cope with it, and long and exasperating delays occurred. Eventually it became necessary to consider other and more modern means of communication between the various points of the island and the mainland. With this end in view the Port of New York Authority recommended that two bridges should be built across the narrow straits. Their plans called for high-level bridges, so that any vessel would be able to pass beneath them. One of the bridges was to be at Elizabeth and the other at Perth Amboy.

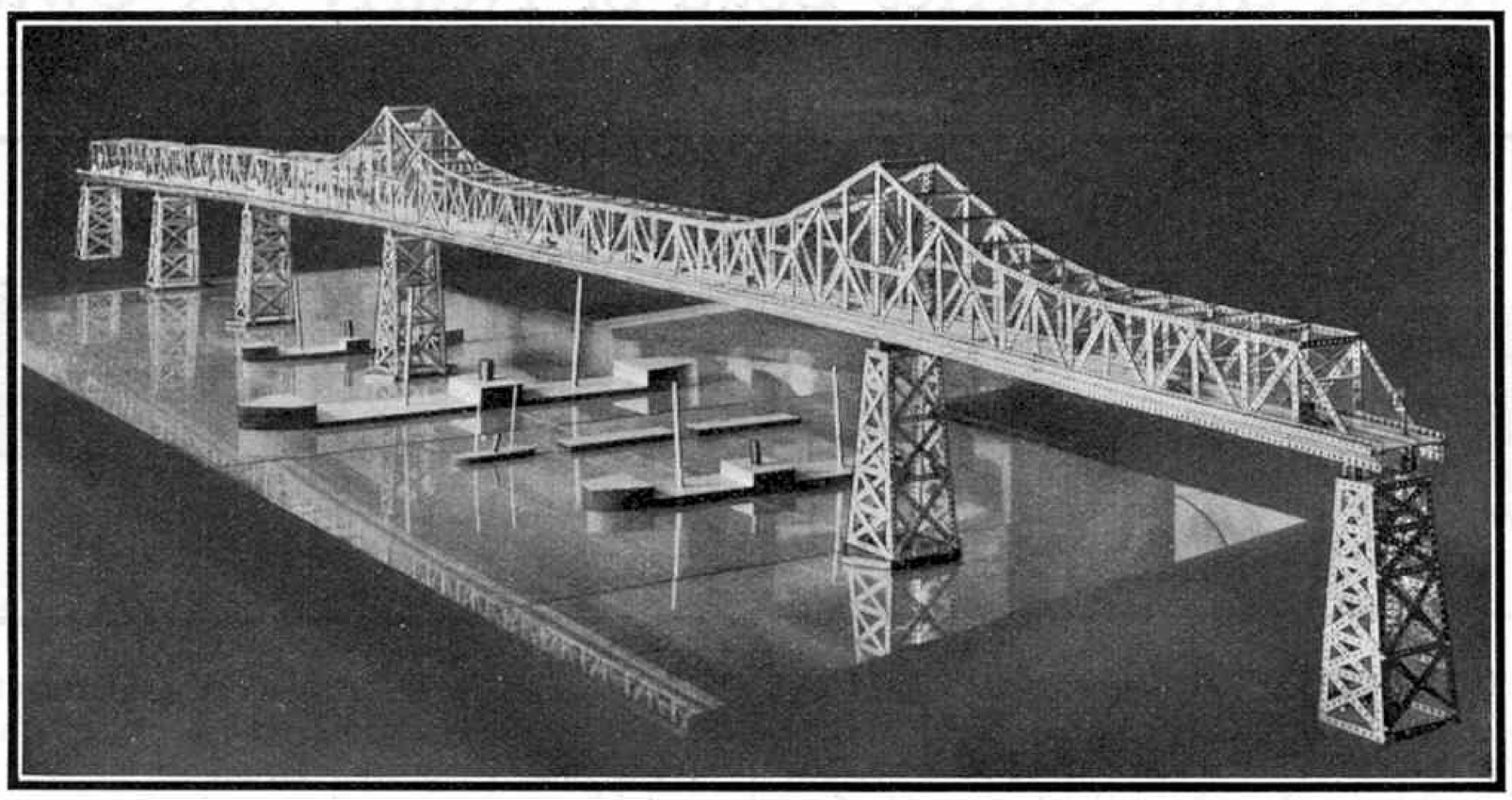
It was clear that two such bridges across the "Arthur Kill," the name by which the channel is known, would bring about a great reduction in delay and general inconvenience, and the proposal was eagerly welcomed by pedestrians and motorists alike. Considerable opposition to the scheme arose from shipping firms and tow-boat men, however, on the ground that some of the piers of the bridges would be placed in the channel, and might prove to be serious obstructions to the freedom of movement of river traffic. It was of course possible to construct bridges that would completely span the waterway without any piers in the river, but the cost of such schemes would be far greater than that of the proposed bridges, and for this reason alone could not be considered.

The final word in all matters relating to waterways, bridges, and such works in the United States rests with the War Department, and their sanction must be obtained before a bridge can be erected over any navigable river. In making a decision on this question the War Department had to consider carefully the whole matter from every standpoint; and accordingly a hearing was arranged in order to give both those in favour of the bridge plans and those against them the opportunity of expressing their views before the engineers of the Department.

At the request of a committee formed by the municipalities in favour of the scheme, scale models of the bridges were built by the Meccano Company Inc. of Elizabeth, N.J., and these were placed on exhibition during the hearing. One of the models was 21 ft. in length and was built to a scale of 1 ft. to 100 ft. The models were placed on wooden bases covered with

green plate glass to represent water, and the depths of the river at various distances from each shore were plainly marked. In addition, scale models representing various types of vessels, from small tug boats to the largest cargo carriers, were placed on the glass river.

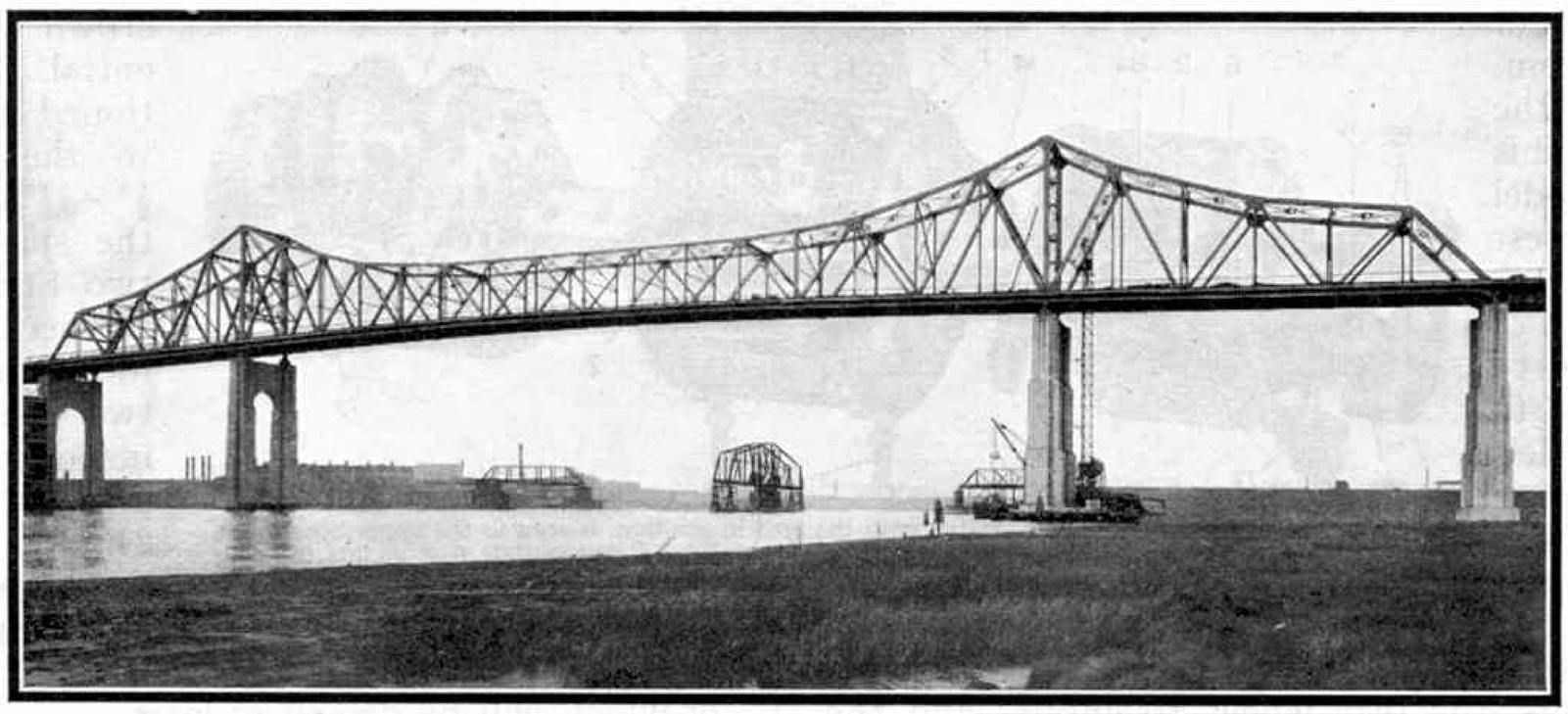
Little objection was raised to the Elizabeth Bridge, the shorter of the two, as in this case the piers were not to be placed in the water. It was the Perth Amboy Bridge that caused the opposition, for two of its piers were to be placed in the river, but at a point where the water is shallow and does not form part of the channel. The Meccano models proved of great assistance in demonstrating beyond doubt that the objections to the bridges raised by the shipping interests were not well founded. It was made clear by the models that the piers in question would not form an obstruction to traffic. After due consideration the construction of the bridges was sanctioned by the War Department, the engineers of which commented very favourably on the models and the useful purpose they had served.



The merit of this Meccano model of Goethals Bridge will be better appreciated by comparing it with the actual bridge illustrated below.

Mr. M. D. Griffith, chairman of the municipalities committee, subsequently paid a high tribute to the assistance that the Meccano models had given. He said: "The Meccano models undoubtedly played a prominent part in strengthening the claims of the Port Authority that the bridges would not obstruct traffic. They certainly were of the greatest assistance in helping the engineers, and others interested in the project, to visualise the bridges as they will appear when completed."

All those who examined these wonderfully accurate models found it difficult to believe that they were made of standard Meccano parts and not of parts specially constructed for the purpose. After the hearing one of the bridges was displayed at the Staten Island Ferry House, where many thousands of people inspected it. The other was exhibited in the store of R. A. Macy & Company, which is the largest department store in the world under one roof.



A fine view of Goethals Bridge, which spans the "Arthur Kill" Channel between Elizabeth, N.Y., and Howland Hook, Staten Island, a distance of 600 feet.

The construction of the two Meccano bridges is made clear by the accompanying photographs. Each of the piers consists of Angle Girders bolted together and braced by an elaborate arrangement of Strips to form tapering towers. The bridges themselves are of massive girder construction, held rigid by a heavy superstructure in which a veritable forest of Strips is used to form ties in triangular formation with the struts, which are formed from built-up girders. The models are probably the finest examples of the kind ever produced. They possess an extraordinary degree of strength, combined with a strikingly handsome and realistic appearance.

A Chance for Model-builders to Win a Cash Prize

We hope that this short article will stimulate interest in Meccano bridge-building amongst Meccano boys generally, and we will be especially glad to hear from any readers who build either of the models dealt with in this article.

With a view to encouraging enterprise and exploiting this field of Meccano structural engineering we will award £1-1s. to the builder of the best model bridge, details of which are received at this office not later than 30th July, 1931.

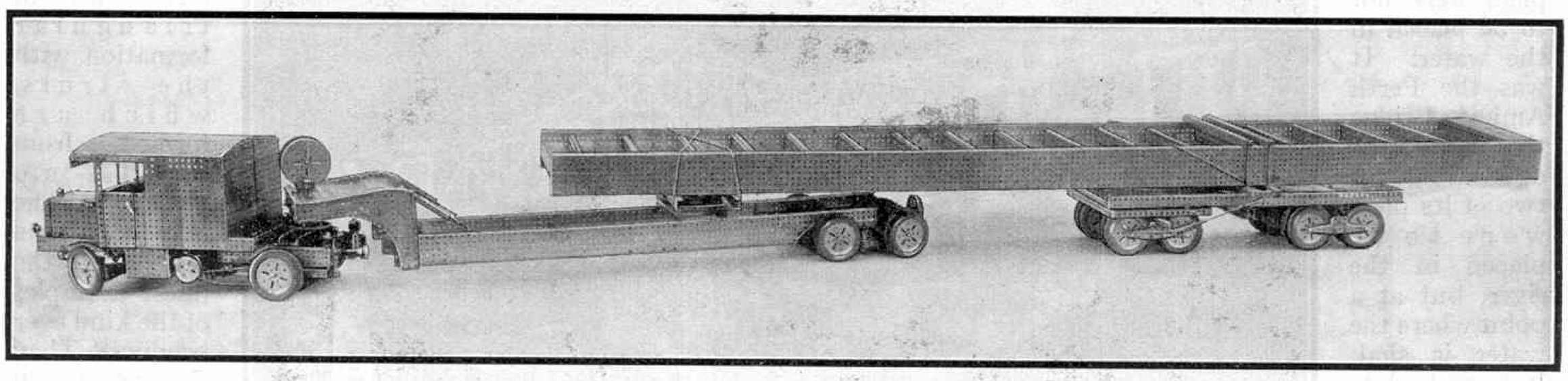
Readers may fashion their models from any type of bridge they prefer or with which they are most familiar, cantilever, arch, girder, or suspension bridges will be accepted under this heading, also transporter, rolling, swing, draw and lift-bridges, etc.

Competitors may, if they like, reproduce one of the famous bridges, such as the Tower Bridge, Quebec or Sydney Harbour Bridges.

Meccano enthusiasts who wish to compete for the prize should send either a photograph or a drawing of their models. Actual models must not be sent. Envelopes containing photos or drawings should be addressed "Special Bridge Contest," Meccano Magazine, Binns Road, Old Swan, Liverpool. The prize-winning model will be described and illustrated in the "*M.M.*"

Giant Meccano Lorry with Trailer

Model that Carries Load of Nearly Six Cwt.



ON page 184 of the "*M.M.*" for March, 1932, a brief description was given of a remarkable Meccano model of the M.R.S. 100-ton lorry, and 16-wheeled trailer that recently was employed for the transport of a girder 68 ft. in length and weighing practically 100 tons from Marylebone goods station to the site of a hotel now being erected near the Marble Arch, London. The model is illustrated on this page and is an exact reproduction in miniature of its original, including the load. Although built to the scale of $1\frac{1}{4}$ in. to 1 ft., it is 11 ft. 6 in. in length from the head lamps to the rear of the girder, which overhangs the trailer, and weighs $1\frac{1}{2}$ cwts. The girder itself accounts for nearly half of this great weight, to which the 5,000 nuts and bolts used in constructing the model make a substantial contribution!

This remarkable model is fitted with a Meccano E.1 Electric Motor and easily carries not only the heavy girder, but also a weight of five cwt. placed on top of the load. It faithfully reproduces every movement of its prototype and is an outstanding example of the capabilities of the Meccano system.

The features of the construction of this magnificent model will be full of interest to Meccano enthusiasts, many of whom will desire to reproduce it, or to make use in models of their own design of the special mechanisms incorporated in it. In the present article, therefore, we describe the building of the more important parts, such as the differentials, the rear wheel assemblies and the gear box, in order to show how the movements required may be effected.

The differentials included in the model are of special interest, for three of these mechanisms are provided in order to enable the drive of the lorry to be transmitted to four double wheels that act independently when turning corners. The main differential, Fig. 2, is exceptionally neat and compact and is built up as follows. The crown wheel, a $1\frac{1}{2}''$ Bevel Gear, carries two Pole Pieces 1, which form a rigid connection between the crown wheel and the frame 2. This frame is constructed from four 1″ Corner Brackets bolted together at their outside corners and carrying at two of the opposite corners two $1'' \times \frac{1}{2}''$ Angle Brackets. Each of the slotted holes of the Brackets is fitted with a $\frac{1}{2}''$ Bolt on which a $\frac{3}{4}''$ Contrate is free to rotate. These Contrates mesh with two $\frac{1}{2}''$ Pinions 3 and 4 mounted on $6\frac{1}{2}''$ Rods that are journalled at their inner ends in the Collar 5.

The differential casing consists of two Face Plates, passed over the $6\frac{1}{2}''$ Rods of the differential, and connected together by 2″ Strips. Each side of the front of the casing is fitted with a Crank 12 (Fig. 3), and a $1\frac{1}{2}''$ Strip 13. The Crank shown in Fig. 3 carries a $1\frac{1}{2}''$ Rod, to the inner end of which is secured a Coupling. This Coupling, that is also secured to the Crank opposite 13 by a 1″ Rod, supports, in its centre tapped hole, a $1\frac{1}{2}''$ Rod. The Bush Wheel 14 is mounted on the outer end of this Rod and the inner end carries a $\frac{1}{2}''$ Bevel Gear that meshes with the crown wheel of the differential. The 2″ Strips mentioned earlier are attached to the Face Plates by $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Brackets and the space between every two Strips is filled by a further 2″ Strip secured to its neighbour by means of two Flat Brackets. The inspection cover 6 (Fig. 2) is constructed from two $2\frac{1}{2}''$ and five 2″ Strips and the complete cover is secured to the differential casing by means of two Hinges. The casing is also fitted with two $\frac{3}{4}''$ Bolts 10, the use of which will be described later.

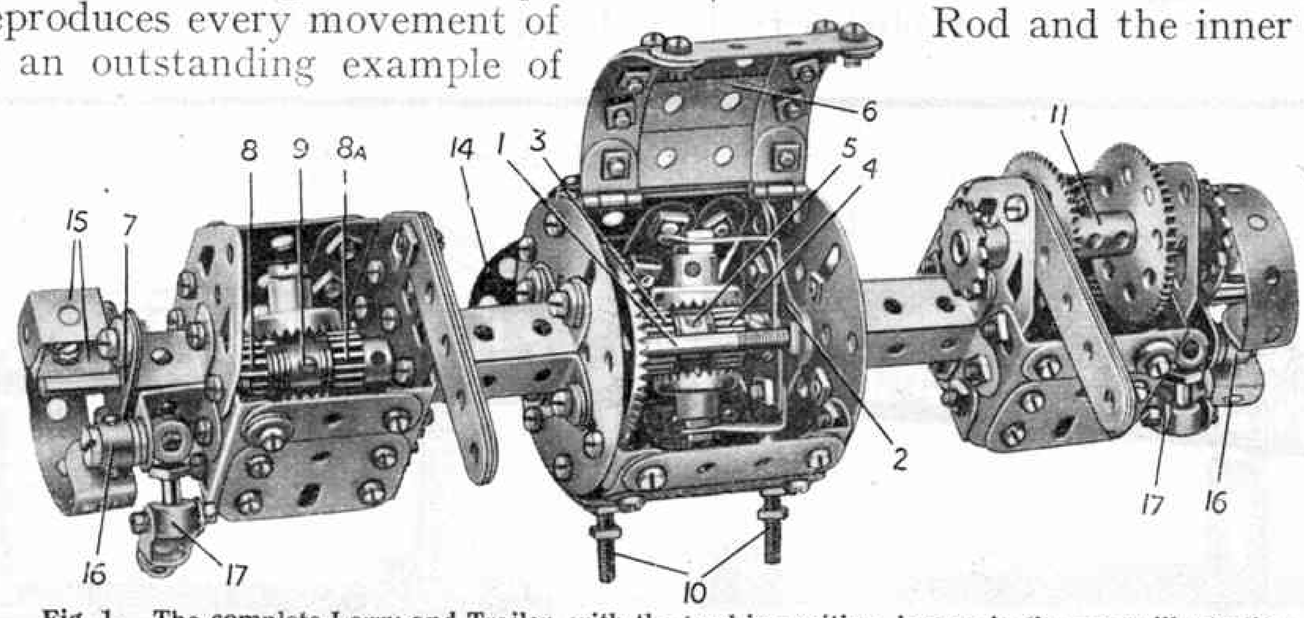


Fig. 1. The complete Lorry and Trailer, with the load in position, is seen in the upper illustration on this page. Fig. 2. The lower illustration shows the three differentials that enable the four driving wheels to operate independently when turning a corner.

Each secondary differential casing is constructed from $1\frac{1}{2}''$ Angle Girders and $1\frac{1}{2}''$ Flat Girders and Strips and is attached to the main differential casing by means of four $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips. The top edges of these casings are fitted with Flat Trunnions and at the outer ends of each are four Double Brackets, arranged in a similar manner to the Double Angle Strips forming the connection between each differential casing. The upper and lower Double Brackets carry a $1\frac{1}{2}''$ Strip 7 and the

two $1\frac{1}{2}''$ Strips at the outer ends of the assembly carry the ends of the $6\frac{1}{2}''$ Rods of the main differential.

Each secondary differential consists of two idle $\frac{1}{2}''$ Pinions 8 and 8a, which are spaced apart from a central "spider" Collar 9 by the requisite number of Washers. On its inner face the Pinion 8a bears against a Flat Bracket and the Pinion 8 bears against a Collar on its outer face. The "spider" 9 is secured by two Grub Screws to its Rod, the Grub Screws being in opposite holes, and each of the two remaining holes carries a Pivot Bolt on which a $\frac{3}{4}''$ Contrate is free to rotate. The Bolts are locked in the threaded holes of the "spider" by means of Nuts. The Pinions 8 and 8a mesh with 57-teeth Gears that are secured on 1″ Rods journalled at their outer ends in the centre

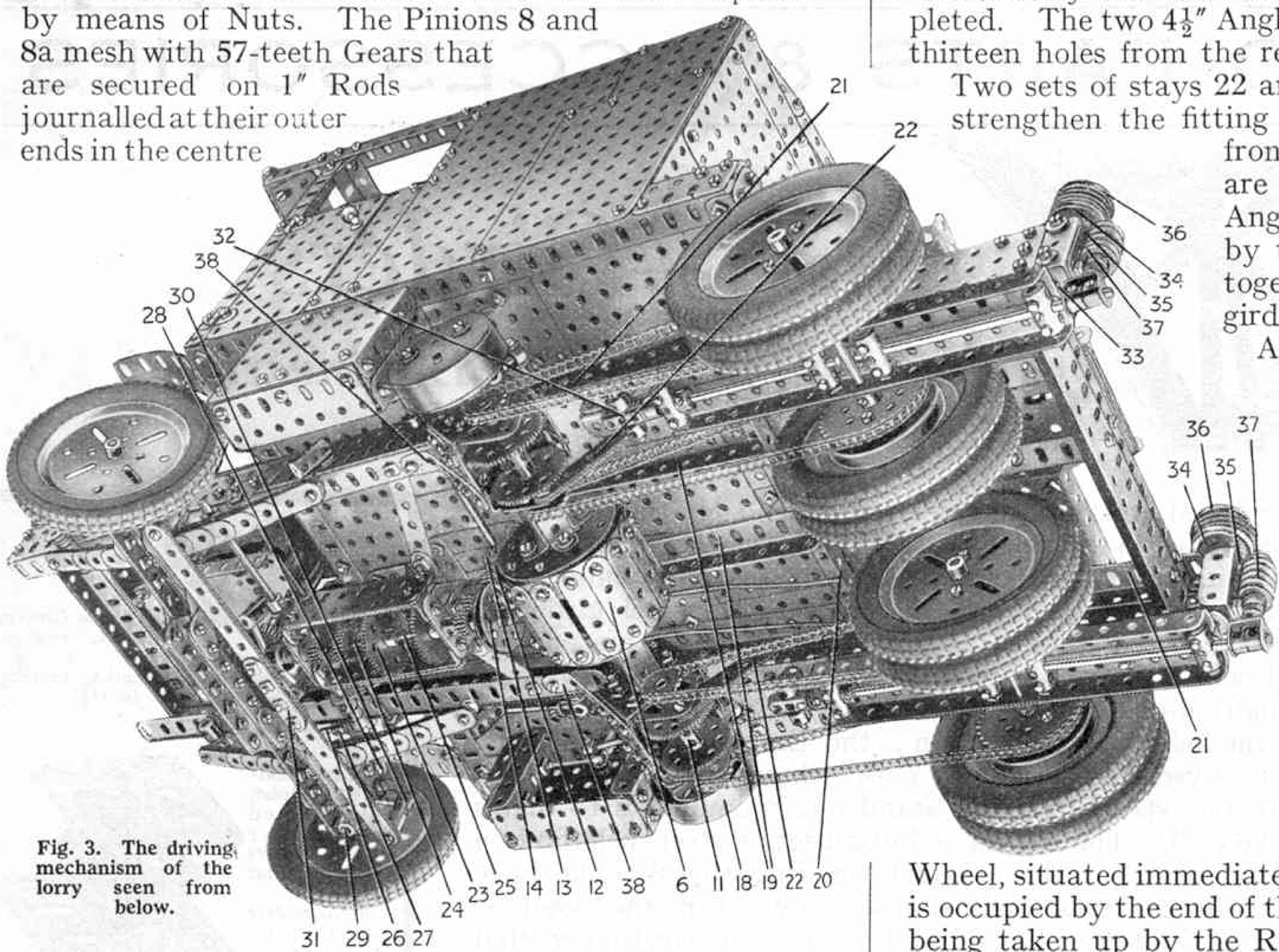


Fig. 3. The driving mechanism of the lorry seen from below.

holes of the Flat Trunnions, previously mentioned. The inner ends of these Rods are carried in Couplings, one of which is shown at 11, and the extreme outer ends are fitted with $\frac{3}{4}''$ Sprocket Wheels.

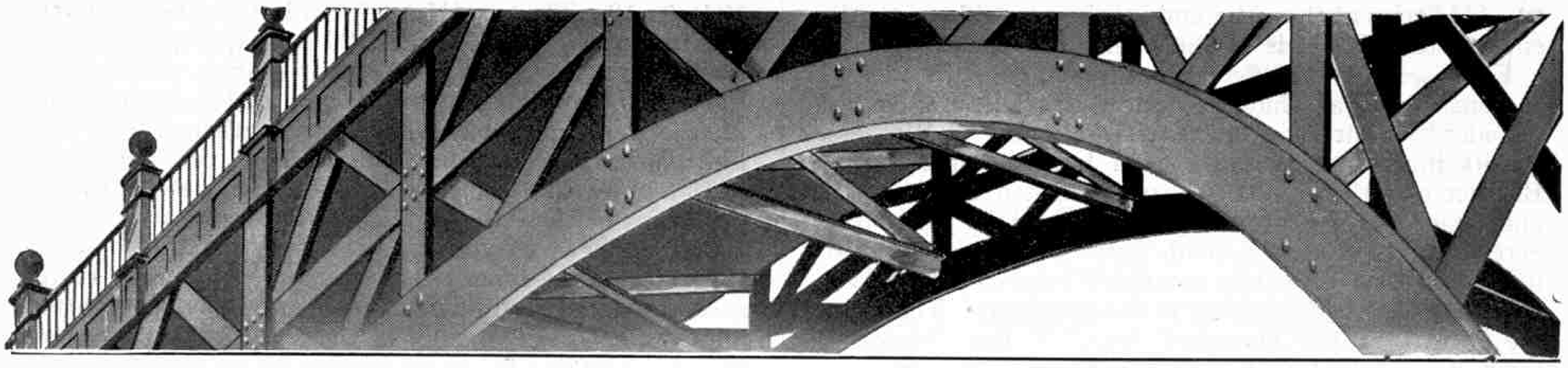
The outer ends of the $6\frac{1}{2}''$ Rods of the main differential are fitted with internal expanding brakes, one of which is shown partly dismantled to the left-hand side of Fig. 2. Each brake shoe consists of a $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip, the long side of which is curved to the inside diameter of a Boiler End. One end of these shoes is bolted securely to two Double Brackets 15 that are pivotally attached to one of the Double Brackets on the end of the secondary differential casing. The operating cam 16, a Collar fitted with two Grub Screws, is gripped on the shank of a Pivot Bolt. This Bolt passes through the Double Bracket, shown in the illustration, and carries a "spider" collar on its threaded portion. This Collar carries a Threaded Pin, as shown, which in turn carries a Swivel Bearing 17 and this will be used later for connection to the brake pedal. It will be seen that on operating the Swivel Bearing the Grub Screws of the Collar 16 force the brake shoes outward to press against the inner face of the Boiler End 18, Fig. 3. When the pressure on the brake is released the shoes contract under the influence of a short length of Spring Cord stretched between the two brake shoes.

When the differential and brake unit is completed it is secured to two $4\frac{1}{2}''$ Angle Girders 19 by means of the two $\frac{3}{4}''$ Bolts 10. The two $4\frac{1}{2}''$ Angle Girders are then bolted to two further $4\frac{1}{2}''$ Angle Girders 20 overlapping five holes, and these are secured to the main frames of the lorry. Each of the main frames consists of a $24\frac{1}{2}''$ Angle Girder 21, the front portion of which is strengthened by a $12\frac{1}{2}''$ Flat Girder and Angle Girder. The rear portion, a section of which is shown in Figs. 1 and 3, is strengthened by means of three $3'' \times 1\frac{1}{2}''$ Flat Plates and a $9\frac{1}{2}''$ Angle Girder. The spaces between the ends of the $12\frac{1}{2}''$ Angle Girders and the inner edges of the $3'' \times 1\frac{1}{2}''$ Flat Plates accommodate the differential unit, and this may be fitted immediately the two sides of the lorry frames are completed. The two $4\frac{1}{2}''$ Angle Girders 20 are bolted in place thirteen holes from the rear of the $4\frac{1}{2}''$ Girders 21.

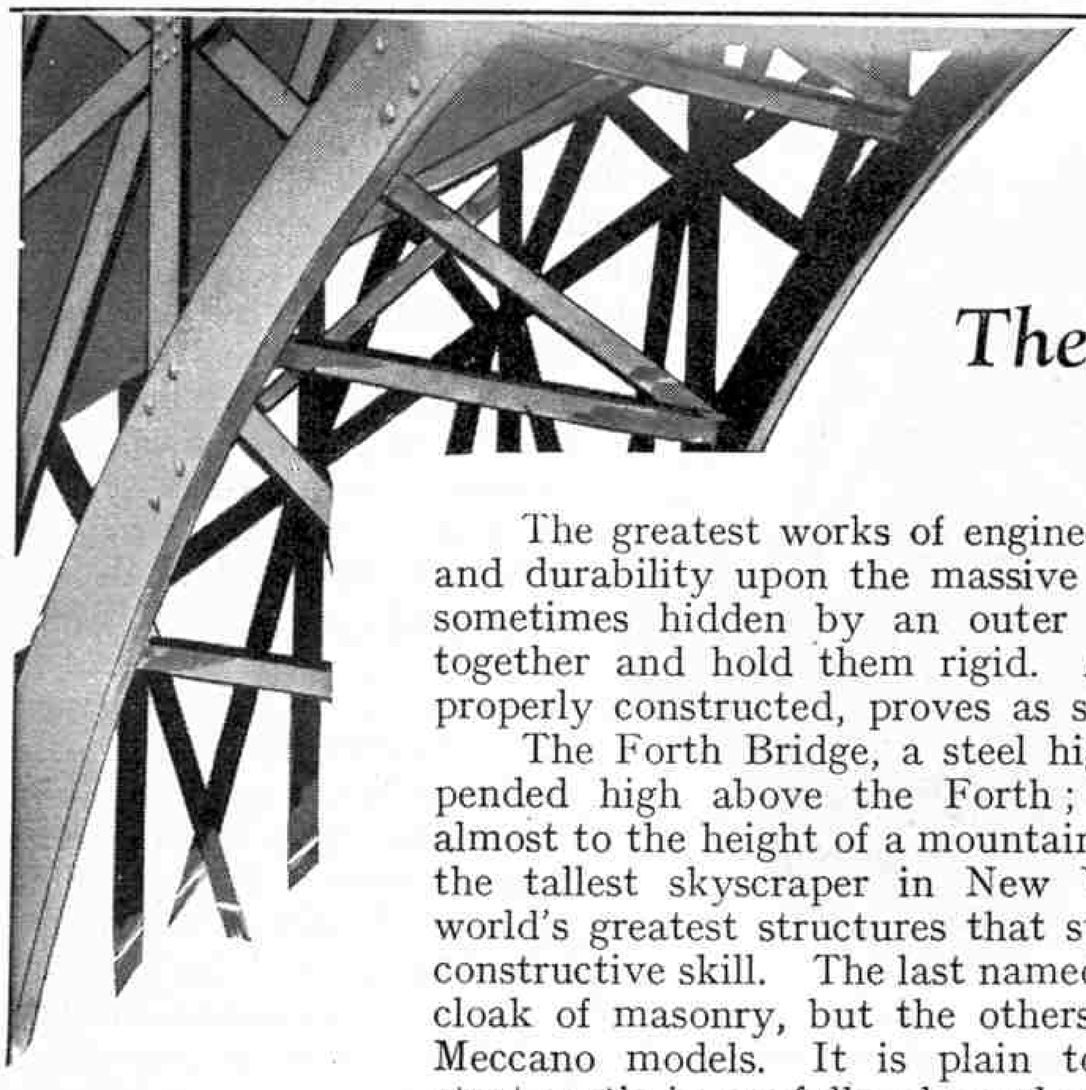
Two sets of stays 22 and 38 are provided in order to strengthen the fitting of the differential unit. The front portions of the lorry frames are connected together b a $5\frac{1}{2}''$ Angle Girder and the rear portions by two $7\frac{1}{2}''$ Angle Girders, bolted together to form a channel section girder.

An E1 Electric Motor provides the motive power for the model and the drive is transmitted from this through a compact single plate clutch to the gear-box, which provides four forward speeds and one reverse, the gear ratios being 9 : 1, 6 : 1, 4 : 1, and 2 : 1 forward and 3 : 1 reverse. The construction of the gear box framework and the position of the gears will be seen clearly from Fig. 3. It should be noted, however, that only half of the boss of the 1″ Gear Wheel, situated immediately behind the 57-teeth Gear 23, is occupied by the end of the Rod 24, the remaining space being taken up by the Rod 25. Thus the Gear Wheel supports both lay-shafts and the space taken up by an extra bearing is saved. The connection between the gear-box and the differential unit is formed from two Bush Wheels one of which is seen at 14. Four Bolts are secured in the holes of one Bush Wheel and the shanks of these engage opposite holes in the Wheel 14.

The construction of the front axle and springs is shown clearly in Fig. 3. The steering is operated on the worm and nut principle, and is an excellent example of the heavier type of Ackermann's Steering Gear. The steering column, a $6\frac{1}{2}''$ Rod, is fitted at its lower end with a 2″ Screwed Rod, the necessary connection being made by means of a Threaded Coupling. The Screwed Rod operates a Threaded Boss that is pivotally attached to one end of a built-up bell crank. Four Simple Bell Cran s clamped together form this crank and it is pivotally attached by a Pivot Bolt to a $1\frac{1}{2}''$ Angle Girder on the frame of the lorry. The lower end of the crank carries a Swivel Bearing and this is fitted with a $1\frac{1}{2}''$ Rod 26. The free end of this Rod is secured by a second Swivel Bearing 27 to a Crank 28 that is fixed on a vertical $1\frac{1}{2}''$ Rod, a portion of which is shown at 29. This Rod carries a Coupling which in turn supports a $1\frac{1}{2}''$ Rod carrying a Threaded Coupling 30. The lower end of this Coupling carries the track rod 31 and this operates the inside wheel of the lorry. Each front wheel is carried on a 1″ Rod supported in the longitudinal bore of a Coupling which, as described earlier, carries the Rod and Threaded Coupling 30.



MECCANO PARTS & ACCESSORIES



No. 1.—*Girders*

Their Importance in Engineering

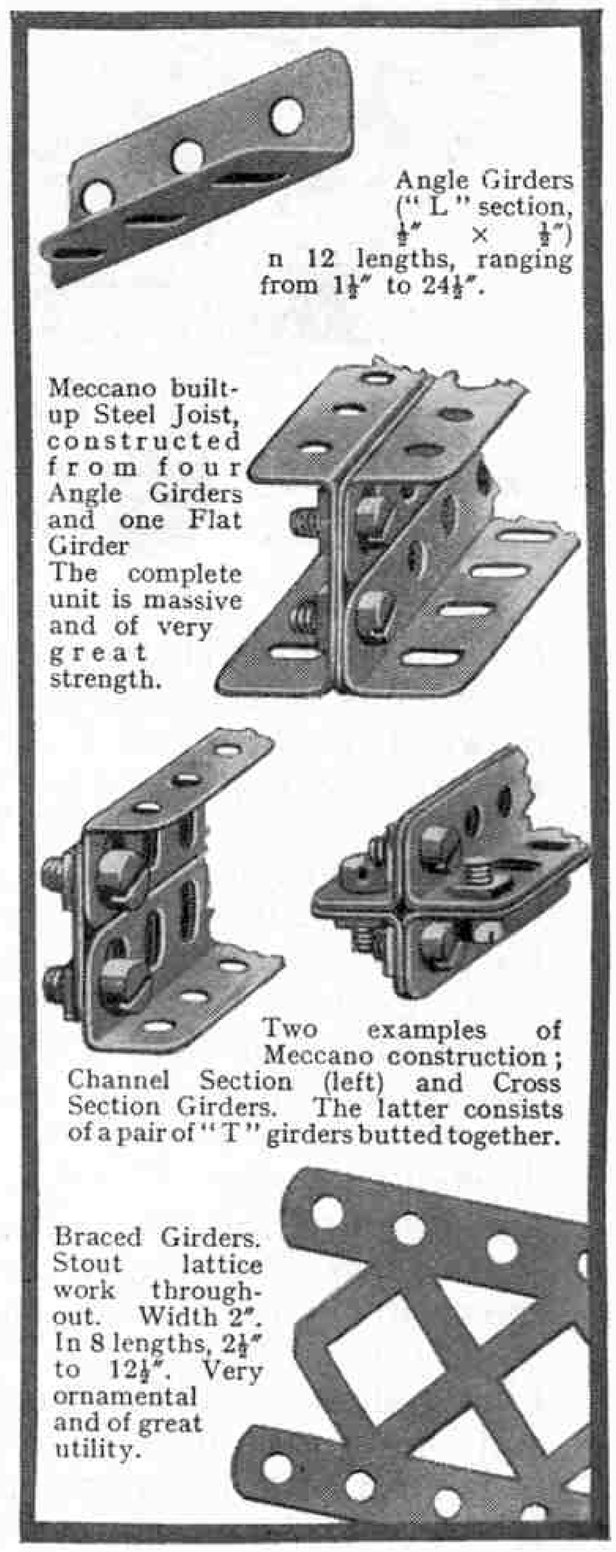
The greatest works of engineering depend for their strength and durability upon the massive girders of steel which, though sometimes hidden by an outer casing of masonry, bind them together and hold them rigid. A single rolled steel girder, if properly constructed, proves as strong as a wall of masonry.

The Forth Bridge, a steel highway 1½ miles in length, suspended high above the Forth; the Eiffel Tower, extending almost to the height of a mountain; the Empire State Building, the tallest skyscraper in New York—these are three of the world's greatest structures that stand like monuments to man's constructive skill. The last named disguises its steel skeleton in a cloak of masonry, but the others tower into the sky like huge Meccano models. It is plain to see how even the smallest strut or tie is carefully planned and placed into position so that it may bear its allotted portion of strain or thrust.

Meccano Girders fulfil the same important duty in Meccano engineering. They are fitted into models and braced by Strips or Rods until the finished structure will support a man's weight, without the slightest disruption. Meccano Girders are made of the finest steel, and are beautifully enamelled in green. The edges and corners are rounded and smoothed off, while the perfect accuracy of their manufacture makes them invaluable in the construction of even the most intricate mechanisms. The following is a complete list of Meccano Girders and also of the different Meccano Strips, which may be used to form built-up girders.

No.			s.	d.	No.			s.	d.
	Perforated Strips.								
1.	12½″	... ½ doz.	1	0	3.	3½″	... ½ doz.	0	4
1a.	9½″	... „	0	9	4.	3″	... „	0	3
1b.	7½″	... „	0	8	5.	2½″	... „	0	3
2.	5½″	... „	0	6	6.	2″	... „	0	3
2a.	4½″	... „	0	5	6a.	1½″	... „	0	3
	Angle Girders.								
7.	24½″	... each	0	8	9a.	4½″	... ½ doz.	0	10
7a.	18½″	... „	0	6	9b.	3½″	... „	0	8
8.	12½″	... ½ doz.	1	9	9c.	3″	... „	0	8
8a.	9½″	... „	1	3	9d.	2½″	... „	0	7
8b.	7½″	... „	1	2	9e.	2″	... „	0	6
9.	5½″	... „	1	0	9f.	1½″	... „	0	6
	Double Angle Strips.								
46.	2½″ × 1″	½ doz.	0	6	48a.	2½″ × ½″	½ doz.	0	5
47.	2½″ × 1½″	„	0	9	48b.	3½″ × ½″	„	0	6
47a.	3″ × 1½″	„	0	10	48c.	4½″ × ½″	„	0	9
48.	1½″ × ½″	„	0	4	48d.	5½″ × ½″	„	0	9
55.	Perforated Strips, slotted, 5½″ ...		each		0	2			
55a.	„ „ „ 2″ ...		„		0	1			
89.	5½″ Curved Strips, 10″ radius ...		„		0	2			

No.			s.	d.
89a.	3″ Curved Strips, cranked, 1¾″ radius, 4 to circle	each	0	2
89b.	4″ „ „ cranked, 4½″ radius, 8 to circle	„	0	2
90.	2½″ „ „ 2⅜″ radius ...	„	0	1
90a.	2½″ „ „ cranked, 1⅜″ radius, 4 to circle	„	0	1
	Braced Girders.			
97.	3½″ long ½ doz.	0	9	
97a.	3″ „ „	0	8	
98.	2½″ „ „	0	8	
99.	12½″ „ „	2	6	
99a.	9½″ long ½ doz.	2	0	
99b.	7½″ „ „	2	0	
100.	5½″ „ „	1	0	
100a.	4½″ „ „	0	10	
	Flat Girders.			
103.	5½″ long ½ doz.	0	10	
103a.	9½″ „ „	1	2	
103b.	12½″ „ „	1	3	
103c.	4½″ „ „	0	9	
103d.	3½″ „ „	0	7	
103e.	3″ long ½ doz.	0	6	
103f.	2½″ „ „	0	5	
103g.	2″ „ „	0	4	
103h.	1½″ „ „	0	4	
103k.	7½″ „ „	1	0	
113.	Girder Frames	each	0	3
143.	Circular Girders, 5½″ diam. ...	„	1	0
145.	„ Strips, 7½″ diam. over all	„	0	9



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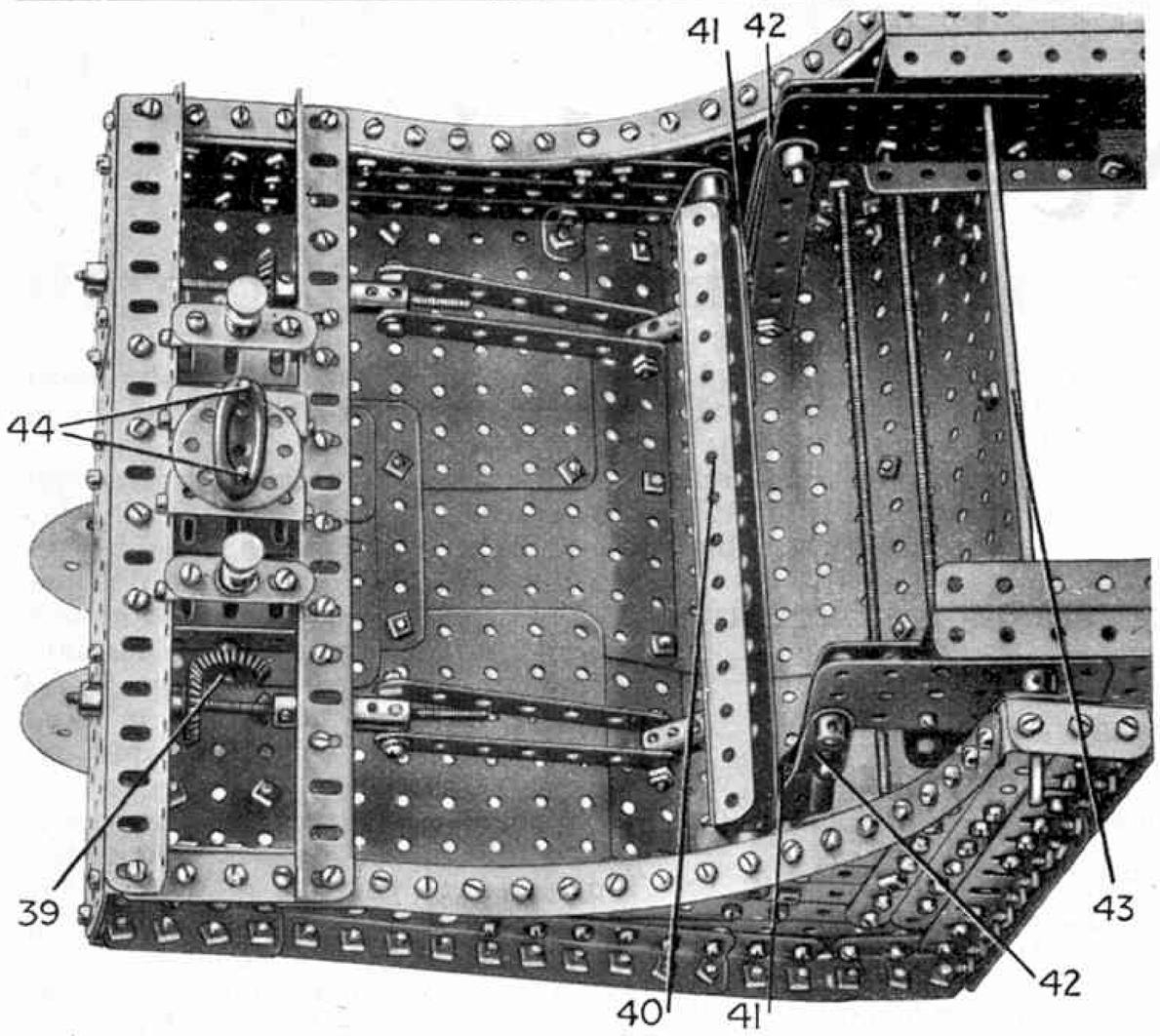


Fig. 4. Close-up view of the mechanism by means of which the height of the rear section of the lorry may be adjusted.

The method of mounting and driving the rear wheels is seen clearly from the illustration, the shock absorbers being the only parts needing description. Each rear axle beam, swivelling about the pivot 32, operates a 1″ Rod 33 that passes through the end hole of the 9½″ Girder of the lorry frame. The inner end of the 1″ Rod carries a Collar and this is in contact with a Single Bent Strip that in turn presses against a 1″ fast Pulley 34. The Single Bent Strip is held in a position in which it is free to slide, by a ½″ × ½″ Angle Bracket and the two ends of the Bent Strip pass one each side of a Handrail Support. The securing nut of the Handrail Support is shown at 35. This Handrail Support also carries a Screwed Rod over which is passed four 1″ Rubber Rings. These are held firmly against the Pulley 34 by means of a second similar Pulley 36, locked on the Threaded Rod by Grub Screws. Thus when the rear wheels of the lorry come into contact with uneven surfaces on the road the 1″ Rod 33 compresses the Rubber Rings and in this way a great percentage of the shock is absorbed. The ½″ Loose Pulleys 37 represent Compression Springs but in the model their only useful purpose is to prevent side-play in the lorry axle beams.

The construction of the radiator and cab of the lorry is carried out with Flat Plates of varying sizes and the pivot for the load-carrying portion of the lorry (a Flanged Ball Race and Bush Wheel) is mounted directly over the driving wheels on a platform of Angle Girders.

The swan neck may now be built. This is the structure that pivots on the rear of the power unit and connects the two parts of the lorry. Its general construction is shown clearly in Figs. 1 and 4 and needs no further description. The raising and lowering of the swan neck in actual practice is carried out hydraulically, but in the model a mechanical movement has been substituted. The movement is operated from the two large wheels mounted on top of the swan neck and the drive from these is transmitted by Sprocket Chain to a ¾″ Sprocket Wheel on the Rod 39. This Rod is fitted at each end with a 1″ Bevel Gear and these mesh with further 1″ Bevel Gears mounted on 5″ Screwed Rods. It will be noticed that the Bevel Gears mounted on the Screwed Rods engage different sides of their respective gears. The 5″ Screwed Rods are journalled as shown in the illustration and carry Threaded Couplings, and each of these carries, pivotally, two 3½″ Strips. The free ends of these Strips are attached by means of ¾″ Bolts to Couplings that are secured by Pivot Bolts to the rolling beam 40. This beam is mounted by means of four Handrail Supports on two 4½″ Rods, the outer ends of which are secured in Cranks bolted to the sides of the swan neck. Threaded Pins are now fitted in the second holes from the ends of the rolling beam, and each of these carries a Coupling 41 that is coupled to the ends of the load-carrying girders by means of 3½″ Strips. In order to relieve the mechanism of some of the strain, two Springs are attached to each side of the swan neck and also to the last-mentioned 3½″ Strips at the points 42.

The swan neck is coupled to the load-carrying Girders, at their front ends, by an 11½″ Rod 43, the space between the swan neck and Girders being filled in by Couplings. The two Threaded Pins 44 fit the holes of a Bush Wheel mounted on the rear of the motive portion of the lorry. The 1″ Rubber Ring passed round these Threaded Pins, and the two Spring Buffers mounted on either side of the pivot form shock absorbers for the swan neck.

The rear wheel unit consists of two sets of four double wheels. Its general form is shown in Fig. 5, two of the Double Wheels having been removed in order to show the construction of the brakes and wheel mountings. The rearmost wheel mounting consists of a square tube built up from four 1½″ Angle Girders and fitted at each end with a Coupling. Each Coupling carries a 1½″ Rod and on this is mounted its respective double wheel. Two ½″ × ½″ Angle Brackets are fitted to each end of the tube and the slotted holes of these carry Bolts that support the brakes. A Flat Girder 45 also is fitted to carry a 1½″ Strip and the brake spring. The tube is carried on a vertical 3½″ Screwed Rod supported in a loosely mounted Coupling 46 and is prevented from moving vertically by a Socket Coupling fitted with a Coupling and a Threaded Boss, both of which are shown clearly in the illustration. A locknut 47 is also provided and this prevents the back-axle mounting from slipping. Each set of rear wheels of the unit is able to rock about the Coupling 46 and on the pivot 48, and steer about the vertical 3½″ Screwed Rod. The steering is controlled from a 3″ Pulley Wheel 49 that through a built-up shaft of Socket Couplings and Couplings rotates a ½″ Double Width Pinion 50. This Pinion meshes with a 1½″ Contrate mounted on a vertical 2½″ Rod journalled in a Coupling. The lower end of the Rod carries a Collar to which is bolted a 1½″ Strip, by its centre hole. Each end of this Strip carries a Hinge that is connected by a 4½″ Strip to a Hinge on the inside end of its respective rear axle. These two Hinges on the rear axles are held in place by Collars. It will be seen that on turning the Wheel 49 both rear sets of wheels turn in similar directions, thus assisting the lorry when manœuvring round a corner.

The fore set of wheels do not steer and only rock about the points 51 and 48, but the construction of their mountings is similar to that of the rear sets except for the addition of Flat Trunnions, as shown in the illustration. The brakes of all wheels are operated by Bowden wire constructed from Spring Cord and Meccano Bare Iron Wire. The control ends of the separate lengths of Bare Iron Wire are secured to a Collar carried on an 8″ Rod that passes down the centre of the steering column, and is controlled from the 2″ Pulley Wheel 52. The complete rear axle unit is connected to the load-carrying Girders by four ⅜″ Bolts 53.

The platform of the trailer is built from Angle Girders and is 29″ long and 13″ wide. Its front end is mounted on a turntable that in turn is carried on two strongly-constructed oscillating beams, each of which carries four double wheels. The rear of the trailer is mounted directly on two oscillating beams of similar construction to those mentioned. The platform itself carries a 4″ Ball Bearing and on this is placed the Girder forming the load of the lorry. This is a scale reproduction of the 99¼-ton girder carried by the 100-ton lorry and its trailer from Marylebone goods station to Cumberland Place, as explained on page 184 of the "*M.M.*" for March. It weighs ¾ cwt. and is constructed from 24½″ Angle Girders and 5½″ × 3½″ Flat Plates built in the form of an "H." Eighteen 12½″ lateral "T" girders are fitted for strengthening purposes, a number of which are shown in Fig. 1. The two turntables on which this huge Girder is carried are built up from Circular Plates and Hub Discs, the Girder itself resting on built-up 12½″ transverse girders which are bolted to the Hub Discs of the turntables.

The trailer turntable carrying the road wheels, and also that supporting the Girder, are fitted on each side with extensions coupled together by means of flexible wire, as shown in Fig. 1. The effect of this is to keep the trailer bogie parallel to the load and thus to enable the unit to be efficiently steered.

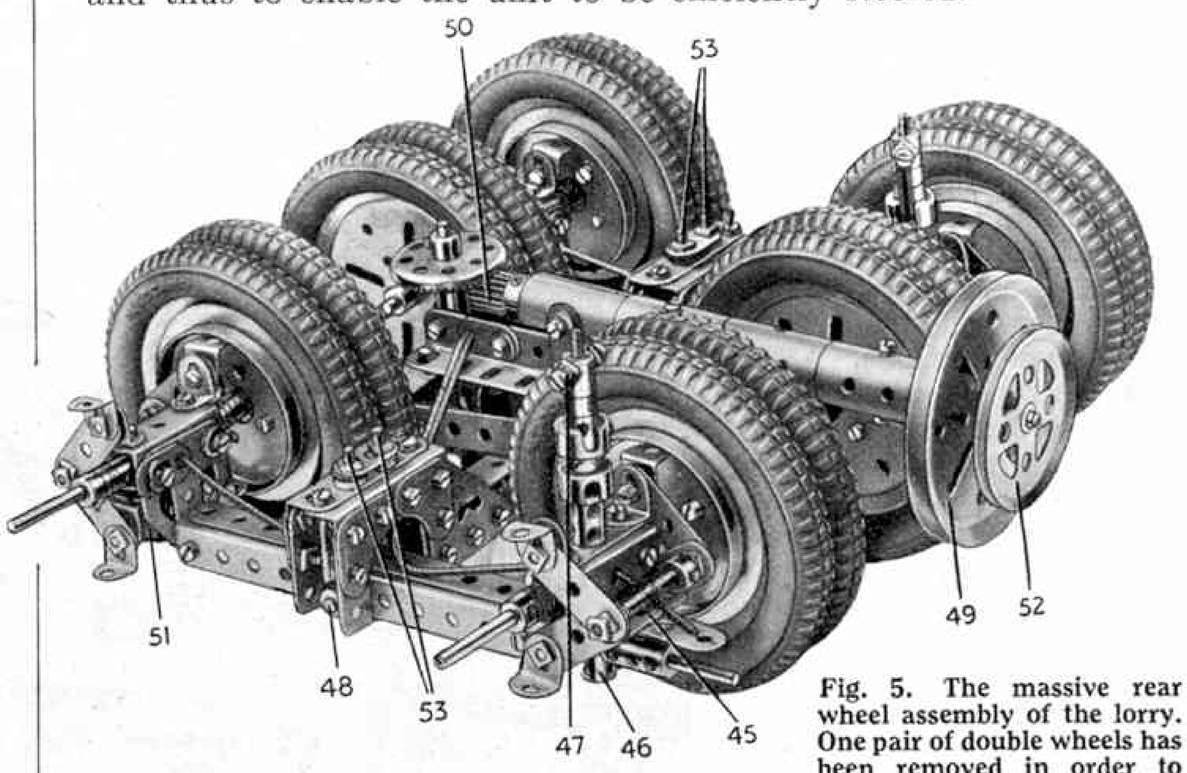


Fig. 5. The massive rear wheel assembly of the lorry. One pair of double wheels has been removed in order to illustrate the construction of the mountings and the brakes.

Prizes for New Models

Here is a splendid opportunity for every owner of a Meccano Outfit to win a valuable prize. All a competitor has to do is to send us a photograph or a drawing of any kind of new Meccano model that has been built entirely by the competitor himself. The Contest is open to boys and girls of all ages living in any part of the world. Entry Forms are not required and there are no fees to pay. Model-builders who do not possess cameras, or who are not good at drawing, need not be deterred from entering the Contest. If they wish they may submit photographs or drawings prepared by their friends, provided that the model is constructed by the competitor himself, without assistance from anyone. All kinds of models are eligible, and if they wish competitors may use the new Meccano Aeroplane Constructor parts in conjunction with the standard Meccano parts.

Each entry must be accompanied by a written description giving full constructional details of the model submitted. Mechanisms such as gear-boxes must be clearly explained so that, if successful, the model can be illustrated and described in the "*M.M.*" for other model-builders to construct.

Prizes Offered in this Contest

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

First Prize : Meccano or Hornby Train goods value £3-3s., and a Certificate.
Second Prize : Meccano or Hornby Train goods value £2-2s., and a Certificate.
Third Prize : Meccano or Hornby Train goods value £1-1s., and a Certificate.
Five Prizes of Meccano goods value 10/6.
Five Prizes of Meccano goods value 5/–.
Ten Meccano Engineer's Pocket Books.

The Prizes to be awarded in Section B are as follows :—

First Prize : Meccano goods value £2-2s., and a Certificate.
Second Prize : Meccano goods value £1-1s., and a Certificate.
Third Prize : Meccano goods value 10/6, and a Certificate.
Five Prizes of Meccano goods value 5/–.
Five Prizes of "Famous Trains" by C. J. Allen.
Ten Meccano Engineer's Pocket Books.

Entries will be divided into three Sections—A, for competitors over 14 living in the British Isles ; B, for competitors under 14 living in the British Isles ; and C, for competitors of all ages living Overseas.

Although the Overseas entries are grouped into a single section, the age of each competitor will be taken into account when judging the models. A list of the prizes to be awarded in each Section appears in the centre of this page.

Those competitors who make a practice of studying the "Contest Results" pages of the "*M.M.*" probably will have noticed that most of the prize-winning models in recent contests are models that can be set to work or that may be put to some practical use.

Many competitors fail to win prizes simply because they do not trouble to find interesting subjects. This is a great mistake, because no matter how big and complicated a model may be, it does not appeal to the judges unless it is new and not merely a variation of models shown in the Instruction Manuals. There are thousands of subjects for model-builders to choose from, and careful selection will be amply rewarded.

To many competitors the prospect of seeing their models, if successful, illustrated in the "*M.M.*," is a far greater attraction than the chance of winning a prize. We would therefore like to remind such competitors that they must send clear photographs, for drawings are useless for reproduction in the "*M.M.*"

Competitors must write their age, name and address clearly on the back of each photograph or sheet of paper sent in, together with the letter A, B or C indicating the Section for which they are eligible. Entries should be addressed: "May" Model-building Contest, Meccano Ltd., Binns Road, Old Swan, Liverpool.

Photographs or drawings of unsuccessful models will be returned to the senders provided that a stamped addressed envelope of the necessary size is enclosed with the entry. Photographs of prize-winning models become the property of Meccano Ltd.

Closing dates. Entries for Sections A and B must be posted to reach Liverpool not later than 30th June, 1932. The closing date for Section C is 31st August, 1932.

A New "Lynx-Eye" Puzzle Contest

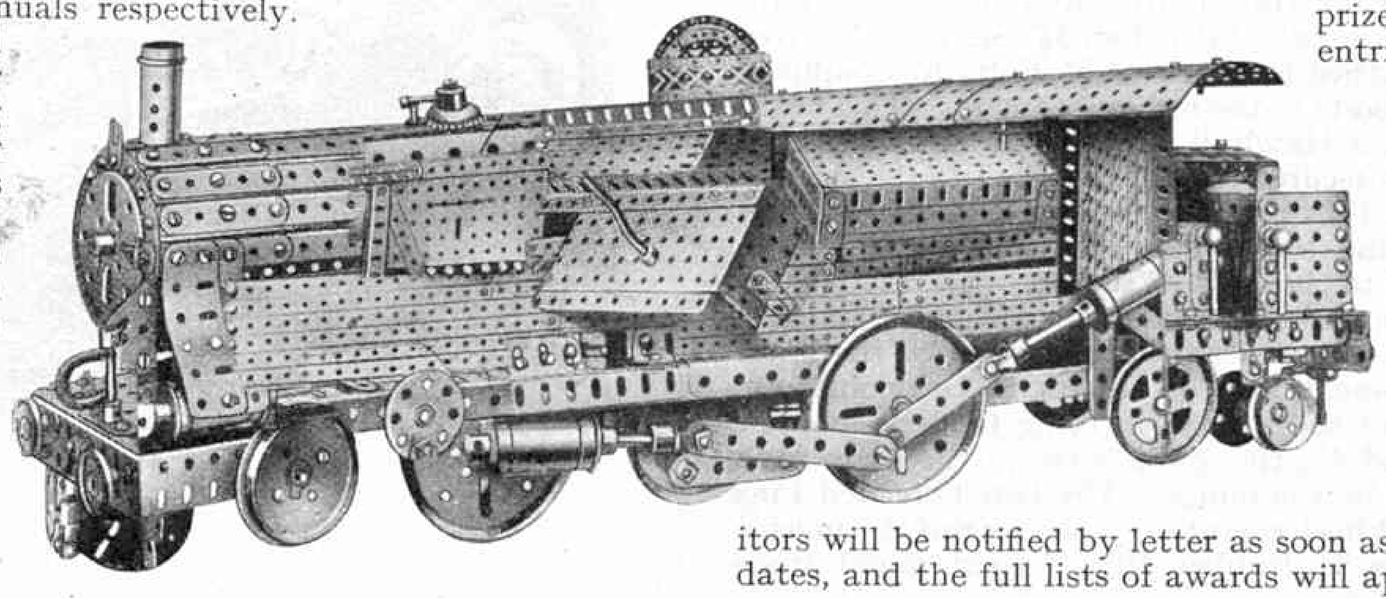
Some time ago we organised a series of "Lynx-Eye" Contests in which competitors were asked to identify fragments of illustrations taken from the Meccano Instruction Manuals. These contests proved very popular, and therefore we are arranging a somewhat similar contest this month.

The illustration of the locomotive shown here is made up from a number of scraps cut from various illustrations of models in the No. 00-4 and No. 5-7 Instruction Manuals. Competitors are invited to study the illustration carefully and then write down on a postcard first the Manual model numbers, and then the names of the models, from which are cut the various pieces that together make up the locomotive.

Although the task of identifying each fragment may at first appear very difficult, a careful inspection of the separate Manuals will soon enable competitors to "spot" from where quite a number of the fragments have been taken. Competitors should note that the Manuals from which the pieces are taken are the latest edition, and can be identified by the figures 31.4 and 31.57 which appear in the bottom left-hand corner of the front covers of the No. 00-4 and No. 5-7 Manuals respectively.

Entries will be divided into two Sections, A, for competitors of all ages living in Great Britain, and B, for competitors of all ages living Overseas.

The following prizes will be awarded in each Section to the competitors who identify the greatest number of fragments correctly. First Prize, Meccano goods value £2-2s. Second Prize, Meccano goods value £1-1s. Third Prize, Meccano goods value 10/6. Ten prizes of Meccano goods value 5/–. Ten prizes of Meccano Engineer's Pocket Books.

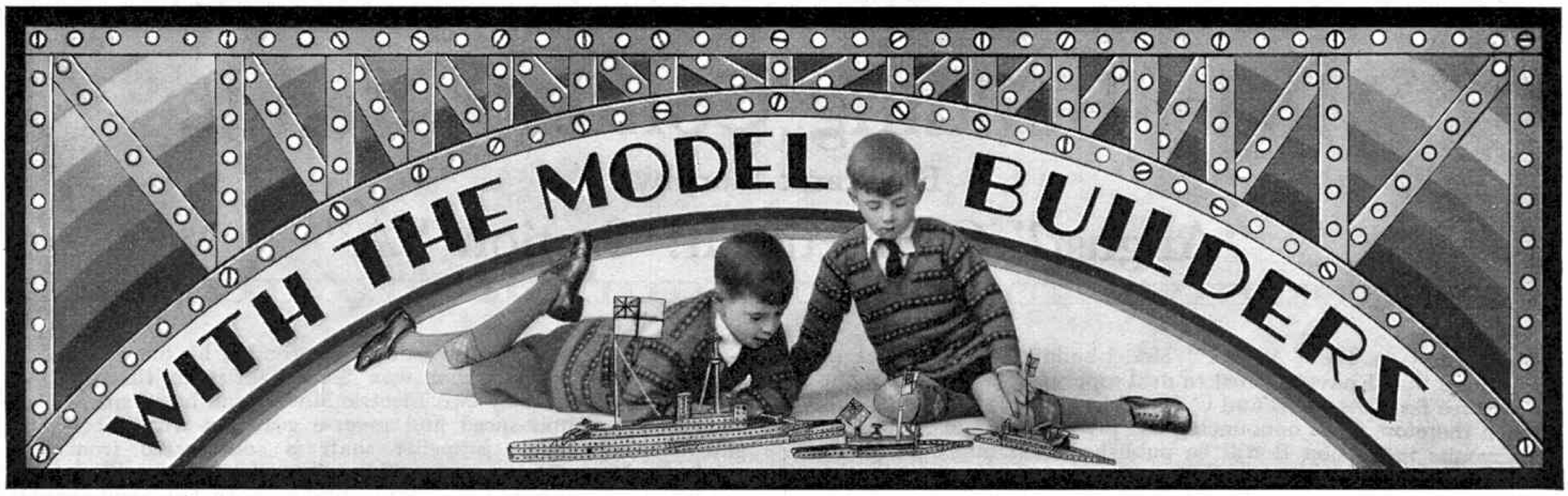


Entries must be submitted on postcards only, and should be addressed: "May" Lynx-Eye Contest, Meccano Ltd., Binns Road, Old Swan, Liverpool. Entries for Section A must reach this office not later than 31st May, 1932, and for Section B not later than 31st August, 1932.

Competitors should note that the Meccano parts shown in the various fragments will in nearly every case provide valuable clues in solving the puzzle. If, for instance, the picture contains part of a Coupling or Gear Wheel, it can only have been taken from one of the larger models ; while if the only parts shown are Pulleys and Strips it may be expected that the fragment has been cut from one of the simple models. It should be mentioned that the fragments are not necessarily printed in the same positions in the illustration on this page as they occupy in the Manuals.

Competitors should not be discouraged because they find that they cannot identify all of the fragments contained in the complete illustration. They may quite easily obtain one of the many prizes offered although their entries are not absolutely correct. If no competitor succeeds in solving the complete illustration the prizes will be given to the readers who send in the best attempts. On the other hand if more than one competitor solves every fragment correctly the prizes will be awarded to the entries first examined.

Prize-winning competitors will be notified by letter as soon as possible after the closing dates, and the full lists of awards will appear in the "*M.M.*"



PRACTICAL USES FOR MECCANO

The Meccano System is designed primarily for the building of models of engineering structures, but the various parts are also of considerable utility to the amateur mechanic, and many practical applications for Meccano in the workshop and in the home have been found from time to time. Although Meccano boys display the greatest enthusiasm and ingenuity in the construction of engineering models, there is a tendency for them to neglect the direct practical application of the parts. This is a pity, because by failing to develop this side of the hobby they miss a great deal of pleasure and interest. Meccano parts have been found of real utility in the construction of advanced laboratory apparatus, and the series of articles entitled "*Scientific Apparatus in Meccano*" has included details of a number of useful scientific appliances. In addition to its application in this direction Meccano may be employed in building an infinite variety of simple practical articles.

To illustrate this point we refer readers to the small tool rack constructed from Meccano parts that is shown in Fig. 1. This rack is built up from straight and Curved Strips and two Trunnions. If desired it may be screwed to the wall above the work bench or table, and it will then form a convenient receptacle for the model-builder's tools. Although the rack is of such simple construction it will be found to serve its purpose excellently, and of course there is no reason why the idea should not be developed and a complete tool rack constructed from Meccano parts. This simple example will help to show the possibilities of Meccano for this kind of construction, and we shall be glad to have particulars and photographs if possible of any similar articles readers may build from time to time.

MOUNTING SOLENOIDS

Solenoids, consisting of the Meccano Bobbin (electrical part No. 301) wound with either the Meccano 23 or 26 S.W.G. Wire, are required frequently in the construction of Meccano electrically-controlled mechanisms. Some readers appear to be uncertain as to the best method of securing the complete solenoid in position in the model, and a few notes on this subject therefore will be useful.

In cases where the Bobbin is wound full of wire, the following procedure may be adopted. A strip of stiff brown paper is first of all wrapped several times round the outside turns of wire on the solenoid, and then glued in place. The solenoid is then clamped in position between two 1½" Strips or 1½" Angle Girders, 1" Screwed Rods, fitted with Nuts, being used to hold the Strips or Girders in position.

In some mechanisms it is not required to wind the bobbin fully; in an Overload Release for an Electric Motor, for instance, only a few turns of wire are required. In these cases the outside turns of wire should be protected with stiff brown paper as just described, and the solenoid is then mounted in a Single Bent Strip, a Bolt being passed through the top hole in the Strip so that the sides may be drawn together, thus clamping the Bobbin rigidly in position. An important point to bear in mind is that the turns of wire of the solenoid must be adequately protected. If the brown paper insulation were not used there would be a risk of the Strips cutting through the insulation of the wire and making contact. This would not cause much trouble if the outside end of the winding is earthed, but where the outside end of the wire is connected to the battery, a complete short circuit would result. Electrician's insulating tape may be used in place of the brown paper covering, although this does not provide quite as neat an appearance.

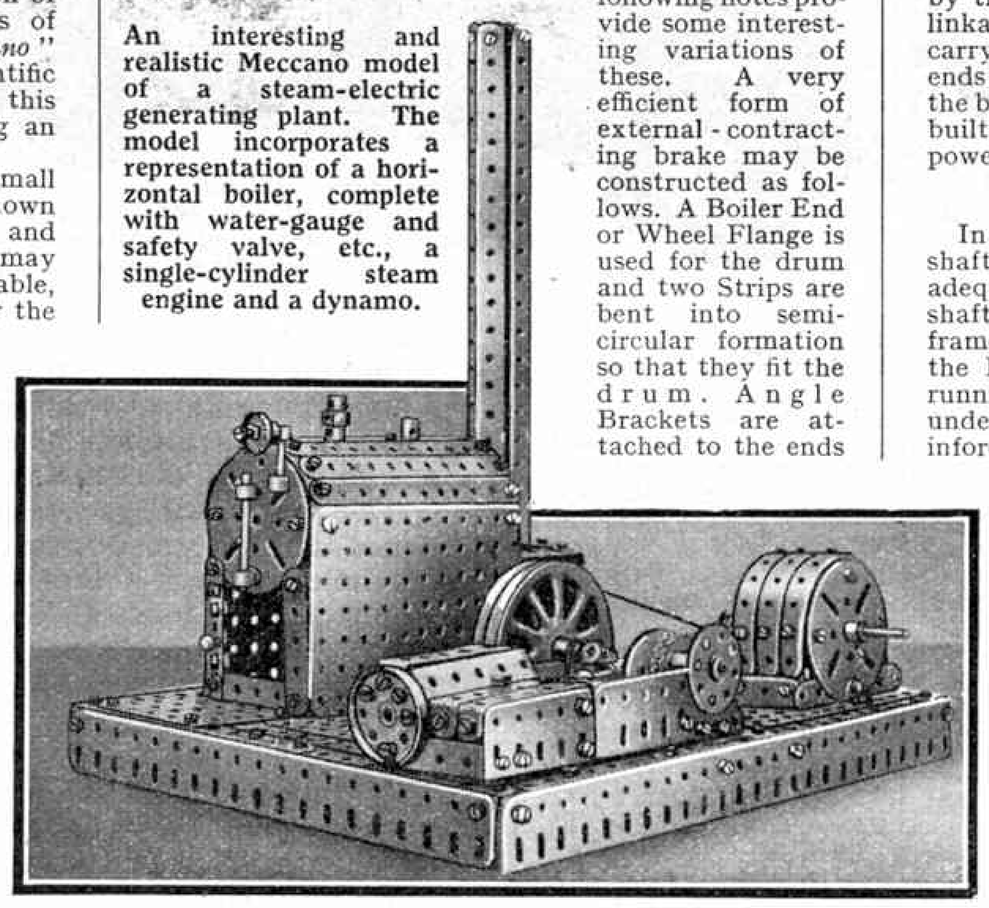
When the solenoid is fitted with a Pole Piece, part No. 308, thus producing an electro-magnet, the method of attachment is made simpler. The Pole Piece is threaded with standard Meccano threads at each end and a Bobbin may thus be clamped rigidly to the Pole Piece by means of two Nuts. A 1"×1" Angle Bracket is slipped on to one end of the Pole Piece and held in position by means of a Nut; and the Angle Bracket is then bolted into position in the model.

BRAKE CONSTRUCTION

In modern fast-moving vehicles and machinery the design and assembly of the brakes are very important factors, and the braking gear is just as necessary in models and mechanisms built with Meccano. Generally speaking there are two distinct types of brakes in use in engineering, the external-contracting pattern, and the internal-expanding type. Of these the former is the more popular for use in stationary machines and heavy mechanisms, while the internal-expanding type is used extensively in motor vehicles of all types.

Several standard types of brakes are shown in Section 6 of the Standard Mechanisms Manual, and the following notes provide some interesting variations of these. A very efficient form of external-contracting brake may be constructed as follows. A Boiler End or Wheel Flange is used for the drum and two Strips are bent into semi-circular formation so that they fit the drum. Angle Brackets are attached to the ends of the Strips, one pair being pivoted together by means of a Bolt and Lock-nuts. The other ends of the Strips are attached to a small bell crank and lever fitted with a spring, so that when the Lever is operated the bent Strips are brought into close contact with the surface of the drum, and the required braking action is obtained.

An interesting and realistic Meccano model of a steam-electric generating plant. The model incorporates a representation of a horizontal boiler, complete with water-gauge and safety valve, etc., a single-cylinder steam engine and a dynamo.



A modification of the well-known cord and pulley brake operated by a screw and hand wheel, consists in using a length of Sprocket Chain and a Wheel Flange or Boiler End in place of the Cord and Pulley. The Sprocket Chain is arranged round the outside surface of the drum, one end being attached to the screw operating mechanism. The other end is anchored to a fixed point on the model. When the Chain is tightened around the drum by means of the screw and hand wheel, a particularly powerful braking action is obtained.

A useful rim brake for the driving wheels of model locomotives may be constructed by mounting one or more Corner Brackets (part No. 133a) on the end of a Strip suitably pivoted to the frame of the engine. The curved edge of the Corner Bracket fits closely round the rim of a Wheel Flange, and if Wheel Flanges are used (in conjunction with the 3" Face Plates) to form the driving wheels of the model, an efficient braking action will be obtained.

Dealing with brakes of the internal-expanding pattern, a useful version of this type of brake may be constructed by employing pivoted Strips fitted with Collars that act as brake-shoes. The Strips are controlled by a lever, and when the latter is operated the Collars are pressed against the inside surface of a Wheel Flange or Boiler End. This type of brake is fitted to the Meccano Motor Chassis (Super Model No. 1). A neat and efficient brake that follows closely the design of the well-known Bendix internal-expanding brake may be constructed as follows. A Meccano Boiler End is used as the drum of the brake and two Strips are bent so as to fit inside this drum. The ends of the Strips are turned over and Angle Brackets secured to the bent-over portions. A pair of Angle Brackets are pivoted together by means of a Bolt, and this Bolt is also passed through a hole in a Face Plate secured rigidly to the frame of the model. A Collar fitted with two 7/32" Grub Screws (part No. 69b) is placed in between the bent-over ends of the Strips. The Collar is mounted on a Rod fitted with a Crank so that it may be rotated by the usual brake lever connected to it by suitable linkage. When the brake lever is operated the Rod carrying the Collar is rotated, and this causes the ends of the Grub Screws to force the free ends of the bent Strips outward against the drum. If carefully built, a brake of this type will be found remarkably powerful, while its compactness is a very useful feature.

REINFORCED BEARING

In Meccano engineering, as in actual practice, when a shaft is rotated at high speed it is necessary to provide adequate bearing surface for it. If fast revolving shafts are merely journalled in the Plates or Strips of the framework of the model, there will be a tendency for the Rods to wear the holes unevenly, and irregular running will result. The bearings of all shafts that are under considerable strain should therefore be "reinforced." The simplest method of reinforcing a bearing in a Strip or Plate is to bolt a 1½" Strip in position so that a double bearing thickness is obtained. A still better plan is to use a Meccano Double Arm Crank or Bush Wheel. These parts form really satisfactory bearings, as their bosses form adequate support for the Rods. Another advantage of using a Double Arm Crank or a Bush Wheel is that the set screw holes may be used as oil holes for lubricating the shafting. Alternatively Meccano Grease Cups may be screwed into the set screw holes of the bosses. A reinforced bearing consisting of a Bush Wheel fitted with a Grease Cup will provide a smooth bearing surface having a very low friction factor.

LARGE LOOSE PULLEY.—We were interested in your suggestion that a 3" diameter loose pulley without boss and set screw should be added to the existing range. A pulley of this type would be useful in the simpler models and your idea will be given careful consideration. (*Reply to A. Parks, Battle.*)

A NOVEL MULTIPLE GEAR.—A special gear resembling three Contrate Wheels of different diameters mounted together would certainly form a novel addition to the Meccano system. The special gear would be used in conjunction with a narrow width pinion, the pinion being moved across the face of the gear so as to engage with the various sets of teeth. In this way an extremely compact change speed gear-box would be formed. While the idea has possibilities, there are several drawbacks to its being employed in a practical manner in gear-box construction. (*Reply to S. Pratt, Stanmore.*)

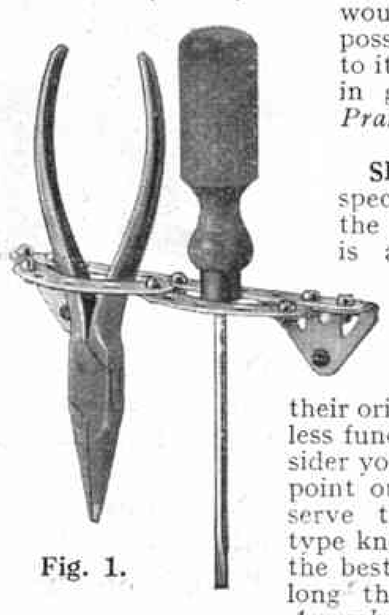


Fig. 1.

SPECIAL PLIERS.—A pair of pliers specially designed for opening and closing the links of the Meccano Sprocket Chain is an interesting idea. Your proposed pliers would have specially-shaped points for prising open the links of the Chain so that it may be separated, and for closing the links when joining the Chain without damaging their original shapes. These pliers would doubtless function very efficiently, and we shall consider your proposal. In the meantime we would point out that a pair of fine-nosed pliers will serve this purpose very well indeed; the type known as "telephone" pliers are perhaps the best for this job, as they have particularly long thin points. (*Reply to R. C. Rodway, Amersham.*)

Model-Building Contests Results

By Frank Hornby

"August" Competition: Section "A"

THE entry in the "August" Model-building Contest was so large that I have decided to deal separately with each of the three Sections (A, B and C) into which it was divided. This month therefore I am announcing the prize-winners in Section A. The results in Section B will be published next month, and the Overseas Section will then be dealt with.

Examples of the many fine models received in Section A are illustrated on this and the opposite page, and the full list of prize-winners is as follows:—

Section A (for Home competitors over 14 years of age).

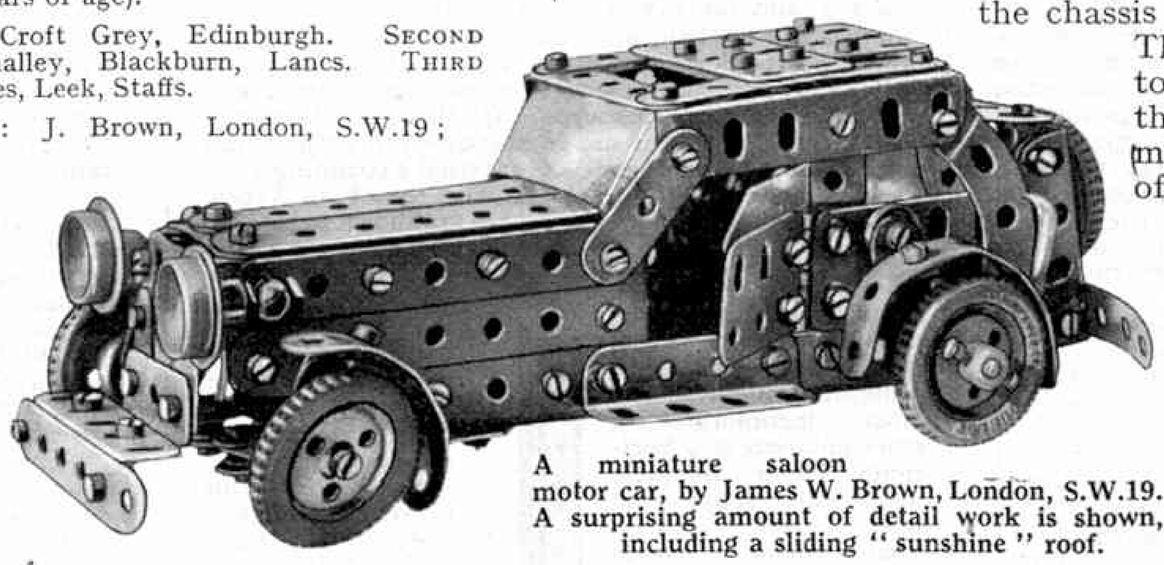
FIRST PRIZE, Cheque for £3-3s.: S. Croft Grey, Edinburgh. SECOND PRIZE, Cheque for £2-2s.: Eric Whalley, Blackburn, Lancs. THIRD PRIZE, Cheque for £1-1s.: Kenneth Brookes, Leek, Staffs.

SIX PRIZES of solid leather Pocket Wallets: J. Brown, London, S.W.19; D. Young, West Croydon, Surrey; L. Richardson, London, N.7; M. Powley, Sunderland; R. Morison, Cambridge; A. McKerrell and I. Morton (joint entry), Midlothian, Scotland.

TWELVE PRIZES of Meccano or Hornby Train goods value 5/-: A. Farr, Costessey, Nr. Norwich; L. Frayn, Plymouth; J. Matthews, Fillongley, Nr. Coventry; L. Balchin, Dunstable, Beds.; H. Wrathall, Blundellsands, Liverpool; M. Waterkeyn, Spinkhill, Nr. Sheffield; J. Morrison, Newlands, Glasgow, S.3; W. Malcolm, Edinburgh; R. Lawford, Bexley Heath, Kent; C. Percivall, Basingstoke, Hants.; L. Willis, London, S.E.9; R. Lamont, Greenock.

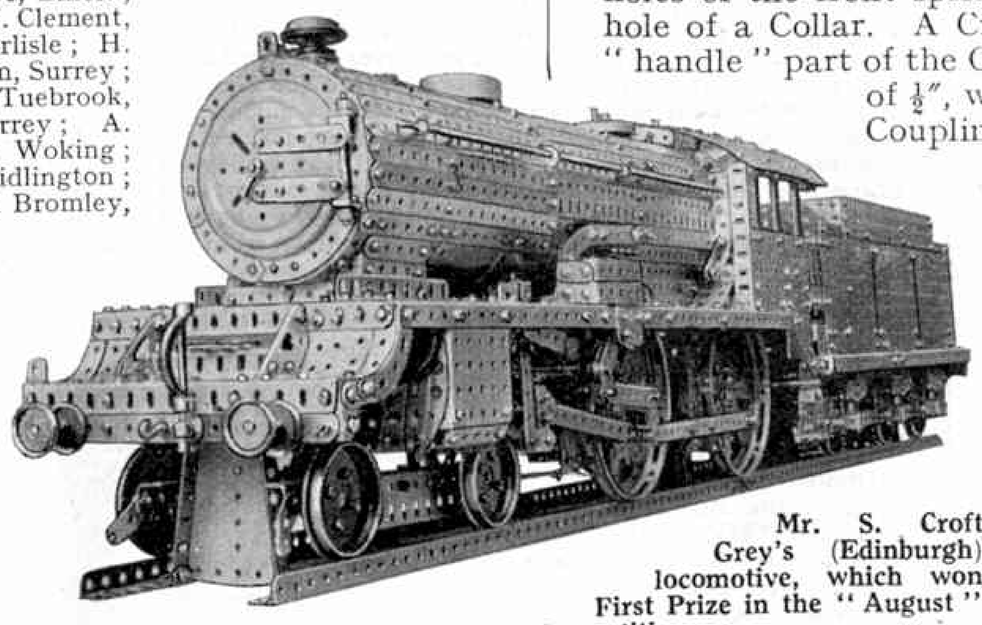
PRIZES of Meccano Engineer's Pocket Books: E. Deakin, Leicester; E. Hines, Addiscombe, Surrey; F. Drane, London, S.W.18; A. Armstrong, Fernhurst, Sussex; J. Kernkert, Esher, Surrey; S. Herbert, London, S.E.15; H. Kendrick, Walsall; M. Barraclough, Bournemouth; K. Heath, Wellington College, Berks.; P. Woodman, Streatham Rise, Exeter; J. Whittle, Wigan; J. McDonald, Yeovil, Somerset; H. Hill, Sheffield; S. Pearson, Haltwhistle, Northumberland; G. Moore, London, E.3; J. Holmes, Wishaw; J. Williams, Two Dales, Nr. Matlock, Derbys.; J. Powell, St. Ives, Hunts.; J. Winder, Darwen; D. Conington, Huntingdon, Hunts.; N. Bird, Hull; H. Brown, G. Waldron and R. Waldron (joint entry), Combe Down, Bath; R. Marshall, Cardiff; P. Rankin, Banbury, Oxon; T. Lloyd, Midhurst, Sussex; T. Kennett, London, W.; J. Cunningham, Burnbank, Lanarkshire; R. Harkness, Braintree, Essex; L. Jones, Cardiff; T. Baker, Taunton, Somerset; K. Batchelor, Dorking, Surrey; R. Lawler, Glossop; W. Raybould, Bloxwich, Staffs.; W. Lansbury, Banbury, Oxon; R. Nightingale, Langley, Nr. Birmingham; M. Young, Purley, Surrey; B. Simpson, London, S.W.5; N. Southgate, Stow Market, Suffolk; S. Davidge, London, N.16.

CERTIFICATE OF MERIT: R. Mason, Newcastle, Staffs.; C. Marston, Halifax; G. Smith, Acomb, York; A. Baldwin, Sunderland; S. Coleman, London, W.10; W. Huxley, Market Drayton, Shrops.; D. Goligher, Chesham Bois, Bucks.; K. Coppin, Swindon; T. Ryan, Cahirciveen, Co. Kerry, Ireland; F. Roberts, Plympton, Devon; F. Clark, Canterbury; D. Longman, Leeds; C. Rollings, Hounslow, Middx.; H. Bourne, Scunthorpe, Lincs.; R. McKeand, Portpatrick, Wigtonshire; W. Clement, Willington, Co. Durham; E. Hodgson, Carlisle; H. Lewis, Pontypool, Mon.; L. Libaert, Cheam, Surrey; C. Hitchcock, Burnham-on-Sea; J. Orwin, Tuebrook, Liverpool; S. Downes, Farncombe, Surrey; A. Williams, Cardiff; V. Kaile, Mayford, Nr. Woking; C. Dell, Orpington, Kent; A. Reveley, Bridlington; E. Luck, Ashton-under-Lyne; D. Morgan, Bromley, Kent; R. Boyd, London, S.E.3.



A miniature saloon motor car, by James W. Brown, London, S.W.19. A surprising amount of detail work is shown, including a sliding "sunshine" roof.

First Prize was awarded for the fine L.N.E.R. 4-4-0 "Shire" class locomotive shown here. This model is one of the best I have seen recently, and incorporates a complete working replica of Walschaerts valve gear, with Gresley combining motion for the inside cylinder, the engine being of the three-cylinder type. The valve gear is operated by screw mechanism from the cab.



Mr. S. Croft Grey's (Edinburgh) locomotive, which won First Prize in the "August" Competition.

Special details include a balanced crank, dummy brakes and spring gear for the driving wheels, and a mechanical lubricator worked from a rocking shaft that is operated by the inside cross-head as in the original.

The model is driven by an Electric Motor hidden in the tender and controlled by a Resistance Controller. The photograph reproduced shows a number of other details that have been well worked out in standard Meccano parts.

Eric Whalley has every reason to be proud of his fine model of a Leyland motor chassis that won Second Prize in this Contest. The model is driven by two Electric Motors and has a single plate clutch and a three-speed and reverse gear-box with "ball and gate" change. The propeller shaft is constructed from two Angle Girders. There are two "live" rear axles, and the wheels are fitted with internal expanding brakes, with two semi-circular shoes in each brake drum.

The side members of the chassis are built-up channel girders made rigid by cross members, the length of the chassis being 3′ 2″ and the width 5½″. The side members are bent so as to keep the chassis level over the rear bogie. The drive transmission to the clutch is at a ratio of 6:1, and the clutch is constructed similarly to that used in the Meccano Super Model Motor Chassis (Instruction Leaflet No. 1).

The gear-box provides three speeds forward and one reverse, the various gears being selected by a central gear-changing lever of the "ball and gate" pattern. The "gate" is made in the form of a letter H, and enables the gears to be located accurately. The "H" was made from two 2″ slotted Strips (part No. 55a) placed side by side, and a small piece cut out to form the connecting slot. The gear-box is attractively arranged between two Face Plates as shown in the accompanying illustration.

The differential mechanism is arranged inside a special crown wheel that is formed from a 5½″ Rack Strip bent into a circle, with one hole overlap. Three ⅞″ Bevels are mounted on Threaded Pins, which project towards the centre and are placed at an angle of 120 degrees to each other. Two other Bevel Gears are put against these, one being fastened to each half of the axle. At the rear end of the propeller shaft is a ½″ Pinion that meshes with the teeth of the crown wheel. This arrangement is repeated for both axles.

The propeller shaft between the two rear axles is constructed from the new Flexible Coupling Units, which take the twists and tensions of the rear bogie when driving over rough ground.

To form the steering gear, a Bolt is passed through the centre holes of the front spring leaves and is tightened into the tapped hole of a Collar. A Crank Handle is secured in this Collar, the "handle" part of the Crank Handle being cut off to leave a length of ½″, which is then inserted in the centre hole of a Coupling. A Bush Wheel has two Collars bolted to its face side through their tapped holes, and a Coupling rides between them, being held in position by ⅝″ Bolts passed through the Collars into the Coupling. The track rod and link are held loosely to a bracket projecting from the face of the Bush Wheel. Both ends of the axle are made alike, and it is supported at its centre in a Coupling. A small Flanged Wheel is used to represent the device for quick changing of wheels and is held on the outer end of the stub axles.

The petrol tank is constructed from two Boilers placed horizontally end to end on the left-hand side of the chassis, and a pipe (Axle Rod) leads from the tank to the autovac, which is on the right-hand side of the engine and is made from a Sleeve Piece capped at each end with small Flanged Wheels.

A few years ago there was quite an epidemic of Meccano models of motor-cycles, but in recent contests such models have been scarce. It is therefore quite a change to find the Third Prize in the "August" Competition won by Kenneth Brookes with the model

of a Francis-Barnett 2 h.p. motor cycle illustrated here. The scale adopted is 1/6th, which is sufficiently large to allow a fair amount of detail work to be incorporated.

The front fork is supported by a 1½″ Strip and a Flat Bracket on a 2″ Rod that is free to slide in the head of the tank, the amount of movement being limited to ¼″ by means of four Washers. A Collar and a Compression Spring on the same 2″ Rod form a neat shock absorber.

The sides of the tank are spaced apart by Double Brackets, through which pass 1″ Screwed Rods; nuts on the ends of the Rods hold the sides rigidly together. The frame is similarly spaced apart at the bottom bracket by means of four nuts on a 2″ Screwed Rod.

The exhaust pipes are the only parts of the machine not Meccano, and are made from thick canvas-covered aerial wire. The cylinder consists of three 1″ loose Pulleys, two ½″ Pulleys, and a Collar held on a 2″ Screwed Rod. The lower end of this Rod is threaded into another Collar loosely held in the middle of the driving shaft, so that the cylinder is held quite firmly and the driving shaft is free to revolve without strain.

When the model is pushed along the ground the driving shaft with its flywheel and driving pulleys (1″ and ½″ fixed Pulleys respectively) revolves, being driven by a cord from a secondary shaft. A dummy gear lever is fitted on the tank, but the gear-box and kick-starter were omitted on account of the nature of the transmission and the size of the model. The model is fitted with front and rear lamps, number plates, Meccano Dunlop Tyres, carrier, spring saddle and rear stand.

L. Richardson's entry deserves mention on account of its originality. It is a complete midget golf course, in which all the obstacles and the mallets are constructed from Meccano parts. I hope to illustrate this entry in a special article in a future issue of the "*M.M.*"

"A Cochrane Boiler" is the title of Duncan Young's model. This entry also is unique, and so well built that I hope to be able to illustrate it in a future "*M.M.*"

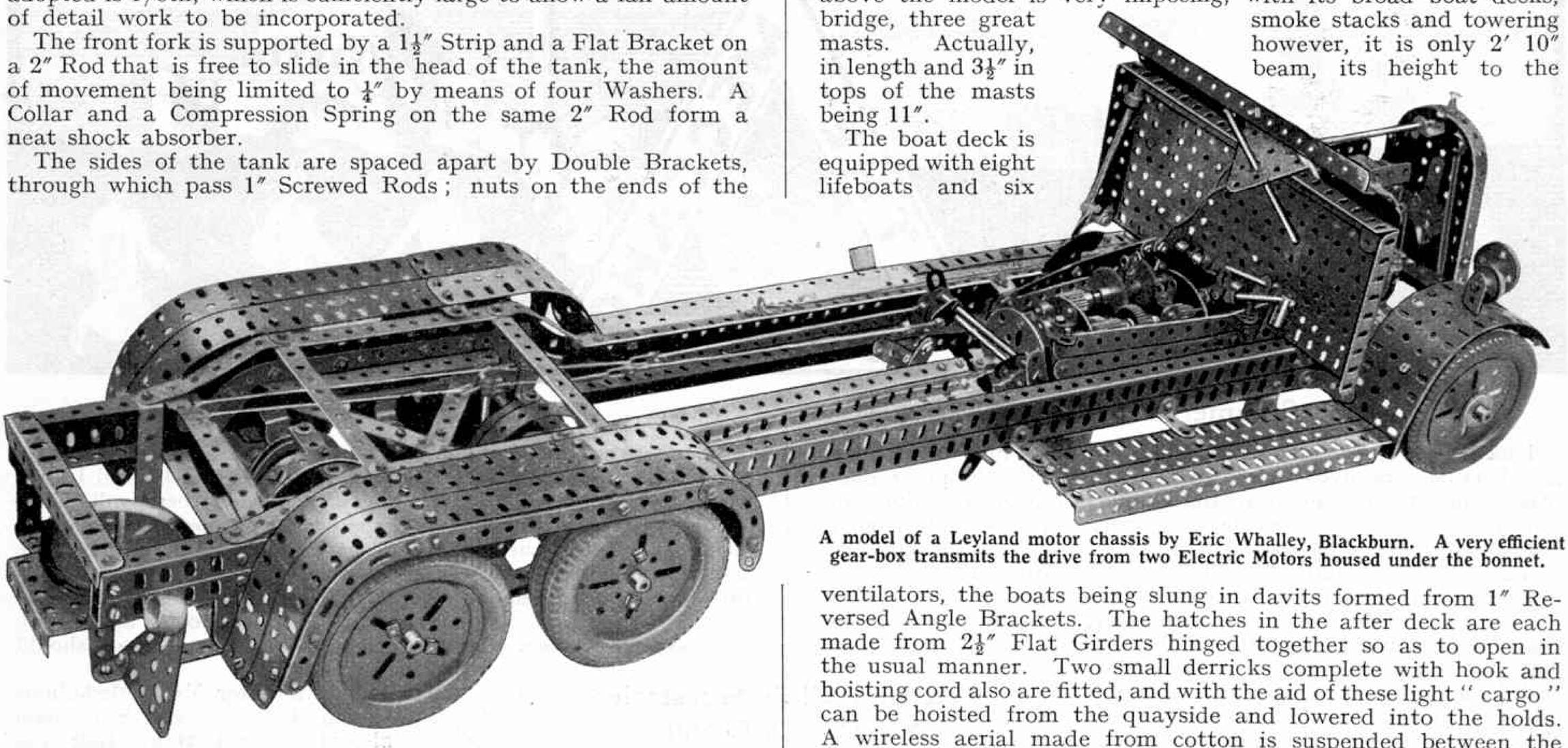
James W. Brown is responsible for the small but remarkably realistic model of a saloon motor car illustrated here. The picture speaks for itself, and no words of mine are needed to emphasize the claims of the model to a prize in this Contest.

M. Powley sent a model motorcycle that is excellently constructed, and I. S. Morton and A. McKerrell jointly won a prize with a model of an articulated heavy motor chassis.

A model of a petrol-driven mobile log saw, of the type used in the lumber forests for cutting logs in convenient lengths for transportation to the saw mills, won a prize for R. Morison. Saws of this kind are used principally in Canada and can be moved from place to place by one man. Morison's model is driven by a Meccano Electric Motor mounted underneath a dummy cylinder and connected by Sprocket Chain with a main shaft, which in turn drives a crank that moves the saw backward and forward between guide rods. The guide rods are pivoted to enable the saw to work at any required angle.

This Contest produced a particularly good model of the R.M.S. "*Berengaria*," the famous Cunard Atlantic liner. Viewed from above the model is very imposing, with its broad boat decks, bridge, three great smoke stacks and towering masts. However, it is only 2′ 10″ in length and 3½″ in beam, its height to the tops of the masts being 11″.

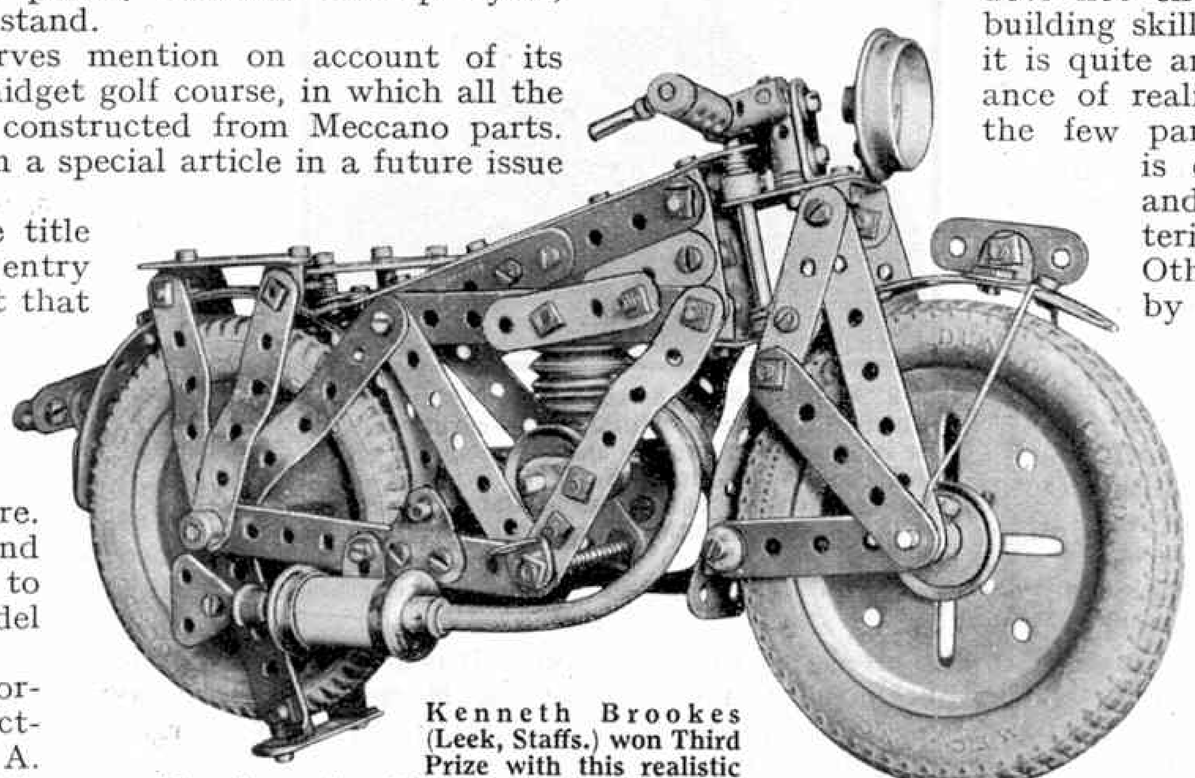
The boat deck is equipped with eight lifeboats and six ventilators, the boats being slung in davits formed from 1″ Reversed Angle Brackets. The hatches in the after deck are each made from 2½″ Flat Girders hinged together so as to open in the usual manner. Two small derricks complete with hook and hoisting cord also are fitted, and with the aid of these light "cargo" can be hoisted from the quayside and lowered into the holds. A wireless aerial made from cotton is suspended between the masts. The model is the work of H. L. Wrathall, Blundellsands, Liverpool.



A model of a Leyland motor chassis by Eric Whalley, Blackburn. A very efficient gear-box transmits the drive from two Electric Motors housed under the bonnet.

Another interesting ship model that attracted my attention is an ocean tramp steamer. This entry was sent by Michael Waterkeyn, Sheffield, and has a squat funnel, which gives it the appearance of a motor vessel. Very little internal detail work has been done in the model, for Waterkeyn's object was to reproduce as accurately as possible the general outline of a ship of this type. His motto of "one thing well done" has brought him success in this Competition, for the silhouette of the model is identical with the lines of an actual tramp.

With the development of centralization in the generation of electrical power, common sights of the countryside to-day are the huge high-power overhead cable-carriers. It was one of these that gave Robert Lawford, Bexley Heath, the idea for his successful model in this Contest. Although a subject of this kind does not entail any great degree of model-building skill for its reproduction in Meccano, it is quite an easy matter to lose all appearance of realism unless good use is made of the few parts employed. Lawford's model is original, well-built and realistic, and these are the essential characteristics of a prize-winning model. Other model-builders would profit by paying a little more attention to these items.



Kenneth Brookes (Leek, Staffs.) won Third Prize with this realistic model motor cycle. The minute detail work is notable, and especially the saddle and pillion seat arrangements.

Some time ago a competition was held among the schoolboys of Greenock, in which competitors were asked to write essays on the best methods of perpetuating the memory of James Watt, Greenock's greatest son. The competition was won by our reader Russell L. Lamont, who is a prize-winner in the "Autumn" Contest. Lamont suggested that a "James Watt" Bed should be endowed in the local infirmary, and eventually a fund was inaugurated for that purpose.

Not satisfied with winning the essay competition, Lamont set to work to raise some of the money for carrying out his idea. He built a Meccano model of the "Rocket" locomotive that could be set in motion by inserting a coin in a slot provided. The model was displayed at various places in Greenock and realised the useful sum of £3-6s.-6d.! This model Lamont entered in the "August" Competition, in which it was awarded a prize. It is a splendid piece of work, the engine itself being 15″ in length.

The automatic coin-in-the-slot mechanism is decidedly ingenious and I regret that considerations of space prevent me describing it fully here.

Better Summer Programmes

I have been delighted to read in reports from many clubs that members have resolved to improve this year upon the programme of last summer, a determination that should lead to good results. The outdoor season may be made as healthy and profitable from a club point of view as the two winter sessions, for the interests and capacities of members usually are sufficiently varied to enable a good programme to be arranged, and games such as cricket are splendid for developing the team spirit that is so prominent a feature of a Meccano club. Cycling also is valuable in this respect, and I am firmly convinced that the best qualities of boys are brought out when they are enjoying an open-air holiday under canvas.

Club Savings Banks

One of the little difficulties that have to be overcome during the summer session is that of raising funds for the excursions included in the programme. The problem may be solved by starting a club savings bank, into which members pay small sums at regular intervals. It is surprising how quickly these small amounts add up to a respectable total, and even if the full amount required cannot be saved, any difference remaining when the time comes for a particular visit usually may be made up with very little effort. This scheme has been adopted in many clubs and I strongly recommend it to all those who have not yet given it a trial.

In many clubs the expenses of summer excursions are met from the profits of Exhibitions and Concerts. For instance, the Leader of one club uses the money raised in this manner to pay for a club excursion occupying an entire day. This plan works admirably in clubs where current expenses may be met from subscriptions, and a proportion of the proceeds of Exhibitions may be used in this manner even in organisations in which these funds are not wholly available for special purposes.

Before leaving the subject of club savings banks I should like to refer to another use that may be made of them, particularly if they are active throughout the year instead of the weeks of preparation for summer excursions. This is the purchase of new Meccano parts by members who wish to enlarge their outfits. When this plan is followed, the amounts set aside each week by members usually are so small that they are scarcely missed, but they accumulate quickly and enable very satisfactory increases in stocks of parts to be made. Practically all members are pleased to take part in a scheme of this kind, and a well-conducted club savings bank cannot be other than successful.

Savings banks funds may be employed very usefully in many other directions, of course, and Leaders should encourage members to save for definite purposes that will bring them permanent advantages. If a bank is established in a club, it is advisable to appoint a special official to carry on the work, and the Leader himself should act as treasurer. The accounts should be published separately from those of the club, and space for this purpose is provided on the simple form of balance sheet referred to elsewhere on this page.

Meccano Club Secretaries
No. 22. D. E. Mills

D. E. Mills has been secretary of the Clacton High School M.C. since its affiliation in February, 1931. He is a capable secretary and the members of the club support him energetically in carrying out a varied programme of Model-building, Lectures and outdoor activities.

Club Balance Sheets

There are still a few clubs from which I have not received copies of balance sheets for the year ending 31st March, 1932, and I hope that Leaders who have not already forwarded these will do so at an early opportunity. I prepared simple printed forms in order to simplify the task of preparing Meccano club balance sheets, and supplies of these were forwarded to all Leaders. Any further copies desired may be obtained on application to Headquarters, and Leaders who for any reason have not received forms also should write for supplies.

Recommendations for Merit Medallions for last session should be sent in as soon as possible. I do not think that the value of these coveted awards is realised in all clubs. There is no restriction in regard to the character of the good work that qualifies members to receive them, and as I wish to recognise deserving efforts on behalf of the Guild and their clubs of all keen Meccano boys, I should like Leaders to give careful consideration to the scheme. I publish an annual list of those to whom Merit Medallions are awarded, and I hope that the one to be produced at the end of the present year will be the largest that has ever appeared.

Correspondents Wanted

Members of the Guild enrolling in the Correspondence Club show an increasing tendency to ask for pen friends interested in Stamp Collecting. At present a number of members at home and overseas who pursue this attractive hobby require correspondents, and I should like to hear from others who wish to exchange with them views on stamp topics and other matters of common interest.

* * * *

A joint Exhibition organised by the Harlesden Wesleyan and Wembley Meccano Clubs will be held on Saturday, 7th May, in the Lecture Hall of the Harlesden Wesleyan Church, Tavistock Road. Proceedings will begin at 2.30 p.m., the Exhibition will be open until 9.0 p.m. The charge for admission will be 6d., children 3d. It is hoped that members of other Meccano clubs and Branches of the Hornby Railway Company will be present, and they will be admitted free of charge if they are wearing their badges.

Proposed Clubs

Attempts are being made to establish Meccano Clubs in the following places, and boys interested in becoming members should communicate with the promoters whose names and addresses are given below :—

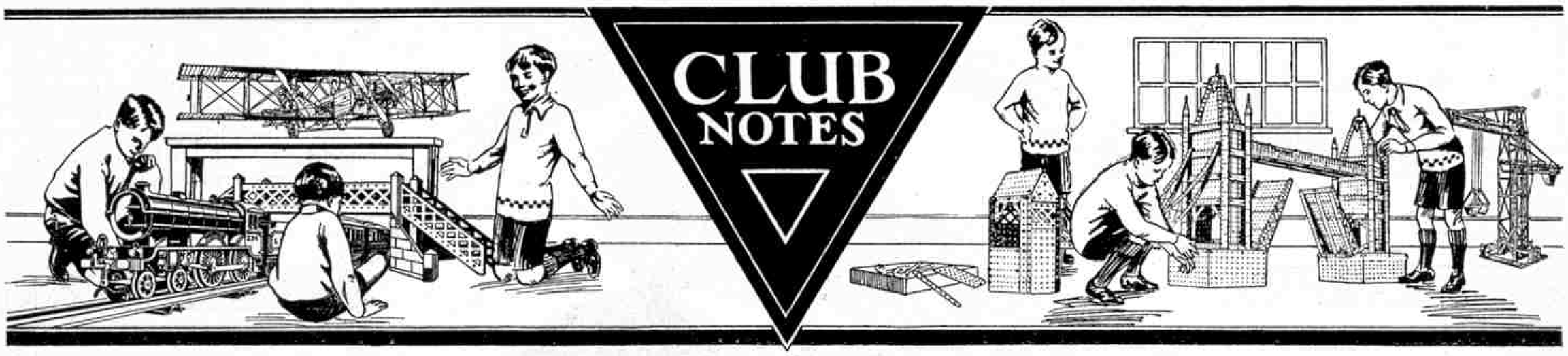
CANADA—Fred S. Thomson, 695, Grosvenor Avenue, Westmount, Quebec.

CANADA—Fred B. Gamble, Boys' Work Secretary, Y.M.C.A., Regina, Saskatchewan.

LONDON—Mr. M. C. Hackett, The Manor School, Squires Lane, Finchley, N.

NORTHAMPTON—S. Cocking, 4, King Edward Road.

RICHMOND—Kenneth H. Sides, 102, Queens Road, Richmond.



Orwell M.C.—The most interesting of recent meetings was the club Concert. Mr. D. H. Sands, President of the club, presided, and with the kind assistance of many friends a splendid programme was presented. On Model-building Evenings excellent Cranes and Bridges were constructed in special contests, while Mr. J. Finlayson, Leader of the club, gave an attractive lecture on Belts, Chains, Spur Gearing and other driving devices. Club roll: 38. *Secretary:* Miss E. D. Hepburn, Rutherburn, Milnathort.

Braintree High School M.C.—The Fourth Annual Exhibition was very successful. Mr. Bullock, of Courtaulds Ltd., announced the results of the Model-building Contest, and Mrs. Bullock kindly presented the prizes. The exhibits included a Fire Engine that put out a real fire by means of a realistic jet of water, a Penny-in-the-Slot Stereoscopic Projector, and a Hornby Train Layout that was incorporated in a large dock scene. Club roll: 24. *Secretary:* P. Allen, St. Edmunds, Bocking, Braintree.

Weymouth Central School M.C.—Members recently visited a dredger engaged in excavation work in preparation for the building of new landing stages at Weymouth. After scaling the tower of the dredger in order to watch the buckets as they brought up material from the bottom of the sea, members were shown round boiler and engine rooms and then boarded the tug that towed the hoppers in which the mud was taken out to sea to be dumped. The sea trip was very enjoyable and some of the members were privileged to steer the vessel for a few moments. *Secretary:* S. Cann, 20, Southlands Road, Weymouth.

Harpenden M.C.—At one meeting a model Motor Car and an Electric Train were awarded 26 marks out of 30 in a special Model-building Contest, other models receiving high marks including an Electric Train and a Swing Bridge, to which 24 marks and 22 marks respectively were awarded. Each member present at another meeting built a model Aeroplane, high marks again being earned by the best models on view, although the judging was very strict. Games concluded most meetings and the construction of a Hornby Train layout and lectures by members have added variety and interest to the programme. Club roll: 20. *Secretary:* F. V. Grant, Station Road, Harpenden.

Barton-on-Humber M.C.—Members have adopted as their motto "*Ever Striving*" and their programme shows that they try to live up to it. Many original models have been built, including model Workshops for entry in a special competition, and Hornby Railway Evenings are held regularly. Mr. H. Stonebridge, Leader of the club, has given interesting talks on railway matters, including one on "*Edinburgh and the Lowlands*," his personal knowledge of the ground covered adding to the interest of his subject, which also was illustrated by means of lantern slides. Other interesting features have been the acquisition of a "Cutting Book" in which extracts relating to engineering and railway developments are to be pasted, and a "Contractor's Book," in which drawings are made of original models that are likely to be useful in club work. Club roll: 12. *Secretary:* Mr. H. Wood, 37, Castle Dykes West, Barton-on-Humber.

Great Baddow M.C.—An excellent series of models built by members included a Tower Wagon, Swivelling Crane, Snow Plough, Automatic Rail Press and a representation of the Autogiro. The club's first Blindfold Contest proved a great attraction. The simple subject set was an Easy Chair and one member built it in 15 minutes, making only one mistake. At the Ninth Birthday Party of the club a cake with nine candles on it kindly given by Mrs. Beale was cut by Mr. Beale, President of the club. Games and competitions followed tea, and medals and prizes won by members during the session were presented by Mrs. Scott. Club roll: 36. *Secretary:* Miss D. K. French, Jeffrey's House, Gt. addow.

St. Columba's (Sunderland) M.C.—The introduction of simple games such as Ring Board and Bagatelle has proved popular, and competitions are held frequently. A Model-building Contest to run through the session also has been arranged. Simplicity Contests, Originality Competitions and other similar events are arranged weekly, and are keenly contested, many new ideas for model-building construction being submitted in them. Club roll: 20. *Secretary:* D. Ferguson, 3, Edward Burdis Street, Southwick, Sunderland.

Entwelve (London) M.C.—Has now been affiliated. So far Model-building has been the chief activity, a few indoor games providing variety, but now other hobbies are to be introduced. Arrangements have been made for additional games and Model-building contests, and other competitions also are to be held. Club roll: 15. *Secretary:* A. F. Bailey, "Lenabo," Friern Park, N. Finchley, N.12.

Froebel House (Plymouth) M.C.—Steady progress in Model-building is reported, especially among the Junior members, interesting models built including a Single Span Arch Bridge and a Motor Cycle and Side Car. Club roll: 18. *Secretary:* T. H. Dudley, 9, Home Park Road, Saltash, Cornwall.

St. Peter's (Wolverhampton) M.C.—Contractors' Evenings and a Model-building Competition have been held, entries in the Contest being judged on a special Musical Evening open to visitors. A furious debate was held on a proposal that cyclists should be taxed, and the proposition was negative by a narrow majority after the cyclists and their opponents had hurled home-truths at each other! A talk by Father Urwin, former Leader of the club, on "*Photography—a Hobby and a Career*" was greatly enjoyed, the lecturer's demonstrations of photographic work adding to the interest. Club roll: 30. *Secretary:* R. Frank Mann, 25, Queen Street, Wolverhampton.

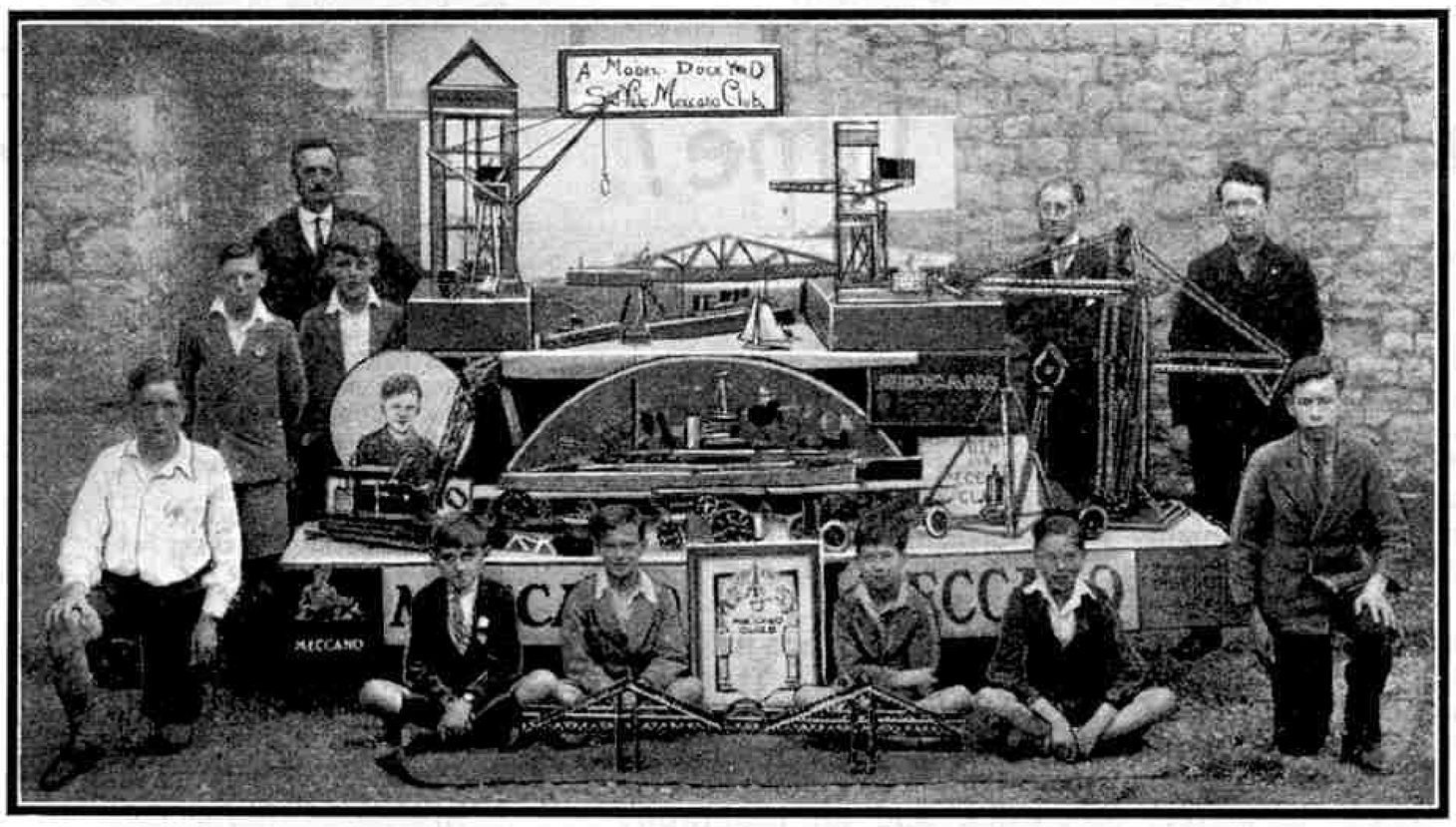
Stamford Hill M.C.—Model-building Contests between the "Nuts" and "Bolts" are special features of the programme. Competition between the sections is very keen, and in one Contest a Floating Crane built by the "Nuts" secured only one more mark than the "Bolts" Hammerhead Crane. Other models constructed have included a Windmill and a Ship Coaler that was set to work in a model harbour; and a demonstration was given of the Twin-Cylinder Horizontal Steam Engine on loan from Headquarters. Club roll: 11. *Secretary:* D. Weitzman, 63, Amhurst Park, Stamford Hill, N.16.

Gorse Hill Baptist M.C.—Good progress has been made since 1st January, when members made New Year resolutions to attend more regularly. Model-building is actively pursued. Submarines have been popular subjects recently and a remarkable fleet of these vessels has been built. Club roll: 18. *Secretary:* C.P. Culley, 5, Ipswich Street, Swindon.

Hornsea M.C.—The Second Anniversary of the club was celebrated by a Tea and Concert. The programme given by members of the club was kindly arranged by Mr. Henley, who also contributed a story. Other interesting meetings have included Lantern Lectures on "*The Navy*" and "*Diesel Oil Engines*," and talks on Wireless and Weather Forecasts. In addition, successful Hornby Train Evenings have been arranged, and the usual Model-building activities have been continued. Club roll: 84. *Secretary:* P. Thom, 5, Alexandra Road, Hornsea.

Laindon M.C.—Special attention has been given recently to the club's Hornby Train layout. The amount of rolling stock has been increased and very extensive timetable operations are now carried out, chiefly in connection with goods traffic, trains carrying realistic loads being made up and despatched. Preparations are being made for the outdoor season, and members are determined to improve on the programme of last summer. Club roll: 15. *Secretary:* J. P. Tourle, "St. Ives," Leicester Road, Laindon.

Holy Trinity M.C.—The experiment of allowing members themselves to run the meetings has been continued, sections for different hobbies having been formed under the leadership of senior members, while storekeepers have been appointed to take charge of material and tools. Special meetings are devoted to Model-building, and at these a series of discussions on standard mechanisms, gear ratios and similar topics have taken place. Cinema programmes and microscope demonstrations have been features of other meetings and visits have been paid to the L.U. Tram Depot at Fulwell, the L.C.C Tram Depot at Charleton, and the factory of Messrs. A. G. Spalding & Bros. Ltd. at Putney. A well-stocked tool chest has been purchased for the use of members. Club roll: 39. *Secretary:* J. A. Hines, 331, Liverpool Road, Islington, N.1.



A group of members of the Sid Vale (Sidmouth) M.C. with models built for the club's recent successful Exhibition, at which an extensive dockyard scene was the chief feature. The club was affiliated in November, 1930, and has been very active under the leadership of Rev. J. W. Dickson, whose portrait was published on page 218 of the "M.M." for March of this year.

NEW ZEALAND

Dunedin Hobbies M.C.—A lantern lecture on "*A Tour Round the World*" has attracted great interest. Lectures are very popular with members, and recent events of this kind have included talks on scientific subjects, with experiments, while a specially interesting series of lectures on aviation has been arranged. An excellent programme of Model-building and visits to local factories also has been carried out. There is room for more members, and those who wish to join should communicate with the secretary. Club roll: 24. *Secretary:* R. W. Millis, 33, Clifford Street, Dalmore.

Sumner (Christchurch) M.C.—Model-building Contests and special competitions on railway matters are keenly contested, members earning most marks during each session being awarded prizes. At other meetings talks on interesting subjects are given, visitors often being present. One of these talks by Mr. Handisides, Manager of a local firm of locksmiths, dealt with the working of metals. Club roll: 22. *Secretary:* I. C. Booth, 41, Head Street, Sumner, Christchurch.

SOUTH AFRICA

Turffontein M.C.—A splendidly varied programme of Model-building, Debates, and other activities has been followed. Two senior members have given talks on "*Stamp Collecting*" and "*Model Aeroplanes*" respectively, and Mr. R. Robert, who has been acting as Leader in the absence of Mr. J. O. Lucas, has shown how interesting such hobbies as Model Railway work, Fretwork and Cardboard Modelling may be made. A "Find It Out" Competition, also arranged by Mr. Robert, tested members' ingenuity, the mysterious objects to be identified being very skilfully chosen. Interesting excursions also have been made and various social events have included an Exhibition. Club roll: 41. *Secretary:* J. J. Pienaar, Box 1011, Johannesburg.

Guarantee

Hornby Trains are tested and their efficiency is guaranteed. A form of guarantee is furnished with each loco.

Hornby Trains are richly enamelled, highly finished in four different colours, and lettered to represent L.M.S., L.N.E.R., S.R. and G.W. locos and rolling stock.

"Royal Scot"

Always on Time!

"That's her signal . . . and here she comes—dead on time as usual!"

It's just the same with Hornby Trains.

Whether on passenger service, goods traffic, or carrying out shunting operations, Hornby Locos may be depended upon to give the utmost satisfaction. They are British-made throughout, fully guaranteed, and beautifully enamelled in correct railway colours—L.M.S., L.N.E.R., G.W. or S.R. You can't help being thrilled when you see a Hornby Loco dashing along the track, smoothly over the points, steadily round the curves, full speed ahead on the straight.

Your miniature railway is exact in every detail when it is constructed with Hornby Rolling Stock and Accessories. There are Passenger Coaches, Pullman Cars, Trucks, Wagons and Vans of the same types as you see on the big railways. Amongst the Accessories there are Stations, Tunnels, Bridges, Signals and Level Crossings, all made in perfect proportion and all beautifully finished in colours.

HORNBY TRAIN PRICES

CLOCKWORK

M0 Goods Set	5/-
M0 Passenger Set	5/9
M1 Passenger Set	9/3
M1 Goods Set	10/-
M2 Passenger Set	10/9
M3 Tank Goods Set	15/-
No. 0 Passenger Set	17/6
No. 0 Goods Set	18/6
No. 1 Goods Set	25/-
No. 1 Tank Goods Set	25/-
No. 1 Passenger Set	28/6
No. 1 Special Goods Set	32/6
No. 1 Special Passenger Set	35/-
No. 2 Mixed Goods Set	40/-
Metropolitan Train Set C	45/-
No. 3C Train Set, Riviera "Blue"	62/6
No. 2 Special Pullman Set	67/6
No. 3C Train Sets	67/6

ELECTRIC (6-volt)

No. 3E Train Set, Riviera "Blue"	80/-
No. 3E Train Sets	85/-
Metropolitan Train Set L.V.	85/-

HORNBY TRAINS

BRITISH AND GUARANTEED

Manufactured by

Meccano Ltd., Old Swan, Liverpool

This is No. 3C L.M.S. "Royal Scot" Pullman Train, one of the famous trains in the Hornby System. It is seen passing under a Hornby Signal Gantry.

Branch Notes

MARLBOROUGH (SOUTHPORT).—The station at "Rossendale" has now been put into perfect order, and electric light fixed in "Deepstone" locomotive shed. Interesting additions to the Branch rolling stock include an aluminium saloon fitted with Hornby bogies and Mansell Wheels. This was made by the General Manager and is intended for use on heavy grades. A House and Station Buildings for use at "Hawksley" have been constructed in wood by one of the members. Monthly competitions for comparison of speed and hauling powers of express locomotives have been started, and outdoor work has included attractive visits to the 6 in. gauge track of Mr. N. H. Greenwood, Birkdale, and the Preston Locomotive Sheds. Secretary: G. R. Bartram, "Milestones," Blundell Drive, Birkdale.

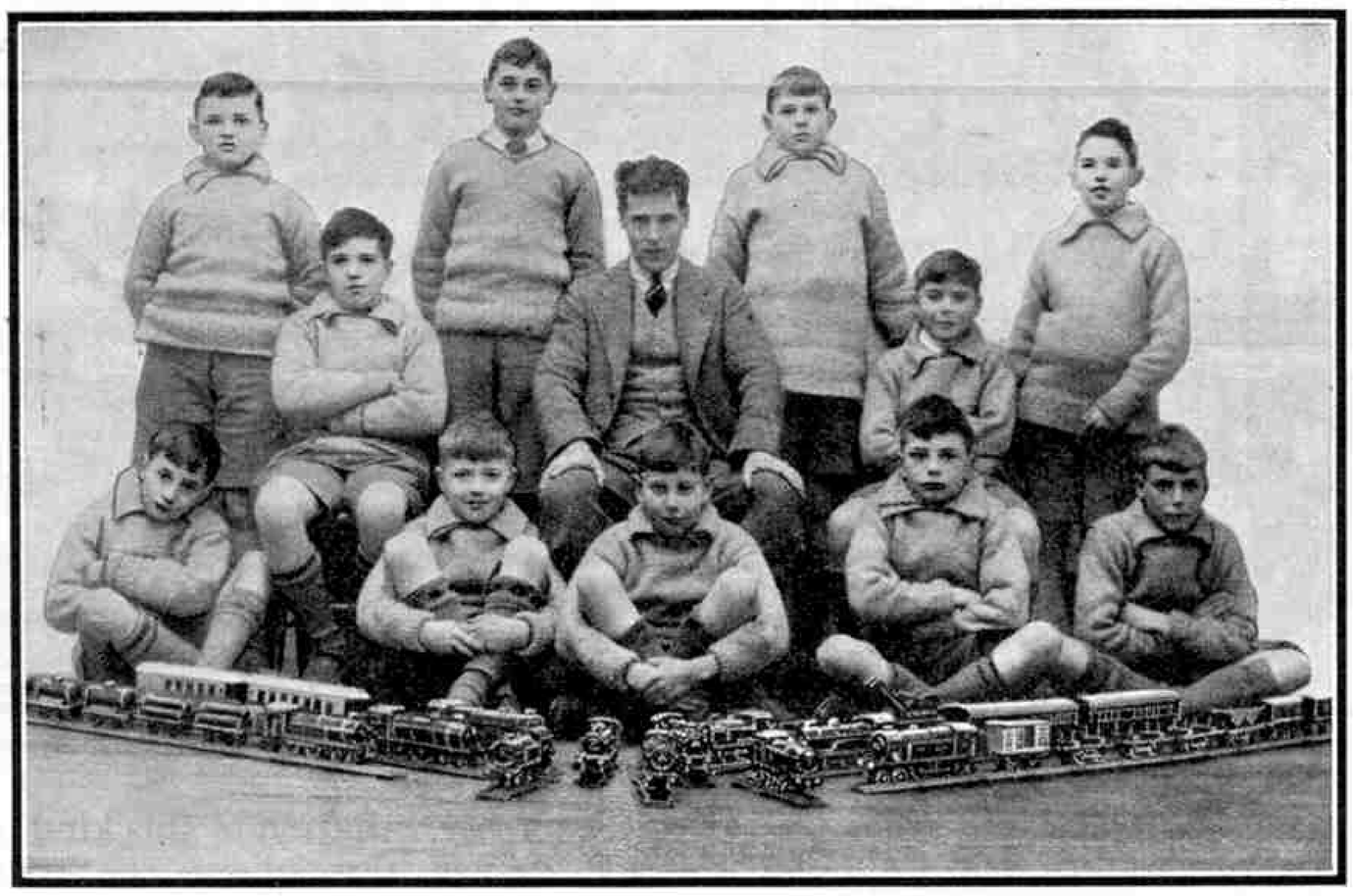
EXHALL.—Senior members have been engaged in relaying the Branch track after the Exhibition, sections on which junior members can carry out track work being laid down first. A 24-Lever Frame is to be used for controlling the main station. Secretary: M. Melville, Exhall Vicarage, Nr. Coventry.

NOTTINGHAM HIGH SCHOOL.—The Branch has acquired a large Meccano Outfit, kindly presented by one of the Masters. Track work is varied in character, for steam locomotives are now available in addition to those operated by clockwork and electric motors. A special series of interesting lantern lectures have been held, and arrangements for future meetings include a talk on "*How Aeroplanes Fly*" and a visit to the L.M.S.R. works at Derby. Secretary: F. R. N. Nabarro, 4, Grosvenor Avenue, Mapperley Park, Nottingham.

COMELY BANK.—The track has been laid down, defective rails being repaired and new ones added where necessary, and is now in splendid order. Timetables also have been worked out and track operations are in full swing. The next step is to lay the rails on trestle tables, and this will be done when funds permit. Monthly lantern lectures are to be arranged. Secretary: H. W. Govan, 35, Comely Bank, Edinburgh.

WOODFORD.—The satisfactory increase in membership may make it possible to form an associated Branch at Ilford, where many of the members live. Colour light signals have been placed in important positions on the Branch track and the complete system is to be fitted up in this manner. Members are divided into "North" and "South" sections, and these are taking part in a competition in the maintenance and working of the stations, named "Northborough" and "Southtown" respectively, in their charge. An interesting feature of track work is that at each meeting a special period is set aside for examination and oiling of rolling stock. Secretary: J. H. Skelt, "Walberswick," Woodside Road, Woodford, Wells, Essex.

WEST NORWOOD.—Very satisfactory performances have been recorded on the Branch layout, and in a locomotive reliability contest, engines were tested for speed and pulling power, a Hornby No. 1 Special Tank giving the best results. Outdoor work has included visits to the L.N.E.R. locomotive depot at Stratford, and the S.R. hump shunting yard at Feltham. At Stratford special interest was taken in the feed water heating apparatus fitted to the 4-6-0 locomotives, No. 8542 and 8518, and at Feltham members inspected the engine shed and were given a footplate trip. Secretary: W. H. Bugg, 80, Wolfington Road, West Norwood, London, S.E.27.



A group of members of the Westbury House Branch, No. 171. Chairman, Mr. E. H. Godber-Ford; Secretary, P. Chamberlin. The Branch has been incorporated less than a year, and the members have worked energetically to build up an extensive electric layout that includes many realistic accessories, and on which interesting operations of a varied character are carried out.

AUSTRALIA

ANNANDALE (BRIGHTON).—Meetings have been devoted chiefly to train operations on tracks laid down out of doors, special attention being paid to providing realistic surroundings. Certain members have visited the Newport Workshops of the Victoria Railways, and this is to be followed by a Branch visit, when members hope to obtain information that may be applied in their own operations. The monthly subscription has been raised in order to enable the Branch stock of railway materials to be increased. Secretary: W. G. A. Jack, 33, Normanby Street, Brighton, S.5, Victoria.

NEW ZEALAND

MINTON.—Special attention has been given to the construction and wiring of electric signals on the Branch track, and the provision of electric light. An interesting addition to the accessories is a bungalow built by two of the members. Experiments have led to the discovery of a means of automatically slipping coaches from the Branch electric train, and this is proving very successful in track working. Excursions have been made to the Addington Train Yards, and to the works of the Canterbury Frozen Meat Company. Secretary: J. R. Fisher, 107, Normans Road, Papanui, Christchurch.

Branches in Course of Formation

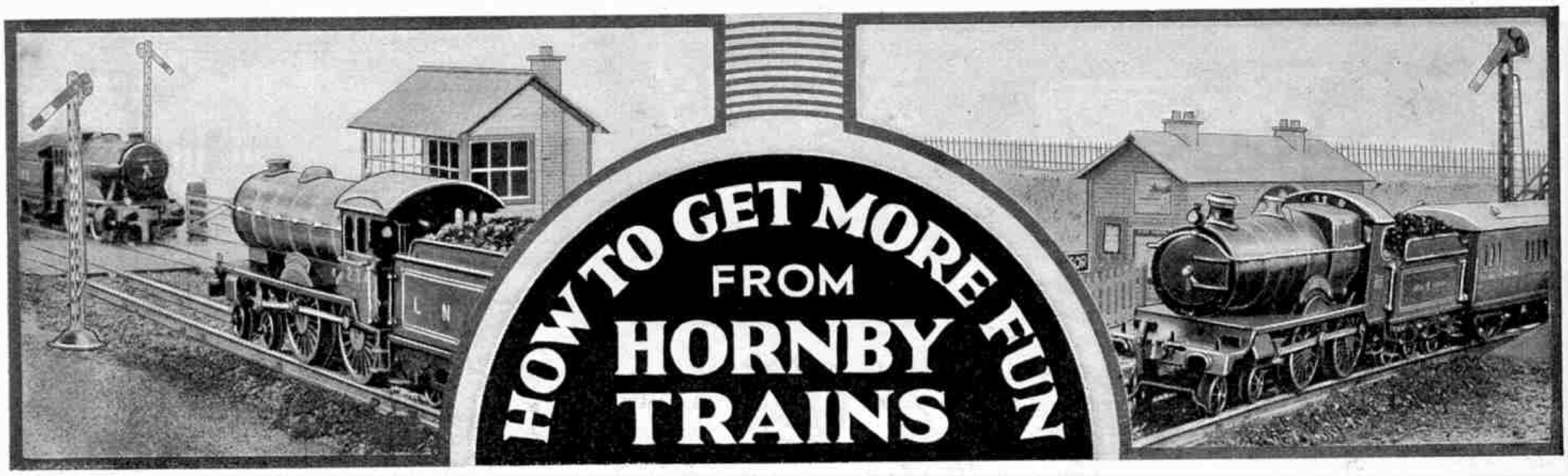
The following new Branches of the Hornby Railway Company are now being formed, and boys who are interested and desirous of linking up with this unique organisation should communicate with the promoters, whose names and addresses are given here. All owners of Hornby trains or accessories are eligible for membership, and the various secretaries will be pleased to extend a warm welcome to all who send in their applications:—

ALFRETON.—Godfrey Cox, High Street.

DUBLIN.—R. Free, 10, Grantham Street, S.C. Road.

ICKENHAM.—J. Robinson, "The Homestead," Swakeley's Road.

PENDLETON.—Cyril Barnfield, 79, Hayfield Road.

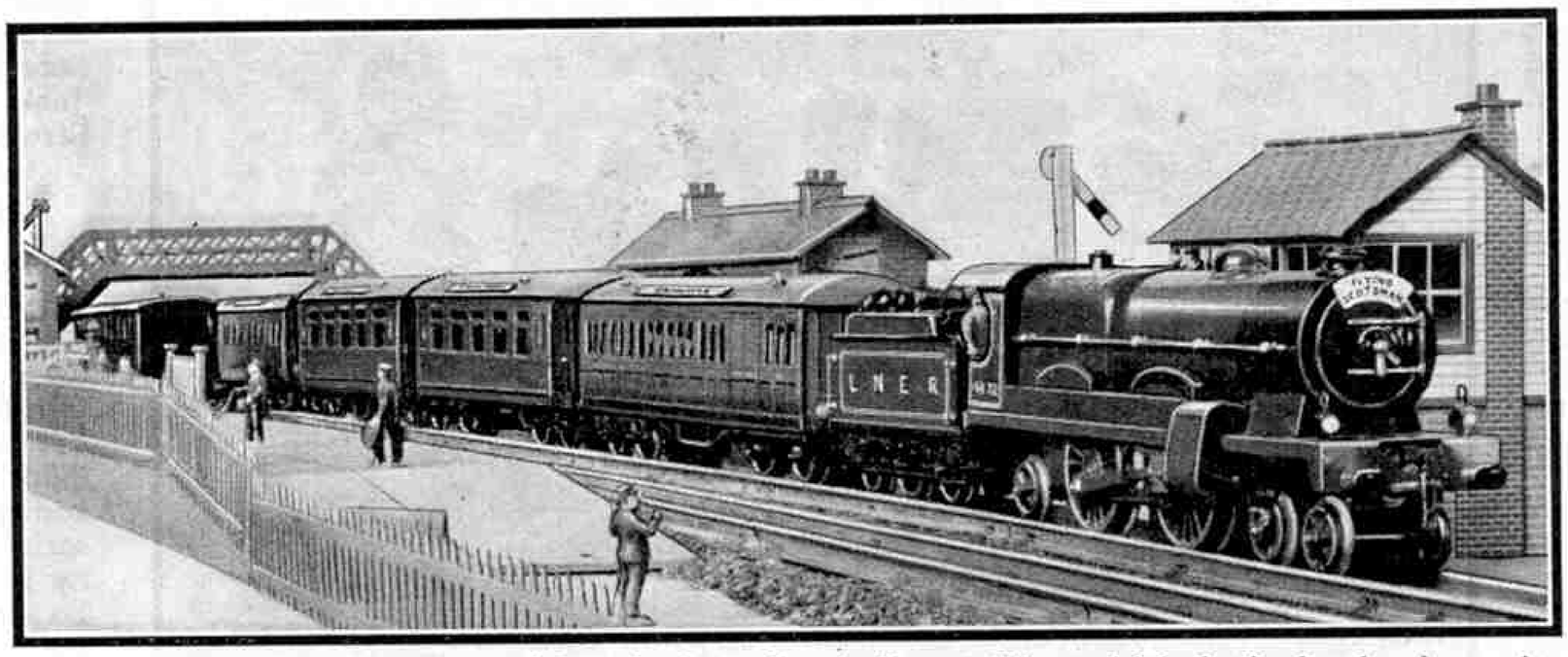


XLIII.—SOME MINOR IMPROVEMENTS

REMARKABLE progress has been made recently in the Hornby System with the result that a miniature railway built up of Hornby components, and finished off by the provision of the latest accessories, has a very satisfactory air of realism about it. Various items such as the Modelled Miniatures, Station Hoardings, and Train Nameboards have all been dealt with by "Tommy Dodd," and the subject of cuttings has also had some attention. Suggestions for further additions have been pouring in from readers, and in a number of cases the subjects of their proposals are actually included among matters engaging our attention. Introductions must, of necessity, be gradual, and as in some cases the articles suggested would have only a limited application, or could be easily made at home to suit particular requirements, we think that a consideration of various minor improvements will not be without some interest for our readers.

It will be recalled that a great deal of attention has been given to the slogan "Buy British," and an interesting phase of the movement to encourage this was the running of the famous "*Cornish Riviera Express*" of the G.W.R. as a demonstration train. The locomotive employed carried a striking circular board on the smoke-box front, and the coaches of the train bore appropriate posters. Such an interesting event is quite worthy of reproduction in miniature. One of the accompanying illustrations, in addition to showing the use of the Hornby Posters, shows a miniature express train arranged as the real G.W.R. one was. The Hornby "County of Bedford" Locomotive carries a circular board made of white card, and decorated as far as possible in accordance with the detail shown upon the actual thing. Such a board may easily be prepared, and in this case was attached to the handrail of the engine by means of fine cotton. Stamp paper could also be used, looped round the handrail and attached to the back of the board, as the latter will only be required once or twice.

These large circular boards are very popular in these days, and are frequently prepared for special purposes. Trips in connection with the visits of particular organisations to pleasure resorts, industrial centres or plants, and other similar excursions, furnish a good opportunity for special decorations on the front of the engine in this manner, so that Hornby Railway owners will not lack the opportunity of making use of such effective touches in miniature. Readers will remember how in the November issue of last year the world-famed "*Cheltenham Flier*" was dealt with, one illustration showing the locomotive bearing a specially prepared board, describing it as the "World's Fastest Train." This was a smaller affair than the circular pattern we have been describing, but it was none the less striking.



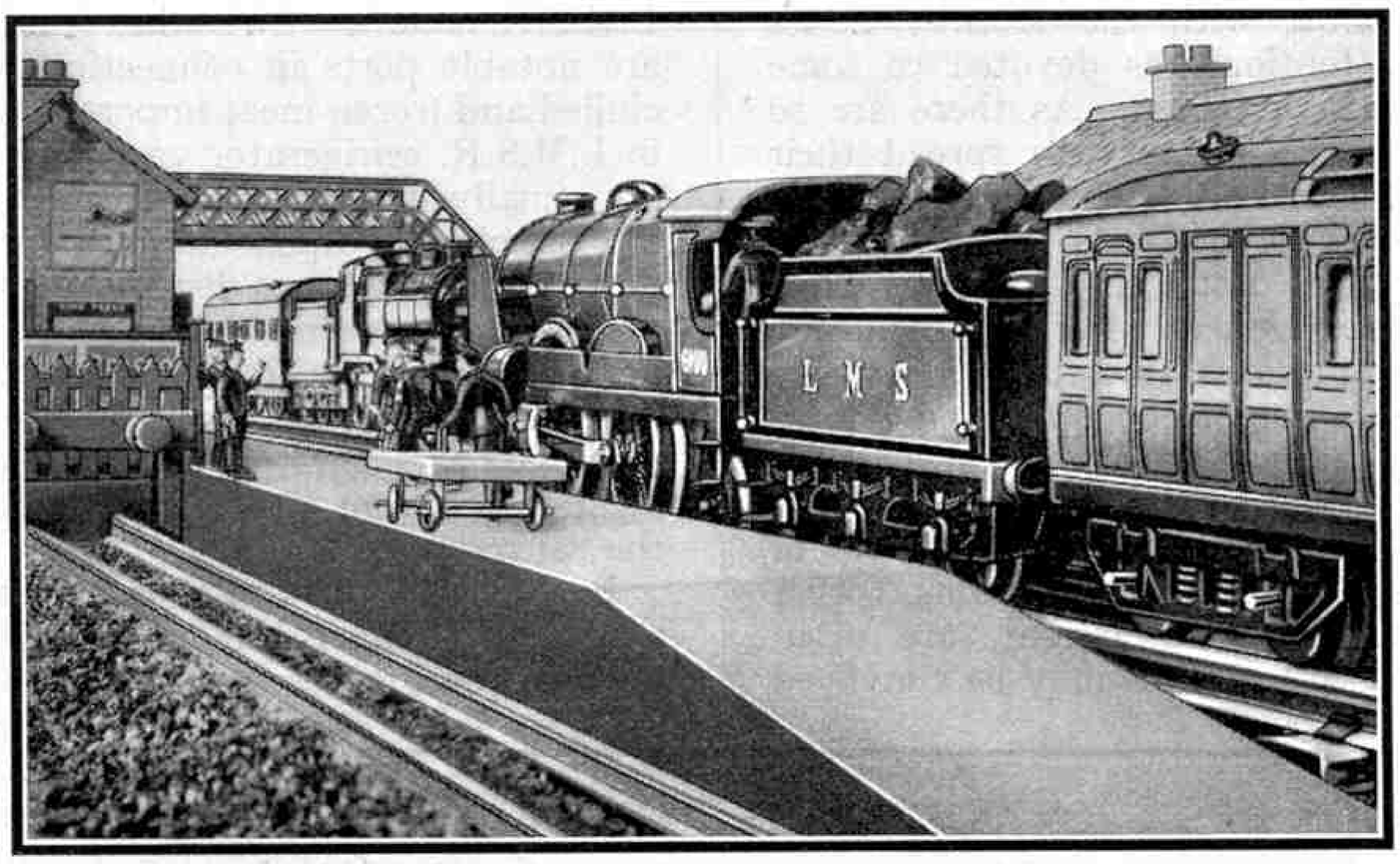
Attention is directed to the importance of the train shown above by the use of the special destination board. Accessories of this kind are easily made, as described in this article.

A further variation of this kind of thing is particularly well known throughout the route traversed by the renowned "*Flying Scotsman*." When the non-stop running between King's Cross and Edinburgh and back is carried out during the summer period, the title of the train is displayed on the front of the engine as well as on the coach roof boards. A semi-circular white board is carried on the smoke-box front, and the words "*Flying Scotsman*" appear on it. This rare instance, apart from the "*Cheltenham Flier*," of the train name appearing on the front of the engine, seems to have been developed from the practice of the North British Railway, whose "*Lothian Coast Express*" in former days was similarly indicated. Semi-circular destination boards attached to the front ends of the locomotives are still used in the Southern Scottish Area of the L.N.E.R., as the N.B. system is now known.

Here then are splendid opportunities for novel practices on miniature L.N.E.R. layouts, and the possibilities in this direction are well shown in the photograph representing the "*Flying Scotsman*" on a Hornby layout. The nameboard on the engine is attached to the top lamp bracket, being looped over this with a strip of stiff paper attached to the board. It may be easily prepared from a

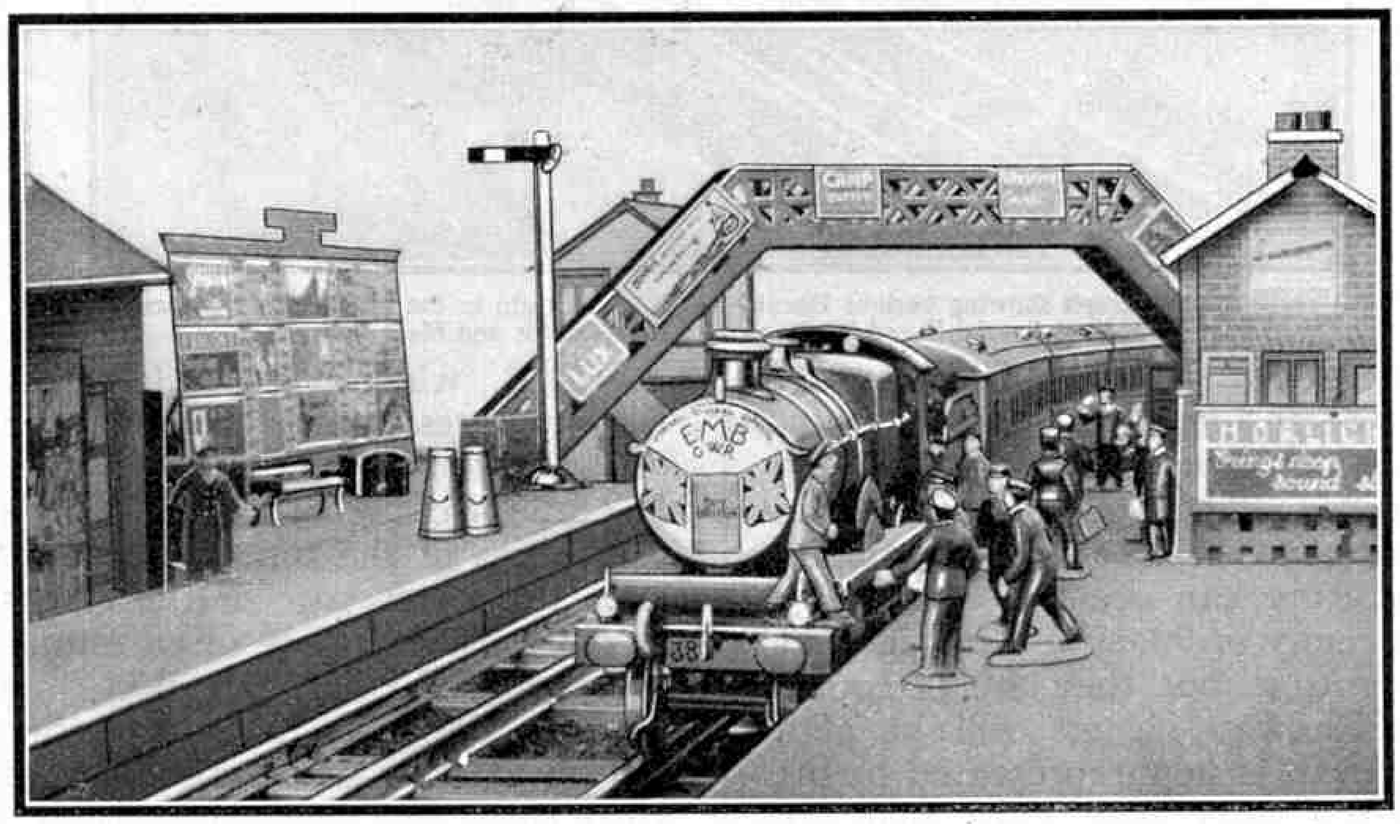
piece of card, and if it is marked out with a radius at the top of seven-eighths of an inch and a depth of five-sixteenths of an inch it will be found quite suitable. Sufficiently good lettering will probably be within the capabilities of most H.R.C. enthusiasts, or they may be able to persuade a friend who is skilful in this direction to do it for them.

Another point is that the various features of the smoke-box door have been cleaned up bright, such as the hinge straps and bar and also the rim of the door itself. They thus imitate in a successful manner the polished metal finish of these parts on the actual engines. The narrow blade of a penknife or a fine screwdriver will remove the black paint quite satisfactorily by gentle scraping. The same may also be carried out by owners of No. 3 and No. 2 Special Locomotives belonging to other groups, and the front-end appearance of engines treated thus is very pleasing. The smoke-box door handles of Hornby Locomotives are already supplied finished bright, so that there is no need to touch these items.



Smoke deflectors for Hornby "Royal Scots" and "Lord Nelsons" are interesting and up-to-date fittings. Enthusiasts who require them should follow the instructions given on this page.

Mention of the smoke-box reminds us of another possibility in connection with the No. 3 Clockwork and Electric Locomotives. Readers will be aware that for a long time the question of the exhaust steam hanging about the boiler and impeding the driver's vision has been engaging the attention of locomotive engineers. The efficient working of modern locomotives, and their necessarily short chimneys, have caused this problem to present itself. On the G.W.R. and to some extent on the L.N.E.R. the tapered form of boiler barrel and the general contour of the principal locomotives have prevented this trouble from being felt to any great extent. The S.R. for a number of years now have been using the "blinkers" or side plates fitted along the sides of the smoke-box, in order to induce an upward current of air, and so lift the exhaust well clear of the cab. The "Lord Nelson" class and the "King Arthurs" are thus fitted, and their use is being extended to other locomotives also. The L.M.S.R. after several experiments have adapted similar fittings for many of the "Royal Scots," and some of the rebuilt "Claughtons" also.


An effective decoration on the front of a Hornby No. 2 Special Locomotive. Circular boards of this kind are frequently used nowadays for special purposes.

Miniature railway owners who follow L.M.S.R. and S.R. practice, and base their layouts and operations on these lines, thus have the opportunity of providing a further novelty where Hornby "Royal Scots" or "Lord Nelsons" are in service. Opinions differ as to the appearance of engines thus fitted, so that the question of the manufacture of these side sheets has not been considered, and in any case the sheets are easily made and fitted to miniature locomotives as the following will show.

There is some difference between the patterns employed on the two systems. The L.M.S.R. employ flat sheets painted black; the front corners have a small radius, and they stand vertically on the footplate at the side of the smoke-box. The S.R. variety turn inward somewhat toward the boiler, and are painted green, and the front corners are rounded to a greater extent. However their making and fitting is carried out in thin card—a plain postcard will do—in this way. Two rectangles of card are marked out and cut $1\frac{3}{4}$ in. long and $1\frac{1}{2}$ in. high. A strip $\frac{1}{8}$ in. wide is marked along the bottom of each, and carefully bent so as to stand at right-angles to the rest of the piece. The pieces are then trimmed at the front top corner, one being made left-handed and the other right-handed, the narrow bent part being inside. For L.M.S.R. engines the radius of the curve at the front may be quite small, and the curve may be marked round a Meccano Washer, or anything similar, in order to get it simply and quickly. For S.R. engines a larger radius is necessary, and here a 1 in. Loose Pulley may be employed. Also as the S.R. side sheets turn in slightly, a bend should be made $\frac{1}{4}$ in. above the first one, and the upper portion of the sides given a certain amount of inward setting.

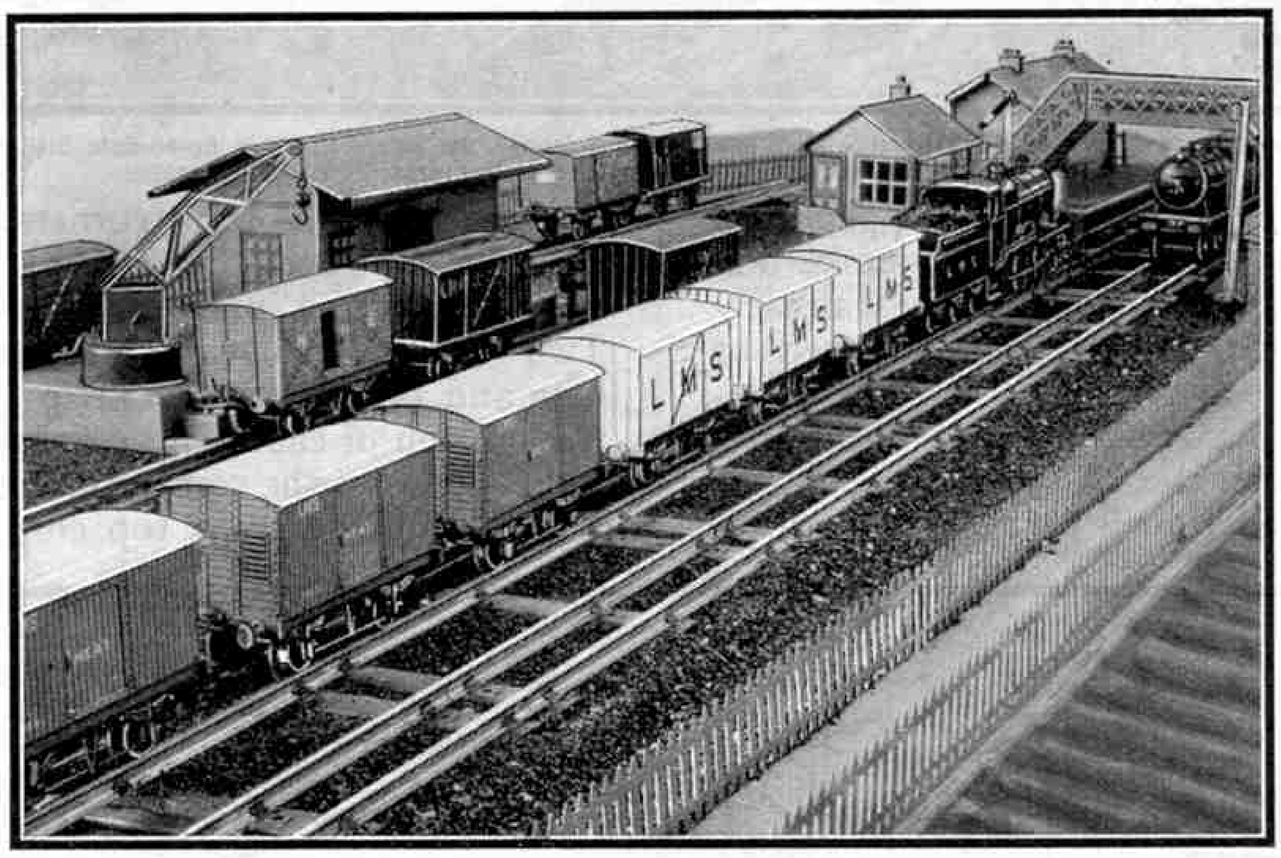
If the footplate in front of the cylinders of the No. 3 engine is examined two lugs will be found on each side by the extreme edge. These secure the frame that holds the bogie in position. They should be gently prised up with a penknife, and their positions marked on the "smoke deflectors," allowing the latter to touch the front of the cylinders. Two (Continued on page 388

Covered Wagons in the Hornby Series (II)

By "Tommy Dodd"

IN the last article dealing with the Hornby Series wagons particular attention was devoted to some of the covered wagons or Vans. As there are so many of these it has been necessary to spread their consideration over two articles. This is more of an advantage than otherwise, as the Vans fall practically into two big classes. The first class that we have described were those for general freight, including cement, cattle and gunpowder traffic, that is usually carried by the ordinary service of goods trains. Attention has been drawn already to the interest of such trains, but even more enthusiasm is likely to be generated by the Vans about to be described, and the types of trains in which they usually run. These trains, owing to the perishable nature of their freight, are often run at express speeds, or several vans may be conveyed as part of a passenger train.

After concluding with Cattle Trucks, therefore, the next Van is the familiar Refrigerator. These are of similar construction to the No. 1 Luggage Van, but their special nature is indicated by their colour. As in actual practice, those of the L.M.S.R., L.N.E.R. and G.W.R. are painted white, but those of the S.R. are finished in the peculiar pinkish buff shade that distinguishes the actual vehicles. Refrigerator vans are used in large numbers by our railway companies, and as their name implies they are specially fitted so that the inside of the van is maintained at a suitably cool temperature, ice tanks being incorporated for the purpose. The walls of the vehicles include a layer of insulating material, so that no appreciable variation of temperature can occur.



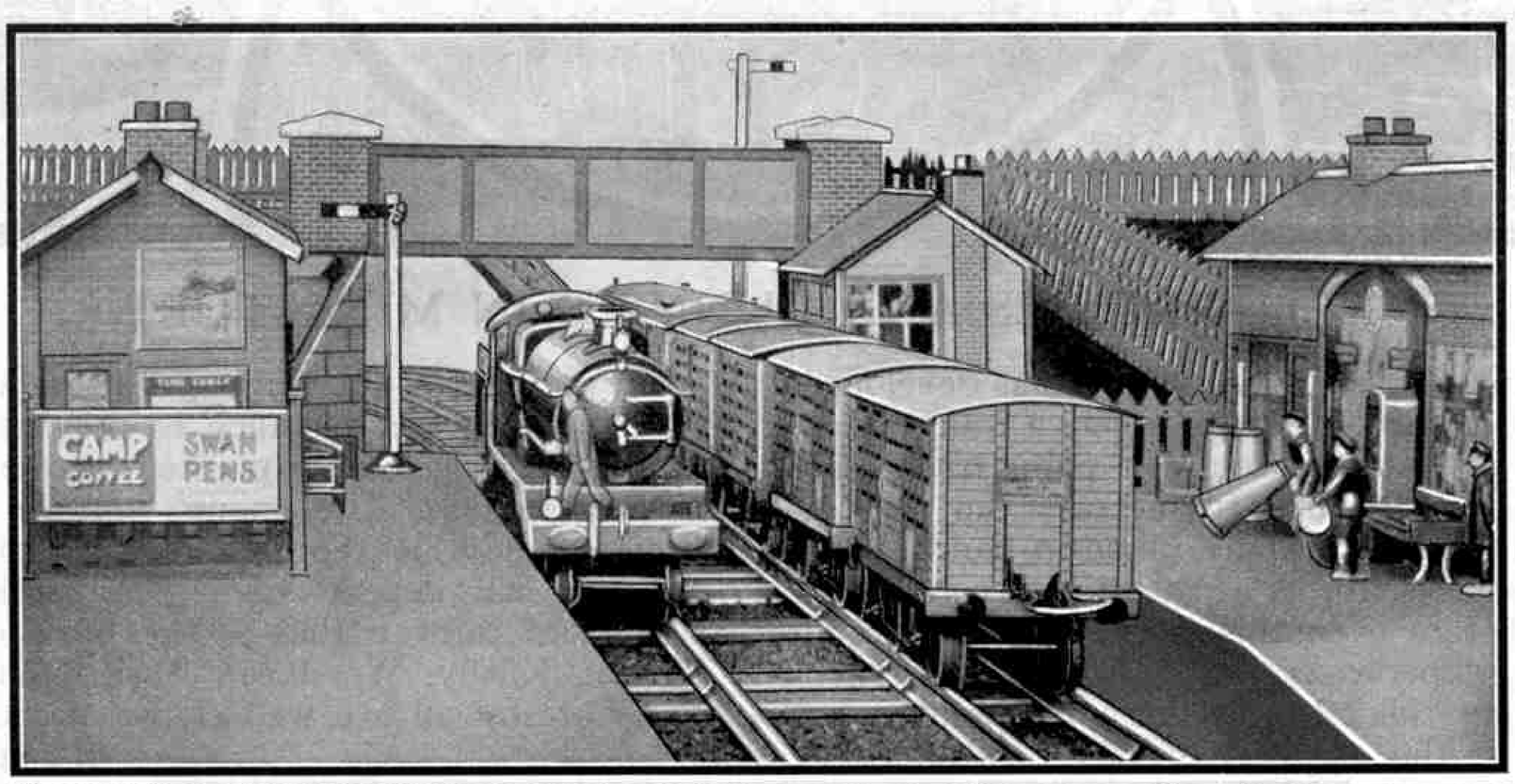
A realistic photograph showing various Hornby Vans. The train in the foreground represents a "Meat Special," and is made up of Refrigerator and Meat Vans.

There are also a great many ordinary meat vans that are not fitted for refrigeration, but they are of course insulated. All Hornby Railway owners will be glad to hear that this type of van is now represented in the Series. This is one of the three new Vans that are available, and the other two will be mentioned in due course. They are all finished by the tinprinting process, which allows a great amount of detail to be reproduced. The Meat Van, which represents an L.M.S.R. pattern of these vehicles, is a neat-looking van, the sides having vertical boards. The various battens, pillars and strapping seen on the originals are clearly reproduced, and the purpose of the Van is indicated on the door. One of our illustrations shows a train composed of Hornby Refrigerator and Meat Vans, and it represents in miniature one of the many fast perishable trains that run over L.M.S.R. metals. Birkenhead and Liverpool particularly are notable ports in connection with meat traffic, and chilled and frozen meat imported there is soon on its way in L.M.S.R. refrigerator vans. The ordinary meat vans are usually employed for fresh meat. Imported cattle are slaughtered upon landing, and the meat is quickly despatched to various distributing centres. The G.W.R. of course, according to their usual custom, distinguish their meat and refrigerator vans by the familiar titles Mica A and Mica B, the word "Mica" presumably being employed as suggestive of insulation. Also one of their meat trains from Birkenhead to Smithfield is known to the railwaymen as "*The Meat.*"

Particularly attractive is the second of these three new Vans. This is intended for fish traffic on miniature railways, and represents the type of vehicle standardised for general use on the L.N.E.R. The louvred ventilating slits that are characteristic of the real vans are well represented, and also the various raised timbers outside the planking on the sides. This is exactly the opposite form of construction to that shown by the new flush-boarded meat van, so that each is thoroughly distinctive and yet quite representative of its kind. The train shown in the lower photograph on page 383 represents in miniature a sight that is particularly familiar on the L.N.E.R., which is noted for its fish traffic. The trains run at express speeds even over such long journeys as the 597 miles from Mallaig on the West Highland line, or the 522 miles from Aberdeen, to King's Cross. Owing to the difficulties of the routes north of the Border the speed over the latter part of the run is high, and passenger engines are therefore often employed. Grimsby is the premier L.N.E.R. fish port, and the former Great Central Railway did much toward its development. It is interesting that the heavy traffic in fish that is dealt with there has been responsible for a special race of "fish" engines on the Great Central, each successive class being practically a small-wheeled variation of the latest passenger engines of its period.

Although milk tank wagons represent the most up-to-date method of dealing with milk traffic, the milk van is still the more popular vehicle, and is in use all over the country. This is the subject of the third of the new tinprinted Vans, and is known as Milk Traffic Van No. 0. It is representative of milk vans generally, and reproduces the open-boarded pattern with outside timbers that is commonly in use. The G.W.R. are the

company represented, "Siphon" being the term applied to milk traffic vans on that line, a letter placed after it indicating particular types, such as "Siphon G." Owners of miniature systems that favour that line will lose no time in obtaining one at least, and they are likely to be found on other systems too. Each of these three Vans is worthy of notice by all Hornby Railway managers, as they are lower in price—2/6—than the usual enamel-finished vehicles. The tinprinting process gives the opportunity for incorporating more detail, and full advantage has been taken in preparing these new items. Sliding doors are fitted to each, as is now usual in modern practice.



The details incorporated in the Milk Vans of the Hornby Series are well seen in this picture. The engine is running round the train for the return journey while milk cans are dealt with by the station staff.

There has been for some time, of course, a Milk Traffic Van in the Series, complete with miniature milk cans. This has been, and still remains a firm favourite. It also is of the open-boarded type—ventilation being essential in such a van—and the openings in the sides are actually pierced. An enormous milk traffic is dealt with on our railways, and it has been stated, as previously mentioned in the "*M.M.*," that if all the churns handled in one year at Clapham Junction on the S.R. were placed in a single line they would reach from Waterloo to Guildford, a distance of 30 miles! There is therefore every reason for the employment of milk vans in miniature. They may be attached singly to passenger or goods trains as convenient, or may of course be operated in numbers to form a complete train. Milk and milk empties are a prominent feature on suburban lines every day, and all our readers, we are sure, are familiar with the rumble of the empty cans as they are seized by the station staff and bowled across the platform. When the cans are full, less noise is made, of course, for they are heavy, and therefore they need judicious handling.

Complete trains of Fish Vans such as that shown in miniature in this photograph are characteristic of the L.N.E.R. The Hornby Fish Vans with their tinprinted finish are fine representations of the actual vehicles.

Another interesting introduction that has been made this season is the Banana Van. Vans for fruit traffic have frequently been asked for by Hornby Railway owners, and they are now provided with a very suitable vehicle. This is of standard construction, similar to the No. 1 Luggage Van, and is finished in a striking yellow shade. The word "Bananas" appears diagonally on the panels forming each side of the Van, with the door placed centrally between them. An attractive transfer bearing the familiar name "Fyffes" appears on the doors, so that the special nature of the Van is at once indicated. Banana vans represent the opposite extreme in railway vehicles to refrigerator meat vans. Both have to be maintained at even temperatures, but whereas ice is carried to keep meat cool, so a banana van is specially fitted and steam-heated in the winter to assist in ripening the fruit in transit. The process is commenced in the ship in which they are brought from abroad, and is continued when they are unloaded into railway vehicles for distribution. Avonmouth on the G.W.R. and Garston on the L.M.S.R. are well-known ports for banana traffic, and at the former place no fewer than 5,938,764 stems of bananas were dealt with during 1930. The running of special banana trains is therefore an interesting feature on miniature systems that serve seaports, as suggested recently in the "*M.M.*" Upon their arrival at the main terminus of a model railway, some of these may be kept at the platform for unloading, while others may be reforwarded by local passenger or goods trains to destinations in the "suburban area."

The Biscuit Vans of the Hornby Series now claim our attention. These are three in number, each representing a well-known firm of biscuit manufacturers. They are of standard construction, similar to the No. 1 Luggage Van, but are of course finished in special colours. That representing Messrs. Jacob & Co., is painted dark crimson, and the lettering is attractively carried out in gold. The Royal Arms boldly emblazoned on the door signifies the Royal Appointment of the firm. The other two Vans are similar,

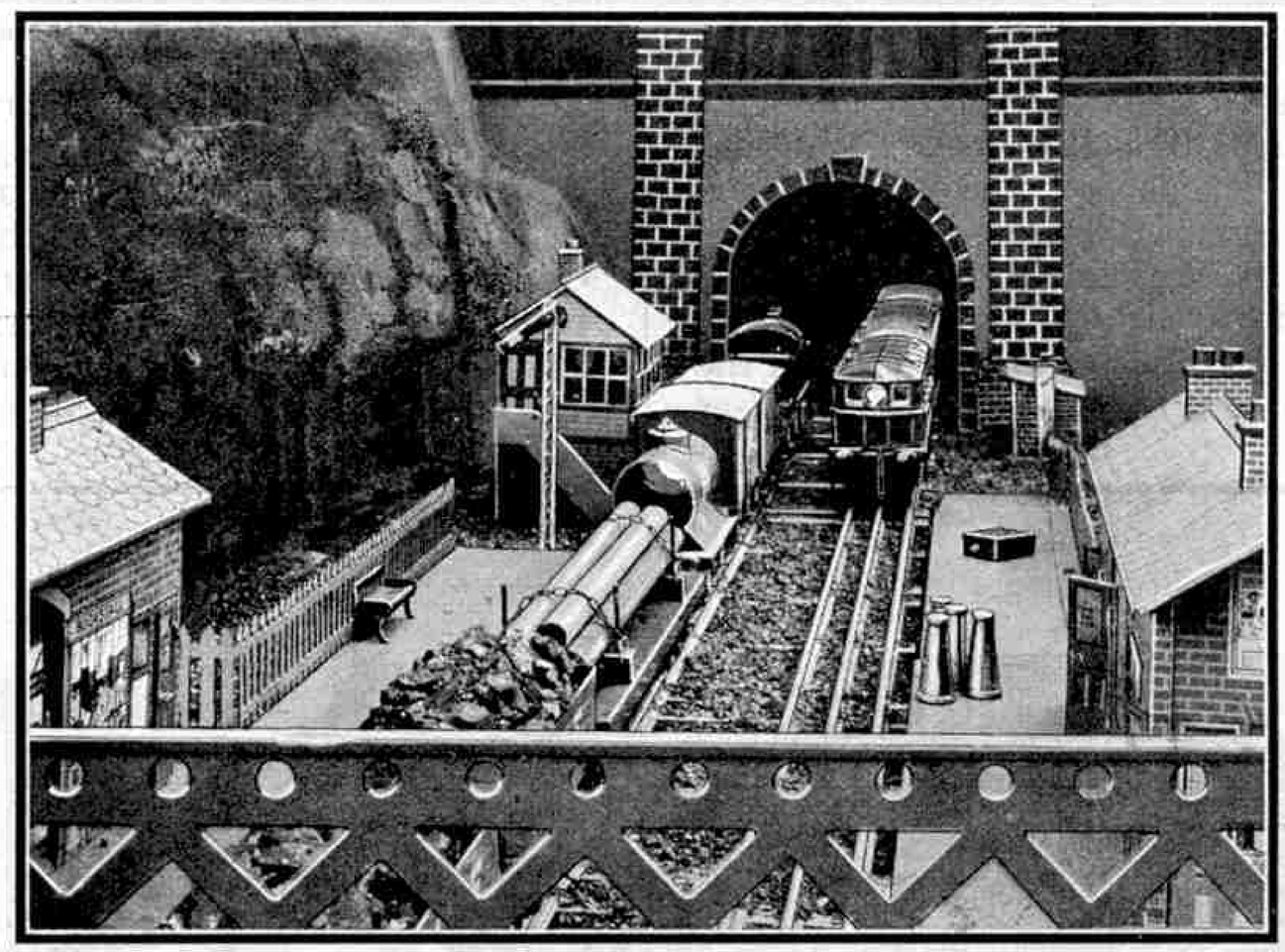
(*Continued on page 388*)

XLI.—BRIDGES AND TUNNELS IN MINIATURE

As soon as a miniature railway system has developed beyond the elementary stage, where a train makes a number of journeys round a plain track, the addition of different features to increase the realism and add to the interest is usually taken in hand. One station at least is necessary as a place to start and stop the trains, but before even this is provided, a strong desire is usually experienced for a bridge or tunnel. In the early stages the latter is often represented by laying the track on the floor so that it passes under a chair or other article of furniture, and the "tunnel" so formed is usually considered satisfactory for the time being, as imagination plays a great part in the operation of a miniature railway by very junior enthusiasts. Of course if simple tunnel mouths are made up they may be placed in position, and the effect thus obtained will not be at all unrealistic if some suitable covering for the top may be arranged.

However, with the various Tunnels now available in the Hornby Series, the necessity for such makeshift schemes practically disappears, particularly with the straight and curved varieties that can now be obtained with such a realistic finish. Last month the possibilities of the various cutting components in conjunction with tunnels were referred to by "Tommy Dodd," but it will be of advantage probably to refresh the memories of readers on the subject. The approach to a tunnel in actual practice is usually marked by a cutting into which the train passes, growing deeper and deeper until suddenly the train is swallowed up in the gloom of the tunnel. Similar conditions in reverse order obtain on emerging once more into the daylight. Sometimes the approach may be short, as where the contours of the ground alter abruptly, and the line enters a wall of rock that appears to rise almost sheer above the railway.

In either case miniature approaches are essential, and even if cuttings are not arranged to lead up to the main portions of the tunnel, the sloping end pieces may be used, and will do much to prevent the tunnel from appearing as if simply planted on the spot for no particular reason. The many notable tunnels of real practice may be represented in miniature, but those selected will depend upon the particular railway or section of railway that is the basis of the line. The Severn, Kilsby, Woodhead, Totley, Watford, Bramhope and Catesby all are well-known names, and there are of course South of England representatives such as Clayton and Merstham tunnels.



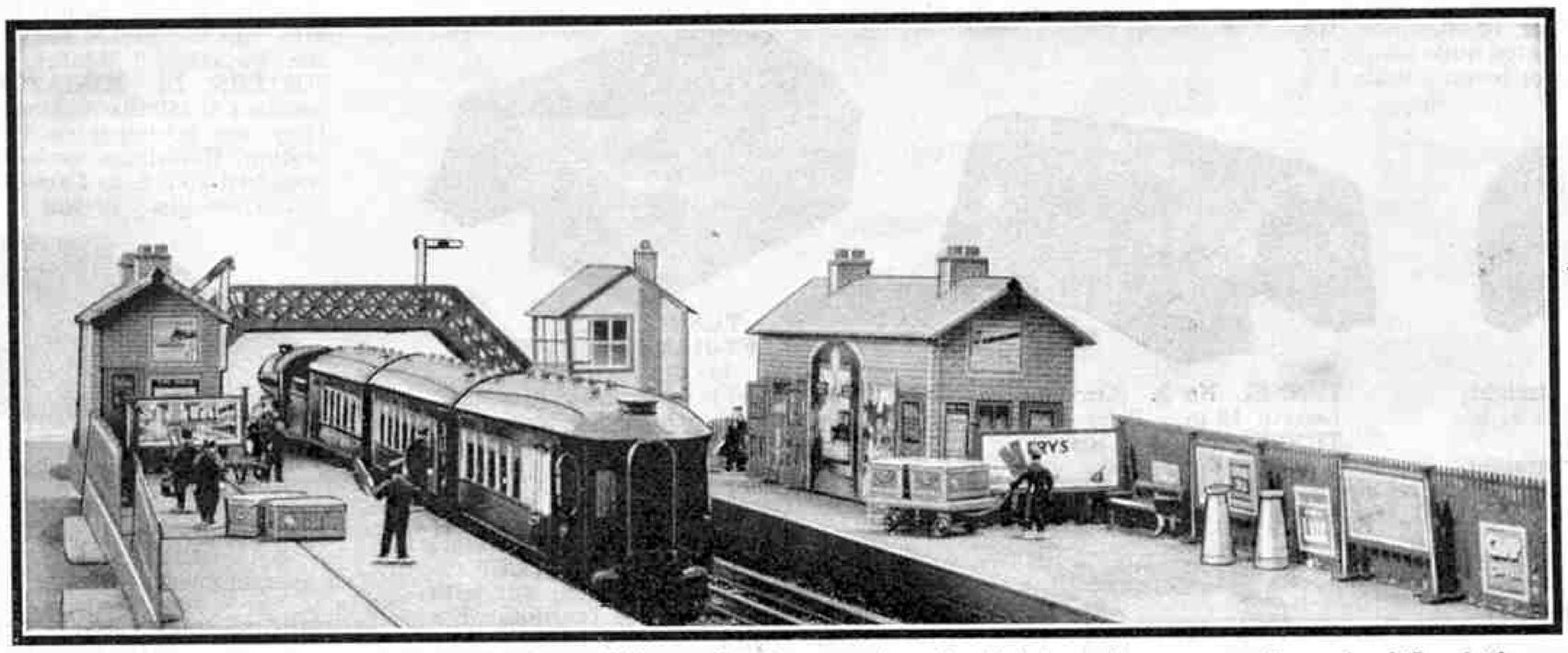
An interesting photograph showing a tunnel mouth made from cardboard as suggested in this article. A Metropolitan train is emerging from the tunnel, and a goods train hauled by an L.N.E.R. locomotive is about to enter it.

The advantage of employing standard tunnels of the kind referred to is that no matter how many may be placed end to end to form a long bore, a train that happens to derail can always be attended to, for the section concerned merely needs lifting up. This is a great convenience, as will be appreciated by those who have attempted to extricate a derailed locomotive that has entangled itself with different parts of a permanent tunnel. The older metal Hornby Tunnel must not be forgotten, and this is decidedly popular with those who require a substantial article of pleasing appearance.

Many enthusiasts prefer to make up their own tunnels to suit the particular circumstances of their layouts. For their benefit the Hornby Tunnel Ends were introduced, these being similar to the mouth portion of the metal tunnel, but specially arranged with brackets for attachment to Meccano Strips, Girders, or other suitable framework. The bore of the tunnel, and the contours of the ground under which it passes, may be arranged in any desired manner, the entrances being appropriately finished off if the Tunnel Ends are used. For portable layouts such tunnels will probably be of a temporary nature only, the Meccano skeleton or framework being dismantled at the same time as the line itself. In this case a suitable covering for the tunnel will be a green cloth of some kind, such as an old curtain; or crepe

paper, which is easily made to assume natural shapes, is cheap and can thus be readily replaced.

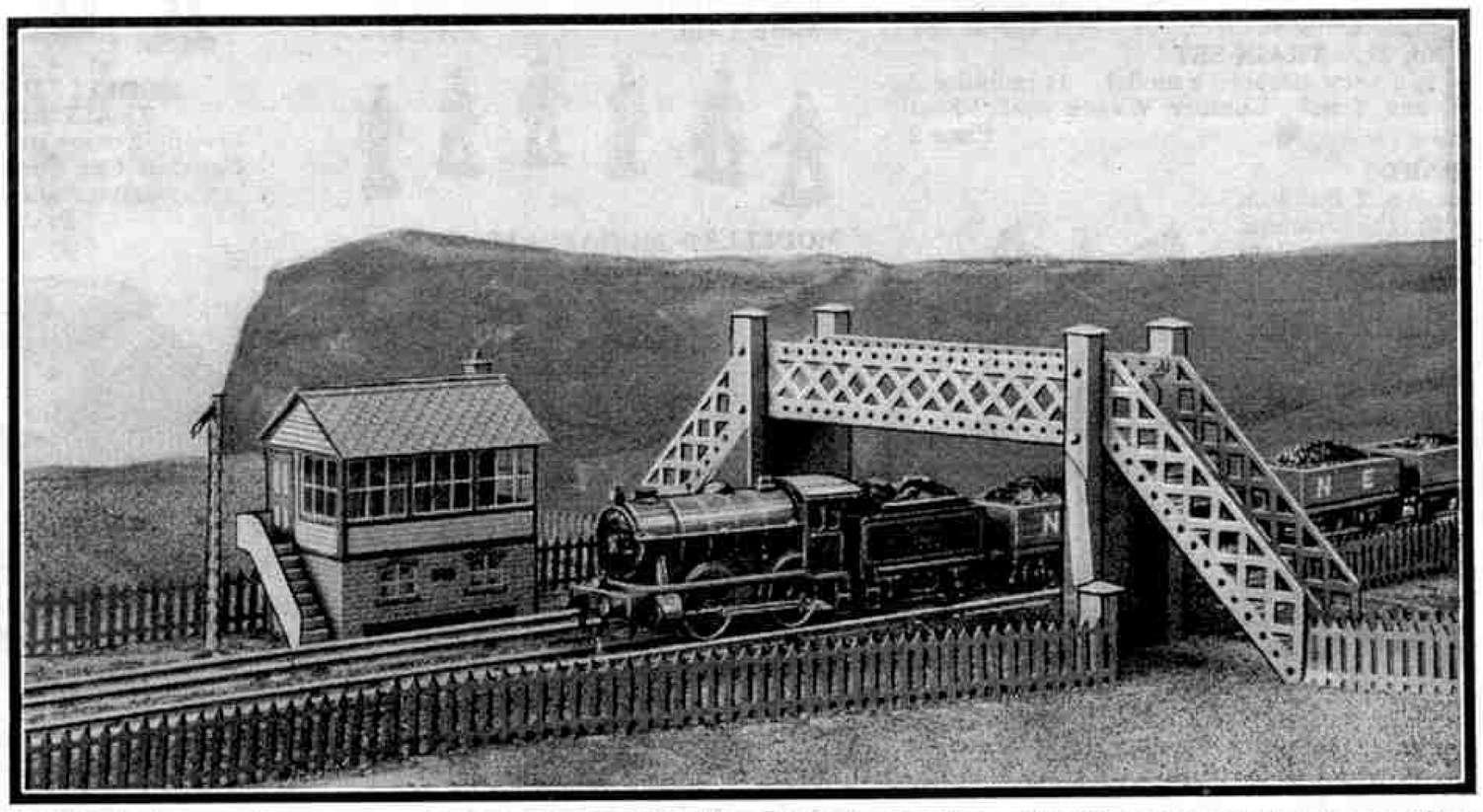
Where a permanent system is laid down, the scheme of laying brown paper soaked in paste over the prepared tunnel framework may be employed. Numerous hints on this form of construction have been given at various times in the "*M.M.*," the finishing touches with sand, small stones, artificial moss, paint and other materials being made according to the fancy and skill of the builder. As suggested last month, tunnels are often useful in disguising the presence of certain parts of the line, and for forming an effective division between two sections.



The Hornby o. 1 Footbridge may be used in many different situations on a layout. It is here shown across the ends of the platforms of a station and looks very effective, for such bridges are frequently placed there in actual practice.

Any special effects that are desired in the matter of tunnel mouths—for there are many ornamental ones up and down the country—may be reproduced by the use of cardboard for the building material for the actual tunnel face. This work need not be carried out in great detail, for it is sufficient to get the broad effects of the actual thing, so that the missing detail is suggested by the eye when the tunnel mouth is observed. Real tunnel mouths, even though ornamental, are invariably very murky-looking, and the same effect in miniature should be sought.

Turning to the subject of bridges, we find that a great deal of choice is possible, for real bridges exist in so many different forms and sizes. There are footbridges and road bridges to span the track, and bridges of various kinds for carrying the railway over a road or another railway, over a broad river, or perhaps a small water-course. Footbridges are well represented in the Hornby Series, but the other types of bridges vary so much in detail that most miniature railway owners prefer to build them up as required for a particular position on the line. Wood or cardboard may be used for such work, and some excellent results are to be obtained if care is taken. For more elaborate structures Meccano is often an obvious suggestion, and an effective bridge made up of Strips, Girders, Plates and other parts adds considerably to the charm of the layout. Small culverts under the line are usually difficult to arrange, unless the track is permanent ; but if laid out of doors on a dry sunny day such features may be incorporated. An arched section from a set of constructional blocks will make a very good culvert face, or if these are not available a satisfactory substitute can easily be made.



In this photograph there appears the Hornby No. 3 Lattice Girder Footbridge. This is of very sturdy construction and represents the typical girder footbridges of actual practice.

The Footbridges of the Hornby Series may be used in numerous situations on a layout, and though extremely effective when used alone, they are much more so when the reason for their use is apparent. That is to say, when a miniature footpath is led up to the line and the way over is provided by the footbridge. Another scheme is to employ a footbridge at a station, where in actual practice such bridges are commonly seen. One of our photographs shows one of the Hornby Footbridges used to connect the two platforms of a station in a very realistic manner. Where such a bridge is placed at the ends of the platforms it forms a useful method of supporting the necessary "home" and "starting" signals for the station, and two of the Hornby Footbridges, the No. 1A and No. 2 are fitted with detachable signal posts. The bridges themselves are similar, but the former has signals of the "M" pattern and the other is provided with the regular Hornby pattern of post and semaphore. The No. 1 Footbridge is of course of the plain variety without the signal posts.

The No. 3 Lattice Girder Bridge is of a very stout nature and has therefore a fine appearance. It is representative of the type of girder footbridge frequently seen in the open country in actual practice. The span of the bridge is supported by and bolted to four stout pillars or columns connected by a section of wall. These are braced by means of sloping abutments, and the stairway portions are arranged to be bolted to the pillars also.

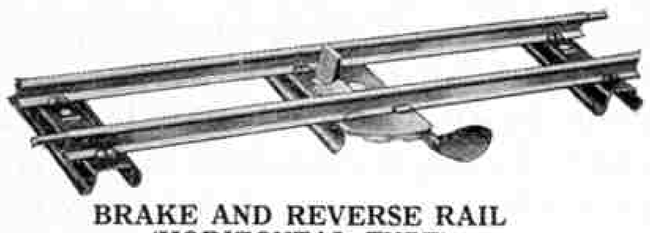
Other types and styles of footbridges are found, such as those formed of plate girders instead of lattice-work. These do not have such an attractive appearance as the more "open" style of lattice bridge, and have not therefore been included in the Hornby range. Those who specially require such accessories can make them to suit themselves, using cardboard or wood as preferred.

HORNBY ACCESSORIES

The range of Hornby Accessories, already comprehensive, has now been increased by the addition of a number of splendid new items. A selection of these is illustrated and described below. If you are a Hornby enthusiast you will appreciate at once the extent to which the new Tunnels, Cuttings, etc., will enhance the realism and effectiveness of your Hornby railway layout.

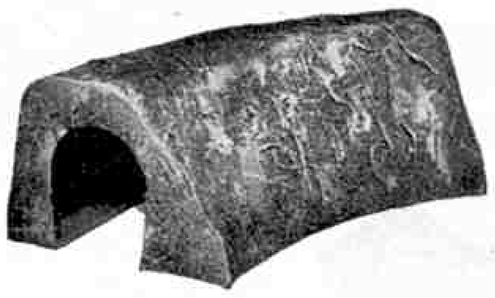
Tell your dealer that you want to see these new goods as soon as he has supplies available.

MECCANO LTD., OLD SWAN, LIVERPOOL



BRAKE AND REVERSE RAIL (HORIZONTAL TYPE)
This special rail is designed on an entirely new principle. It has independent catches for reversing or stopping the train. These are operated quite simply by means of one control lever. Price **1/6**

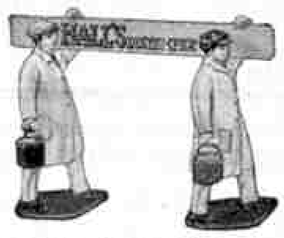
TUNNEL No. 0 (Straight)
Length 6 in., width 6½ in. Price **1/6**
TUNNEL No. 1 (Straight)
Length 7 11/16 in. Width 6¼ in. (as illustrated). Price **2/-**
TUNNEL No. 2 (Straight)
Length 15⅝ in. Width 9½ in. Price **4/-**



TUNNEL No 3. (Curved)
Length 13 in. Price **4/6**
TUNNEL No. 4 (Curved)
(as illustrated)
Length 20 in. For 2 ft. radius tracks only. Price **5/6**

TUNNEL No. 5 (LEFT-HAND, CURVED)
(as illustrated)
This tunnel is in the form of a small hill, through which the track runs obliquely. For 2 ft. radius tracks. Base measurement: 15⅞ in. × 14¾ in. Length of track 17¼ in. Price **7/6**
TUNNEL No. 6 (RIGHT-HAND, CURVED)
Similar to No. 5 Tunnel, but with track in the reverse position. For 2 ft. radius tracks only. Base measurement 15⅞ in. × 14¾ in. Length of track 17¼ in. Price **7/6**

MODELLED MINIATURES No. 1 STATION STAFF
These splendid models, which are beautifully enamelled in colours, add the final touch of realism to Hornby Station Platforms. Price **2/-** per set.



MODELLED MINIATURES No. 13 HALL'S DISTEMPER ADVERTISEMENT
This miniature of a well-known line-side advertisement is intended to be placed in the fields adjoining the railway track. Price **1/-**

Cutting No. 4

CUTTING No. 4 (STRAIGHT)
This is a double cutting, mounted on a base over which the railway track is laid.
Base measurement: Length 15⅝ in., width 15 in. Price **6/-**

MODELLED MINIATURES No. 4 ENGINEERING STAFF
This set comprises six figures representing Electrician, two Fitters, Storekeeper, Greaser and Engine Room Attendant. Price **2/-** per set.

STATION HOARDING
This is a realistic accessory, suitable for the station platform. Price **8d.**

Station Hoarding

POSTER BOARDS to carry Hornby Miniature Posters. Provided with lugs for attachment to paled fencing, etc. Packet of 6 (3 large, 3 small), Price **6d.**
POSTERS IN MINIATURE are reproductions of familiar national advertisements. They are intended to be pasted on the Station Hoardings or the Poster Boards described above, and are beautifully printed in full colours. Packet of 51 ... Price **6d.**

Two No. 1 and one No. 2 Cuttings are illustrated here.

CUTTING No. 1 (END SECTION)
(Illustrated)
Base measurement: Length 7 11/16 in., width 6 in. Price, per pair **3/-**
CUTTING No. 2 (CENTRE SECTION, STRAIGHT)
(Illustrated)
The addition of these centre sections enables a Hornby Railway cutting to be extended to any length. They are intended to be used in conjunction with the End Sections (Cutting No. 1), between which they are fitted.
Base measurement: Length 10¼ in., width 6 in. Price **2/-**
CUTTING No. 3 (CENTRE SECTION, CURVED)
This is used for curved tracks in the same manner as the straight centre section, described above, is used for straight tracks. It is suitable for both 1 ft. and 2 ft. radius tracks. Price **2/-**

MODELLED MINIATURES No. 5 TRAIN AND HOTEL STAFF
Five figures are included in this set, including Pullman Car Conductor, two Pullman Car Waiters and two Hotel Porters. Price **2/-** per set

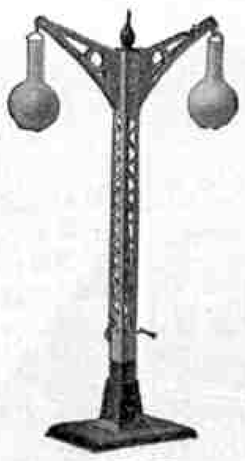
MODELLED MINIATURES No. 21. TRAIN SET
This new miniature train set is a very attractive model. It includes die-cast Locomotive, Wagon, Crane Truck, Lumber Wagon and "Shell" Petrol Tank Wagon. Price **3/-**

TRAIN NAME BOARDS
These name boards are for No. 2 Pullman Coaches and add greatly to the realistic appearance of the coaches. Details are as follows:—

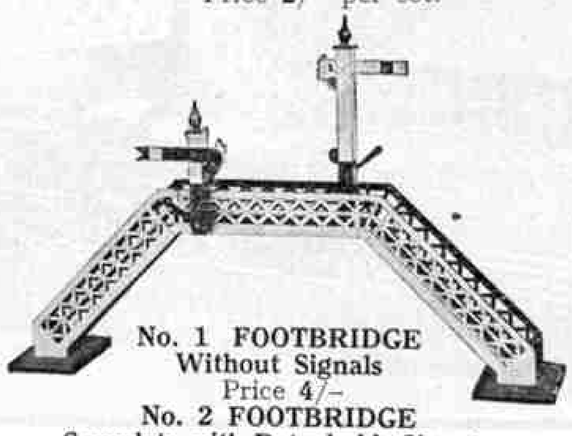
No. 1 The Flying Scotsman.
No. 2 The Scarborough Flier.
No. 3 The Royal Scot.
No. 4 The Merseyside Express.
No. 5 The Golden Arrow.
No. 6 The Bournemouth Belle.
No. 7 Cornish Riviera Express.
No. 8 Torbay Limited Express.
No. 9 King's Cross, York and Edinburgh.
No. 10 King's Cross, Edinburgh and Aberdeen.
No. 11 London (Euston) and Liverpool (Lime Street).
No. 12 London (Euston) and Glasgow (Central).
No. 13 Victoria and Dover.
No. 14 Waterloo, Salisbury and Exeter.
No. 15 Paddington, Exeter and Plymouth.
No. 16 Paddington and Bristol.

Price per packet of four of a kind, **4d.**

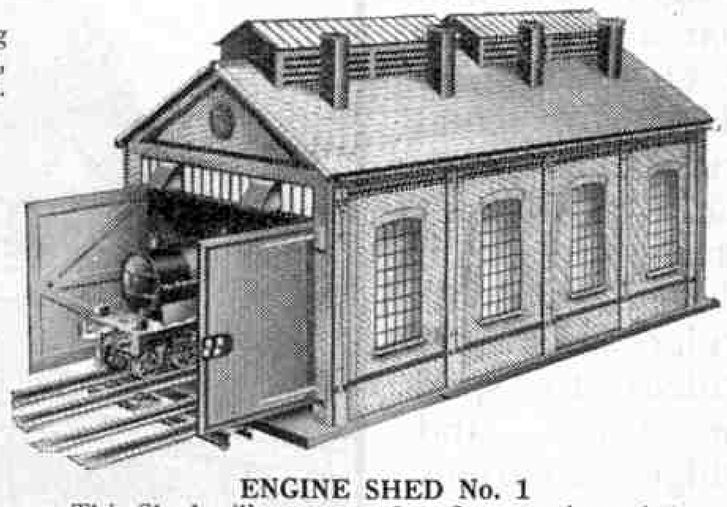
CLIPS FOR TRAIN NAME BOARDS
These clips are for use with coaches that are not fitted with brackets to take the Name Boards. There are two types: No. 2S, for No. 2 Special Pullman and No. 2 Special Pullman Composite Coaches; and No. 2, for No. 2 Pullman and No. 2 Saloon Coaches. Price per packet of twelve, **1/-** (either kind).



LAMP STANDARD No. 2
(Double)
Price **4/6**



No. 1 FOOTBRIDGE
Without Signals
Price **4/-**
No. 2 FOOTBRIDGE
Complete with Detachable Signals
(as illustrated). Price **7/6**
Signals for Footbridge
Price, per pair, **3/9**



ENGINE SHED No. 1
This Shed will accommodate Locomotives of the M Series, No. 0 and No. 1 types. Price **15/-**
ENGINE SHED No. 2
(as illustrated)
This Shed will accommodate any of the Hornby Locomotives and Tenders. Price **22/6**

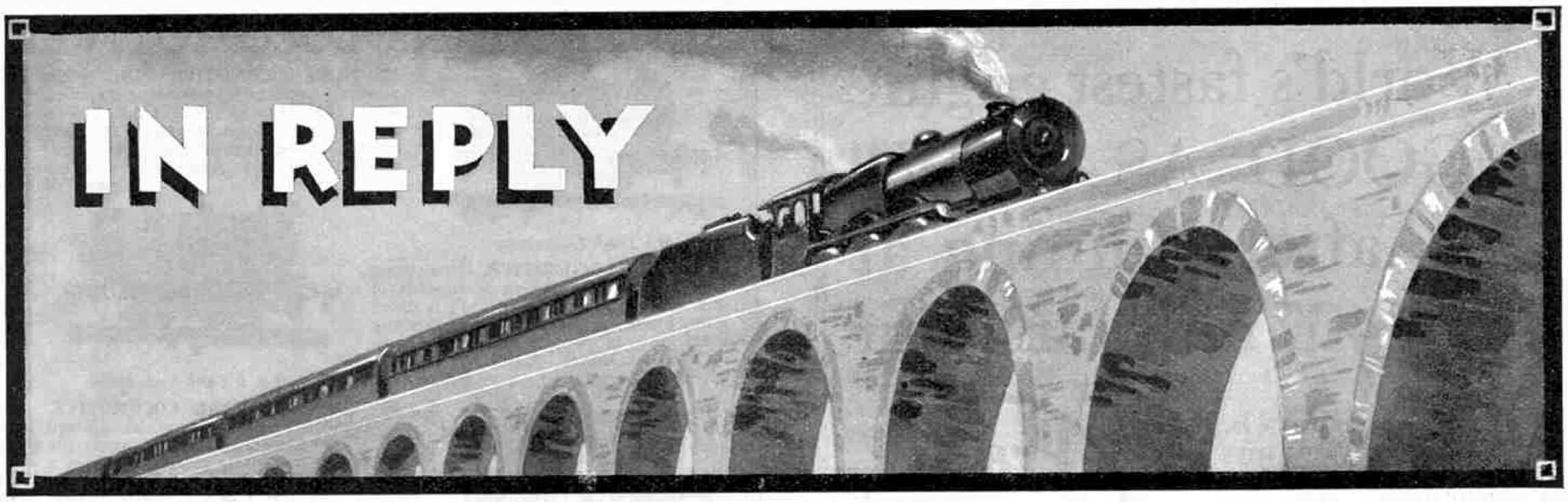
OILCAN No. 1
This new oilcan is of improved design. It replaces the No. 1 Oilcan previously listed. Price **6d.**

HORNBY ACCESSORIES FITTED FOR ELECTRIC LIGHTING. The following Hornby Accessories will in future be available suitably wired and fitted for electric lighting. These items are additional to the ordinary range.

Electric Engine Shed, No. E1E	...	Price	18/6	Junction Signal E	Price 10/-
Electric Engine Shed No. E2E	...	,,	26/-	Signal Gantry E	,, 18/-
Station No. 2E	,,	12/6	Electric Level Crossing No. E1E ...	,, 7/-
Island Platform E	,,	9/-	Electric Level Crossing No. E2E ...	,, 11/-
Goods Platform E	,,	15/-	Buffer Stops No. 1E	,, 2/-
Signal Cabin No. 2E	,,	5/6	Buffer Stops No. 2E	,, 7/-
Signal No. 2E	,,	4/6	Water Tank E	,, 10/-
Double Arm Signal No. 2E	,,	6/6		

In order to facilitate the electrical connection of the above range of accessories, we have introduced a series o flexible leads, fitted with plugs at one end and sockets that fit the accessories at the other. These leads are available in 3 lengths:—9 in., 18 in., and 36 in.—prices—**1/4, 1/5, 1/6** respectively.

We have also introduced a special Distribution Box to enable two or more accessories to be lighted simultaneously. This appliance is fitted with a pair of plugs, for connection to the transformer or accumulator, and also with five pairs of sockets to accommodate the flexible leads described above. Price of Distribution Box **2/6**.



Suggested Hornby Train Improvements

CAB DETAILS FOR HORNBY LOCOMOTIVES

The cab controls and fittings of any locomotive are an irresistible attraction to model railway enthusiasts, who usually have a strong desire to incorporate typical fittings in the cabs of their miniature engines. Formerly the only engines thus provided were the large-scale models, seen in museums and at exhibitions, in which a special feature is made of including every detail found on the prototype represented. A great step forward was taken when the now well-known No. 2 Special Locomotives were introduced into the Hornby Series, for their cabs are fitted up in a much more complete manner than is usual with Gauge 0 locomotives, and representations of various footplate fittings, such as the steam and water gauges and the fire-hole door, appear on the boiler back-plate. These may be seen very clearly in the photograph reproduced on this page of the rear end of a Hornby G.W.R. "County of Bedford" Locomotive, for the fittings have been specially "picked out" in correct colours, giving the cab a very pleasing appearance. The other No. 2 Special Tender Locomotives may be treated similarly, the details varying according to the practice of the company concerned, and the necessary alterations may be carried out without difficulty.

The first step is to smooth down any little irregularities there may be in the back-plate casting. The whole of the casting, including the back-plate, footblock and the "splashers" in the cab, then should be painted black, leaving the inside of the spectacle plate and side sheets green. A satisfactory paint is the "cylinder black" sold for use on motor cycles and cars, for this dries quickly with a semi-matt finish that is very suitable for miniature railway work. It may be obtained quite cheaply at cycle stores and garages. The dials of the gauges should be painted white, and a thin streak of white or, if preferred, silver paint should be applied down the centre of the water-gauge.

The bezel of each circular gauge and the union underneath, the water-gauge frame and cocks, and the lubricating "boxes" at the rear of the inside cab splashers must then be carefully coated with gold paint in order to give them a similar appearance to their brass originals. Probably two applications will be necessary, and the instructions of the makers on this point should be carefully carried out, for different brands of such paint vary slightly.

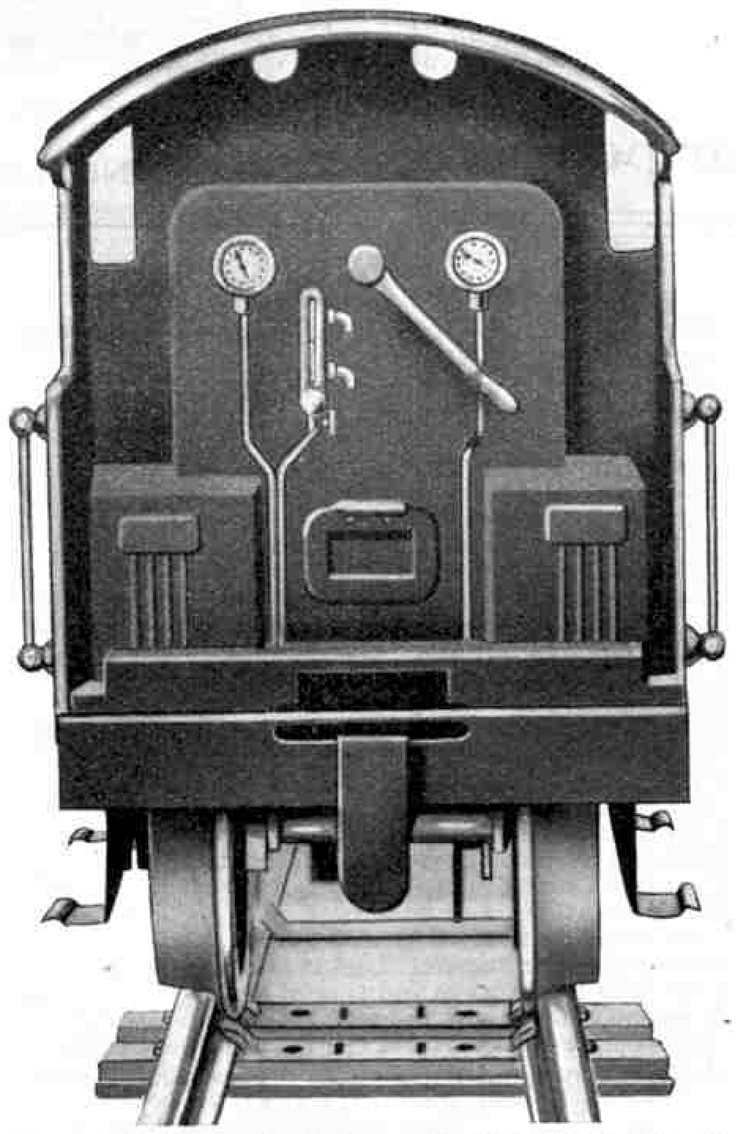
The copper piping found on real engines now remains to be shown. The addition of a little brown colour to the gold previously used will give a satisfactory copper tint, and the pressure-gauge tubes, the water-gauge blow-down pipe and the oil pipes leading from the lubricating boxes should be very carefully picked out with this colour. If any smudges are made accidentally they may be left to dry and Indian ink or black paint used to conceal them, for any attempt to wipe them off will probably spoil matters. The pointers on the gauges should be indicated in black. The pressure-gauge, in this case the left-hand one, may have a small red mark upon the dial to indicate the blowing-off point, and if desired the water level may be shown by a fine line across the white portion of the water-gauge. Finally the regulator handle may be picked out in red paint in the case of engines of the G.W.R. "County" class, or in silver if the bright steel of other companies' engines is to be reproduced.

TRAIN WEIGHTS

Hornby Locomotives have always been remarkable for their hauling power, and those in the present range are extremely capable in this respect. Much depends upon the particular layout adopted, the amount of straight track in use, and the condition of the line, the locomotive and the vehicles composing the train.

In actual practice the composition of a train and its weight have to be recorded by the guard, and the details are entered in his journal. The weights of the vehicles are marked on them for this purpose, a favourite position being on the ends of coaches, about half-way up, so that they may be easily read from the platform. These figures give the weight of the vehicle empty, or the "tare" weight as it is called. On goods wagons this weight is usually painted on the sides, so that when a loaded wagon is passed over a weighbridge the actual weight of the load carried can be quickly determined.

The comparative weights of miniature locomotives and rolling stock can readily be calculated once a recognised basis for the figures is found. This naturally varies with the size or scale of the models, and for Gauge 0 29 tons may be taken as equal to 1 lb. actual



Our photograph shows the cab of a Hornby No. 2 Special Locomotive in which the fittings have been "picked out" in paint in the manner described on this page. The treatment gives the cab of the engine a very attractive appearance.

weight. A ton in actual practice therefore is represented in Gauge 0 stock by a little more than half-an-ounce. The actual figure is .55 oz., and if the various items of rolling stock in use on a layout, and the locomotives also if desired, are carefully weighed, their scale weights in miniature may be worked out on the basis that every ounce represents 1 ton 16 cwt. 1 qr. Load limits for various classes of engines then may be laid down after trials, and it will be found that the correct use of tonnage figures adds greatly to the fun of operations.

SUBURBAN SET TRAINS

Suburban traffic is still a matter of considerable importance to our railways, in spite of the competition of tramway and motor-bus services. Of steam-operated services, those on the G.E. section of the L.N.E.R. are probably the most noteworthy in the world for their intensive nature. There are also of course several examples of electrified suburban railways, of which the S.R. system claims to be the most extensive.

The importance of such traffic should not be lost upon the owners of miniature railways, and a great deal of fun is to be obtained from the organisation and operation of a more or less intensive suburban service. It is desirable for suburban work that the trains should have as great a carrying capacity as possible, and yet not be of undue weight, so as to avoid overtaxing the powers of the small tank engines often employed. Again, excessive length is to be avoided, so that running-round facilities at terminals are not interfered with, thus causing delay; and so that suburban stations, which may be on the short side, shall be able to accommodate a full-length train.

These requirements and the necessity for avoiding undue shunting in preparing the trains have resulted in the scheme of employing what are variously known as "set trains," "block trains," or "twin trains" for such work. These are usually made up of a definite number of coaches, with a guard's and luggage compartment at each end of the train, and the vehicles when in service are rarely uncoupled. Strengthening units of two or more coaches may be added at either end during "rush periods."

On a Hornby railway a very interesting set train may be made up of No. 1 Passenger Coaches, using the corresponding Guards' Vans at each end of the train if possible. In order to keep the length of the train down, and to maintain its operation as a unit, real practice may be copied in the "close-coupling" of the various vehicles. Close-coupled set trains have long been known, the usual screw couplings and buffers being dispensed with between adjacent vehicles. A special link is used to couple the coaches permanently, and specially short buffers replace the ordinary long coach buffers.

Using Hornby No. 1 Coaches, therefore, the couplings and buffers are removed, except at the look-out ends of the Guards' Vans at each end of the train. Where only one Van is used, an ordinary coach will form the head of the train, and it will have the buffers and couplings removed at one end only. The eyelets forming the coupling pivots should be removed by pinching in their turned-over portions underneath the coaches with a pair of pliers. The buffers are removed by twisting them off, care being taken not to distort the buffer beam in the process. Some bending may take place, in which case the pliers may be used to straighten up the beams again. The roof is now removed from each coach, and the couplings are replaced by a Meccano Flat Bracket attached to the floor of the coaches by means of a Meccano Nut and Bolt. The oval hole is used, and the Bracket should be fixed so that it projects beyond the buffer beam as much as possible. Lock-nuts should be fitted for additional security, and when this has been done the roof may be replaced. The Brackets should be bent very slightly up or down as the case may be, so that one passes quite easily under that fitted to the adjacent vehicle, a little play being left between them.

The train is then assembled in order, with the Brackets overlapping. A Meccano Bolt is passed through each hole, those ½" long being advisable, as they project downwards below the edges of the buffer beams, and allow the necessary Nuts to be fitted easily. After a "trial run" of the set, so as to see that these Nuts are not run up the Bolts too closely to the Brackets, additional lock-nuts may be fitted. A set train made up in this way has a very smart and interesting appearance. The number of vehicles composing the train depends upon the conditions to be fulfilled and the particular line they are to run on. A small addition of interest will be to number and label such sets according to the district they are used in, as in actual practice. In timetable working this will be necessary to enable the various sets to be identified. "Binnswan District Set No. 1," or some similar title, will look quite effective, and may be painted on the ends of the train, or a narrow label may be stuck on to represent a lettered board.

World's fastest engine "GOOD AS NEW" after running at 407 miles an hour

Extract from the London "Daily Telegraph," Mar. 3, 1932

DERBY.

"I have just seen, at the Rolls-Royce works here, the engine used by Flight-Lt. G. Stainforth in his world record flight of 407½ miles per hour last September. It had been completely dismantled for scientific examination, and its 2,450 parts were exposed on a bench.

"They look like the parts of an unused engine, and show no sign of the practically full-throttle 2,560 h.p. developed at the speed of 3,400 revolutions per minute, which was attained during the record flight."

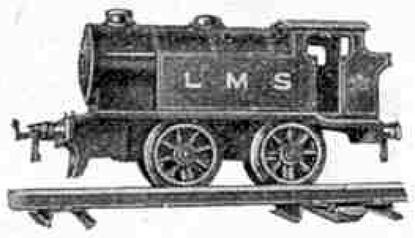
on

Pratts WITH ETHYL

SPECIAL

Now same price as regular petrols

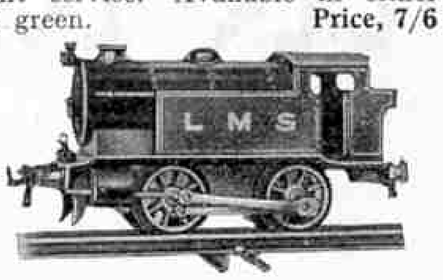
HORNBY TANK LOCOMOTIVES



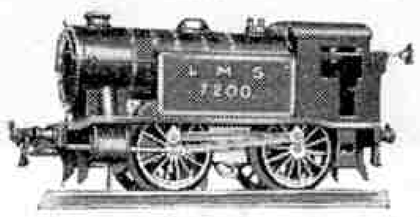
M3 Tank Locomotive

M3 TANK LOCOMOTIVE. This is the powerful Locomotive (reversing) supplied with the Hornby M3 Tank Goods Set. It is a handsome and extremely reliable model that will give long and excellent service. Available in either red or green. **Price, 7/6**

No. 1 TANK LOCOMOTIVE. This strong and durable Locomotive is capable of any amount of hard work. It is fitted with brake mechanism and reversing gear, and is supplied in colours to represent L.M.S.R., L.N.E.R., G.W.R. or S.R. Locomotives. **Price, 13/6**



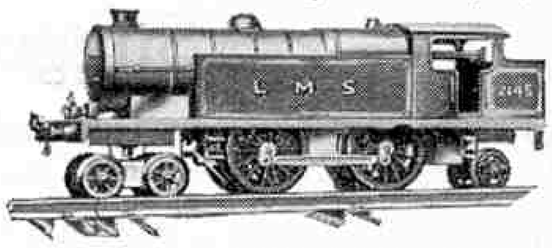
No. 1 Tank Locomotive



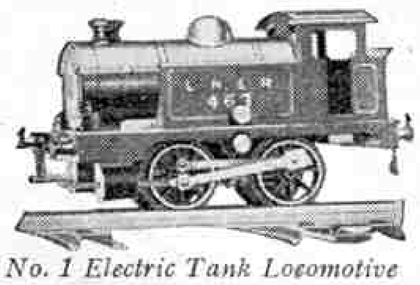
No. 1 Special Tank Locomotive

No. 1 SPECIAL TANK LOCOMOTIVE. This splendid Locomotive which is fitted with brake mechanism and reversing gear, has remarkable power and gives a very long run. It is available in the colours of the L.M.S., L.N.E., G.W. and Southern Railways. **Price, 18/-**

No. 2 SPECIAL TANK LOCOMOTIVE. This Locomotive has great length of run and exceptional pulling power. It is fitted with brake mechanism and reversing gear. In every respect it is a perfect model, beautifully finished in the colours of the L.M.S., L.N.E., G.W. and Southern Railways. **Price, 25/-**



No. 2 Special Tank Locomotive



No. 1 Electric Tank Locomotive

No. 1 ELECTRIC TANK LOCOMOTIVE. This Locomotive is of the permanent magnet type, and may be run from a 6-volt accumulator. It can be stopped, re-started, reversed and the speed varied by the operation of levers at the side of the track. It is supplied with a terminal connecting plate, speed and reverse control switch and 3 feet of flex, and it is available in the colours of the L.M.S., L.N.E., G.W., and Southern Railway Locomotives. **Price, 32/6**

This Locomotive cannot be run from the mains supply.

MECCANO LTD. - OLD SWAN - LIVERPOOL

Aviation of the Future—*(Continued from page 331)*

future certainly will incorporate devices to lessen the shock. They may have helicopter screws to enable them to rise vertically from the ground and to descend under complete control to make contact with the ground without any shock whatever. Another possibility is the provision of extensible wings that during flight would be contracted in order to enable high speeds to be attained, and would be spread out over a maximum area when landing or travelling slowly. The development of machines so fitted would make the provision of large landing grounds unnecessary, and there would be ample room for aerodromes on the roofs of the gigantic buildings of cities of the future.

The provision of helicopter screws will make aeroplanes safer and easier to handle, and other devices at present undreamed of also may be introduced for this purpose. Passengers in the giant machines of the future will laugh when they think of the pioneer days when parachutes were provided, for except on small private aircraft, flight then will be largely automatic. Stability will be given to the machines by means of special devices; engines will be far more reliable than those of to-day; and the failure of one or two power units will not matter very much, for each machine will be equipped with a large number of these, and repairs then will be carried out immediately by mechanics included in the crew. Even flying the machines themselves will be automatic, for on the well-established routes there will be complete control by wireless, and the height and course of each aeroplane will be settled in accordance with weather reports and forecasts.

The Seven Ages of Man

(By A. V. K., with apologies to William Shakespeare)

All the world's on wheels,
And all the men and women merely riders:
They have their huge pneumatics and their solids;
And one man in his time tries many types,
His life being seven rides. At first the infant,
Gurgling contentment in a well-tyred pram.,
Then the smiling schoolboy with his scooter
With lovely springing tyres, flying like wind
Quite willingly to school. And then the worker,
Riding his push-bike, gets there in time, having
No trouble with puncture-proof tyres. Then a scorcher,
Riding motor-bike, and "pillioned" by a pal
Clothed for the ride, the countryside to cover,
Defying all laws and regulations,
Even the policeman's signals. And then the "tripper,"
With shining eyes and ever-smiling face,
Faster can go with the old "solids" scrapped;
And so he's better pleased. The sixth age shifts
Into the swift and silent motor-car,
With big pneumatic tyres so well inflated
That not a single bump is ever felt
By those inside; and punctures,
That dread curse of all keen motorists,
Are hardly ever known. Last ride of all,
That ends this strange and tyreful history,
Is second childishness and well-tyred bath-chair!
'Tis tyres, tyres here, tyres there, tyres everywhere!

(Reprinted by permission from the "Thornycroft Basingstoke Works Magazine.")

For Staines Readers

An interesting Model-building Competition was held at Staines recently by the London Cycle and Sports Company. The entries were of a high standard and the Meccano representative who was sent to judge them was very pleased with the quality and number of the models.

The first prize was won by G. McKirdy, age 8, with a fine model of H.M.S. Nottingham. The second prize was awarded to J. Capon, age 11, for an excellent model of a Motor Lorry Chassis; and the third went to G. Greenslade, age 12, for an Anti-Aircraft Gun complete with Base. In addition, consolation prizes were won by A. McKirdy, age 5; C. Mann; R. Johnson and P. Bainbridge.

"MECCANO MAGAZINE" BINDERS

Your Magazines may be kept clean and tidy by enclosing them in one of the special binders we supply. Two sizes, price 3/- and 4/6 post free, from Meccano Ltd., Old Swan, Liverpool.

How to Get More Fun—*(Cont. from page 381)*

small nicks should be pierced in the bend or fold at the bottom of the sheets, and the lugs passing through these are turned over and so secure the deflectors in position.

The painting of the sheets should be carried out on the inside before final attachment. To secure them more firmly—for the card will probably have a tendency to spring outward—small holes should be made in the sheets immediately above and below the level of the engine handrail. The smoke deflectors may then be "stitched on" with cotton or fine wire.

Tommy Dodd—*(Continued from page 383)*

except that Messrs. Carr's vehicle is painted in dark blue, and that of Messrs. Crawford is finished in red. Each carries the Royal Arms, the former on the door and the latter on the van sides.

Probably all miniature railway owners do a certain amount of constructional work for their lines, and to them a tube of seccotine is indispensable. The manufacturers of this famous product, M'Caw, Stevenson & Orr Ltd., of Belfast, are therefore represented in this series of private owners' special traffic vans by the Seccotine Van. It is finished in blue, and the lettering on the sides "Seccotine Sticks Everything" is carried out in the style familiar on the cartons containing the tubes.

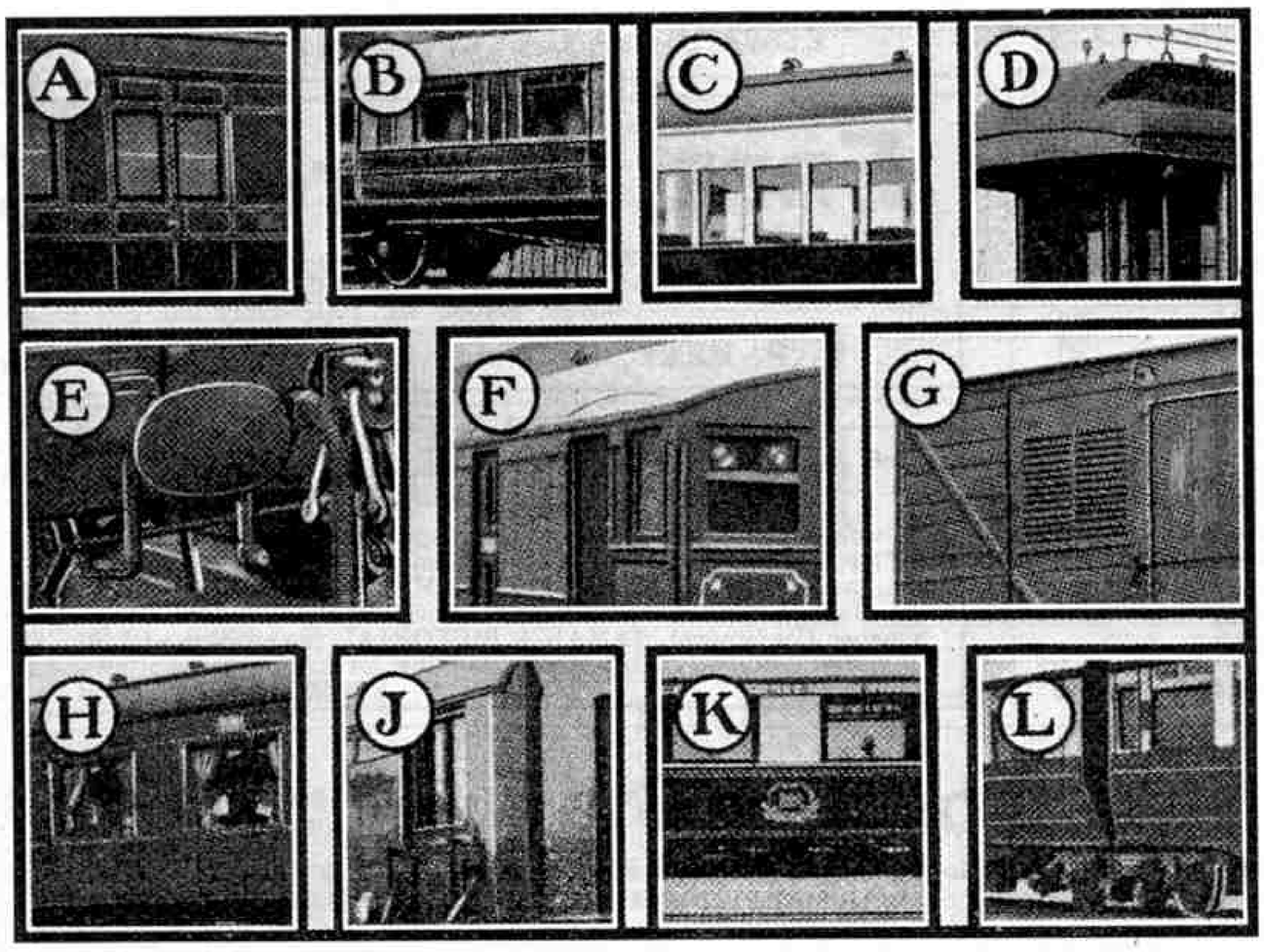
In connection with the working of the Vans dealt with in this article it should be remembered that they usually run loaded in one direction only, as there could hardly be a return load, of say, fish to a seaport. The working of the empty vehicles to their starting point will, however, prove interesting in miniature.

H.R.C. COMPETITION PAGE

Competitions appearing on this page are open only to members of the Hornby Railway Company. Envelopes containing entries should have the title of the competition clearly written in the top left-hand corner and should be addressed to the Hornby Railway Company, Binns Road, Old Swan, Liverpool. The name, address and membership number of each competitor should appear in clear writing on every sheet of paper used.

ROLLING STOCK CONTEST No. 2

In recent years the railway companies have made vast strides towards the improvement of their rolling stock, and large numbers of luxurious coaches have been placed in service. The practice of each railway group has characteristic features, which are maintained in the construction of almost all new stock. For instance, the L.N.E.R. favours bow-ended coaches and articulated train sets, while the L.M.S.R. is very partial to centre-corridor stock. Such characteristics make coaches easily distinguishable, and we have no doubt that H.R.C. members can readily recognise almost any type of railway vehicle.



On this page we reproduce a selection of various portions of different railway vehicles. Competitors are required to state their type, the company to which they belong, and any other interesting details concerning them.

Prizes consisting of Hornby Railway material (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– will be awarded respectively to the senders of the four best entries submitted. In addition a number of consolation prizes will be given.

In the event of a tie for any prize, neatness and novelty of presentation will be one of the deciding factors. The contest will be divided as usual into two sections—Home and Overseas.

Entries should be placed in an envelope clearly marked H.R.C. "*Rolling Stock Contest No. 2,*" and posted to reach Meccano Ltd., Binns Road, Old Swan, Liverpool, on or before 31st May. The closing date for the Overseas Section is 31st August. Competitors should make a careful note of the closing dates as any entry received after published dates will not be entertained.

It must be remembered that the omission of the H.R.C. number from any entry will cause it to be disqualified. This is an important condition to which members should pay special attention, as its neglect in the past has occasionally caused entries to be discarded that might otherwise have been successful. Members should also take care to ensure that their name and full address is clearly written on the back of each sheet of paper submitted, as a number of entries are sent in each month not bearing any name and address.

Missing Words Contest

For our contest this month we reproduce below some interesting facts about the inauguration of a well-known L.N.E.R. train. It will be seen that a number of words have been omitted and represented by a "dash." We want competitors to fill in the correct words from the list below.

List of Words :—July, via, September, Bradford, extended, Newcastle, restaurant, Glasgow, Ripon, Leeds, Berwick, Harrogate, train.

"The Harrogate and Edinburgh Pullman — is composed entirely of first and third-class Pullman — cars. This train was first placed in service in — 1923 to serve Leeds, —, Harrogate, —, Darlington and — . From July, 1925, the train was extended to serve — and Edinburgh, and from — 1925 the train was divided, the Harrogate and Edinburgh Pullman ceasing to serve Leeds and Bradford and running non-stop to — via Church Fenton. A new West Riding Pullman was instituted to serve — non-stop and Bradford. Commencing May, 1928, the Harrogate and Edinburgh Pullman was named '*The Queen of Scots*' and ran — Leeds (Central) and was extended to and from — . The West Riding Pullman was — from Leeds to Harrogate."

Entries for this contest should be submitted on postcards, in the top right-hand corner of which should appear the competitor's name, H.R.C. membership number and full address. Prizes consisting of Hornby Railway material (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded to the four competitors whose entries compare most nearly to the correct solution.

Envelopes containing entries should be clearly marked H.R.C. "*Missing Words Contest,*" and posted to reach Headquarters at Meccano Ltd., Binns Road, Old Swan, Liverpool, on or before 31st May. Overseas closing date, 31st August.

COMPETITION RESULTS

HOME

February "Tenders Contest." First: A. Richardson (20073), Armley, Leeds. Second: J. H. Owen (25954), Radford, Coventry. Third: J. W. C. Lowe (25627), Clacton-on-Sea, Essex. Fourth: A. R. Holmes (17022), Peterborough. Consolation Prizes: J. L. Stevenson (22346), Colinton, Midlothian; R. E. Bradfield (3970), Didcot, Berks.; G. Hughes (7036), New Barnet, Herts.; G. H. Preston (12020), West Ealing, London, W.13; P. A. Vicary (25935), Cromer; E. Humphreys (28471), Lincoln; R. L. Pott (9196), Cowley, Oxford; B. C. Clay (21511), Harrogate; G. Scales (2946), Scarborough; J. Bryce (9070), Paisley; E. G. Absolon (6295), Wood Green, London, N.22; M. O. Swansborough (26426), Enfield Wash, Middx.

February "Questions Contest No. 3." First: H. T. Buckingham (23588), Leighton Buzzard. Second: A. F. Agnew (20882), Dublin, S.W.7. Third: J. C. Thorne (298), Maidstone, Kent. Fourth: A. Burst (21133), London, S.W.1. Consolation Prizes: A. Mossop (27655), Egremont, Cumb.; W. Nicholson (26556), Drumburgh, Nr. Carlisle; E. Clough (25443), Swinton, Manchester; B. Such (24846), Redditch; R. Billings (4431), Plumstead, London, S.E.18; H. J. Cohen (12763), Leyton, London, E.10; C. Sinclair (16058), Crookston, Glasgow, S.W.2; N. Claydon (2021), Kettering, Northants.; R. W. Finch (13518), Palmer's Green, London, N.13; R. Wharton (2779), Maryport, Cumb.; L. Darby (25760), Old Trafford, Manchester; W. A. Alexander (2601), Eccles, Manchester.

OVERSEAS

November "Marshalling Yard Contest." First: V. L. M. Noguera (22773), Buenos Aires, Argentine. Second: R. B. McMillan (9592), Melbourne, S.C.2, Australia. Third: J. A. Rodriguez (3647), Montreal, P.Q., Canada. Fourth: T. Watson (18065), Leichhardt, N.S.W., Australia. Consolation Prizes: A. Schwartz (24271), N. Rhodesia, S. Africa; E. C. Stonyer (10306), South Canterbury, New Zealand; A. Jack (12401), Brighton, S.5, Victoria, Australia; A. F. G. King (17779), S. Rhodesia, S. Africa; B. Chiles (9191), Port Elizabeth, S. Africa; J. A. Coates (23863), Verdun, Quebec, Canada; G. E. Schulz (15425), Coromby, Victoria, Australia.

November "Voting Contest." First: R. Garcia (23445), Trinidad, British West Indies. Second: F. van Bulck (1875), Forest-Brussels, Belgium. Third: C. Humm (24284), Geraldine, New Zealand. Fourth: A. Johnstone (16298), N.S.W., Australia.

STAMP BARGAINS HERE!

Here are a few of our wonderful Long Sets. Stamps in each are all different and from one country only. They are just the packets to fill up blank album pages.

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ANTIGUA'S TERCENTENARY CELEBRATIONS

AMONG British Colonial possessions in the New World, Antigua is one of the few that may claim the distinction of having been discovered by Columbus. That was in 1493 in the course of the Genoese navigator's second voyage of discovery in the New World. The island remained uninhabited for a further 140 years until 1632, when a party of British settlers from St. Kitts landed upon it and commenced colonisation.

The tercentenary of British association is therefore celebrated this year, and in commemoration of the event Antigua issued on 1st January a special set of stamps comprising 11 values, ranging from ½d. to 10/– in value, using the four designs shown in our illustrations.

Antigua is the seat of Government of the Leeward Islands group, which consists of five presidencies, (1) Antigua, Barbuda and Redonda; (2) St. Kitts-Nevis with Anguilla; (3) Dominica; (4) Montserrat; (5) The Virgin Islands. Antigua is the largest island of the group, and is 108 sq. miles in area, with a circumference of 54 miles.

Unlike most of the West Indian islands it does not possess a central range of mountains, and the highest point of land is among the hills in the South-West of the island, a mere 1,328 ft. above sea level. The comparative flatness of the land results in a scarcity of rivers and streams. This fact, coupled with the almost complete de-forestation, makes the island particularly liable to drought. Fortunately the soil is fertile and retentive of moisture, and despite the wide fluctuation in the annual rainfall—the average in recent years has been 45 in.—the agricultural industry has struggled along with no really great difficulty. Approximately one-quarter of the island's area, some 17,000 acres, is under cultivation, principally for the sugar and cotton industries and the greater part of the population, estimated at 30,000 in 1929, is associated with these industries in one way or another. The island also exports considerable quantities of molasses, fruit and arrowroot.

Redonda is more or less uninhabited, and Barbuda, although cultivated intensely in its more fertile parts, is principally noted for the excellence of its sporting facilities. It boasts many splendid herds of wild deer and its tarpon fishing is famous.

As we have already stated, Antigua was discovered by Columbus in 1493, and it is believed that he named the island after a church in Seville, Santa Maria la Antigua.

In 1632 the first band of British settlers arrived with Sir Thomas Warner, but serious development was not put in hand until 1663, when another group of settlers arrived under the leadership of Lord Willoughby, to whom the British Government had granted the island. This party was not allowed to settle down, however, for in 1666 a French force attacked and captured the island. It remained in French hands for only a short time, however, and a determined effort led to its recapture by the British a few months later. Subsequently it was formally restored to Britain by the treaty of Breda and it has remained British territory to this day.

The capital of the island is St. Johns, a town of some 7,000 inhabitants, where stands the Governor's residence, Government House, which is illustrated in the design used for the 2d., 2½d. and 3d. values of the new stamp issue. The history of the residency dates back to the early part of the 18th century, but it contains little of interest apart from the remarkably beautiful grounds surrounding it.

The old dockyard at English Harbour, illustrated on the ½d., 1d., and 1½d. values, is of vastly greater interest, for it was here that Lord Nelson refitted his ships and took in supplies in 1805, in the course of his famous pursuit of the French Admiral Villeneuve from the Mediterranean to the West Indies and back. On the outward run of this voyage Nelson succeeded in crossing the Atlantic in the remarkably fast time of 24 days, an outstanding feat of seamanship to which we referred in our stamp article in the December, 1931, "*M.M.*" The design of the 6d., 1/– and 2/6 values shows Nelson's flagship "*Victory*" lying off St. Johns just before the return voyage to Europe, which ended, as most boys know, in the blockading of the French fleet at Cadiz and finally the battle of Trafalgar, at which Nelson scored a crushing victory and met his death. To-day English Harbour is only rarely used by shipping, but the Naval Barracks there still contain many relics of its past glories, including an inscription painted on its walls by H.M. King George, when, as Prince George in his naval service days, he visited the island.

Finally there are the 5/– and 10/– values, the design for which shows the 17th century vessel in which Sir Thomas Warner and his band of settlers reached the islands from St. Kitts in 1632. The ship is seen through a long corridor and three arches symbolic of the three centuries that have passed.

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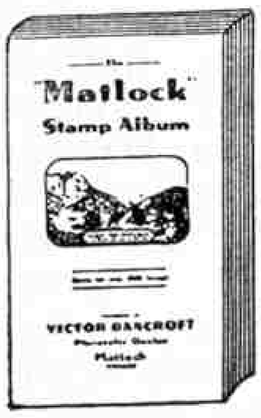

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Stamp Gossip

and Notes on New Issues

New United States Issues

The Washington bi-centenary commemorative series, a specimen from which was illustrated in our April issue, is the United States' most important commemorative since the Columbian Exposition issue of 1893, and it is not surprising, therefore, that throughout the first day of issue, 1st January, the Head Post Office at Washington was thronged by crowds of stamp collectors eager to secure specimens of the new stamps with "first day" cancellations.

The issue consists of 12 stamps, ranging from ½c. to 10c. in value, with designs showing different portraits of Washington taken from well-known paintings and sculptures in the possession of U.S. Museums and historical societies.

The international Olympic winter games held at Lake Placid, New York State, during February, was also made the occasion of a commemorative stamp issue. The design, illustrated here, shows a ski-er making a high jump, against an expansive background of snow and leaden skies. The stamp is coloured with the conventional red and white, a compulsory but somewhat unfortunate choice for a subject of this nature.

American new issues have been particularly prominent recently, for in addition to the commemoratives just described, the Canal Zone permanent issue has been augmented by three new portrait designs for general use, and a series of three air mail stamps. The general issue portraits are as follows:—10c., General H. F. Hodges, a member of the original Isthmian Canal Commission; 15c., Mr. Jackson Smith, also a member of the Commission; 20c., Admiral H. H. Rousseau. With these new stamps the Canal Zone permanent issue consists of eight stamps, the 1c. and 2c., and the 5c., 12c., and 50c. values having been issued in 1928 and 1929 respectively.

Each of the air stamps takes a design, illustrated last month, showing a monoplane flying over the Gaillard Cut and in the middle distance a typical freighter proceeding through the Canal. This stamp makes an interesting addition to the several existing stamp views of the Canal.

We thank Stanley Gibbons Ltd. for their courtesy in loaning the stamps from which the illustrations for our stamp pages have been made.

Roumania's New Air Post Stamps

Among the many beautiful new issues of recent days, Roumania's series of air mail stamps must take a foremost place. The production standard is very high indeed. The series consists of five values, 2, 3, 5, 10 and 20 lei, the designs in all cases representing aircraft of different types passing over local scenes. Our illustration of the 5 lei value is typical.

We also illustrate the recently issued 16 lei stamp showing a composite picture of Roumania's three Kings, Carol (Prince of Roumania 1866-1881, King 1881-1914), King Ferdinand (1914–1927), and the present King Carol, who ascended the throne on 8th June, 1930. Previously Carol had renounced his rights, and on the death of King Ferdinand in 1927, Carol's young son, Michael, succeeded to the crown and with the aid of a Regent reigned until his father returned to the country and re-asserted his right to occupy the throne.

Improved Design for Sarawak

There are few more romantic figures in British Colonial history than the white Raja of Sarawak, Sir Charles Vyner Brooke, and therefore special interest attaches to the recent change in the stamp designs employed in his territory. As our illustration shows, the old portrait of Sir Charles Brooke has been substituted by a more recent likeness, and the opportunity has been taken to introduce a framing more in accordance with modern ideas in design. It will be agreed that the new design is a great improvement.

Italian Naval Commemoratives

After a quiescent period of nearly a year, Italy has issued another commemorative set, on this occasion to celebrate the 50th anniversary of the foundation of the Naval Academy at Leghorn. The issue contains three stamps: 20c., a view of the Tower of the Marzocco; 50c., a sailing vessel, the "*Amerijo Vespucci*"; and 1L.25., the modern battleship "*Trento*."

The tower of the Marzocco is an ancient Florentine watch tower built in 1423 on the site of a still older tower.

* * * *

Poland is suffering considerably from the activities of the stamp "faker." Extensive quantities of current issues have been counterfeited, and to overcome the trouble the further issues are to be printed upon a new type of paper, with Posthorn Watermarks repeated throughout the sheet. The 30gr. stamp will be the first value to appear.

Spain Celebrates Postal Congress

The third Pan-American Postal Union Congress held in Madrid in October last was celebrated by the issue of a special commemorative stamp series, and, although it has become quite "an old Spanish custom" to issue special commemorative stamps on the slightest provocation, this set at least possesses genuine interest.

It consists of eight stamps, five for general postal purposes and three for air mail use. The designs are of exceptional interest, the 5 and 40c. values showing the famous fountain of the Lions in the Alhambra at Granada; the 10, 25 and 50c., an interior view of Cordoba Cathedral, built in 787 by the Moorish chieftain Abderahman, and considered by many to be the finest piece of Moslem mosque architecture. The 15c. and 1 peseta values show the fortified bridge at Toledo, with the castle in the background, while the 30c. bears a portrait of Dr. Francisco Garcia y Santos, a former Postmaster-General of Uruguay, the founder of the Pan-American Postal Union. Only the design used for the 4p. and 10p. values bears reference to the revolution of 1931. This shows the scene in the Puerto del Sol at Madrid on 14th April, 1931, when the Republican flag was hoisted for the first time.

The air stamp designs are also very fine. The 5c., 10c. and 25c. values show an aeroplane in flight, with a view of the Royal Palace and San Francisco el Grande in the background, while the 50c. and 1p. values show the General Post Office at Madrid. The 4p. stamp, which is illustrated here, gives a splendid aerial view of Madrid, with the Calle de Alcala and the Plaza de Castelan in the foreground. In the middle distance to the right the General Post Office is again to be seen.

A specially interesting feature of the designs in this series is that in all values

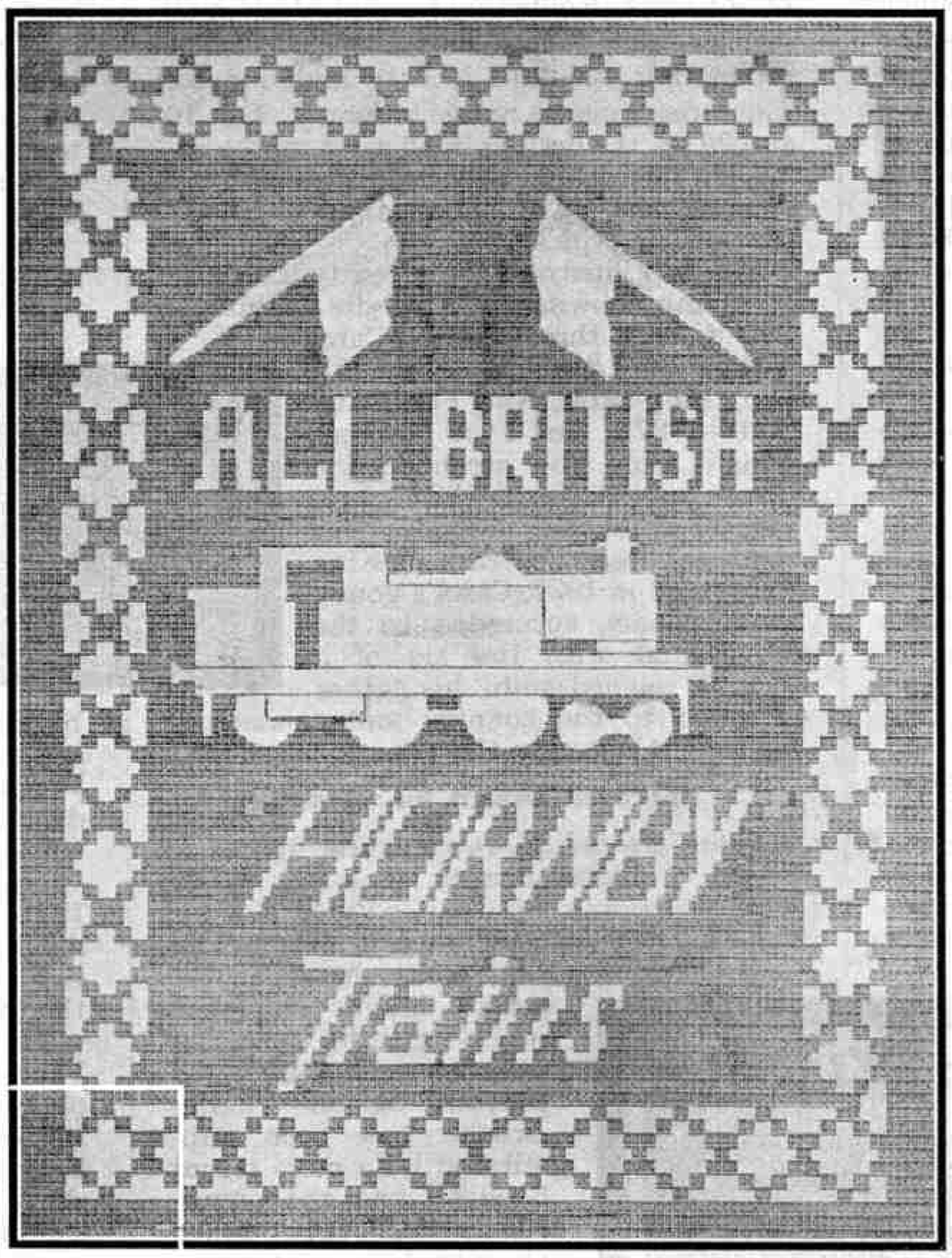
likely to be employed for franking registered mail, there is incorporated a representation of the back of a registered envelope, sealed in the manner required by the official regulations. In our illustration of the 4p. air stamp this device can be seen at the foot of the stamp, partially obscured by the words "Union" and "Postal."

Competition Page

HAVE YOU A TYPEWRITER?

Typewriting machines in recent years have become an increasingly common feature of the well-equipped household and gradually the old idea that personal correspondence must be personally written is dying. This tendency is becoming more and more apparent in the Editorial postbag. Where five years ago one letter was typewritten, to-day there are at least six, and it is worth mentioning that very few of the typewritten letters are written on cheap toys with rubber type.

When man first learned to write he conveyed his meaning by picture signs. The order of things to-day is reversed. The clever typist can make his writing machine draw sign pictures, and in the centre of this page we reproduce a striking effort sent to Mr. Frank Hornby by one of our readers. It is one of the cleverest pieces of typewriting designing that we have ever seen. The original measures $11\frac{1}{4}$ in. in width by 15 in. in depth and, as the considerable reduction in size for reproduction has resulted in the individual characters becoming indistinct, a small section is reproduced at the foot of the page in its exact size in order that the excellence of the work may be clearly noted. The complete reproduction has been marked to show the location of this section.



Doubtless many others among our readers have dabbled in this intriguing pastime and have achieved results of equal or perhaps even greater merit. Such things should not remain hidden and accordingly we offer four prizes this month for the best pieces of typewriter designing submitted. The prizes will consist of Meccano or Hornby Train products (to be chosen by the winners) to the value of 21/–, 15/–, 10/6 and 5/– respectively.

It should be made clear that the awards will be made strictly on the basis of novelty and clarity of design, and a simple straightforward idea neatly worked out will have an equal chance of success with an elaborate but involved design presented on a large scale.

The competitor's name and address must appear on the back of each entry submitted, and the designs must be addressed "Type Designs, Meccano Magazine, Binns Road, Old Swan, Liverpool," and sent to reach this office not later than 31st May. A duplicate set of prizes will be reserved for Overseas readers—those living outside Great Britain, Ireland and the Channel Islands—whose entries must reach us not later than 31st August.

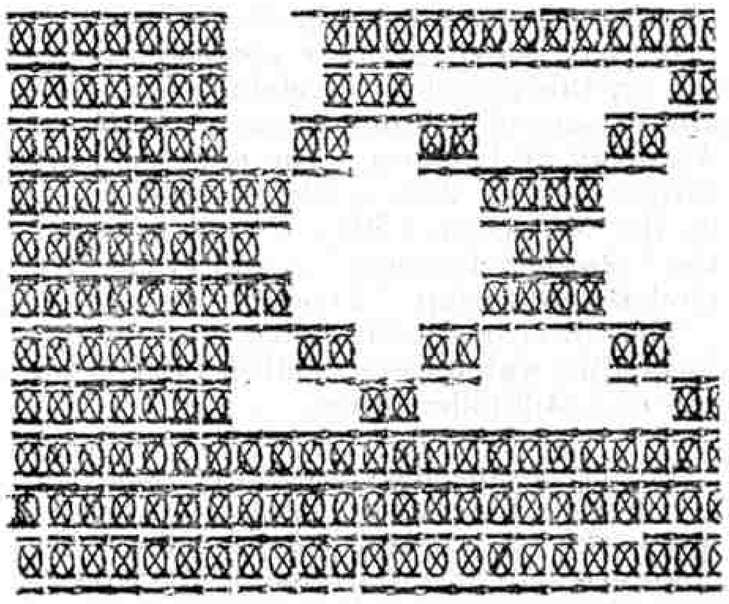
Where desired the entries will be returned, but a stamped addressed wrapper must be sent for the purpose. The prizewinning entries become the property of the Editor, of course, and cannot be returned.

May Photographic Contest

As we announced in our last issue, our monthly photographic contests are open for photographs of any subject made with any make of camera, film or paper. The only restrictions are that each print must bear a title and that the exposure shall have been made by the competitor.

The entries will be divided into two sections, A for those from readers aged 16 and over, B for those under 16, and in each section there will be prizes of photographic materials, or Meccano products, to the value of 21/– and 10/6 for the best and second best entry respectively.

Entries to this month's contest must be addressed "May Photo Contest, Meccano Magazine, Binns Road, Old Swan, Liverpool," and must reach this office not later than 31st May. Overseas, 31st August.



The designer of our illustration is a 14-year old Brentford reader, M. Jones. Apart from the excellence of the design he deserves special congratulations on his remarkable patience. In this small section alone there are 577 characters!

COMPETITION RESULTS

HOME

Christmas Essay.—First Prizes: Section A, H. W. Webb (Wood Green, N.22); Section B, C. G. Gibson (Emyvale, I.F.S.). Second Prizes: Section A, G. A. Grizzell (Poplar, E.14); Section B, R. K. Powell (Guisborough). Consolation Prizes: E. Baines (Doncaster); R. Burrill (Wilmslow); W. E. Challice (Kennington Park, S.E.11); Miss J. Fyson; W. E. Moody (Frome); R. Tallett (Hayes End).

Improbabilities.—1. C. C. O. Young (Bedford); 2. R. F. Nicholas (Portsmouth); 3. H. P. Dicken (Wrexham); 4. E. Longbottom (Derby). Consolation Prizes: J. Cables (London, S.E.13); R. S. Barnard (Lymington); S. H. W. Farr (Gravesend); F. H. King (Liverpool); Wm. Raybould, Jnr. (Bloxwich); T. Wardle (Nottingham).

February Drawing Contest.—Owing to the excellent quality of so many of the entries to this competition, we have awarded three additional prizes of 5/– each.

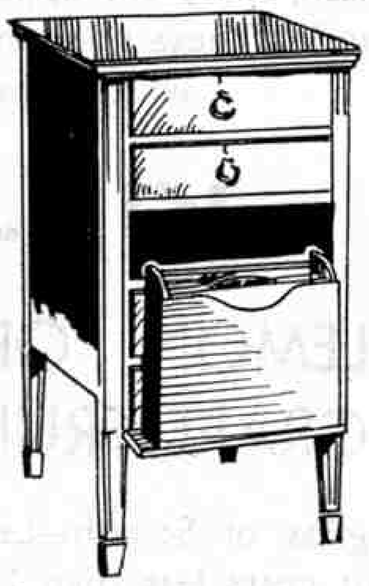
The awards were as follows:—First Prizes: Section A, A. M. Johnston (Dunstable); Section B, A. Baker (Birmingham). Second Prizes: Section A, V. S. Lee (Willesden Green, N.W.2); Section B, C. A. Hobson (Birkenhead); Special Prizes: Section A, A. E. Lukey (Camden Town, N.W.1); P. Rochard, Jnr. (Kendal); Section B, R. Eyre (Heage, Derbys.).

The Care of Records

A GREAT deal of unsatisfactory gramophone reproduction is due to neglect and ill-use of records. First of all there is the trouble that arises from warping. In order to prevent this, records should be stored flat in a suitable cabinet or in envelopes piled up, or vertically in envelopes packed tightly on shelves, like books. Warping is nothing like so common as some writers would have us believe, but when it does occur it is a great nuisance. It is possible to cure a warped record by warming it cautiously and then placing it between two sheets of clean plate glass under the weight of a few heavy books. This process is troublesome, however, and it is much better to take a little care to prevent the defect from arising.

Dust is a more serious enemy, and must be avoided if the best results are to be obtained. When received from the makers, records usually have a considerable amount of dust on them, and this should be removed by means of a brush with bristles that are soft, and yet stiff enough to reach the bottom of the grooves. The best plan is to brush the record with a circular movement while it is revolving on the turntable. When the record has been cleaned in this manner it should be kept clean, and this can only be done if it is always kept, when not in use, in an envelope, an album or a cabinet. Finally, every record should be brushed immediately before it is played and, if one has sufficient enthusiasm, after playing also. This dusting is not in any sense a fad or fancy; it is absolutely necessary if records are to give of their best throughout their career.

Among the many record storage cabinets on the market one of the most ingenious, and certainly one of the most efficient, is made by E.M.G. Hand-Made Gramophones Ltd., 11, Grape Street, New Oxford Street, W.C.1. In this cabinet the records normally lie flat in a series of drawers, separated from each other by plain non-abrasive cards. When a drawer is pulled forward it swings downward by means of a thoroughly reliable hinge device, and thus presents the records on edge in front in the full light, so that every record, whether the first or the last in the drawer, is immediately accessible, without disturbing the arrangement of the others.

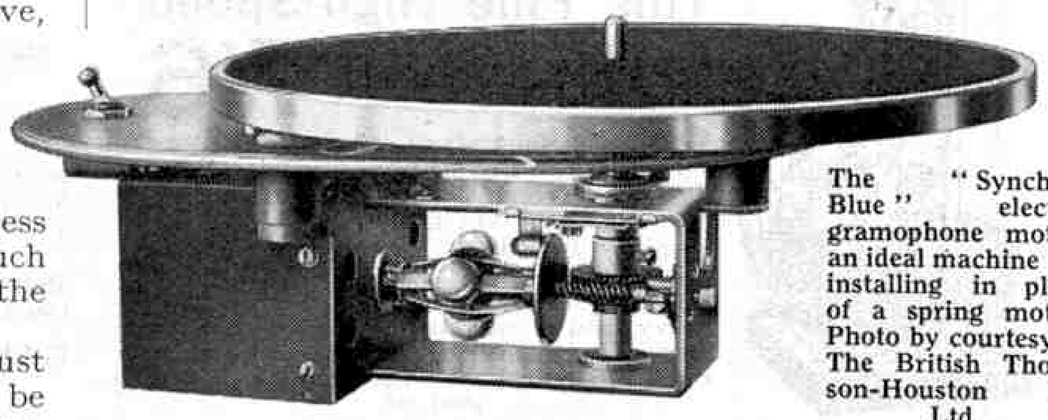


A storage cabinet in which the records normally lie flat, but are presented on edge when the drawers are pulled out and swung down. Illustration by courtesy of E.M.G. Hand-Made Gramophones Ltd.

Thus the records are effectually prevented from warping and at the same time are protected from dust.

A Remarkable Electric Motor

As the result of my reference last month to electric motors for driving gramophones, I have had several enquiries from readers as to whether it is practicable to replace a spring motor by an electric one. It is not only practicable, but quite a simple matter. The British Thomson-Houston Co. Ltd., manufacture a series of motors that are specially adapted for this purpose. All that is necessary in making the change is to remove the clockwork motor, cut a hole of suitable size in the top board, drop the electric motor through, and fix the top plate to the board by four small screws.



The "Synchro-Blue" electric gramophone motor, an ideal machine for installing in place of a spring motor. Photo by courtesy of The British Thomson-Houston Co. Ltd.

The cheapest of these "B.T.H." motors, the "Synchro-Blue," is sold at the remarkably low price of 39/6, and it is certainly wonderful value. Its operation is based on a similar principle to that used in electric clocks, ensuring perfectly constant and correct speed even under fluctuations of supply voltage. The most remarkable feature of the motor is its extreme simplicity. There is no governor gear, and there are only four bearings, so that the motor will run for years without renewal of any parts. Also there is no brushgear, and this, together with rigid construction and a minimum of moving parts, ensures perfectly silent running. The motor is so compact and light that it is suitable for a portable gramophone. It uses so little current that there is no need to stop it between records, and even if it is left switched on all night it will not be damaged, and will not use more than one pennyworth of current. The motor, which by the way cannot interfere with radio or radio-gramophone reception, is supplied with an "on" and "off" switch, voltage adjustment terminals, mains leads, a heavily nickelled turntable and full and simple instructions for fixing.

Fine Organ Reproduction

We have had an epidemic of cinema organ records recently, some of them good, but many of them quite ordinary; now the Columbia Company surprise us with a really remarkable record on the real organ. This record (Col. DX340, 12 in., 4/–) is of Liszt's Prelude and Fugue on the name "*Bach*," played by the well-known Birmingham organist Mr. G. D. Cunningham, on the organ of the Central Hall, Westminster. The music is far from great, but it is undeniably brilliant and even exciting. Liszt wrote only a few works for the organ, and this clever play on the name "*Bach*" is his best-known composition for this instrument. The four musical notes B, A, C, H, form the theme on which the work is built, and to understand this it is necessary to explain that in Continental notation B flat is known as B, and B natural as H. This theme forms the subject of the fugue, opening softly and working up to a thrilling allegro, ending in a colossal coda for full organ. Mr. Cunningham's execution is well known for its clear-cut brilliance, and the recording is really astonishing in its sonority and realism. From the point of view of reproduction this is certainly the greatest organ record yet issued.

A New Ketelbey Record

One good feature about Ketelbey is that he never lets you down. If you do not like his music you let it alone; but if you do like it you are safe in buying his records as they appear, for they are sure to be up to his usual standard. The latest record by the famous composer of "*In a Monastery Garden*" is entitled "*In the Mystic Land of Egypt*" (Col. DB767, 10 in., 2/6), and is played by Charles Prentice and his Orchestra, with vocal effects. The scene is typically Egyptian. First of all is depicted a detachment of native soldiers passing through a village, followed by a song from a boat on the Nile, after which an Arab playing his pipe is pictured. Finally, before the quiet conclusion, some returning soldiers sing in rich harmony the song, which is quite a charming one.

Some Good Band Records

The most striking recent band record is one in which the St. Hilda Professional Band, the Edmonton Silver Prize Band, the G.C. and Met. Railway Silver Prize Band, and the Stoke Newington British Legion Band join forces to play two well-known marches, "*With Sword and Lance*" and "*Under the Double Eagle*" (Regal MR500, 1/6). The Grenadier Guards Band play in splendid style a medley of "*Songs of the Sea*" (Col. DB779, 10 in., 2/6), and two of Waldteufel's irresistible waltzes (Col. DX335), 12 in., 4/–).

Princess Elizabeth's Gramophone

One of the many interesting features of Princess Elizabeth's miniature house at the Ideal Home Exhibition was a portable H.M.V. gramophone finished in royal blue and presented to the Princess by the Gramophone Co. Ltd. Accompanying the instrument was an album of H.M.V. records made by the little Princess's royal relatives, and she no doubt would be interested to compare the human voices with the records of her father, The Duke of York; her grandparents, The King and Queen, and her uncle, The Prince of Wales. A set of the records of Elgar's "*Nursery Suite*," dedicated to the Princess and recorded by "*His Master's Voice*" in the presence of the Duke and Duchess of York, was also provided in her little cottage. The portable gramophone was made by Welsh workmen at The Gramophone Company's factories at Hayes.

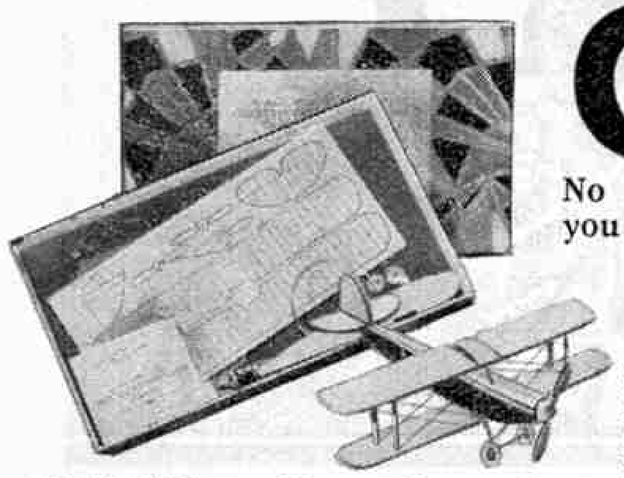
* * * *

That wonderful old melody, "*The Londonderry Air*," is never allowed to rest in peace for long! This time Eddie Peabody attacks it vigorously (Col. DB769, 10 in., 2/6) with banjo, "mando-cello" and mandoline, played in lightning succession and with remarkable brilliance. On the other side of the disc is another long-suffering tune, Rubinstein's "*Melody in F*," played in similar style.

Boys! Your Pocket Money will Buy any of these from

GAMAGES

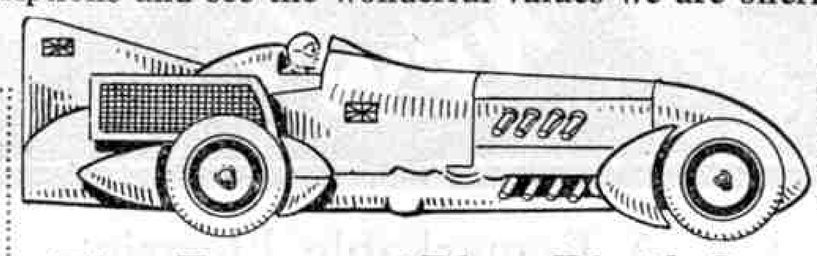
No need to 'see dad' about any of these offers, they are priced so low that you can afford them out of a week or two's pocket money. Just read the descriptions and see the wonderful values we are offering.



Build Your Own Aeroplane

Scale Model Aircraft Construction Sets. 1/40 Scale. Instructions supplied for constructing, including the fuselage, chassis, and wheels assembled. Planes, propeller, fin and rudder marked out on 3-ply wood ready for cutting out. Blueprint, glass paper, croid glue, etc. De Havilland Moth, Avro Avian, Gloster Fighter. Price **2/6** Post 3d.

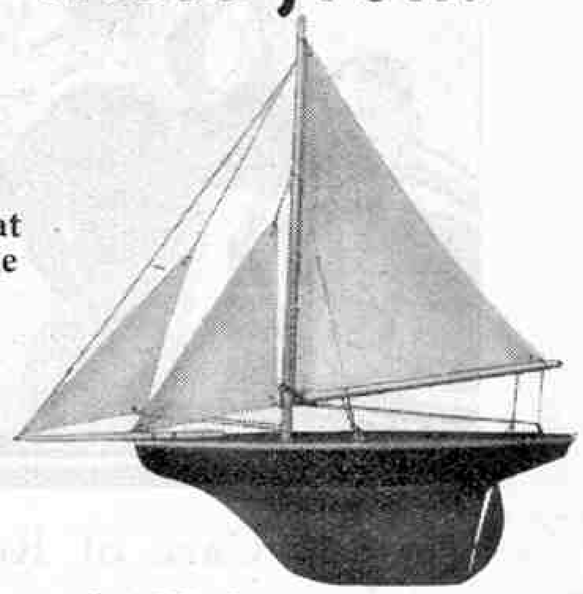
We stock all Hornby Train and Meccano Parts and give prompt delivery to all parts of Britain.



The Famous 'Blue Bird' Car

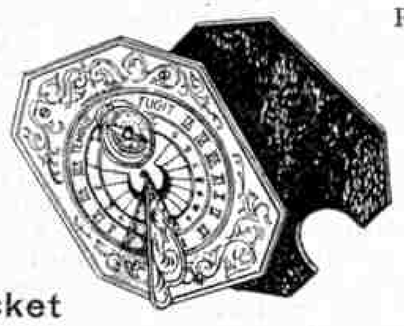
A realistic clockwork-driven model of Sir Malcolm Campbell's record-breaking car. This model will go fast too. Exceptional value at **4/6** Post 6d.

Gamages will build yachts to your own specification.



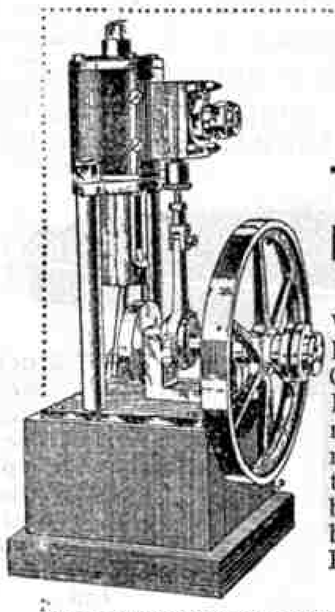
16″ Isle of Wight Yachts

As illustrated. Constructed with hollow hull. Well painted. These yachts are guaranteed to sail and are really amazing value for money. Price only **5/6** Post 6d.



Pocket Sundial and Compass

This is a high-class British-made Instrument. It has an engraved metal dial. An invaluable companion for camping, hiking, etc. Supplied in leather case, 2½″ square. Price complete **5/6** Post Free.



Here's a Wonderful Opportunity

This Fine High-Speed Engine for only 7/6

Vertical (as illustration). ¾″ stroke, ⅞″ bore. Fitted with Double-Action Slide Valve Cylinder, Trunk Guide, Steel Connecting Rod and Crank Shaft, Disc Crank and very massive Fly-wheel. 3-speed Pulley for round belt. All parts arranged for lubrication. The Bedplate is of solid Brass and extra heavy, and is mounted on a stout wooden block. Originally sold at 27/6. Gamages Price **7/6**. Post 9d. Larger Model, **10/6**. Post 9d.

The World's Finest Air Gun Value.

The Famous "DIANA" Air Gun

Foreign.

No. 1 Muzzle Loader. A fine gun at moderate price. It will give you heaps of good sport. Price **4/9** Post 9d.

Slugs, 9d. 1,000.
Darts, 4½d. dozen.

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Fresh Fruit for Drinks

The nicest drinks are made from fresh fruit juice—Sweet juicy Oranges for Orange Squash, pleasant healthful Grape Fruit for Grape Fruit Squash, sharp and appetising Lemons for Lemon Squash. These juices mixed with Tate and Lyles' white cane sugar make

KIA-ORA

LEMON, ORANGE AND GRAPE FRUIT SQUASHES

A glass of Squash—Lemon, Orange or Grape Fruit costs less than 1d. because a large bottle costing 2/– makes 25-30 drinks of pure healthful Orangeade, Lemonade and Grape Fruit, simply by adding water.

Sole Makers :—

KIA-ORA LIMITED
Blackfriars, London, S.E.1

NEARLY EXTINCT!

"Yes, madam, this is a genuine antique," said the shopkeeper, proudly displaying an old chair. "But I can let you have it cheap."

"And you really guarantee that it is an antique?"

"No doubt about it, madam," replied the dealer. "Why, it was so worm-eaten when I bought it that I had to make a new back, a new seat, and three new legs for it."

* * * *

Cinema Manager: "Why aren't you at school, to-day, my little man?"

Boy: "I'm not allowed to go, sir."

Manager: "Not allowed to go? Why not?"

Boy: "Because I've got the measles, sir."

* * * *

The artist was very pleased with his latest picture. "I shall never do anything better than that," he said proudly.

"Oh, come now," said a friend. "Don't lose heart."

* * * *

Park keeper (to tramp found asleep on a seat): "Come on now, I'm just going to shut the gates."

Tramp: "All right, don't slam them."

* * * *

The office boy's request for a rise had been granted.

"I hope you save at least half of your wages," said his employer sententiously.

"Well, sir," said the boy, "I would if I could, but I don't get as much as that."

* * * *

The professor was in the habit of letting his dog sit by his side at meals and one evening when he was out at dinner a lady next to him, wishing to attract his attention, gently touched his sleeve.

"Oh, get away," said the professor, holding out a bone without looking round. "Take this out on the mat and eat it."

* * * *

Old Lady (to tramp): "You were locked in a cage for ten years? Were you in prison, my poor man?"

Tramp (sarcastically): "Oh, no, mum. I was a canary."

* * * *

Village Postmistress: "Old-age pension, Mrs. Green? Why, you don't look a day over sixty!"

Mrs. Green: "Ah, time was when I'd have been pleased with the compliment, but now I'm glad enough to own up to being a septic geranium."

* * * *

The retired Indian colonel was always boring the company with long-winded accounts of his Indian days.

"Yes," said little Jones, one day, "pig sticking must be an awfully exciting sport. By the way, would you care to come round one evening and help us with the slugs?"

* * * *

A FAMILY DOG

"Why on earth have you bought a dachshund?"

"So that my children can all pat him at the same time."

* * * *

Magistrate (to old offender): "You here before me once more! I told you I didn't want to see you again."

Prisoner: "It's not my fault, sir. That's what I told the policeman, but he wouldn't believe me."

COULD BE FELT!

Little Jimmy did not like to be left alone in the dark.

"You must not be afraid of the darkness, Jimmy," said his mother.

"I'm not afraid," replied Jimmy, stoutly. "But it gets in my eyes and I can't see anything."

* * * *

The countryman's son had secured work on a London paper.

"Ay, he be doin' well," said the old man to one of his cronies. "But what he writes hasn't his own name on it. He tells me he is anonymous."

"Anonymous!" exclaimed the other. "I've often read bits by him, but it's the first time I knew it was young George."

* * * *

NO EXCLUSIVE TREATMENT

The architect was explaining the plans of the mansion he had planned for Mrs. Lotocash.

"This is an Italian staircase," he remarked.

"Italian staircase, indeed!" exclaimed the lady. "That would be a sheer waste of money; we might never have any Italians to stay with us, and if we have they must use our staircase."

* * * *

Brown hobbled into his neighbour's house.

"I say," he began, "didn't you say your dog's bark was worse than his bite?"

"Yes. Why . . . ?"

"Well, all I can say is, for heaven's sake don't let him bark. He's just bitten me."

* * * *

"D'you know, I always think of Green when I see you."

"Good heavens, why? We're not a bit like each other."

"Yes, you are. You both owe me ten pounds."

* * * *

Amateur stage manager (frantically): "Falstaff! Where's Falstaff?"

Call Boy (rushing in): "He's overdone the padding and can't get out of the dressing room."

* * * *

"I don't like rice pudding," said the new boarder. "Have I no choice?"

"Yes," said the lady of the house, tartly. "You may take it or leave it!"

* * * *

Friend: "Why on earth is the Doctor's consulting hour so late as nine o'clock at night?"

Wife of New Doctor: "Well, you see, our patient cannot call at any other time."

* * * *

Patient: "Shall I live, Doctor? How am I?"

Doctor: "Oh, you're much better, but I wouldn't start reading any serial stories if I were you."

* * * *

Master: "No pen again, Brown? What would they call a soldier who went into battle without a gun?"

Brown: "An officer, sir."

* * * *

Three Irishmen had won £4 between them. The one who received the money turned the matter over in his mind.

"Now mates," he said as he began to distribute the money. "I ain't going to chate yer. Equal shares all round 'as always been my motto. Now then, there's two pounds for you two and two pounds fer me, too!"

BRAIN WAVES

Magistrate: "The witness says you swept past on your motor cycle as quick as thought."

Accused: "Yes, he would. I was with him at school—he always thought very slowly."

* * * *

Magistrate: "Patrick O'Mulligan, did you, or did you not, shoot these birds?"

Pat: "No, Yer Honour, the only bird I shot on the day I was arrested was a hare, and I knocked him on the head with a stick."

* * * *

"Snowdrops, sir?" inquired the hawker.

"Yes, I believe it does," said the thoughtful man, passing on.

* * * *

The train stopped at a small country station, and an enthusiastic passenger leaned out of the window of his compartment.

"Isn't this exhilarating?" he exclaimed as he rubbed his hands.

"No, it ain't," replied a passing porter, "it's Littleton-on-Weald."

* * * *

Customer (who had recently been given bad eggs): "I want two dozen eggs, but I must be absolutely sure that there are no chickens in them this time."

Assistant: "Well, why not take some duck eggs?"

* * * *

Nature Lover (gazing at tree): "Oh beautiful mammoth oak, if you could only speak, what would you tell me?"

Gardener (nearby): "If you please, mum, he would say he was a sycamore and not an oak!"

* * * *

The farmer's daughter had "taken up" singing. One day her father came in while she was doing her scales.

"What's that extraordinary noise?" he inquired.

"That," replied his wife, "is Mary cultivating her voice."

"Cultivating?" said the farmer. "I call that harrowing!"

* * * *

Customer: "I haven't seen that young assistant of yours for a long time. Not defunct, I hope?"

Shopkeeper: "That 'e 'as, sir, with every penny 'e could lay 'ands on."

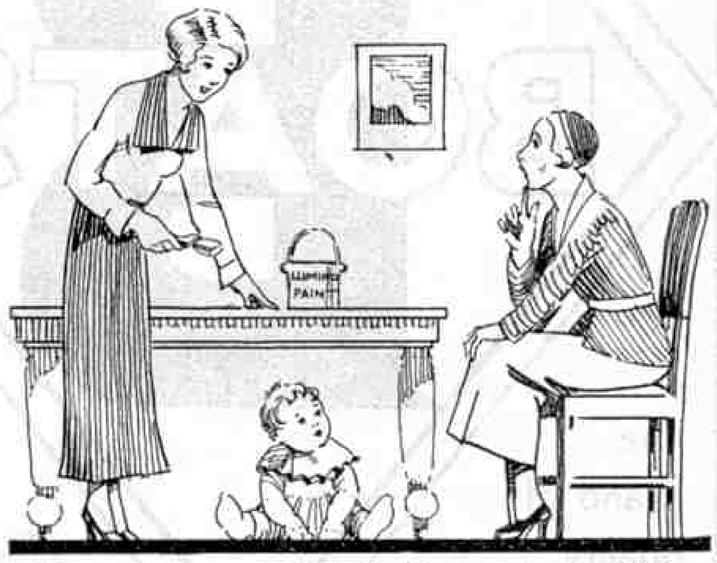
* * * *

"Will you come over to our place next week to see the Morris-dancing?"

"I certainly will. It's wonderful what they can get those small cars to do, nowadays."

* * * *

LIGHTING-UP TIME?



"What do you use these luminous paints for?"

"We paint the baby's face with them every night before putting him to bed and then during the night we can see to give him his bottle without getting a light."

* * * *

Mother: "Bertha, how could you tell auntie that she was stupid? Go and say you are sorry, at once."

Bertha: "Please, auntie, I'm sorry that you are stupid."

* * * *

"How is that cherry tree you bought from me?"

"Oh, it's a peach."

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CHARMING CAREFREE CHEAP

"Camping Holidays on the G.W.R."

New and Enlarged Edition for 1932

Contains Addresses of a large number of selected sites specially chosen for Camping, together with all necessary preliminary particulars relating to site, landowner or tenant, amount of land available, drinking water on site, etc.

Free from G.W.R. London and Provincial Offices, or from the Superintendent of the Line, G.W.R., Paddington Station, London, W.2.

JAMES MILNE, General Manager.

MODEL SAILING YACHTS and SPEEDBOATS

Every Genuine "B" Boat bears this crest.

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The brand of quality.

THESE FAMOUS "B" BOATS ARE THE BEST FOR BOYS and are BRITISH MADE. The beautifully streamlined hulls are designed so as to reduce to a minimum, surface friction. They have been approved by designers and builders of nautical craft and are capable of travelling through the water at a much greater speed than could be attained by the old type flat bottomed boat. All hulls are finished with best quality cellulose paint in two colours, and the decks are genuine African Mahogany, varnished natural colour. The Yachts are fitted with the accurate Bermuda type rigging of best quality fine strong cambric sails, whilst the mechanism of the Electric Speedboats is designed to give long runs at a great speed. All the best Dealers stock the range of "B" BOATS. Send us a post card for illustrated list, and name of your nearest stockists.

INSIST ON HAVING THE "B" BOAT.
IT IS THE BEST IN THE LONG RUN.

All "B" BOATS are ready packed in a strong and attractive carton, and are complete with all accessories.

SAILING YACHTS

No. S.1016	Length 16 inches	Price 10/6 each
No. S.1020	Length 20 inches	Price 16/6 each
No. S.1026	Length 26 inches	Price 25/- each
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(without batteries)

No. E.216	Length 16 inches	Price 15/- each
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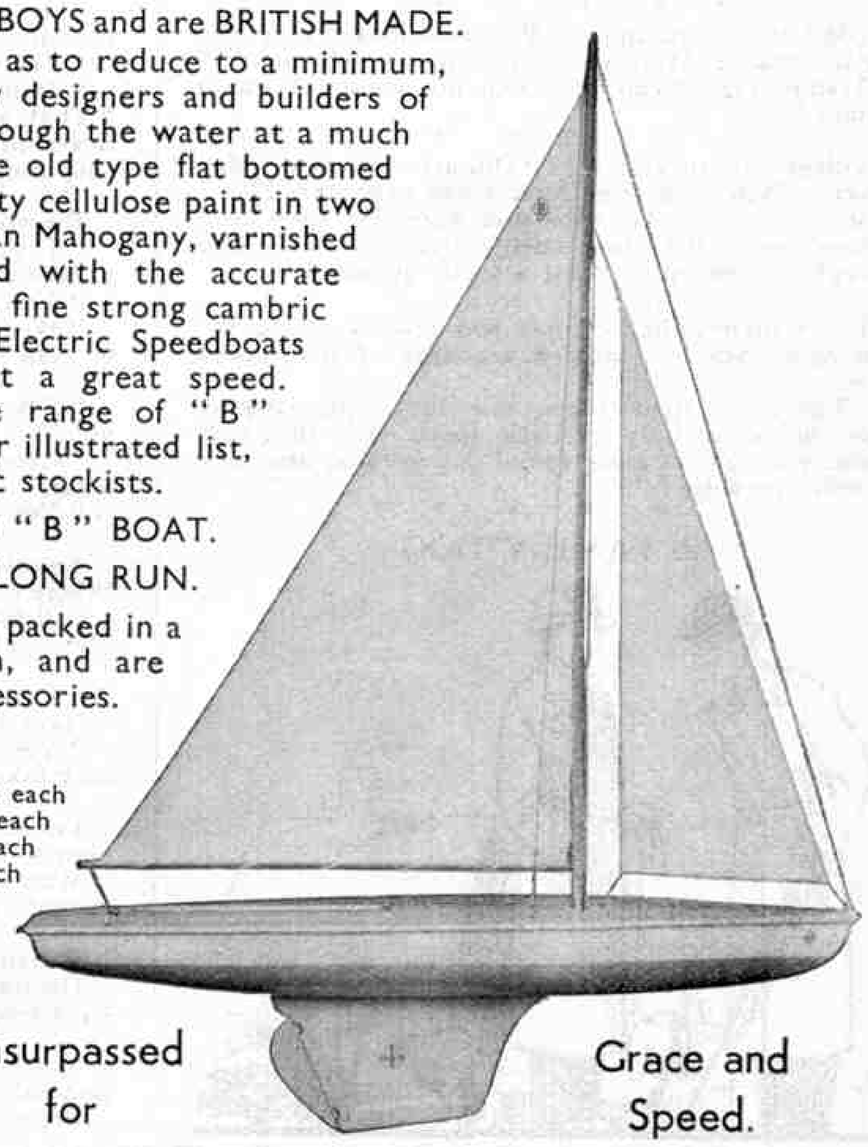
No. E.226	Length 26 inches	Price 30/- each
No. E.233	Length 33 inches	Price 40/- each

BRITISH AND GUARANTEED



Unsurpassed for Grace and Speed.

Manufactured by

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Listen, you Fellows.

here are two tyres that have been specially designed and built for you. One is a Roadster tyre with a tread of tough but lively black rubber. The other is a real Sports tyre with a very fast hard-wearing red tread. They are made by **DUNLOP,** and you know what that means. It means they are the best tyres you can buy.

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TYRES
SADDLES, TOOLBAGS
INFLATERS, REPAIR OUTFITS

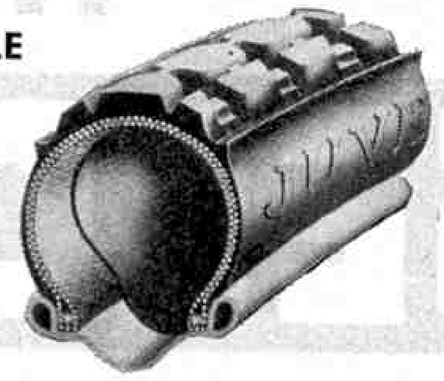
DUNLOP RUBBER CO. LIMITED, Fort Dunlop, Birmingham.
Branches throughout the World.

2H/14

DUNLOP JUVENILE

SIZE (wired type)
22″ x 1⅜″
24″ x 1⅜″
24″ x 1½″
26″ x 1½″

COVER 5/6 TUBE 2/6



DUNLOP SPORTS JUVENILE

SIZE (wired type)
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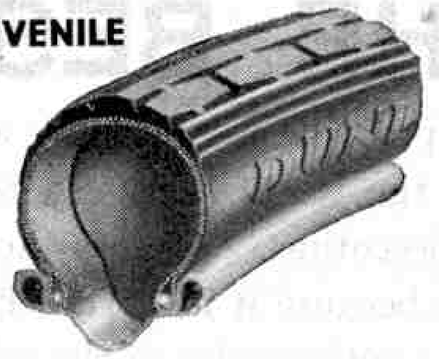
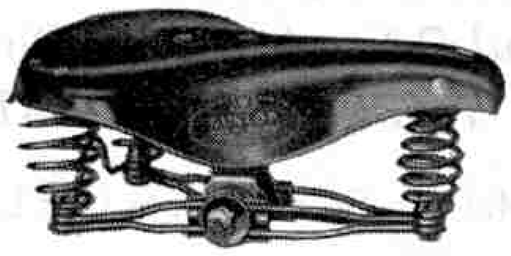
COVER 4/6 TUBE 2/-



When you buy a new cycle be sure it is fitted with a
DUNLOP WATERPROOF SADDLE



Dunlop saddles are absolutely waterproof. Your Dad will tell you how important that is. They are comfortable, they never sag nor lose their shape, and they require no "breaking-in."

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Selected Willow

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All Cane and Rubber Spring Handles.

All Cane Handle 10/6
Rubber Handle 13/6
do. 14/6
do. 15/6

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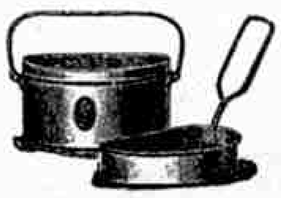
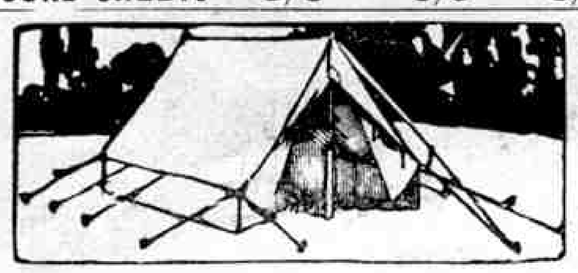


Army pattern, as illustrated 1/3
The "CADET," consisting of 4 separate pieces and packed into one 1/11
The "JAARKEY." A compact flat type, easily carried in rucsac 2/3

WATERPROOF GROUND SHEETS	6′×3′	7′×5′	9′×6′
	3/6	6/9	8/11



The "EASIPITCH"

7 ft. long, 5 ft. wide, 4 ft. 6 in. high. 1 ft. walls, overhanging eaves, ventilators, jointed poles, pegs, mallet, etc., proofed white tent cloth, weight 10 lb., packed in carrier. **Jas. GROSE Ltd.** 20′-

GREEN ROTPROOF CANVAS 25/-
Carriage paid.

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Double texture twill, 2 pockets 5/6
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FRAMED RUC-SACS
15 in. frame one pocket. 12/-
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10′6

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POCKET WATCHES, 5/- and 7/6
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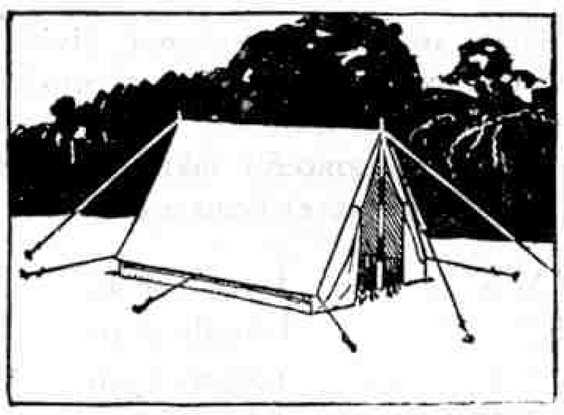

The "LIGHTWEIGHT"

6 ft. long, 4 ft. 3 in. wide, 3 ft. 6 in. high, 6 in. walls, overhanging eaves, genuine weatherproof white tent cloth, jointed poles, pegs, mallet, etc., packed in carrier, net weight 4 lb. **Jas. GROSE Ltd.** 10′6

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SECCOTINE IS MADE BY BRITISH WORK-PEOPLE THROUGHOUT

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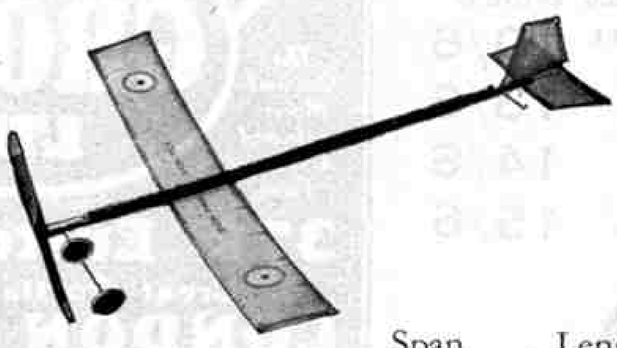
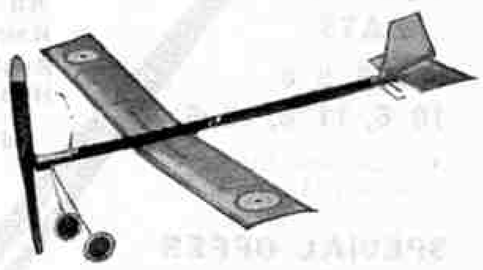
Point for point they are better!

Comparison will show you that these Bowman planes beat all other makes at similar price. In size, speed, strength, endurance and finish they are ahead of all competition. You'll get far more pleasure out of flying a Bowman plane, the champion of the air. All models include best proofed silk-covered planes, shock-proof chassis, aluminium wheels superbly finished with discs and blue and gold lettering.





	Span	Length	Propeller	Flies	Price
The Bullet ...	18 in.	20 in.	8½ in.	500 ft.	**2/6**
The Ranger ...	24 in.	24½ in.	9½ in.	600 ft.	**4/6**
The Vulcan ...	25 in.	29 in.	9½ in.	750 ft.	**6/6**
The Vortex ...	30 in.	32 in.	10 in.	850 ft.	**8/6**

BOWMAN STEAM LAUNCHES

Bowman boats are double powered, giving them a better performance than many more expensive models on the market. With their fine turn of speed, long non-stop runs, and graceful rakish lines, they are famous wherever boats are raced.

"SEAHAWK" ...	Length 28 in.	(Post. 1/3)	**42/–**
"EAGLE" ...	Length 28 in.	(Post. 1/3)	**32/–**
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"SWALLOW" ...	Length 20 in.	(Post. 1/–)	**17/6**

You can see them at Halfords and Hobbies and all good shops.

FREE

Write to-day for free leaflets describing all the Bowman Boats (clockwork, steam and 'aeroboats'), and the wonderful new Bowman Aeroplanes, to Bowman Models (Dept. M.M.11), Dereham, Norfolk.

BOWMAN MODELS

BRITISH AND GUARANTEED

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Here is your chance to win a Lott's Chemistry Set, or to get spares for the one you have! No doubt you've been experimenting on your own and have made up an interesting experiment that's not in the Instruction Book. Tell us about it! For the best original experiment we are offering monthly six fine prizes. **1st Prize:** A No. 3 Lott's Chemistry Set or spares to value of **10/6.** **2nd Prize:** A No. 2 Set or spares to value of **6/–.** **3rd Prize:** A No.1 Set or spares to value of **3/6.** Also three consolation prizes of **2/6.**

Write out your experiment, with your name, address, and age, and attach to it the illustration of the Cathedral, built with Lott's Bricks, shown on the last page of the Chemistry Book in your set.

Post your entry for May before the end of the month, to **"Competition," Dept. M.M., Lott's Bricks Limited, Watford, Herts.,** from whom also can be obtained descriptive booklets about Lott's Chemistry Sets and Lott's Model Bricks.

BOX 1, with 18 Chemicals, accessories, and book of 42 experiments. **Price 3/6**

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Spares supplied. Obtainable from leading toy dealers and stores.

Lott's Chemistry is perfectly safe to handle.

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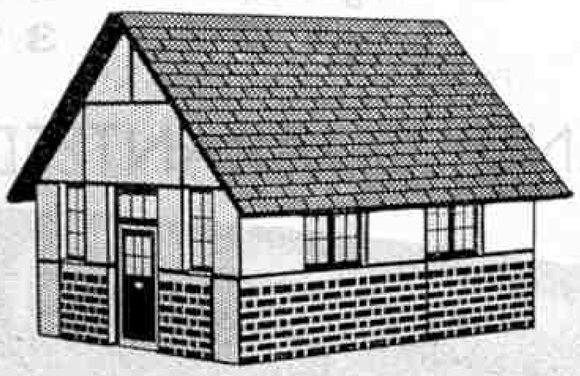
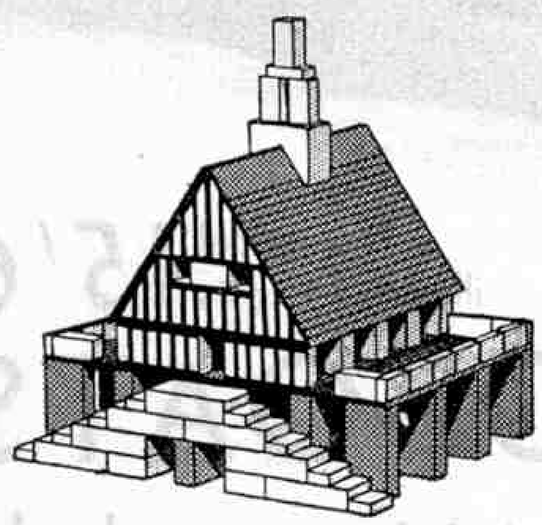


COTTAGE. Box 1, Lodomo



CRICKET PAVILION. Box 3, Tudor Blocks

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A few particulars of some of the sets:—

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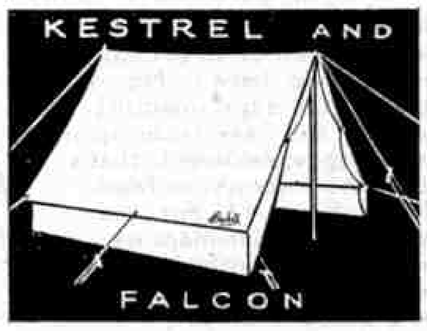

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First home *again!*

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	(Postage 9d.)	

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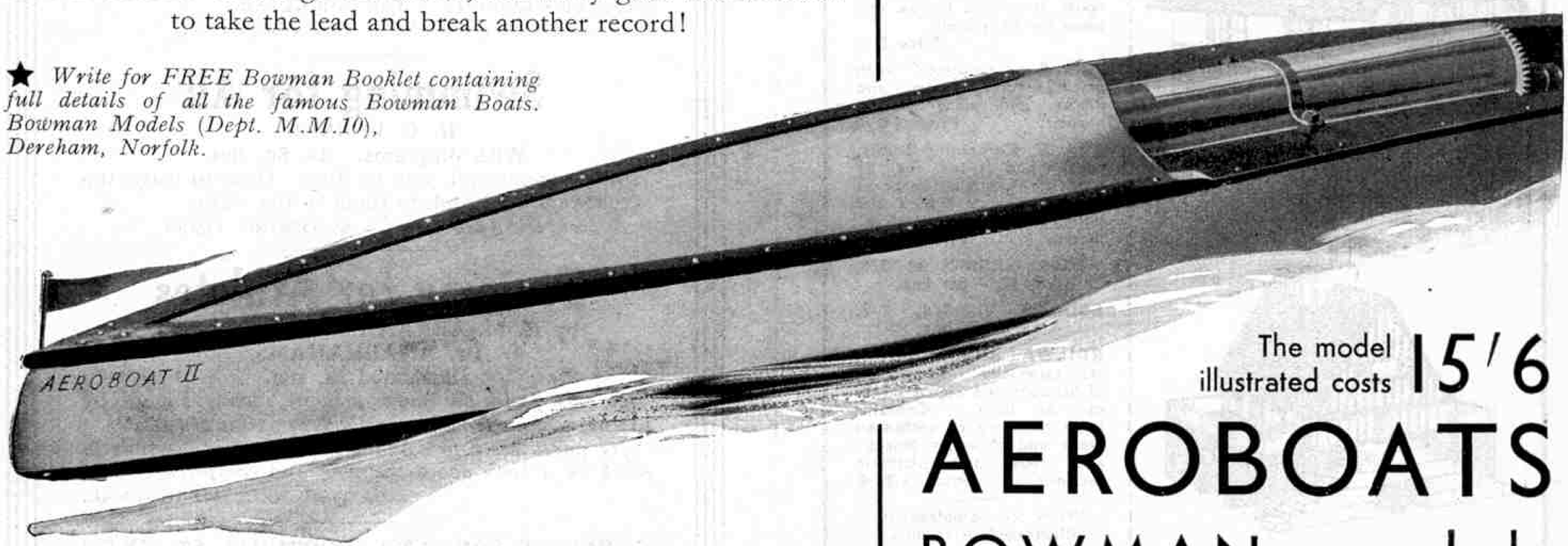

The model illustrated costs **15/6**

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BOWMAN models

You can see them at all Halfords and Hobbies branches or any good shop.

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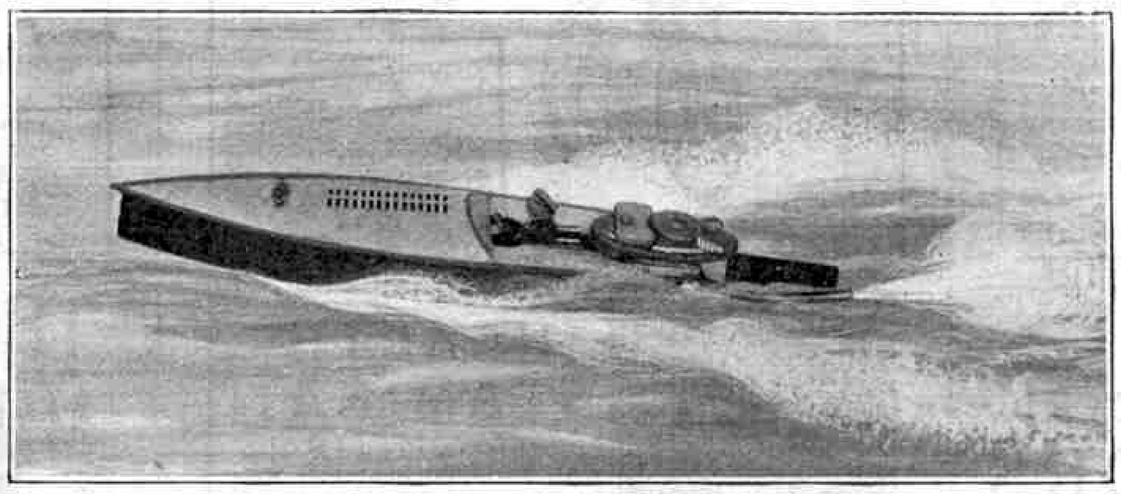

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No danger. Use Meta Fuel and off she goes with a loud Pop! Pop! Pop!

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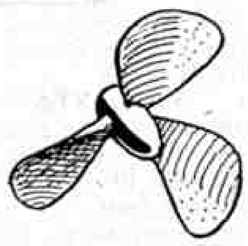

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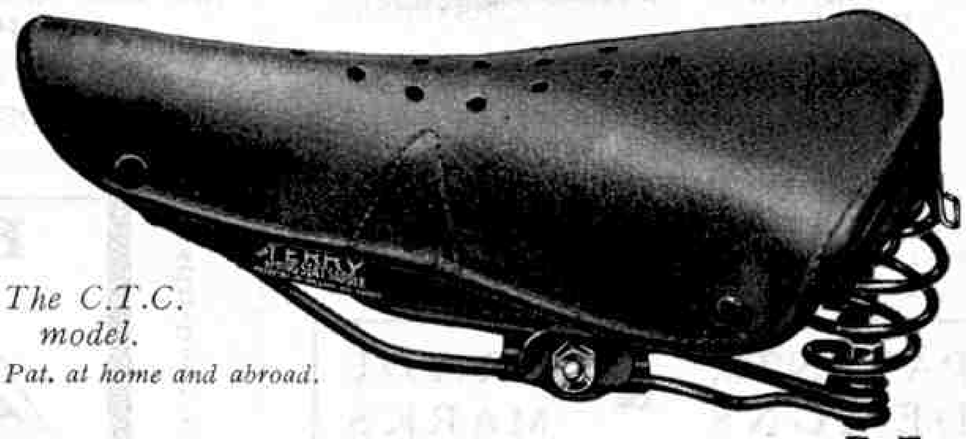

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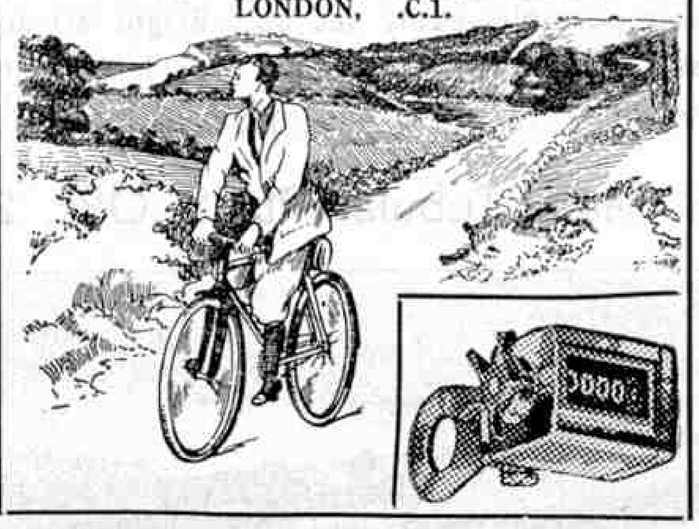

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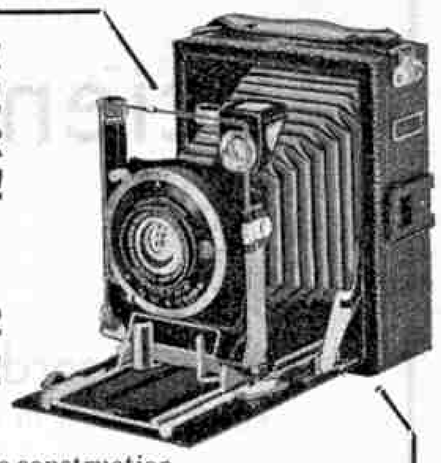

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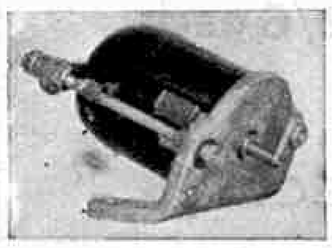

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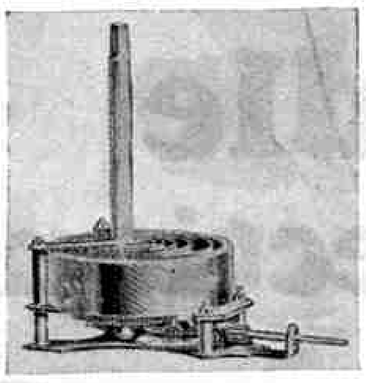

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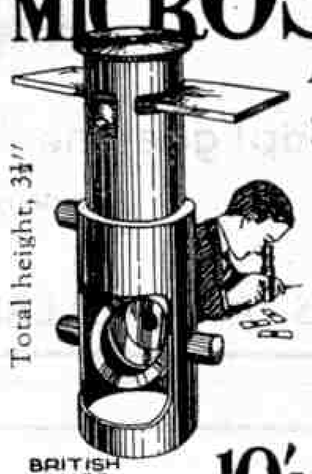

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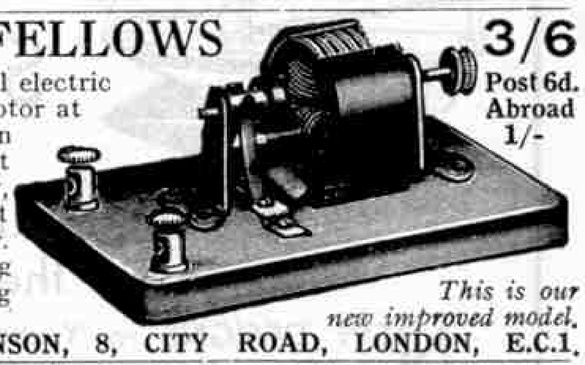

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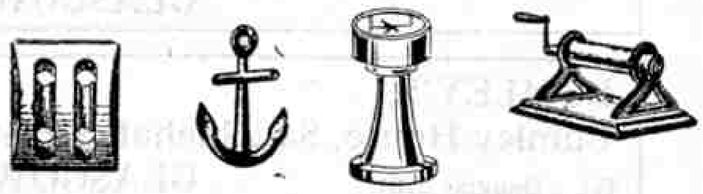

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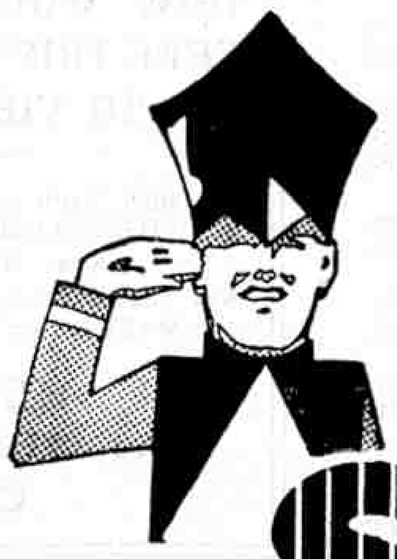

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Bargain. 15/- "K" Motor Boat, going 10/-. Rarely been used. Perfect condition.—Burgess, 17, Glebe Road, Bedford.

Wanted. "Meccano Magazine" dated January, 1930.—L. Lucas, 153, Powerscourt Road, Portsmouth.

Sale. "Meccano Magazines," excellent condition. October, 1927 to December, 1931. What offers?—Eldridge, "Rockford," Stowmarket.

Wanted. "Nelson Lees," "Gems," "Magnets." Good condition. Any date.—Kirby, 50, Blackburn Avenue, Bridlington.

Powerful Permanent Magnets with hooked Keeper, lift 10-14 lbs., 2/-; lift 5-8 lbs., 1/6. Postage free. Magnetos, 5/9. Would make fine Dynamos.—Marchant, Tiptree, Essex.

Sale. Cigarette Cards, 5/- per 1,000.—Pooley, Bekesbourne, Nr. Canterbury.

500 Good Stamps for 6/-. Cigarette Cards 9d. 100. Offers for 144 B.M.'s between Feb. 1928 and Feb. 1931?—Morling, Middleton, Toxford, Suffolk.

Over 300 Stamps for 1/5. Also an Air Gun, 2/6. Apply—S. Hill, Belmont Lodge, Waterford.

Drive Electric Motors, etc., from the mains current. Transformers 110v. or 240v. 10v. 8a. 12/6 each.—J.V.G., 41, Neeld Crescent, Hendon.

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RAILWAY PHOTOGRAPHS

Send 4d. for specimen card and full list (M11) of titles. Also Aeroplane photographs—list (A1) and specimen 4d. (All photographs postcard size). 3d. each, 2/6 per dozen (post free).

Railway Photographs, 23, Hanover St., Liverpool.

Meccano and Hornby Trains are British Made

All Meccano and Hornby Train goods are manufactured in our Liverpool factory, where upwards of 1,000 British men and women are regularly employed in their production.

BOOKS! Hobbies and Money-making Ideas. Stamp for particulars.—C.K.C. Publicity, 42, Whitecross Road, Weston-super-Mare.

SPEED BOAT HULLS. Built on most approved lines for speed. Hand-made Hulls for making your own Racing Boat. Ready for fitting Motor. Very light and strong. Length 3′ 6″. Beam 6″. Satisfaction guaranteed. Price 14/6 post free.—Bottomley Bros. (Dept M.), King Street, Delph, Oldham.

HOW WOULD YOU LIKE A FREE TRIP TO SOUTHAMPTON TO VIEW A LINER?

Six such Trips are being awarded as prizes by "HELPMATES," the new Magazine for boys. Threepence Monthly.

Ask your Newsagent for a copy of "HELPMATES," or send 4d. in stamps to:

HELPMATES
434, COWBRIDGE ROAD
CARDIFF

The "MONARCH" Large De-Luxe CAMERA
Regd.
Sale Price 1/6 ONLY! Post, etc., 4d.
and ALL ACCESSORIES. Guaranteed to produce perfect Large Photos, size 3½ x 2½ ins. Fitted best quality Bi-Convex Lens, Viewfinder, etc. Camera & Outfit complete for P.O. 1/10 only! No more to pay! Thousands Testimonials. W. J. Thomas, Esq.:—"Developed and printed photo; as good as if taken with a £3 camera!" Big Lists of Bargains Post Free! Leeds Bargain Co. (M.), 59, Mt. Preston, Leeds.

MECCANO MAGAZINE

Registered at G.P.O., London, for transmission by Canadian Magazine Post.

EDITORIAL AND ADVERTISING OFFICE:—

OLD SWAN, LIVERPOOL, ENGLAND.

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.

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.

Advertisers are asked to note that private advertisements of goods manufactured by Meccano Limited cannot be accepted.

Small Advertisements. 1/6 per line (average seven words to the line), or 16/- per inch (average 12 lines to the inch). Cash with order.

Display. Quotations for space bookings, and latest net sale 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 6th 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 one inch 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.

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 cases of Australia, where the price is 1/5 per copy (postage extra), and the subscription rates 9/6 for six months and 19/- for 12 months (post free); Canada, where the price is 15c. per copy, and the subscription rates 75c. for six months, and $1.50 for 12 months (post paid).

The U.S.A. price is 15c. per copy, and the subscription rates $1 and $2 for 6 and 12 months respectively (post free).

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., 34, St. Patrick St., Toronto.

UNITED STATES: Meccano Co. of America Inc., New Haven, Conn. Meccano Co. of America Inc., 200, Fifth Av., New York.

AUSTRALIA: Messrs. E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W.

NEW ZEALAND: Models Ltd., P.O. Box 129, Auckland (Kingston Street).

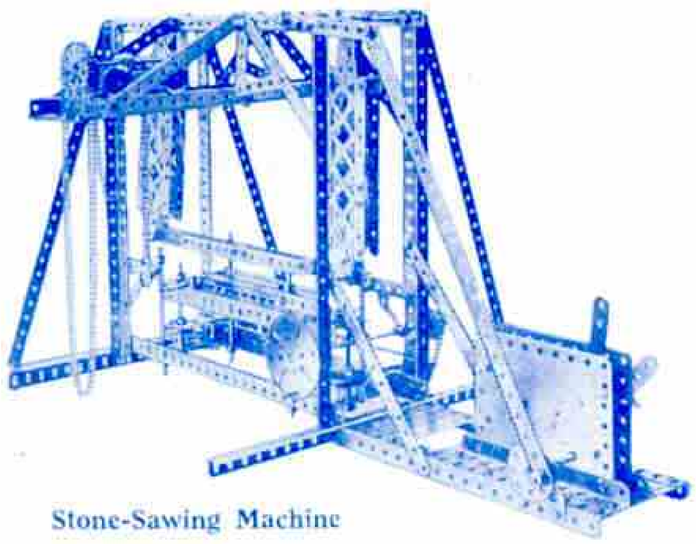
SOUTH AFRICA: Mr. A. E. Harris (P.O. Box 1199), 142, Market Street, Johannesburg.

INDIA: Karachi: Bombay Sports Depot, Elphinstone Street. Bombay: Bombay Sports Depot, Dhobi Talao. Calcutta: Bombay Sports Depot, 13/C, Old Court House Street.

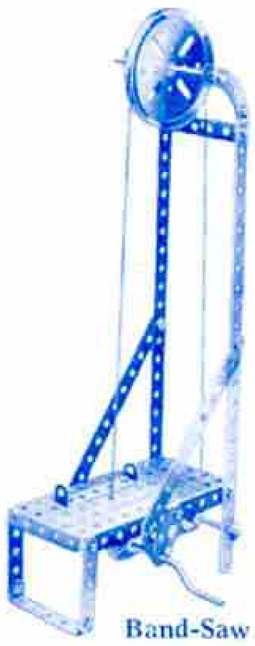
The Editor wishes to make known the fact that it is not necessary for any reader to pay more than the published price. Anyone who is being overcharged should lodge a complaint with the Meccano agent in his country or write direct to the Editor.

BE TALL Your Height increased in 14 days or **money back.** The amazing Stebbing System soon brings **3-5 inches increase and new energy.** Valuable Health Course, also Success and Popularity Course, included FREE with System, sent for **5/-** P.O. Details free. *The first original, and the one GENUINE guaranteed Height Increase System.*

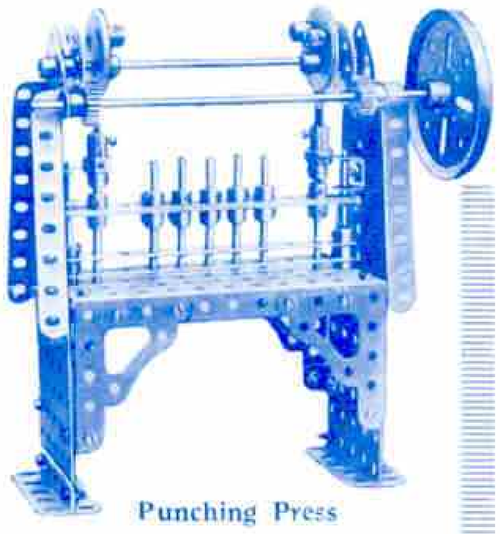
STEBBING SYSTEM (M), 28, Dean Rd., London, N.W.2.



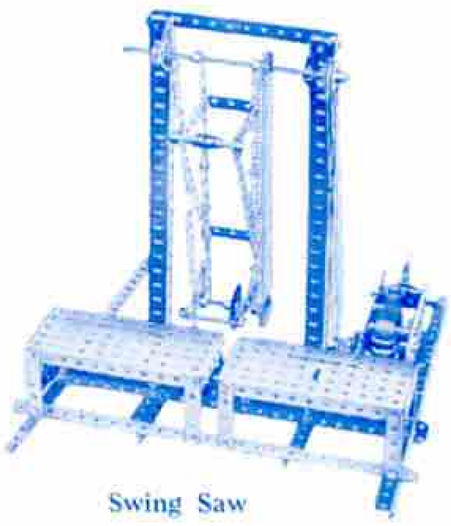
Stone-Sawing Machine



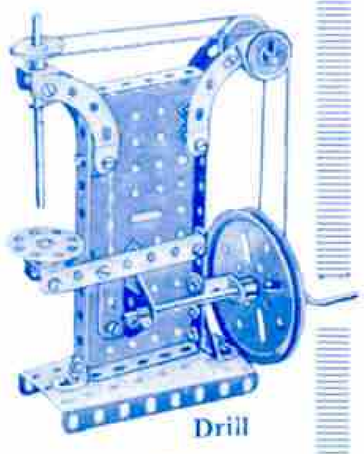
Band-Saw



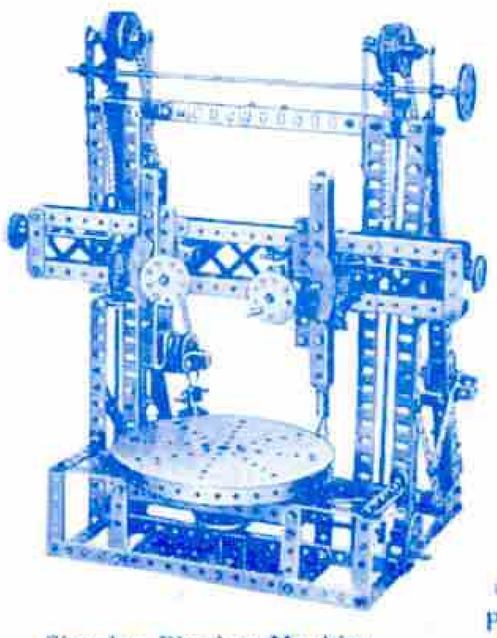
Punching Press



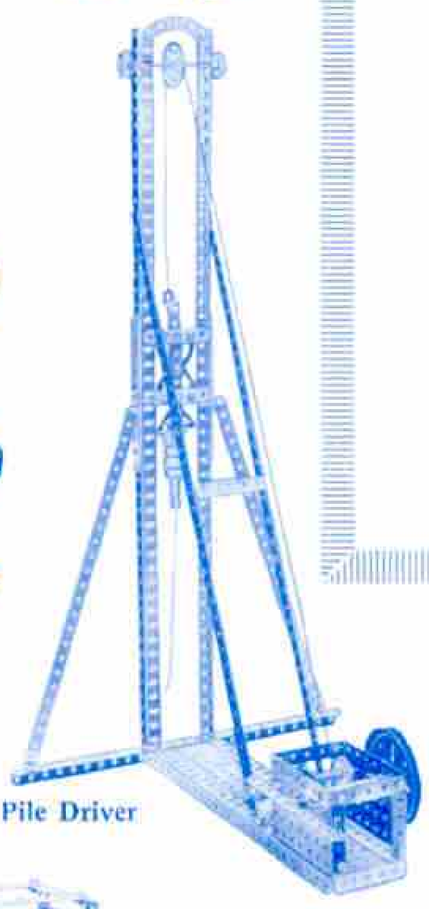
Swing Saw



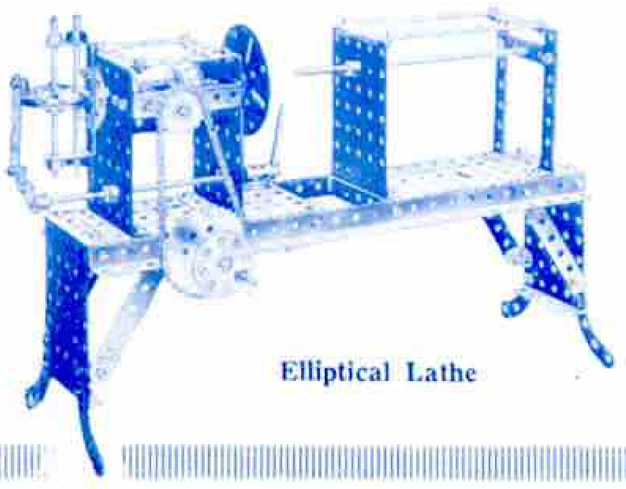
Drill



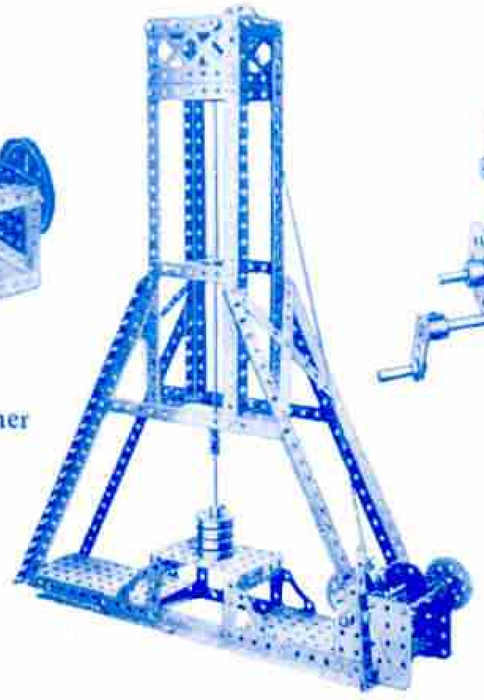
Circular Planing Machine



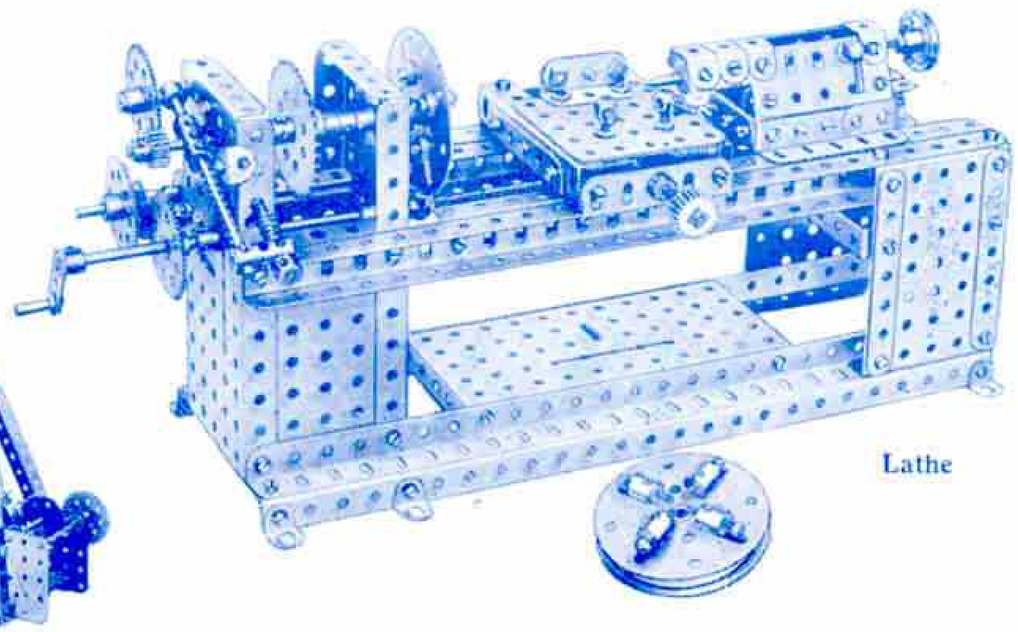
Pile Driver



Elliptical Lathe



Drop Hammer



Lathe

MECCANO

Examples of Model Construction:

1. MACHINE TOOLS

THERE is nothing more fascinating to every boy interested in engineering than the giant mechanical tools with which the world's great workshops and foundries are equipped. The daily work of some of these great machines would have employed hundreds of men a generation or so ago ; their enormous strength has brought into existence the dynamo, steam engine, locomotive, and battleship.

It is interesting to surmise what our earliest ancestors would have thought of a man who could deliver blows of sufficient strength to forge a steel ingot into a liner's crankshaft ; yet with a touch of the finger, the operator of a modern power hammer controls a force equal to fifty or sixty foot-tons !

We illustrate a selection of Meccano models, representative of this important branch of engineering. Meccano Machine Tools are not only miniature reproductions of the real thing ; they may be worked like the real machines. By adding a fretsaw or hacksaw blade to the Sawing Machines, small pieces of wood may be cut through ; similarly, by inserting a small twist-drill in the Drilling Machines, holes may be bored through strips of wood, and so on.

PRICES OF COMPLETE OUTFITS

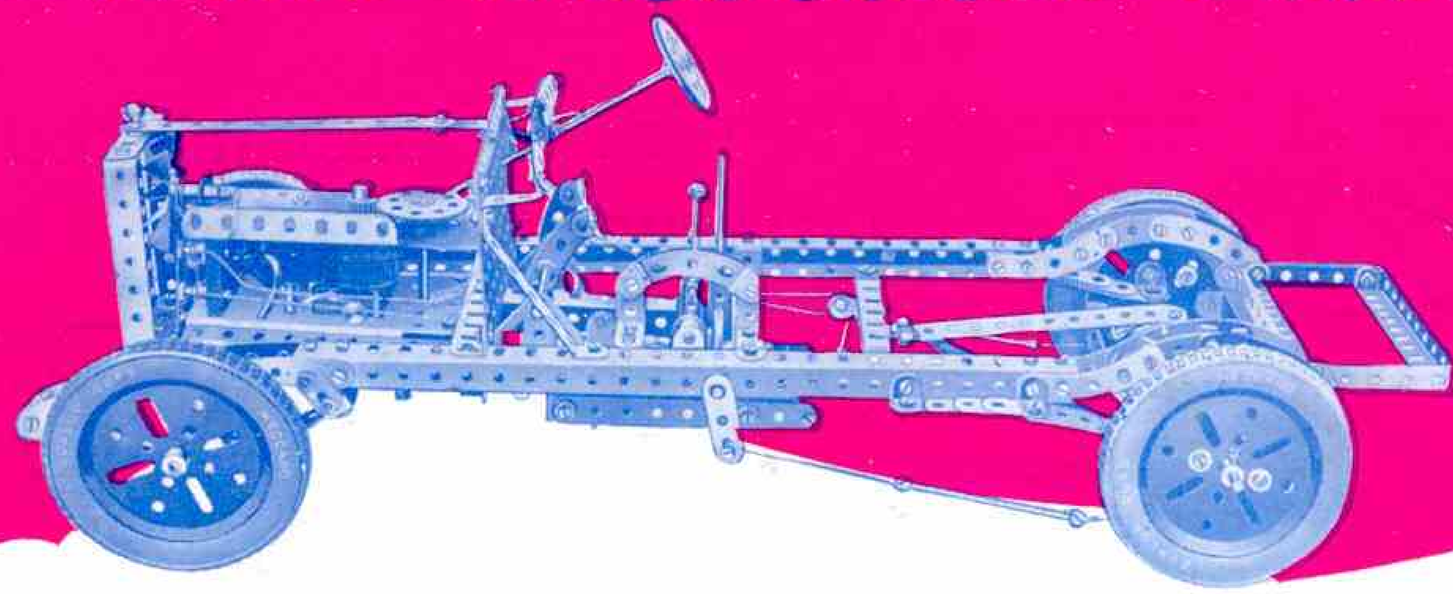
No. 000	2/6
No. 00	3/6
No. 0	5/-
No. 1	10/-
No. 2	16/-
No. 3	27/6
No. 4	52/6
No. 5 (in well-made carton)	70/-
No. 5 (in superior enamelled cabinet with lock and key)	100/-
No. 6 (in well-made carton)	125/-
No. 6 (in superior enamelled cabinet with lock and key)	155/-
No. 7 (in superior enamelled cabinet with lock and key)	450/-

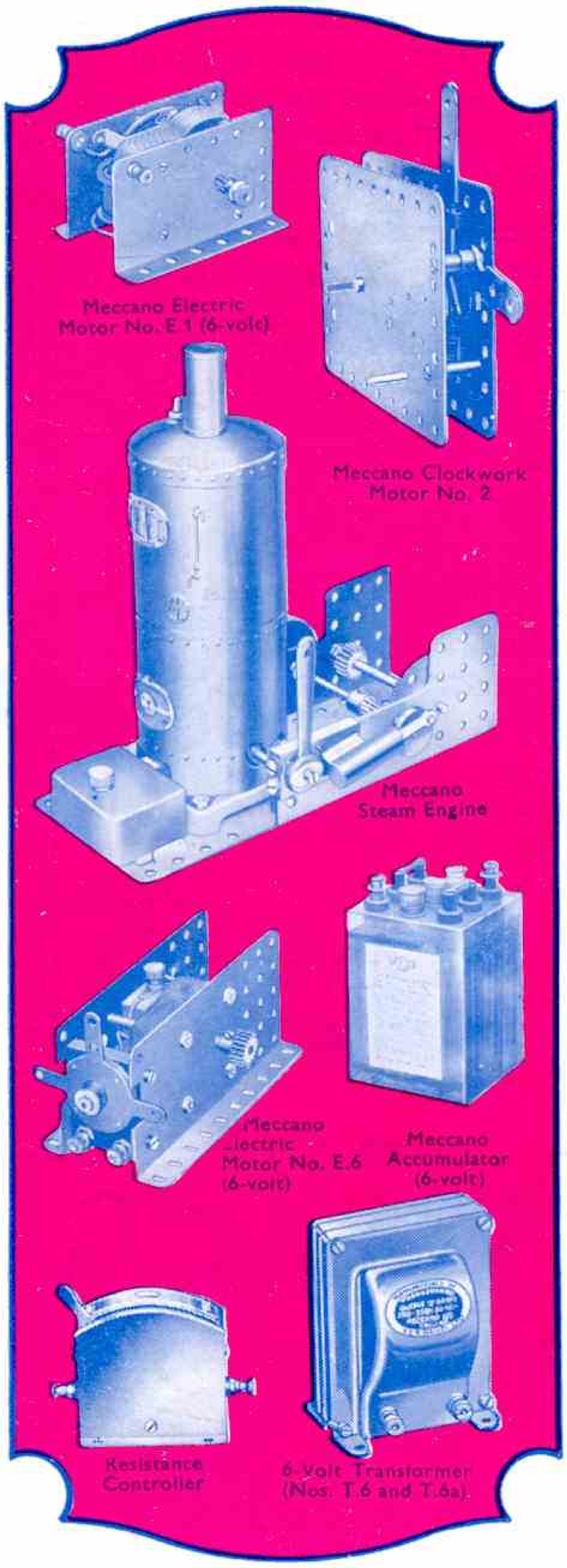
PRICES OF ACCESSORY OUTFITS

No. 00a	1/6
No. 0a	5/6
No. 1a	7/-
No. 2a	12/6
No. 3a	26/-
No. 4a	17/6
No. 5a (in well-made carton)	55/-
No. 5a (with No. 6 Outfit cabinet)	97/6
No. 6a (in superior enamelled cabinet with lock and key)	235/-

MECCANO LTD., Old Swan, LIVERPOOL

I run my models with Meccano Power





If you want to obtain the fullest possible enjoyment from the Meccano hobby you should operate your models with a Meccano Motor or Steam Engine. You push over the control lever of the motor or engine and immediately your Crane, Motor Car, Ship Coaler or Windmill commences to work in exactly the same manner as its " big brother " in real life. Could anything be more exciting ?

The Meccano Motors and Steam Engine are strongly made and the utmost care is taken in their manufacture to ensure that they will give satisfaction. The side plates and bases are pierced with the standard Meccano equidistant holes, which enables a motor or engine to be built into any Meccano model in the exact position required.

Particulars and prices of the Steam Engine, Motors and Accessories are given below.

Meccano Clockwork Motor No. 1
(Non-Reversing)

A long-running and highly efficient clockwork motor (non-reversing), fitted with a brake lever by means of which it may be stopped and started. Price **5/-**

Meccano Clockwork Motor No. 1A
(Reversing)

This is a splendid piece of mechanism, powerful and reliable. It is fitted with starting, stopping and reversing levers. Price **7/6**

Meccano Clockwork Motor No. 2
(Reversing)

This strongly-built clockwork motor is a compact self-contained power unit. Brake and reverse levers enable the motor to be started, stopped and reversed, as required. Price **10/-**

Meccano Steam Engine

On actual test this powerful steam unit has lifted over 56 lbs. Operation of the reversing lever enables the crankshaft, which is fitted with a special compensating flywheel, to run in either direction. There is no danger whatever of the boiler exploding. Price **25/-**

Meccano Electric Motor No. E.1
(6-volt)

This highly efficient Electric Motor (non-reversing) gives excellent service. A 6-volt Accumulator will operate it, but it may also be driven from the mains supply (alternating current only) through one of the Transformers described in the next column. Price **7/6**

Meccano Electric Motor No. E.6
(6-volt)

This 6-volt Motor is designed to build into Meccano models. It may be run from a 6-volt accumulator or, by employing one of the Transformers described below, from the mains supply. It is fitted with reversing motion and provided with stopping and starting controls. Price **15/6**

IMPORTANT.—Meccano 6-volt Motors will not run satisfactorily from dry cells.

Accumulator (6-volt, 20-amps)

The Meccano Accumulator is of substantial construction and is specially recommended for running the Meccano 6-volt Electric Motors. Price **28/6**

Transformers

By means of these Transformers the Meccano 6-volt Electric Motors may be driven from the mains supply (alternating current only).

No. T.6 is available for all standard supply voltages, from 100 to 250 inclusive, at frequencies of **50 cycles and upwards.**

No. T.6a is also available for all standard supply voltages from 100 to 250 inclusive at all standard frequencies. If required No. T.6a Transformer can be wound for frequencies lower than 50 cycles.

The supply voltage and frequency must be specified when ordering either of these transformers. They are both supplied complete with length of flex and adaptor for connection to an ordinary lamp socket.

No. T.6 ... **22/6** No. T.6a ... **30/-**

Resistance Controller

This variable resistance enables the speed of the Meccano 6-volt Electric Motors to be regulated as desired. Price **3/9**

MECCANO LTD.

BINNS ROAD - OLD SWAN - LIVERPOOL

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