VOL. XIX. No. 10 OCTOBER 1934

MECCANO MAGAZINE

HUGE HYDRAULIC PRESS
(See page 762)

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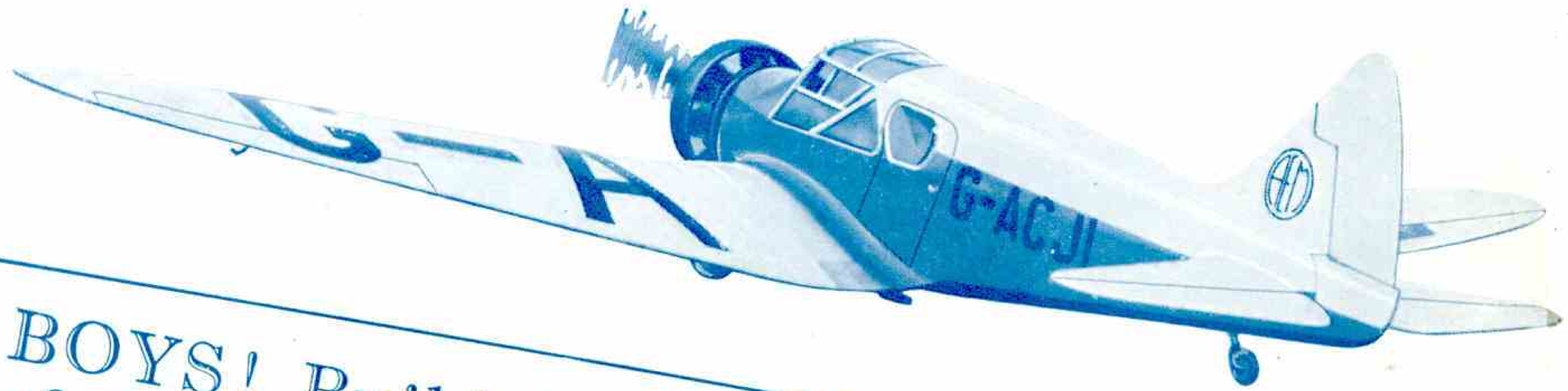

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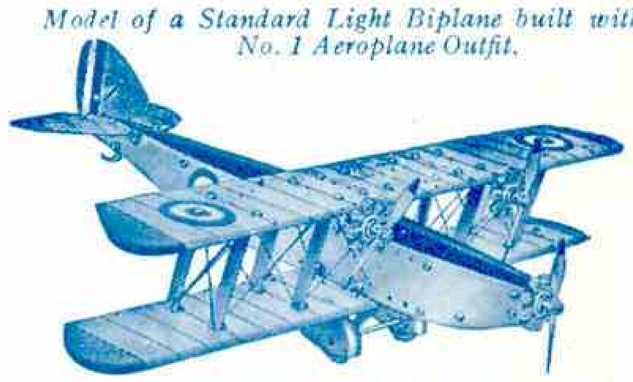

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NEXT MONTH: "HOW MAN BECAME AN ENGINEER." READY 1st NOVEMBER

MECCANO MAGAZINE

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With the Editor

Greenwich and the Prime Meridian

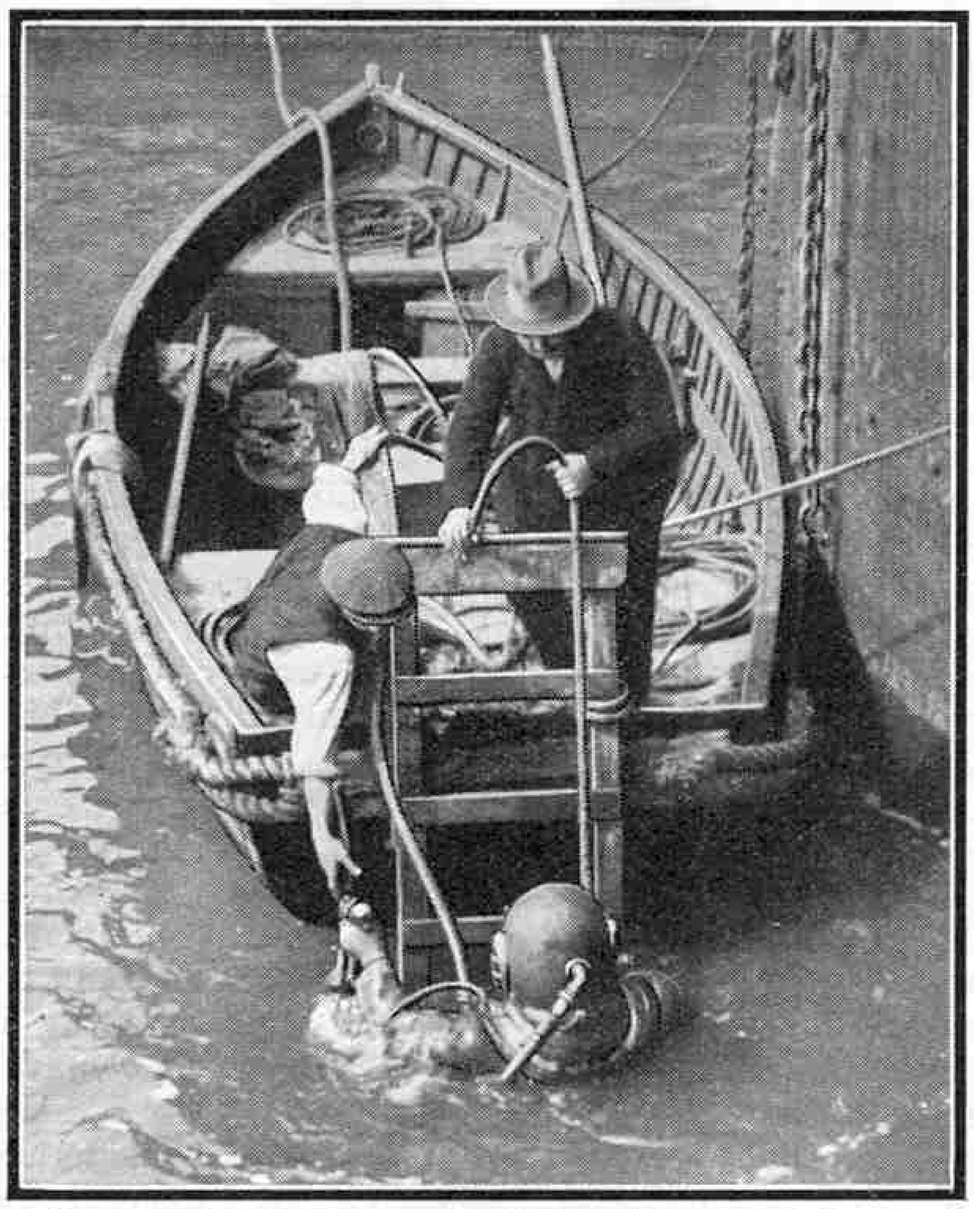
One of the greatest defects of early charts was the absence of a fixed prime or first meridian of longitude. In the 16th and 17th centuries all sorts of places were taken by different chart makers as the first meridian, and even as late as 1870 more than a dozen meridians were in use, including Greenwich, Paris, Cadiz, Naples, Stockholm, Lisbon, Copenhagen, Rio de Janeiro and Washington. This was a thoroughly unsatisfactory arrangement, and one that caused a great deal of trouble to seamen.

Various suggestions for a universal meridian were made, among the places proposed for the purpose being Jerusalem and the Great Pyramid. In October 1883 a conference was held at Rome to discuss the matter, and it was decided, after much deliberation, to recommend that the meridian of Greenwich should be adopted, on the ground that this meridian was the one in widest use. There was a sting in the tail of the resolution, however, for it was proposed that, if the Greenwich meridian were universally accepted, Great Britain in return should adopt the Metric System. Nothing came of the proposal, as many of the Governments could not be persuaded to abandon their own national meridian.

The urgency of the matter caused the holding of another conference in the following year, this time at Washington. On this occasion the United States delegates proposed "the adoption of the meridian passing through the transit instrument at the Observatory of Greenwich as the initial meridian for longitude," and pressed their proposal with such energy that it was adopted. At the same time the suggestion to count the longitude continuously from 0 degrees to 360 degrees was turned down, and it was decided that it should be reckoned east and west of Greenwich up to 180 degrees.

The Royal Astronomical Observatory at Greenwich was founded by King Charles II in 1675, with the object of "Rectifying of the Tables of the Motions of the Heavens and the Places of the Fixed Stars, in order to find out the so much desired Longitude at Sea." Its original purpose thus was to assist navigation. In 1838 a Magnetic and Meteorological Department was added, and since 1873 photographic records of the Sun's surface have been regularly taken.

In 1887 an International Conference meeting at Paris decided to construct a photographic chart of the whole heavens, recording the stars down to the 14th magnitude, the number of which was estimated to be about 20,000,000. A second catalogue was to be formed of stars down to the 11th magnitude, estimated at about 1,250,000. This work was divided up between 18 great observatories, and to Greenwich was allotted the task of dealing with all the stars within 26 degrees of the Pole Star. The greatest task of Greenwich Observatory, however, is to act as what might be described as the time centre of the world.



A diver at work in the Mersey, where he is caulking a leak in the gate of the Langton Graving Dock. Photograph by G. A. Collins, Liverpool.

The MacRobertson Air Races

The MacRobertson air races from England to Australia that are to be flown this month are without doubt among the most important aerial events that have yet been organised. Machines from all over the world have been entered, and they will be manned by the best of the world's pilots. The machines that will take part in these races are, of necessity, fast, but they will not be in any sense freak types, such as those used in the contests for the Schneider Trophy, which were quite unsuitable for anything but racing. The capacity of the machines for long-sustained flying will be tested to the utmost, and no machine that is not of the highest possible reliability will have any chance of success.

The results of the races should supply a great deal of extremely useful information in regard to the possibilities of fast flights over long distances. At present on long flights passengers are landed towards the end of the day, so that they may spend the night at an aerodrome hotel. This practice has a serious effect on the total time occupied by the journey, and the only alternative is the provision of machines with accommodation for passengers to sleep comfortably in the machine. Aeroplanes of this type are already being designed, and at least one machine already built, the Fokker F.XXXVI described on page 780 of this issue, is fitted with sleeping accommodation.

Before night flying can be extended to commercial passenger lines, however, it will be necessary to erect beacons at reasonable intervals along the whole length of the route. Such beacons are already in extensive use for night flying across the American Continent, and although the difficulties involved in lighting such a route as that from England to Australia are much greater than those over a continuous land surface, the obstacles do not appear to be insuperable. Until adequate guidance for night flying can be provided, there seems no alternative but to carry mails at the utmost possible speed, while passengers travel in slower but more comfortable air liners, with their flights arranged so that each night can be spent on the ground.

At the time of going to press, there are about 15 British entrants for the race and only one of these has entered an aeroplane made by foreign constructors. Probably the best-known of the British entrants are Mr. and Mrs. Mollison, who are flying the new De Havilland "Comet." This machine is one of the most interesting British aeroplanes in the event for, with the exception of the seaplanes built for the Schneider Trophy contests, it is the fastest British civil aeroplane that has ever been produced. In spite of its high speed, the machine, which is of the low wing type, is one of the lowest-powered machines entered in the race. Three "Comets" are entered and work has been proceeding night and day to get them ready.

Modern Hydraulic Apparatus

An Interesting French Press

TO-DAY hydraulic machinery is to be found in almost every shipyard and engineering works, where it is used when heavy loads have to be moved, or when great power is required for forging or shaping metal. The prodigious force that can be exerted by a hydraulic cylinder can only be appreciated fully when the machine is seen actually at work; and yet the control of such a machine is so simple that a boy could easily manage it.

The principle of the hydraulic press is employed in a great variety of machines and appliances, one of its most familiar applications being in hydraulic lifts for passengers or goods. In addition to forging and stamping presses there are presses for packing, bending and re-forming tubes and metal rods, all worked by water at high pressure. There are also giant combination steam and hydraulic presses capable of exerting pressures up to 12,000 tons, which stand nearly 50 ft. high and weigh 800 tons or more. The cylinders of these great presses are sometimes as much as 40 in. in diameter, with a ram stroke of 10 ft. or even longer. On the lower end of the ram is fixed a mass of metal shaped like an inverted "T," which takes the pressure of the ram on each end of its cross bar. The water pressure used for operating the ram is approximately $2\frac{1}{2}$ to 3 tons per sq. in. when the press is in action.

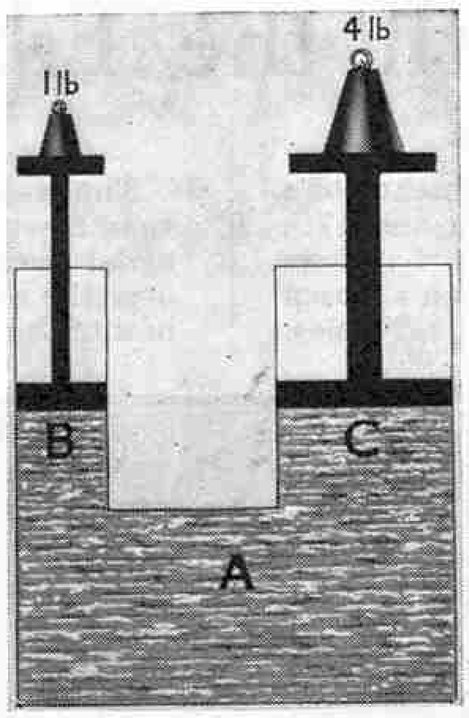


Fig. 1

A small press of a rather different type is illustrated on our cover this month and also on the opposite page. It was built by Les Ateliers et Chantiers de la Loire, France, for an important railway works, and is used principally in the manufacture of boiler casings, locomotive footplates, railway wagon and locomotive chassis and coach parts. This machine consists essentially of three main hydraulic cylinders, and a double action auxiliary cylinder, which is placed on the upper part of the press.

The water passes to the cylinders from a valve distributor block that is shown in the illustration. The distributor is fitted with six hand levers attached to valves, by the operation of which the water can be sent into any one or all of the different cylinders of the press. The two levers shown on the right distribute the water to the auxiliary upper cylinder, while the two middle levers operate the central cylinder. The two levers on the left control the two outer cylinders, which are double acting and raise or lower the press plate. These levers can also be used to operate three small extractor jacks that are situated in the centres of the three main cylinders. The purpose of these is to extract pressings from the dies in which they remain after the pistons are withdrawn.

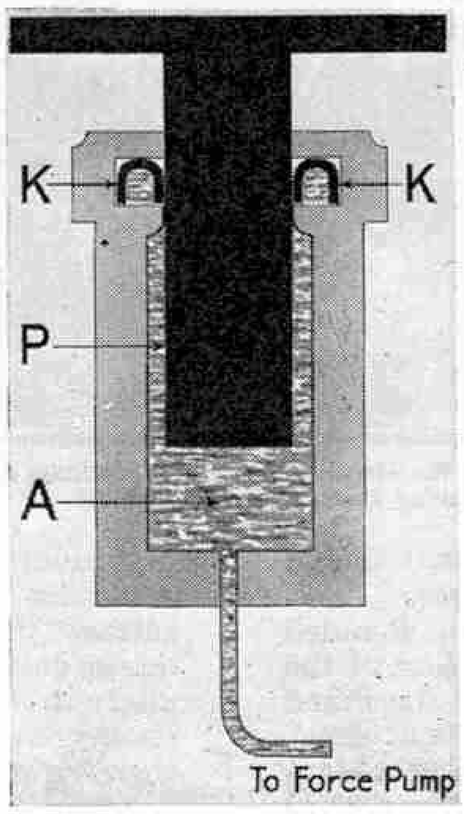


Fig. 2

Different designs of tools are required for the production of the various parts, and they consist of two or more pieces. In the machine illustrated here a tool known as a matrice is assembled on the bed of the press, which is movable, and another tool is fixed to an upper plate which, during the work, remains stationary. The metal to be worked is placed on the matrice. The hydraulic piston is then set in motion and so presses the metal to the desired shape. When the pressing is completed the piston is withdrawn, and the pressed part remains in the matrice, from which it is extracted by the action of the extractor jacks.

The possibility of using water as a source of power had not received much serious attention before 1795, when the famous English engineer Joseph Bramah turned his attention to the matter. He built a press that was operated by water, and as soon as the success of this became known other engineers directed their activities in the same direction, and before long water power was used to work all kinds of machines.

Joseph Bramah was born in 1748 at the village of Stainborough, near Barnsley, in Yorkshire, where his father rented a small farm. He was the eldest of five children, and he commenced work on the farm at a very early age. His favourite boyhood hobby was that of making musical instruments. His few tools were rough ones made for him out of old violins and razor blades by his great friend the village blacksmith, but in spite of this handicap he turned out some excellent work, including a violin cut out of a solid block of wood.

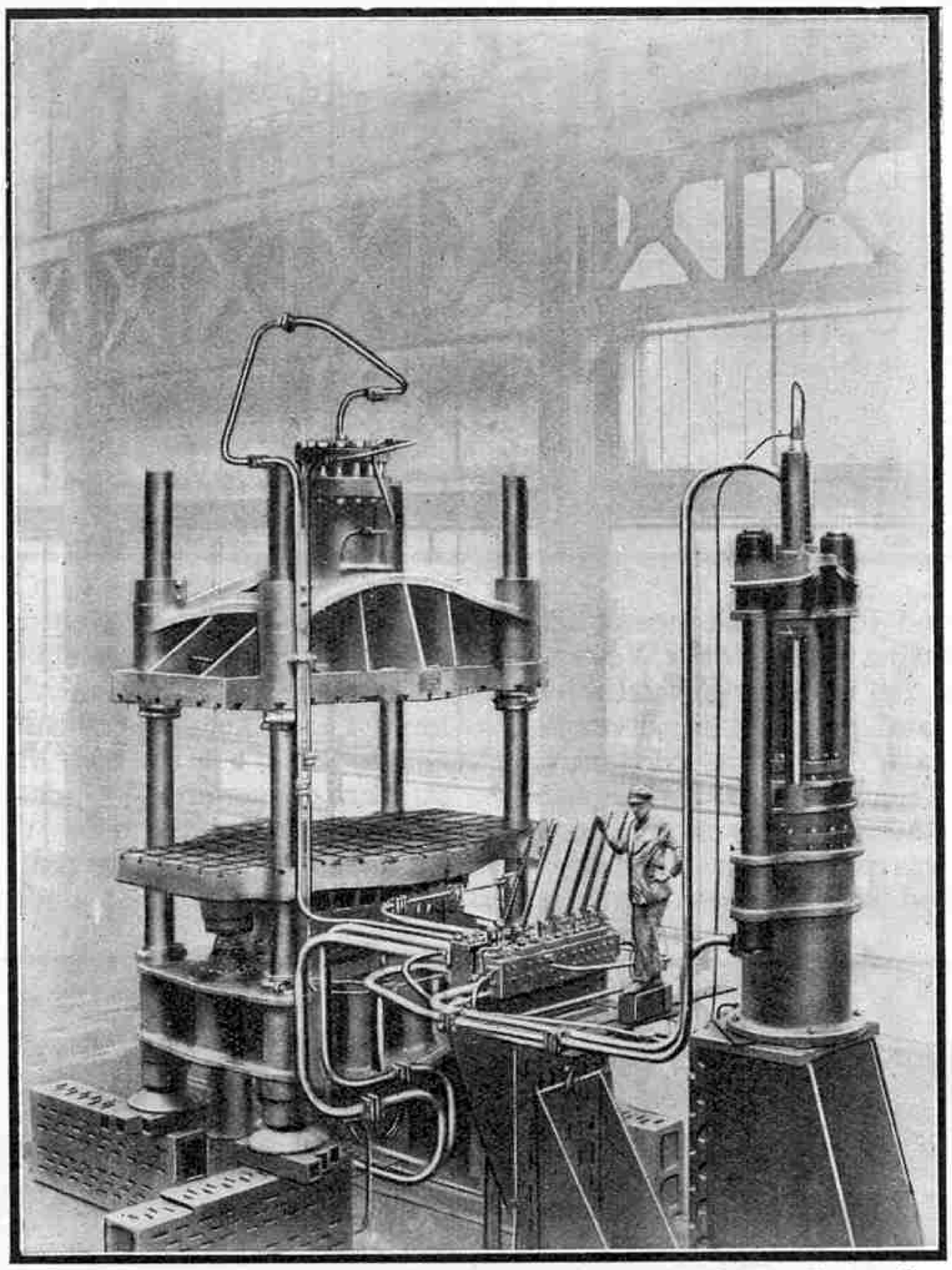
It is quite likely that Bramah would have remained a ploughman all his life but for an accident that occurred when he was about 16, resulting in an injury to his right ankle that made him permanently unfit for farm work. He was confined to the house for a considerable period, which he spent in carving various articles out of wood. His ability for this class of work was obvious to everybody, and when he was able to get about once more he was apprenticed to the village carpenter, under whose tuition he soon became an expert workman. At the termination of his apprenticeship he realised that there was little prospect for him in his own locality, and he therefore tramped to London to try his fortune in the great city. He soon found work with a cabinet maker, and remained with him for some time before setting up in business on his own account.

Bramah's first invention was connected with household water apparatus, and was sufficiently successful to place him on a sound footing. It is interesting to learn that at this time he sent for the blacksmith of his native village to take charge of the blacksmiths'

department in his rapidly growing business.

The principle underlying the action of the hydraulic press had been set out by Pascal, the famous French mathematician (1623-62), as follows. If a vessel is full of water, closed on all sides, has two openings, the one a hundred times as large as the other, and if each be supplied with a piston that fits it exactly, then a man pushing the small piston will exert a force that will equilibrate that of 100 men pushing the large piston, and will overcome that of 99.

This important principle may be illustrated simply by reference to Fig. 1. The water vessel A has two cylindrical necks each fitted with a piston. The bore of cylinder B is one inch and that of cylinder C two inches. The area of piston C is therefore four times that of piston B, and if a weight of 1 lb. be placed on piston B it will balance a weight of 4 lb. on piston C. Bramah's hydraulic press consisted essentially of a large and massive cylinder (A, Fig. 2) in which worked a closely-fitting solid plunger P. A force pump of very small bore communicated with the bottom of the cylinder and by means of this pump small quantities of water were forced at high pressure beneath the plunger, thus gradually forcing it upward. In this apparatus the cylinder A represents the large cylinder C in Fig. 1, and the force pump takes the place of the small cylinder B.



A multiple-cylinder hydraulic press installed at a large railway workshop. The machine was built by Les Ateliers et Chantiers de la Loire, France, to whom we are indebted for our photograph.

It was not until after many difficulties had been overcome that the use of water power became a practical reality. One of the main obstacles that had to be surmounted arose from the tremendous pressure exerted by the pump, which forced the water between the solid piston and the side of the cylinder in which it worked in such quantities as to render the machine very inefficient. Bramah was completely baffled by this difficulty. He tried all kinds of devices without success, and at one time it seemed that his invention was doomed to failure. The problem was to secure a joint sufficiently free to let the piston slide up through it, and at the same time so water-tight as to withstand the tremendous internal force of the pump. In this dilemma Bramah's foreman, Henry Maudslay, came to the rescue. The solution came to him in a flash of genius, and the result was his famous self-tightening collar.

A collar of sound leather of U-section, K, Fig. 2, was fitted, convex side upward, into a recess turned in the neck of the cylinder at the place formerly occupied by the stuffing-box. When the high-pressure water was turned on it forced apart the edges of the collar and thus caused the leather to apply itself to the surface of the rising plunger with a degree of tightness proportionate to the pressure of the water. As soon as the pressure was relaxed and the water released, the collar collapsed, thus allowing the plunger to sink gently down to be ready for the next stroke.

In the steam-hydraulic system, which is now employed in large forging presses, operating power is obtained by means of an intensifier consisting of a steam cylinder that works in conjunction with a hydraulic cylinder, the steam piston having a positive connection with the hydraulic ram. A steam pressure of say 150 lb. per sq. in., acting on the large area of the steam piston, multiplies the pressure on the small area of the hydraulic ram. This gives a pressure in the hydraulic cylinder of the intensifier, and also, as they are directly connected in the main cylinder of the press, of say 2½ tons per sq. in. A "prefiller," or vessel containing water under an air pressure of say 60 lb. per sq. in., also forms part of the installation, its function being to keep the system full of water so as to exclude air, and to bring the press-head down on to the work prior to the exertion of the intensified power.

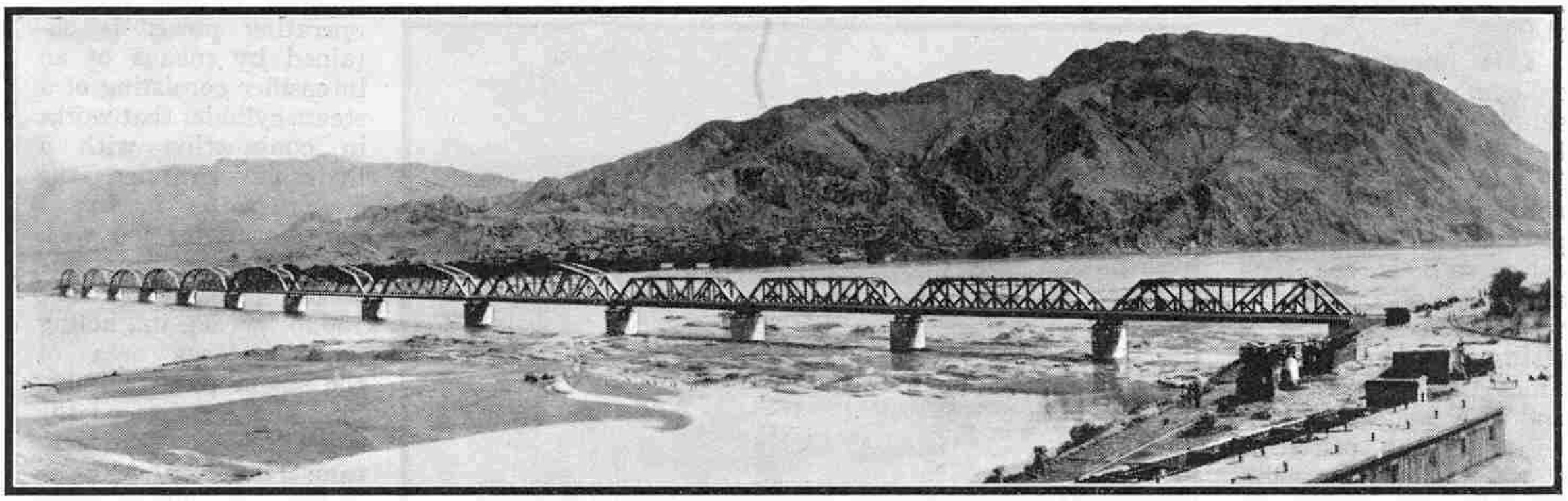
Except in special cases the steam-hydraulic press is now invariably used for heavy forging work, as it is simple in operation and more economical in power, and capable of a faster working speed than any other system.

Presses with a power of over 2,000 tons are made of special duplex-cylinder construction, the features of which are the provision of two cylinders, the absence of rigid connection between the rams and the crosshead, and the provision of a central guide cylinder for the crosshead stalk. These details enable the presses to bear without injury the heavy side strains set up when the work is not directly under the centre of the press, a condition that is unavoidable in some classes of work, and which becomes a serious factor in presses of large size. Machines of this type are now installed in most of the principal steelworks throughout the world.

The hydraulic principle is one of the most efficient means of applying force known to engineers, and its use has made possible the production in an economic manner of many articles that would otherwise be very costly to manufacture.

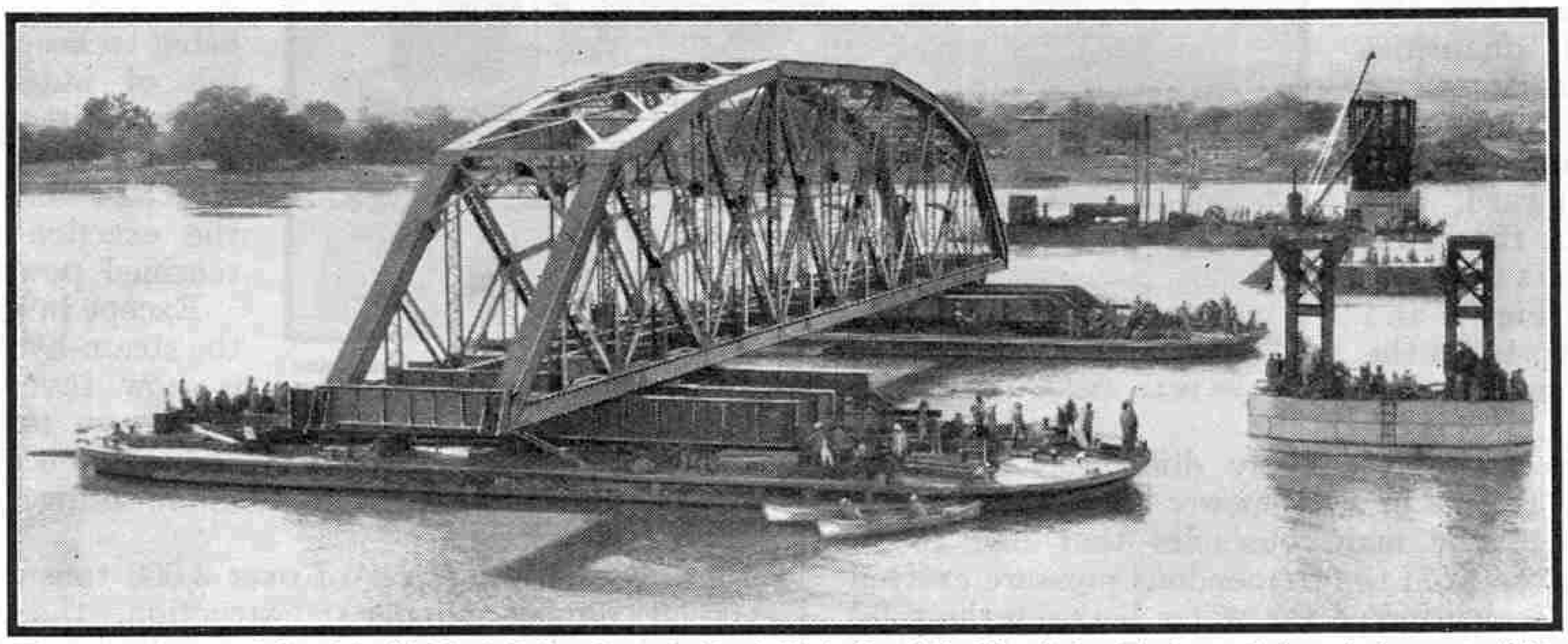
Building a 13-Span Railway Bridge

Interesting Indian Engineering Feat



BETWEEN Mahmud Kot and Jand, a distance of 230 miles, the Multan-Peshawar line of the North Western State Railway, India, runs parallel with the River Indus. At Daud Khel, 45 miles from Jand, a branch line diverges and crosses the river to Kalabagh on the way to Bannu, a town near the Afghanistan frontier. Until three years ago rolling stock was conveyed across the river on a ferry steamer, the deck of which was provided with railway track; but this tedious method was dispensed with in August 1931 when a fine truss girder bridge was completed and put into service.

The construction of the bridge was carried out by the Bridge Department of the North Western State Railway, under the supervision of Mr, W. T. Everall, O.B.E., M.I.C.E., Deputy Chief Engineer of that department, and the work was begun in January 1928. The bridge was designed to have nine truss spans each of 263 ft., giving a total length of 2,367 ft. During the high-river season the Indus at Kalabagh is nearly three-quarters of a mile wide, and therefore a curved embankment 700 ft. long and in line with the shore was erected at the Daud Khel end of the bridge so as to narrow the river at that point to the length of the bridge. The face of this embankment, and also of the abutment of the shore pier at the Kalabagh end of the bridge, was protected by a facing of stone.



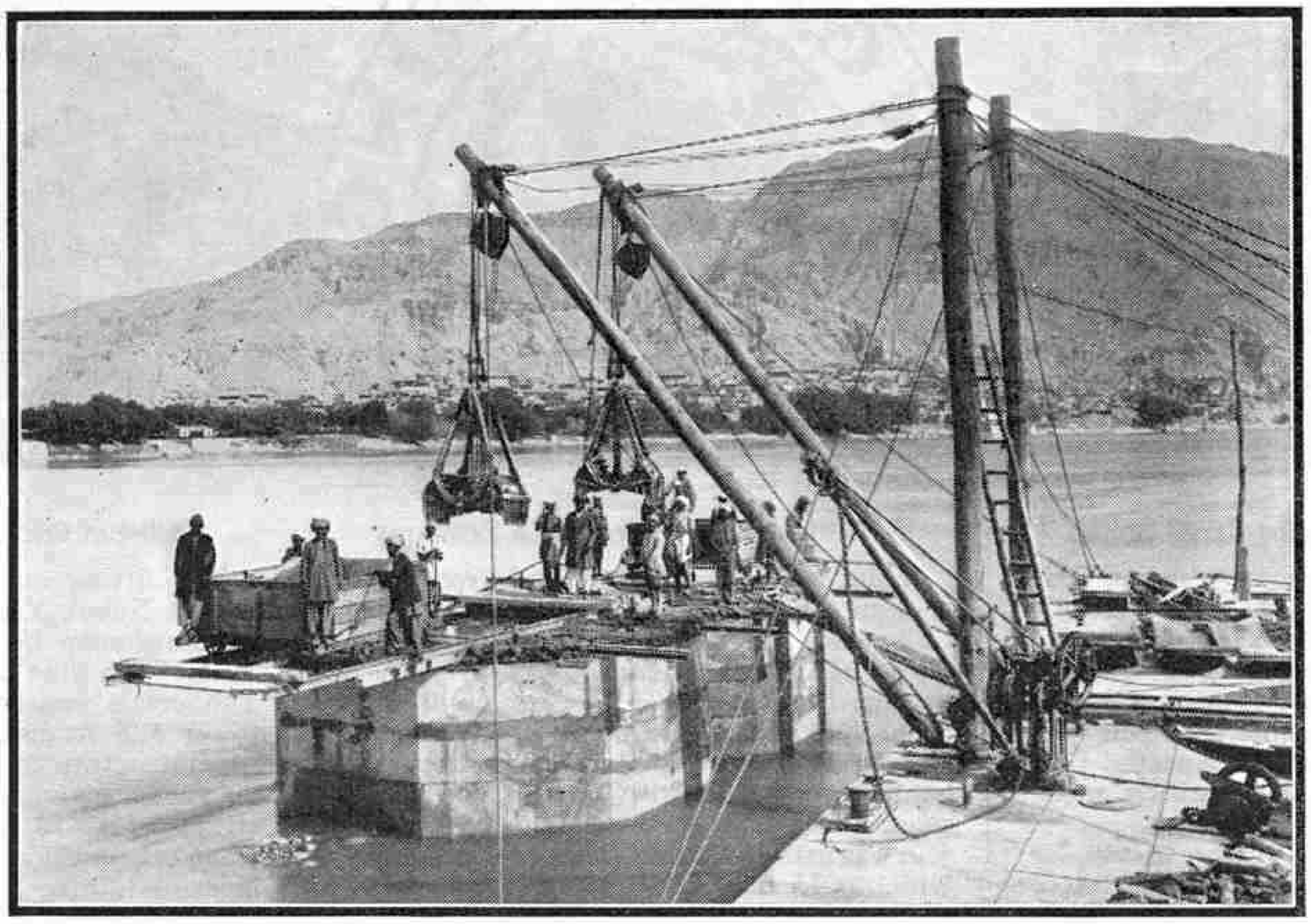
The upper photograph is of the Kalabagh Bridge from the Daud Khel side of the River Indus. The lower photograph shows one of the completed spans being conveyed on pontoons to its allotted place in the bridge. The illustrations to this article are reproduced by courtesy of the Editor of "The Railway Engineer."

The deep-water channel of the river is at the Kalabagh side, where it attains a depth of nearly 20 ft. at low water level. There the river bed consists of a stratum of boulders embedded in coarse sand, but elsewhere in the river this stratum is overlaid by thich layers of finer materials. The pier foundations therefore were sunk deep into the firmer earth so as to be unaffected by any scouring away of the lighter materials. The foundations consisted of structures called wells, which resembled open caissons and were sunk into position by dredging the ground enclosed by them. Each well was shaped like two octagons joined together at one of their sides, and had two vertical shafts, one passing through the centre of each octagon, up which the dredged material was withdrawn. The dredged earth was removed by the grabs of two steam-operated derricks working from an adjacent 250-ton barge and deposited in two tipping wagons on the well-top; when full these wagons were emptied over the downstream side of the well.

The deep-water wells were sunk as far as possible by this method of open dredging, and pneumatic power was then employed to force them down to the required depth. When the various wells had been sunk to their full depth their shafts were filled with sand and sealed at the top

with concrete, and the other parts of the structures were filled up with a layer of sand to close up the cutting edges, and over this with a thick layer of concrete.

The nine spans of the bridge were believed to provide ample clearance for the passage of the river during the flood season, their dimensions being based upon the highest recorded flood discharge, 800,000 cusecs., which occurred during the high-river season of 1878. During the monsoon period in August 1929, however, the river rose to a new record high level, and a flood estimated at the enormous total of 1,200,000 cusecs. swept over the unfinished bridge. The flood was 50 per cent. greater than the bridge had been designed to cope with, and several of the wells were forced out of alignment. Two wells, nearly in midstream, fared the worst, one being tilted 12 ft. out of the vertical, while the other was struck by a 200-ton barge that broke loose from its shore moorings. The swiftly-flowing river swept the barge against the well, which was knocked askew, and enveloped by the wreckage of the barge.

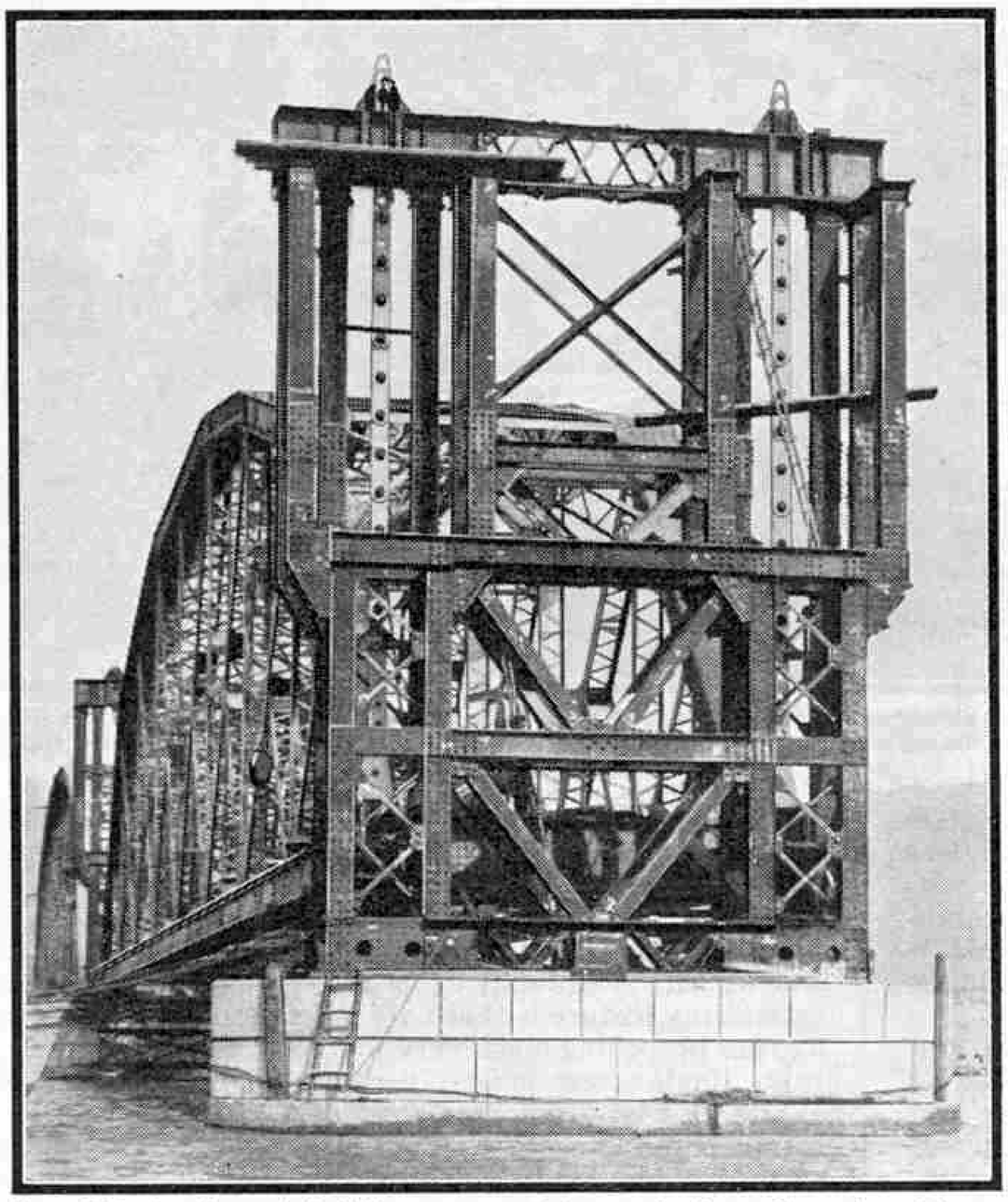


Grabs removing dredged earth during the sinking of one of the piers.

This flood made necessary a revision of the calculations on which the size of the bridge had been based. It was obvious that greater facilities would have to be provided for the passage of flood water, and this was done by abandoning the curved protection bank, and extending the bridge to the full width of the river by means of four additional truss spans. Three of these spans are 175 ft. 4 in. long, and the fourth or shoreward span is 169 ft. 10 in. long.

While the sinking of the wells for the new piers was being carried out the task of clearing the enveloped well in mid-stream was begun, and this work took 3½ months to complete. The righting of the tilted wells also required much time and patience. The river bed on the downstream side of each of these wells was dredged, and pneumatic plant, operating from the well top, excavated material from the dredging shafts. Long girders that projected over the downstream side of the well were secured to the top of the structure. The projecting portion of the girders was loaded with rails, and two crates each loaded with 100 tons of pig iron were lowered against and secured to the downstream side of the well to supplement the weight of the girders and rails. These measures were successful in restoring the wells to an upright position.

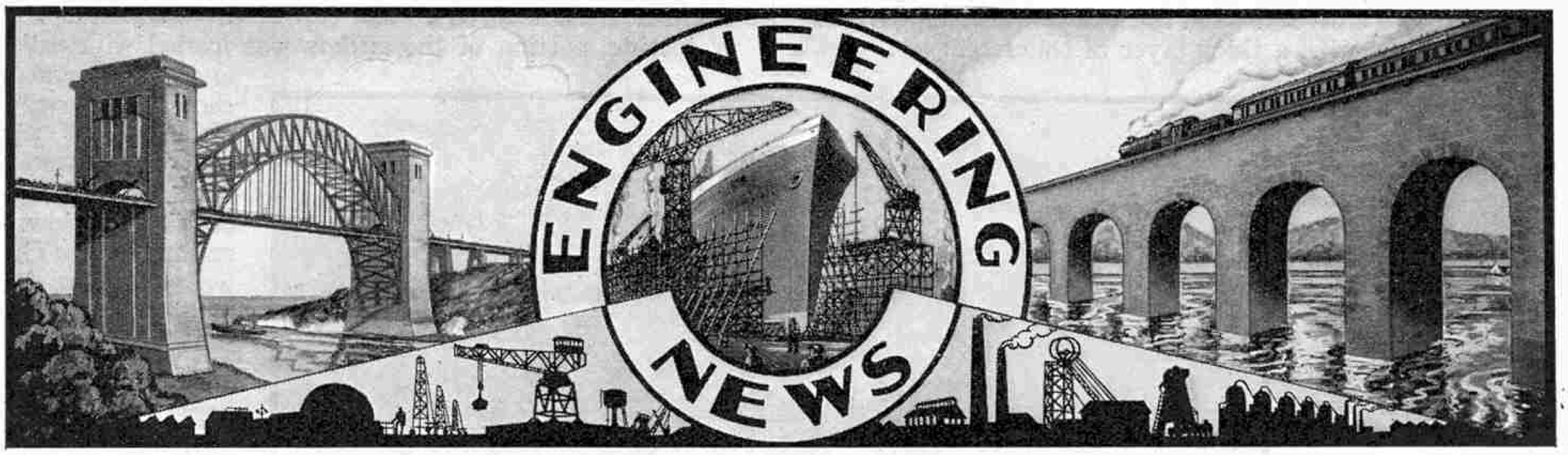
The assembling and riveting of the spans was carried out at the erection yard at the Daud Khel side of the river. Each span, when completed, was moved forward over a roller track laid on a specially erected staging to the river, where two pontoons were waiting to receive it. The riverward end of the span was lowered by means of powerful mechanical jacks on to one of the pontoons, which was kept steady by steel ropes attached to special anchorages upstream and downstream and to some of the piers. The pontoon was then slowly moved out into the river, drawing the span with it until the other end of this was in a position to be lowered by jacks on to the second pontoon. When this was effected the pontoons conveyed the span to its allotted place in the bridge.



One of the trestles and its lifting gear erected on a pier in readiness for raising a completed span into position.

The next task was to lift the span on to its piers, and this was done with the aid of vertical structures called trestles, one of which was erected on each pier. Mechanical jacks raised and transferred the span from its resting place on the pontoons to the base of the trestles. Special lifting gear was then attached to the trestles, and by means of this and mechanical jacks the span was raised. Cast steel bearings were fitted into position and the span was lowered on to them, after which the permanent connections were made.

Work on the bridge scheme was restricted to nine months of the year, operations being suspended during the high river season. In spite of this restriction, however, the bridge was completed nine months ahead of schedule.



New Diesel Engines for Cargo Ships

Two new cargo motor ships, the *"Durham"* and the *"Dorset,"* that are being built for the Federal Steam Navigation Co. Ltd., will be provided with propulsion machinery consisting of two sets of a new type of Sulzer Diesel engine that will give a total of 11,000 b.h.p. It is expected that these engines will give the vessels a speed of 16 knots.

The new engines are of the 8-cylinder type and have a normal output of 5,500 b.h.p. at 126 r.p.m. Improvements have been made in connection with the cooling, and the system of fuel injection also has been altered, the period of injection being kept constant and the stroke of the pump varied by altering the time at which it begins to inject the fuel. By doing this the timing is retarded when the engine is running with a light load and at a low speed, a very desirable feature for a marine engine that is required to run as economically as possible. Simplifications have been made also in the manœuvring control, the engines being actually operated by means of levers on the navigating bridge.

Electric Boilers in Canada

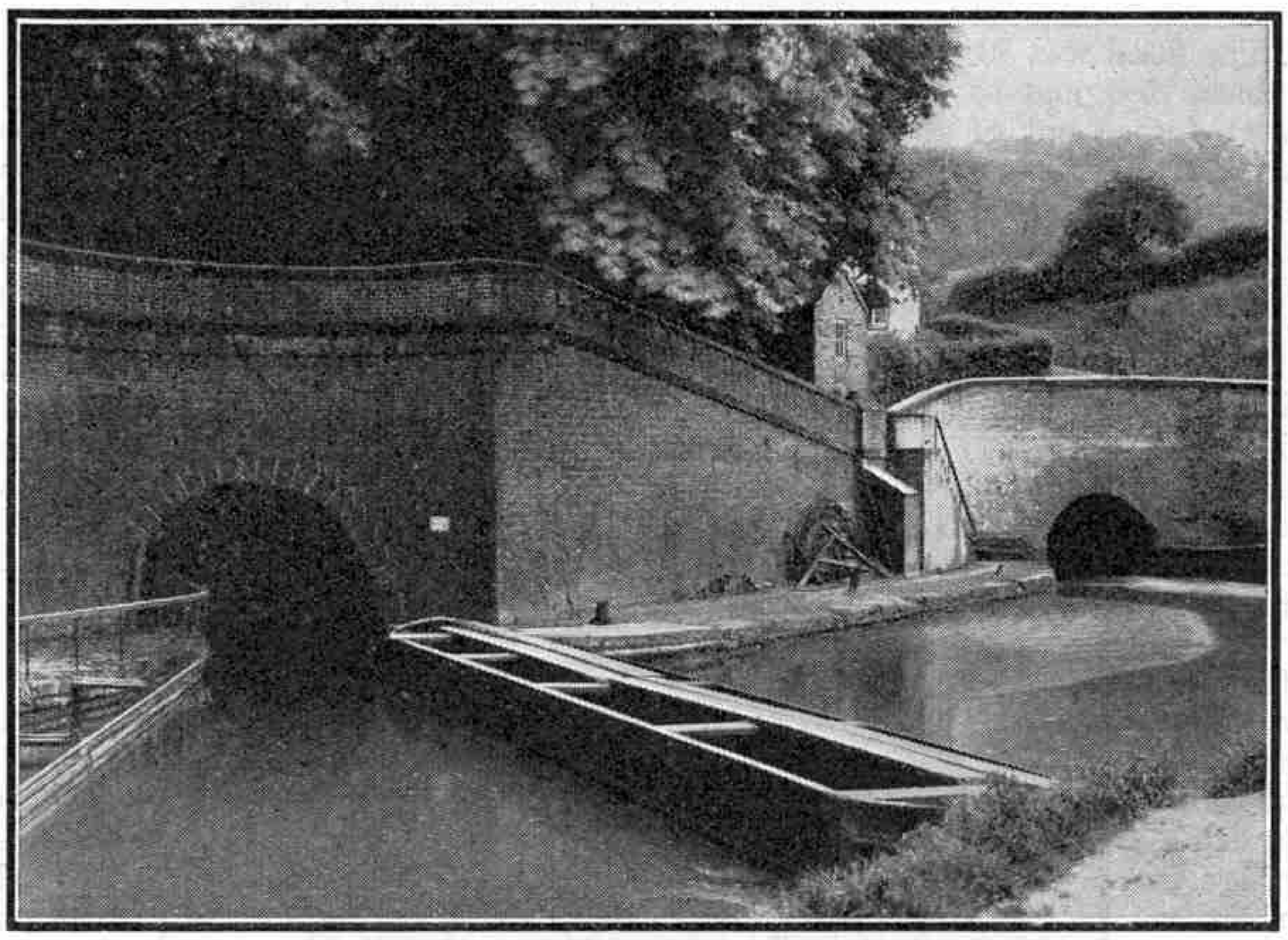
Canadian central electric stations in May of this year developed 1,829,681,000 kw.h of electrical energy and of this, 458,642,000 kw.h, or about 25 per cent. of the total, was delivered to electric boilers. This is estimated to be equivalent to a coal consumption of 88,500 tons, and thus Canada is saving coal at a rate of over 1,000,000 tons a year by using electric boilers.

It is interesting to note that the first electric boilers in Canada were installed 14 years ago by the Shawinigan Water and Power Co. at the Belgo-Canadian Pulp and Paper Mills at Shawinigan Falls, Quebec. Numerous electric boiler installations have since been added by other firms, the total capacity now reaching about 1,250,000 kw.h. If all the boilers were used to their rated capacity they would be capable of consuming a total of 9,000,000 kw.h of energy.

World Record for Cargo Ship Economy

What is claimed to be a world record for economy of consumption for marine engines of normal power has been set up by the cargo steamship *"Addistone."* During a voyage from the Tyne to Genoa, she used only 130 tons of Diesel oil, an average of 12.5 tons per day, equal to 19 tons of north-country coal. On the voyage the vessel maintained an average speed of 9.73 knots, and was using only one of her Scotch boilers, which is 15 ft. 6 in. in diameter and 11 ft. 6 in. in length, and has a working pressure of 200 lb. per sq. inch.

The *"Addistone"* is 400 ft. in length between perpendiculars, 52 ft. in breadth and 31 ft. in height. She carries 7,780 tons deadweight with a draught of 25 ft. 4½ in. An interesting feature is that only a short time ago her propelling machinery was converted from single-screw geared turbines to the White form of drive, consisting of a White combined reciprocating engine and exhaust steam turbine. White's Marine Engineering Co. Ltd., the constructors of the special propulsion machinery, claim that if a 9,000-ton vessel of modern design were to be fitted with their form of drive, only 14 tons of north-country coal a day would be required to maintain a speed of 10 knots, an extremely economical consumption.



An interesting photograph showing the Grand Trunk Canal where it cuts through Harecastle Hill, Staffordshire. The tunnel on the left was constructed by Telford and the one on the right by Brindley. Our photograph is published by courtesy of the L.M.S.R.

250-ton Crane at U.S. Navy Yard

The fitting out facilities at the Puget Sound Naval Yard, Washington, U.S.A., have recently been increased by the addition of a fine 250-ton revolving crane. The crane consists of a fixed octagonal tower 125 ft. high, carrying a horizontal superstructure that rotates on a steel track 60 ft. in diameter. The revolving superstructure is 310 ft. long, and consists of a front cantilever of 190 ft. and a rear cantilever of 120 ft. One of the most important of the tasks carried out by the crane is the accurate placing of heavy guns and turrets on naval vessels undergoing repair or being fitted out at the yard. We hope to give a detailed and illustrated description of this crane in an early issue.

Roller Bearing 3¼ Tons in Weight

Four tapered roller bearings recently made by British Timken Ltd., are each 3¼ tons in weight and 4 ft. 3 in. in diameter. They are claimed to be the largest tapered roller bearings in the world, and are capable of carrying loads up to about 200 tons.

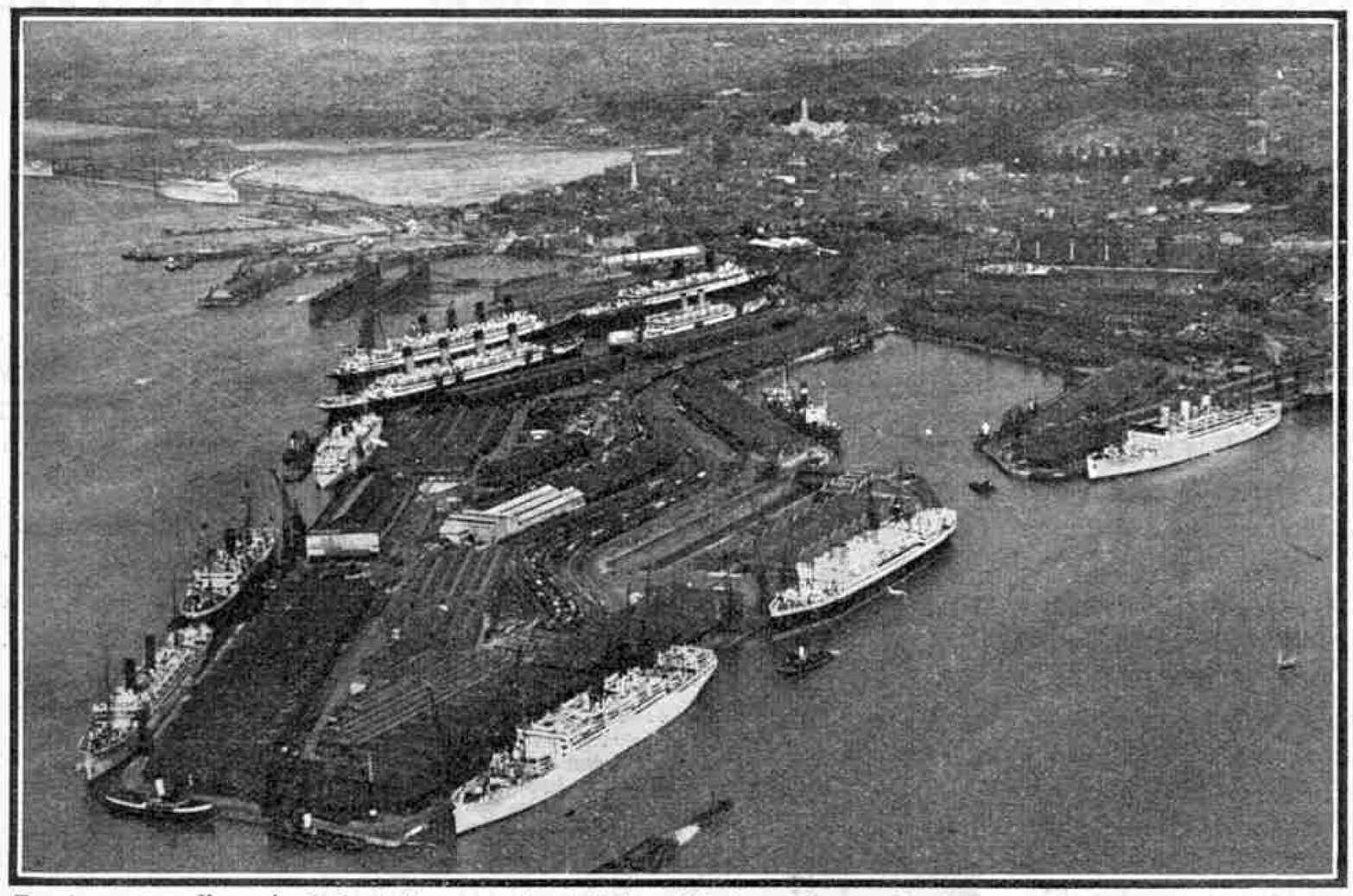
In the manufacture of these bearings it was necessary to employ special methods and equipment, the shaping of the inner cones necessitating the removal of 3½ cwt. of steel from each cone, an operation that took 47 hours in each case. The heat treating of the parts also called for special attention, and they were all left in gas-fired furnaces for 200 hours in three stages.

During the running-in tests on one of the bearings a thrust load of 200 tons was imposed, and the bearing carrying the load was rotated for 8½ hours at a speed of 42 r.p.m. The load was then taken off and the bearing dismantled. It was running quite cool, and all the working surfaces were found to be in perfect condition. In order to check the trueness of the bearing a special indicator was applied to the outer race when it was being rotated under the load, and it was found that the eccentricity of the unit was only eight ten-thousandths of an inch!

Rapid Steel Construction

Work is now proceeding rapidly on a new power station that is being built by the Metropolitan Borough of Fulham. For the shell of this structure 17,000 tons of steel have been used, all of which was fabricated, delivered to the site and erected by Dorman, Long and Co. Ltd. in the short space of 33 weeks, an average of 515 tons of metal placed in position every week for more than eight months.

During the peak period of construction 165 men were employed on erecting the steel framework, the main members of which were lifted into position by means of two 45-ton travelling cranes. Each of these cranes had a gib 140 ft. in length, which is equal to the height of the Nelson column; and the heaviest lift attempted was one of 66 tons.



Fourteen ocean liners in dock at the same time! This aerial view, taken at Southampton, includes the "Homeric," "Mauretania," "Empress of Britain," "Aquitania," "Berengaria," and the "Olympic." The photographs on this page are published by courtesy of the Southern Railway Co. Ltd.

A Roofless Tyre Factory

A motor car tyre manufacturing plant that will be capable of making 300 tyres and 300 inner tubes every day is now being constructed at Buitenzorg, Java, in the Dutch East Indies, for the American Goodyear Tyre and Rubber Co., of Akron, Ohio. About 200 workers will be employed. An unusual feature is that the whole of the works will be entirely open to the air, with the exception of the engine and boiler rooms, which will be housed in a building separate from the main factory. The factory will be made of steel throughout and will conform to the most modern engineering practice for building in tropical countries. It will measure 460 ft. in length and 200 ft. in width, and is being built on the site of an old 28-acre rubber plantation.

Launching 530 Tons of Concrete

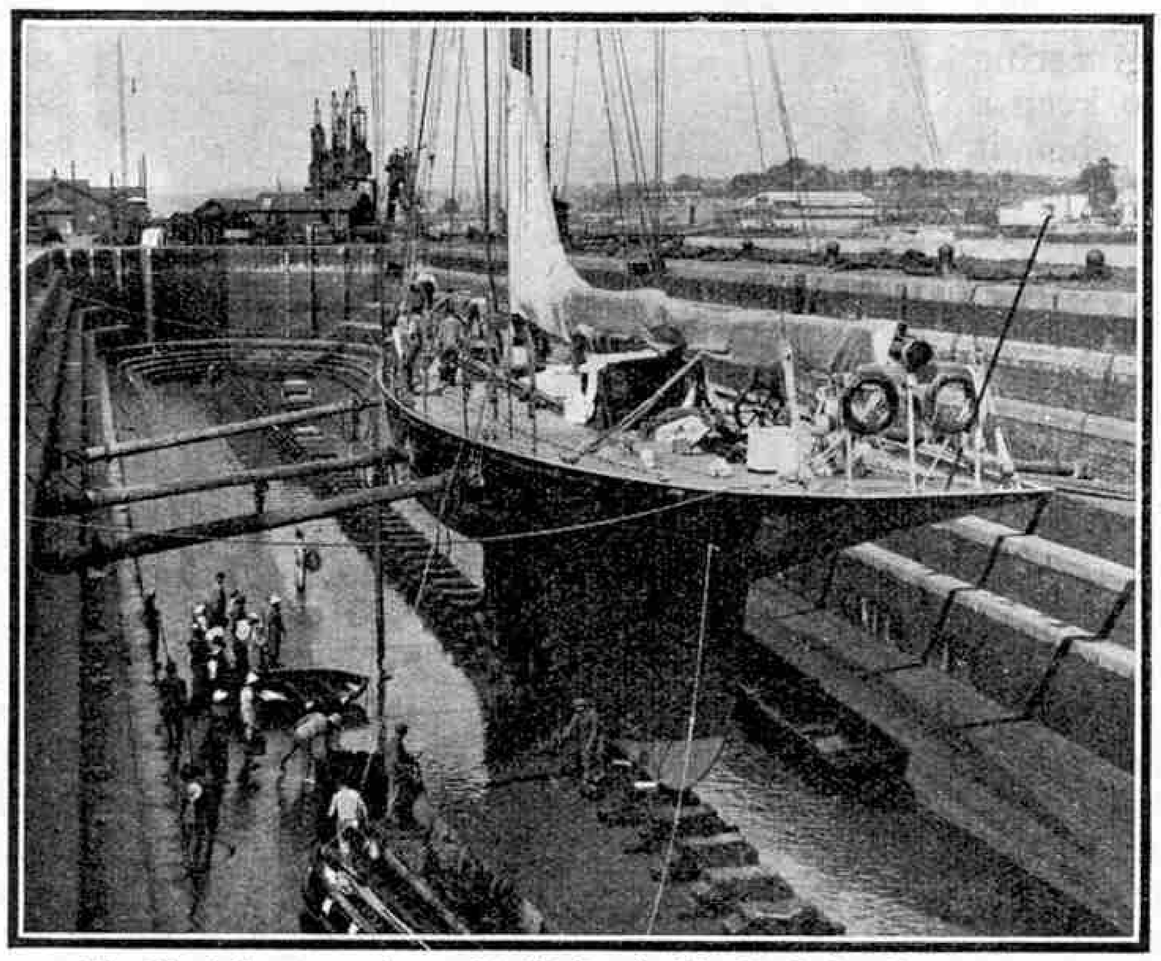
During work in connection with the construction of a dam in the United States, an interesting method of erecting the foundations was evolved. A box-like structure of reinforced concrete, 52 ft. long, 32 ft. wide, 16 ft. high and some 530 tons in weight, was built on a launching way. The concrete structure, which formed the inlet well, the foundations and lower part of the dam, was then slid into the water and towed three miles to the site of the plant.

A similar method was used when a ciasson 52 ft. by 42 ft. by 30 ft. was sunk for the Hudson River tunnel, The structure was provided with double walls of steel, and after it had been towed into position, the space between the walls was filled with concrete as the caisson was sunk.

A Mine Shaft 5,000 ft. Deep

A vertical shaft 19 ft. long by 13 ft. wide is now being sunk to a depth of 5,000 ft. in South Dakota, and it has already been driven down to 2,350 ft. Work on the shaft, which has two hoist compartments each 6 ft. square, and a third compartment to take the counterweight, was started in 1933 and has proceeded steadily. For the first 300 ft. the shaft is provided with concrete lining, as the ground is not very stable; but below this no lining has been found necessary. The hoisting equipment consists of three electric hoists each controlled by a 1,500 h.p. motor connected to drums grooved for 5,600 ft. of wire rope, $1\frac{7}{8}$ in. in diameter. The power is supplied from a hydro-electric station in the vicinity.

When it is finished, the shaft will be provided with special crushing equipment that consists of two gyratory primary crushers and two cone crushers each of which is 7 ft. in diameter.



The King's famous racing yacht, "Britannia," in dry dock at Southampton.

Scotland's Newest Road

The new highway between Edinburgh and Glasgow is the most important road that has been built in Scotland for many years. It is only $43\frac{3}{4}$ miles in length, but the work has taken 11 years owing to the many unexpected engineering difficulties that were encountered. The road is of concrete structure, and for about the first four miles from Glasgow is 120 ft. in width between fences, traffic being accommodated in two separate carriageways, each 30 ft. in width, separated by a 30 ft. reserve space. All the rest of the road on to Edinburgh is 100 ft. in width between fences, but so far only a single carriageway has been driven. This is 30 ft. in width except for the last $1\frac{1}{2}$ miles, where it has been increased by 10 ft.

In the comparatively short distance traversed by the new highway it has been necessary to build 21 railway bridges, one canal bridge, and six bridges over rivers or streams. Much difficulty was experienced in making these structures owing to the fact that the road passes through a coal mining area, and consequently special precautions had to be taken to prevent sinking. The new road is only a quarter of a mile shorter than the old one joining the two towns, but it follows a different route for the greater part of its distance and the gradients on it are much easier.

During most of the time that work has been proceeding, an average of 850 men have been employed on the scheme every day, the total number of man-days being about 1,787,400. About 3,000,000 cu. yd. of material have been excavated for cuttings and embankment, and 106,000 tons of tarmacadam, 115,000 tons of asphalt, 32,000 tons of cement, 8,000,000 bricks and 3,300 tons of steel have been used.

Pneumatic Drills Used Below Water

In Honolulu, pneumatic drills are being employed below water to remove coral that projects above the sand on the beach. This coral is exposed from time to time by the shifting of sand caused by the action of the waves, and is of course very dangerous for bathers. Until recently they have had to avoid sections of the beach where it was known or thought that coral was exposed, while jetties were constructed to cause a new layer of sand to be deposited. Recently, however, an area of about 5,000 sq. yd. has been completely cleared of coral by 15 men working with ordinary pneumatic pavement breakers entirely submerged.

Ingenious Machine Tool Attachments

Cutting Spur Gears on a Shaper

MANY ingenious attempts have been made in recent years to devise schemes by which the scope of machine tools such as lathes, shapers and drilling machines could be widened; in other words to make it possible for such a machine to add to its normal functions certain operations for which it was not originally intended. Notable among such devices are some very interesting gear-cutting attachments that have been introduced by Matterson Ltd., of Rochdale. On page 487 of the June "*M.M.*" we described one of these devices for cutting bevel gears on a shaping machine. As the result of an unfortunate misunderstanding it was stated in this article that the attachment could be fitted to a lathe, and we take this opportunity of making it clear that the device is designed for use with a shaping machine, and is not applicable to a lathe. In this article we describe another attachment of a somewhat similar type that can be used in conjunction with an ordinary shaping machine for generating spur gears.

Automatic gear-generating machines are very expensive, and unless large numbers of gears are required many small engineering shops have their gears made outside rather than go to the expense of installing special machines. Even large engineering works find that it is costly to keep a special gear-generating plant when it is used only occasionally.

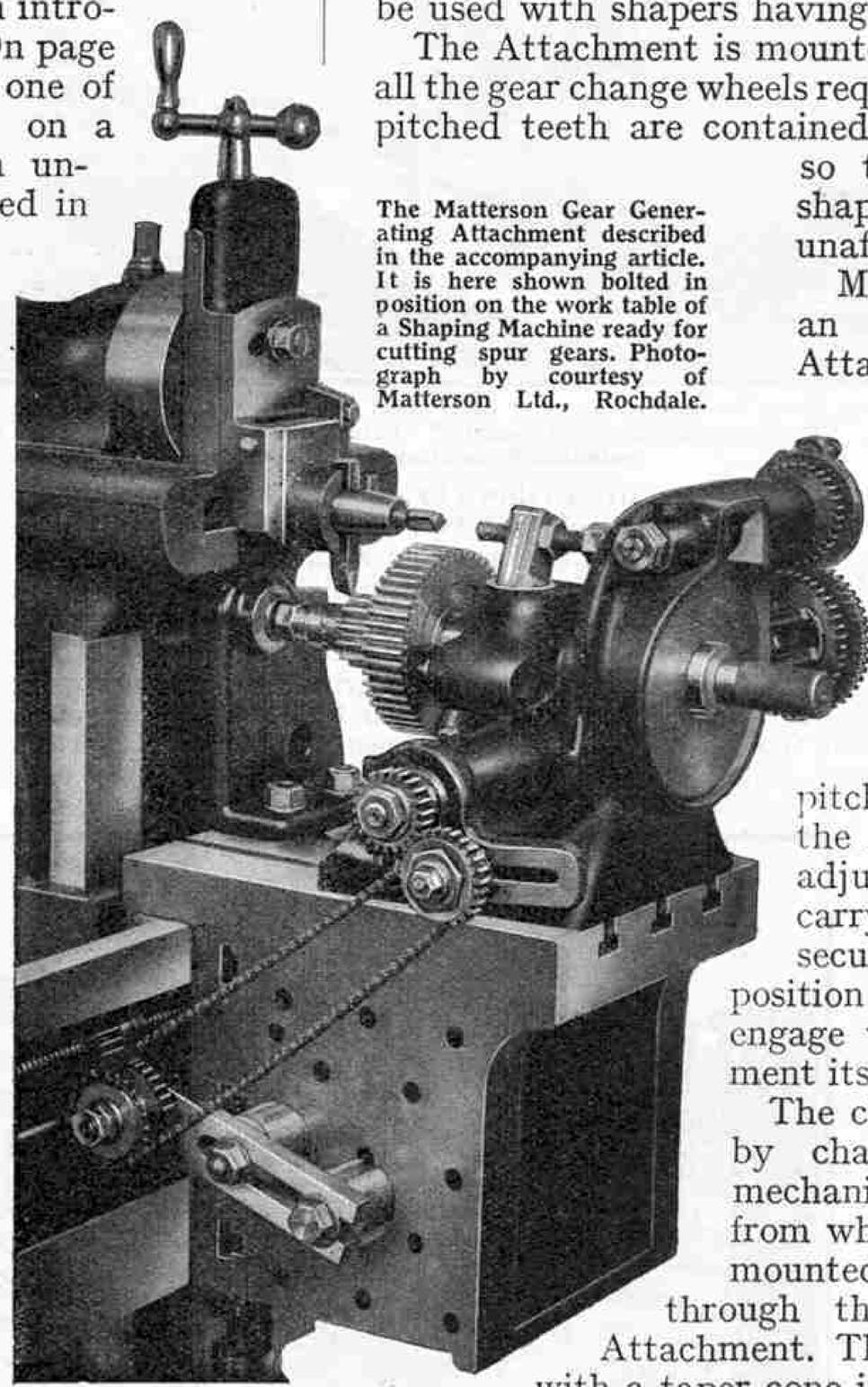
Apart from keeping the shaper machine fully occupied on circular shaping, small internal gears and the like, when the Matterson Attachment is used as an ordinary dividing head, or in work where a better quality is desired than that obtained from ordinary milling cutters, it is possible to cut shoulder pinions and pinions of special pitches and with special characteristics. When it is not required for use on the shaper, the Spur Gear Attachment can be used as an ordinary or spiral dividing head on a milling machine.

It will be seen therefore that the Matterson Attachments are very useful appliances, and their introduction reduces gear making to its simplest possible form. They are capable of cutting gears from any material.

The Attachment can be fitted to a shaper in a remarkably short time, and its cost is small compared with that of a universal milling machine or other special gear-generating machine, although it is capable of turning out the very highest class work.

The illustration on this page shows the Matterson Attachment for cutting Spur Gears on a shaping machine. The only permanent alteration to the shaping machine necessary is the cutting of a spline in the cross feed screw to receive a pinion, the existing feed motion of the shaper being used to operate the Attachment. The dividing for the various numbers of teeth is effected by hand through a graduated hand-wheel operating a driving plate and plunger mechanism. It will be seen from the accompanying illustration that the entire Attachment is very compact, a fact that enables it to be used with shapers having only small work tables.

The Attachment is mounted on the shaper table, and all the gear change wheels required for cutting differently-pitched teeth are contained on the Attachment itself, so that the operation of the shaper for its ordinary work is unaffected.



The Matterson Gear Generating Attachment described in the accompanying article. It is here shown bolted in position on the work table of a Shaping Machine ready for cutting spur gears. Photograph by courtesy of Matterson Ltd., Rochdale.

Matterson Ltd., also supply an additional fitting to the Attachment for generating spiral gears on a shaping machine. This device is capable of dealing with right and left-hand spirals up to 50° and 60° angle respectively, also straight or helical spur gears and spiral faced worm wheels. In this case also the gearing for cutting different pitched gears is incorporated on the Attachment itself, but two adjustable bracket arms that carry the change wheels are secured to the shaper, in such a position that the wheels they carry engage with those on the Attachment itself.

The change wheels are linked up by chain drive with the feed mechanism of the shaper. The blank from which the gear is to be cut is mounted on a mandrel passing through the hollow spindle in the Attachment. The hollow spindle is provided with a taper cone in the nose, for which interchangeable collets can be supplied to handle shank pinions, and the dividing worm is adjustable for wear. Similarly, the nut on the spindle nose is provided with a differential locking device giving fine endwise adjustment.

One advantage of this method of cutting spiral gears is that it is unnecessary to know the lead of the spiral, the normal pitch and angle of tooth only being required.

In changing blanks, the mandrel is withdrawn straight through the hollow spindle and similarly replaced for threading through a further set of blanks.

Gauges for involute cutters, spline shafts, cluster gears for car gear-boxes, are suitable work for the Attachment, and it is used by one well-known manufacturer of air-drills for cutting a small pinion. A rack cutter is used long enough to allow the pinion blank to be cut to roll one complete revolution without dividing.

Cottages Where George Stephenson Lived

Wylam and Killingworth Days

THE two cottages illustrated on this page, one of which was George Stephenson's birthplace and the other his home for 18 years, serve as a reminder of the humble circumstances in which the great pioneer of railways passed his early life. Both cottages are now about 150 years old and are still occupied.

In the cottage shown in the right-hand illustration George Stephenson was born on 9th June, 1781. It is at Wylam-on-Tyne, near Newcastle, and was at one time known as High Street House because it stands on what was the old post road between Newcastle and Hexham, along which the mail was carried on horseback. This two-storeyed cottage was divided into four separate single-roomed dwellings, each with the unplastered walls, exposed rafters and, in the lower rooms, clay floor, typical of labourers' dwellings of that time. The Stephensons occupied the lower room in the western half of the cottage and lived there until 1789. In front of the cottage there was a wooden wagonway along which the coal wagons to and from Wylam colliery were hauled by horses.

In 1789 the colliery closed down, and Stephenson's father, who had been employed there as fireman, obtained similar work at Dewley Burn Colliery, several miles away. It was necessary for him to be close to his work, and therefore the family removed to Dewley Burn, where they lived in one of a group of old single-roomed cottages. In front of this cottage there was also a wagonway, which led from the colliery to the wharf; and George Stephenson's first paid employment was his engagement by a widowed neighbour to keep her cows off this track. For this service he was paid twopence per day.

The cottage shown in the other two illustrations on this page is at Killingworth, and is associated with the period of Stephenson's life during which he produced his first steam locomotive. Much had happened since the old days at Wylam. He had risen from a small beginning as a colliery "picker," when his duties consisted of picking out stones and clinkers from the coal sent up from the mine below, to the responsible position of brakesman. He married in 1802, and on being appointed brakesman at the West Moor Colliery, three years later, he transferred his home to the cottage at Killingworth. The cottage consisted of a single room on the ground floor, and an attic above to which access was obtained by a ladder. Stephenson set to work to enlarge the building, and made it into a comfortable four-roomed dwelling. He also built and installed an oven.

A wagonway crossed the road at the east end of the cottage, and on this track Stephenson tried out his first steam locomotive. This was built in the adjacent wagon shops of the West Moor Colliery, and was called "*My Lord*," but was nicknamed "*Blucher*" by the workmen. The trial took place on 25th July 1814, and the engine succeeded in drawing eight loaded wagons, totalling 30 tons in weight, at a speed of 4 m.p.h. up a gradient of 1 in 450.

The sundial over the cottage door was made by Stephenson and his son Robert during one of the boy's school holidays. When Stephenson proposed the task, Robert protested that he did not know sufficient astronomy and mathematics to be able to make the necessary calculations, but his father insisted on the job being tackled. A textbook on astronomy was closely studied, and many hours were spent in making the calculations necessary to adapt the sundial to the latitude of Killingworth. Stephenson then obtained a large stone and, aided by his son, hewed and polished it and engraved on it the dial markings.

One of the accompanying illustrations gives a close view of the sundial, which is dated August 11th, 1816. The tablet seen immediately below it bears a long inscription to the effect that George Stephenson lived in the cottage from 1805 to 1823, and mentions the "*Blucher*."

In 1838 George Stephenson was one of the Vice Presidents of the Mechanical Science section of the British Association which met that year in Newcastle. During the session he found an opportunity to revisit his old home, where he pointed out with pride some of his handiwork to distinguished members who accompanied him.

(Left) The cottage at Killingworth in which George Stephenson lived from 1805 to 1823, and (above) the sundial and inscription over the door. (Right) The birthplace of George Stephenson at Wylam-on-Tyne.

The Planets and Their Atmospheres

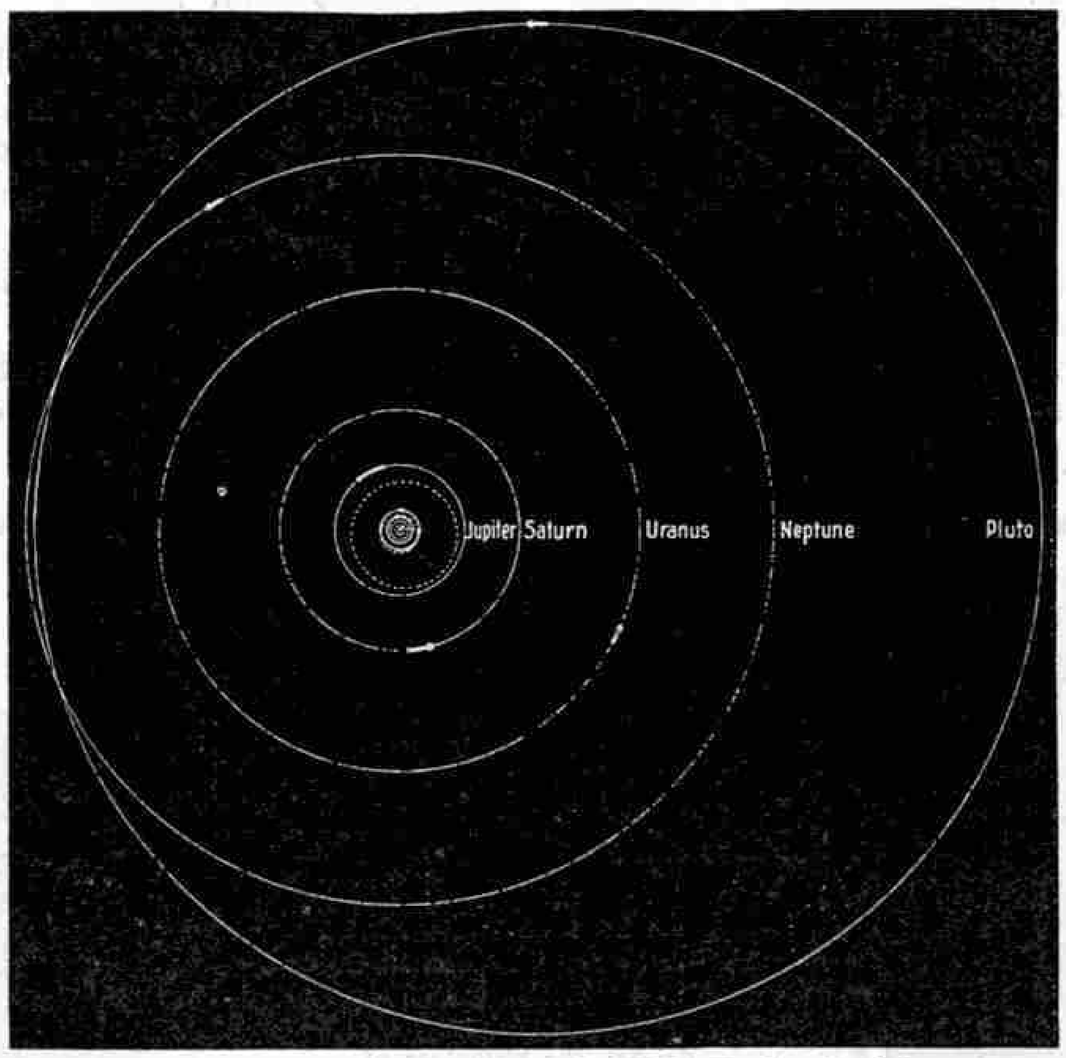
I—Methods of Study

By Dr. Walter S. Adams (Director, Mount Wilson Observatory of Carnegie Institution of Washington)

THROUGHOUT the years since primitive man first raised his eyes to the heavens and saw the evening star, the planets, called by the Greeks the wandering stars, have held remarkable interest for the human mind. With the progress of human thought and discovery our interest in the planets has naturally turned more and more toward their physical characteristics and constitution. The earliest great problem was that of their motions, and with its solution man gained an answer to many of the questions that had so long baffled him—the mystery of Venus as a morning and an evening star; the elusive glimpses of Mercury, now on one side of the Sun and now on the other; and the strange motions of the outer planets, which appear to move among the stars, then stop and retrace their steps.

When the telescope and accurate methods of measurement were developed we rapidly gained a knowledge of their distances, their sizes, masses, and forms. So our knowledge of the individual planets considered as astronomical bodies is very complete. Naturally the degree of accuracy varies with different planets. The mass of Mercury is uncertain within a considerable range, and in the case of Pluto we can do little more than form probable limits for its size and mass based upon considerations of brightness and the disturbances it produces in the motions of other planets. But in general our facts regarding the planets as a whole are very reliable.

It is quite different when we begin to consider the constitution of the planets, their atmospheres, and the conditions prevailing on their surfaces. In the first place planets shine by reflected light and are not self-luminous. Hence the light we receive from a planet is simply sunlight modified to some degree by transmission through the planet's atmosphere in case such an atmosphere exists. Difficult as it is to realise, it is a much more serious problem to learn the composition of the surface of our satellite, the Moon, the nearest object in the sky, than of a star the light of which may be thousands of years in reaching us.



Scale drawing showing the planetary orbits for 1933. The length of the arrow on the orbits of the outer planets, Jupiter, Saturn, Uranus, Neptune and Pluto, represents the distance travelled by the planets in one year. The illustrations to this article are reproduced by courtesy of the Carnegie Institution of Washington.

The gases of the elements composing the atmosphere of the Sun or a star radiate or absorb their own characteristic light and give immediate evidence of their presence when the light is analysed with a spectroscope, while the Moon acts as a mirror and simply reflects the light it receives from the Sun. In fact almost all our knowledge of the nature of the material composing the surface of the Moon is obtained through a study of the influence of reflection by different kinds of materials upon the plane of vibration of light waves, a phenomenon skilfully utilised by Dr. Wright of the Carnegie Institution to prove that the Moon's surface cannot consist of exposed rock, but must be covered by a layer of very fine sand or, more probably, volcanic or meteoric dust.

Much of our information regarding the planets must depend upon direct visual and photographic observations. Surface markings, the periods of rotation, clouds, and varying features on the apparent surface, and to some extent the presence or absence of an atmosphere itself, must all be studied with the telescope, and here we encounter the serious difficulty of atmospheric disturbances.

When a telescope is pointed to the sky it is looking out through the entire depth of the Earth's atmosphere. Each irregularity in the temperature and density of the air through which the light passes bends and twists the beam of light, and as such irregularities change very rapidly there is a continual blurring and quivering of the image. This is the familiar twinkling of the stars so often seen on a windy winter night, and in a telescope the effect is increased in proportion to its magnifying power. Such a blurring effect goes far towards obliterating the surface details and finer markings on the planets or the Sun and Moon, and explains why astronomers seek to locate their observatories where the air is most steady and free from disturbance, and why Percival Lowell established his observatory, primarily for the study of Mars, on an isolated plateau in central Arizona.

It also answers the question most frequently asked of astronomers—whether a telescope cannot be built sufficiently large to bring the Moon within a few miles and Mars within a few hundreds of miles, and so make even the smallest details visible. There is ample light for such observations with existing telescopes and the magnifying power may be made as high as may be desired; but unfortunately the disturbances due to the Earth's atmosphere are magnified along with the planet's disc and nothing is gained.

If the Earth's atmosphere could be removed the astronomer could use a compound microscope attached to his telescope to view the Moon, and the limit of magnification in the case of the planets would be set only by the resolving power of his telescope and the disturbances in the atmospheres of the planets themselves.

These difficulties affecting observations of the planets explain in part why our knowledge of their physical state is less complete than our knowledge of them as astronomical bodies. Much has been learned, however, and much more may be expected with the development of new and more sensitive instruments for measuring radiation and for studying the influence of the atmospheres and the surface materials of the planets upon the quality of the reflected light.

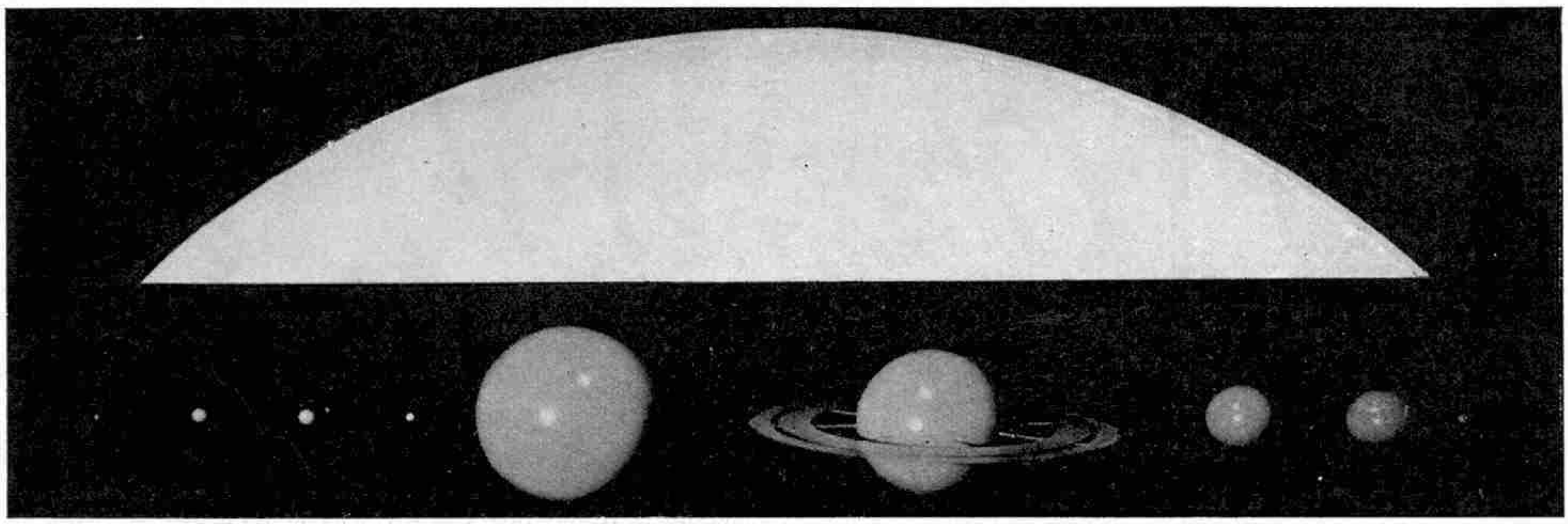
There are three important factors that govern to a large extent physical conditions upon a planet and what we may call its climate. The first is, of course, its distance from the Sun. This determines the amount of heat and light that it receives, a quantity that varies for each unit of area as the square of the distance. Thus Neptune, which is 30 times as far away from the Sun as the Earth, receives only one nine-hundredth as much light and heat on equal areas of its surface.

The second factor is the length of the planet's day, its period of rotation on its axis. This regulates the amount of time during which the Sun's heat falls on different portions of the surface. The more rapidly a planet rotates, the more nearly uniform will be the amount of heat received by all its parts.

An extreme case is that of Mercury, which is generally believed to rotate in the same period of 88 days in which it revolves about the Sun. Hence the planet always turns the same face to the Sun, as does the Moon to the Earth, and one side is intensely heated by the powerful solar radiation while the other side never receives any sunlight and must be extremely cold.

The third consideration that bears especially upon the question of planetary atmospheres is that of the masses of the planets. We do not know definitely that all the planets originally had atmospheres, although this seems probable; but if they did several of the planets would have lost them either completely or in part because they were not massive enough to retain them.

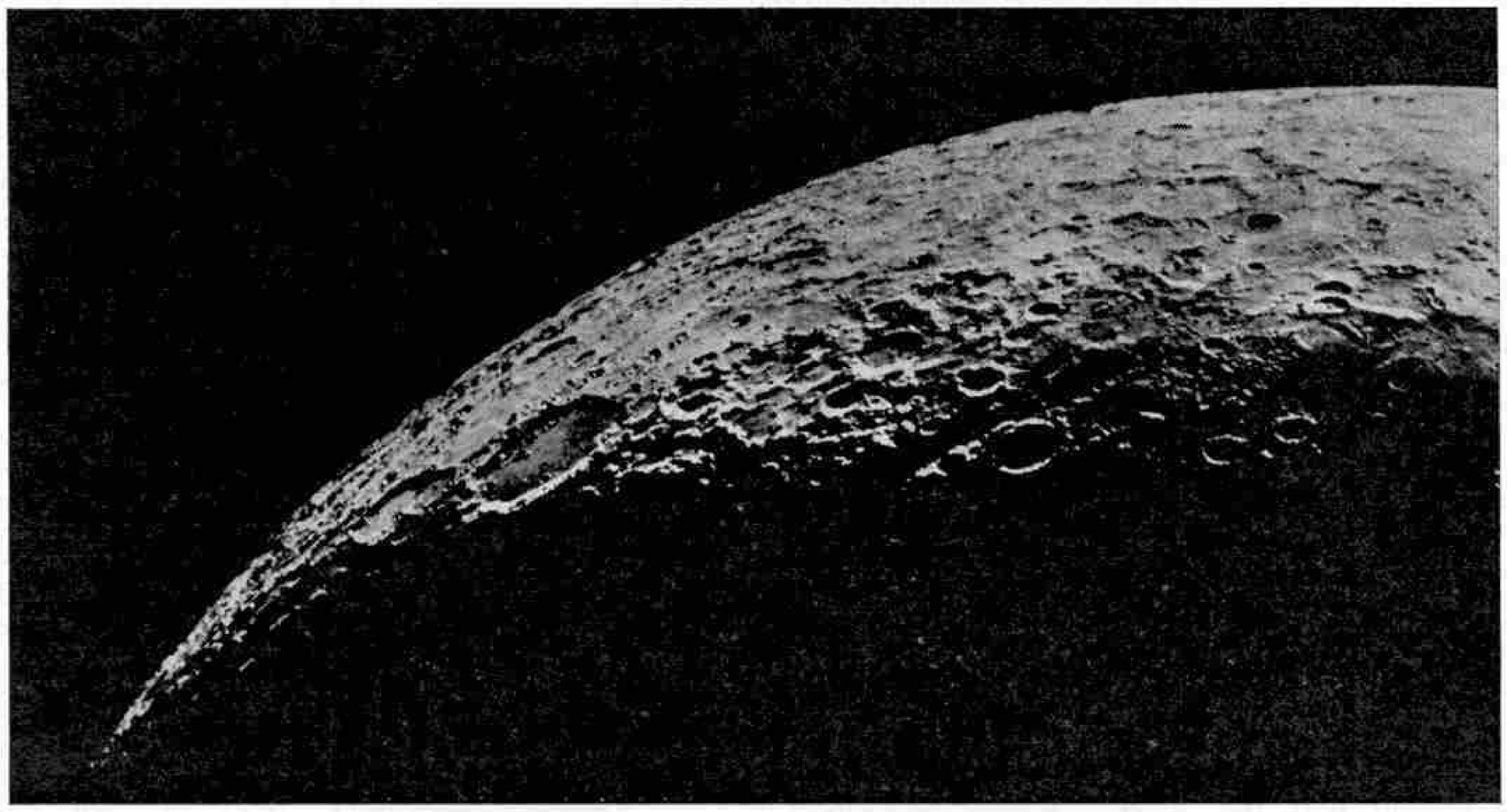
The molecules composing the gases of an atmosphere are constantly flying about with high velocities, colliding with one another



and rebounding in all directions. These velocities are highest for the lightest gases like hydrogen and helium, and lower for the heavier gases like oxygen and nitrogen. Furthermore the velocities are increased by increase of temperature. As a result, if a rapidly moving molecule in the upper part of a planet's atmosphere, where collisions are infrequent, is not attracted by the planet with a force sufficient to counteract its velocity of escape, it will fly off into space and be lost. So a planet has to have a considerable mass in order to retain its atmosphere, and especially to hold the lighter gases like hydrogen and helium, which would be the first to escape. In the earlier stages of their history, when the planets were probably much hotter, the rate of escape for all gases must have been much more rapid.

If we compare the results of observation with what might be expected from theory, we find remarkably good agreement. Mercury, with a mass about one twentieth that of the Earth, has no atmosphere; while Venus, with nearly the mass of the Earth, has an extensive atmosphere.

The Earth has probably lost some of its free hydrogen, but shows a small amount of helium and abundance of the heavier gases like nitrogen and oxygen. Our satellite, the Moon, with one eightieth the mass of the Earth, has no atmosphere, and on Mars, with one tenth the Earth's mass, the atmosphere is thin and of low density.



The upper photograph shows models prepared by the Carnegie Institution's Mount Wilson Observatory to illustrate the relative size of the Sun and planets. In the top row is a segment of the Sun modelled to the same scale as the planets in the bottom row. The planets, from left to right, are Mercury, Venus, Earth and the Moon, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto. The lower photograph was taken with the 100-in. telescope at the Observatory, and is of the southern portion of the Moon 26 days after the "new moon" appears.

On the other hand, the giant major planets with masses ranging from 15 times the mass of the Earth, in the case of Uranus, to over 300, in the case of Jupiter, have dense and extensive atmospheres. They have doubtless retained all of their original gases, including hydrogen and helium, the gravitational attraction of their great masses binding the molecules of the gases firmly to the planets.

The presence of an atmosphere around a planet is usually detected from observations of clouds and variable markings or, as in the case of Venus, from the extension of the horns of the crescent beyond the diameter of the planet owing to the diffuse reflection of light in the planet's atmosphere—an effect similar to our twilight. For our knowledge of its composition we must then depend upon the spectroscope, which analyses the light and shows what modifications the sunlight has undergone in passing through the atmosphere. These usually occur in the form of bands and lines that are due to the absorption of the cold molecules of gas, and appear for the most part in the red and infra-red portions of the spectrum.

The most prominent in the Earth's atmosphere are those due to oxygen, water vapour, and carbon dioxide. Ozone produces a few faint lines in the yellow portion of the spectrum, but its principal bands lie in the ultra-violet and are so strong that they set a definite limit to the extent of the spectra of the Sun and stars. Astrophysically this is most unfortunate but, as Dr. Abbot and others have emphasised, life could hardly exist upon the Earth if exposed directly to this highly penetrating radiation from the Sun.

Since the surfaces of planets must be observed not only through their own atmospheres but through that of the Earth as well, the bands and lines due to our atmosphere are always present in the spectra of the planets. There are two ways in which the effect due to the Earth may be separated from that due to the planet, and the relative abundance of the gases in the two atmospheres may be determined.

The first is by comparing the intensities of the bands in the spectrum of the planet with those obtained from light transmitted through the Earth's atmosphere alone. For example, the spectrum of Mars, in which the light from the Sun has passed first through the planet's atmosphere to the surface, then outward from the surface toward the Earth, and finally through the Earth's atmosphere, is compared with the spectrum of the Moon, which has no atmosphere.

If the altitude of the Moon in the sky is the same as that of Mars, the length of path through the Earth's atmosphere is the same in both cases, and any excess of intensity in the lines of the spectrum of Mars must be ascribed to the gas in the planet's atmosphere. Allowance must, of course, be made for the double path of sunlight through the atmosphere of the planet, which should increase the intensity of the planetary lines.

A second method of separating planetary lines from those of terrestrial origin depends upon the fact that the motion of a planet towards or away from the Earth produces a displacement of the spectral lines. Accordingly, if a time is selected when a planet is approaching or receding rapidly from the Earth and the spectrum can be photographed on a sufficient scale, the planetary lines will appear completely separated from those due to the Earth's atmosphere. This method has marked advantages *(Continued on page 793)*

Photographing a Bursting Soap Bubble

I see that two American scientists have succeeded in taking photographs showing how a soap bubble bursts, and how a pane of glass is broken by a bullet travelling at the rate of about 400 ft. per second. The exposures necessary for these remarkable photographs are about one hundred-thousandth of a second. It is impossible to devise any form of mechanical shutter to give such short exposures, and instead a short but brilliant flash of light is produced, the duration of this being the exact time of exposure required. Thus in taking the photograph it is only necessary to open the shutter, flash the light, and then close the shutter again.

The flash is really a miniature lightning discharge, for it is an electric spark from a condenser charged to 16,000 volts. It occupies only one hundred-thousandth of a second, or even less, and is timed automatically. For instance, in photographing the bursting of a bubble, the bullet is made to pass through the bubble and then strike a contact that releases the electrical energy in the condenser and causes the spark. The contact can be adjusted to produce the flash at different times after the bursting of the bubble, and thus successive stages in the action can be photographed. A series of photographs is obtained by using several bubbles, and these show first the collapse of the near side of the soap film, then the extension of the breakage round the bubble, and finally the wisps of film left hanging from the pipe from which the bubbles was blown.

Other photographs of special interest secured by similar means show the break up of a glass containing milk when dropped on the floor from a height of 5 ft. In this case the impact of glass itself set up the contact that produced the flash, and the fragments into which it broke can be seen separated from each other before they have fallen to the ground, with the milk beginning to pour out of the gaps between them.

It is interesting to compare a photographic triumph of this kind with the laborious efforts of the pioneers of photography. As many of my readers know, photography was made practicable by J. N. Niepce, a French scientist, who discovered that a silvered copper plate that had been exposed to the vapour of iodine was sensitive to light. The image produced on this plate was made permanent by washing in salt water. The chief drawback to the method was the length of exposure necessary, for the images were faint even after light had been allowed to fall on the plate for several hours. This difficulty was overcome by Daguerre, a scenic artist who helped Niepce, and discovered after the older man's death that mercury vapour had such a surprising effect on an exposed plate that exposure could be reduced to about half an hour.

Daguerre announced his discovery in 1839, and in the same year Henry Fox-Talbot, a retired Englishman living in the secluded Wiltshire village of Laycock Abbey, placed on record a description of a method of obtaining photographic images on paper. Daguerre's process was the more beautiful in its results, as well as being the more practicable, and in consequence its discoverer has come to be regarded as the true inventor of photography, despite the almost equal claims of Henry Fox-Talbot and the work of Niepce and others. At any rate, Daguerre's name has become inseparably associated with the first commercial photographic process, and the photographs that were made on silvered copper plates became known throughout the world as "daguerreotypes."

The First Photographic Portrait

It is interesting to find that Daguerre was not the first man to photograph a human face, and indeed when making the announcement of his discovery he stated that he had not yet succeeded in portraiture, but hoped to do so later. Daguerre's early photographs were of whitewashed walls, cottages and landscapes, and his earliest plates were so slow that exposures of impossible length would have been required for portraits, even in brilliant sunshine.

The first photographic portrait. This was the work of Professor Draper, of the University of New York, and the sitter was Miss Dorothy C. Draper, his sister, who remained still during an exposure of half an hour!

The distinction of taking the first human photograph belongs to Professor J. W. Draper, of the University of New York. Draper was born in St. Helens, Lancashire, in 1811, and emigrated to America in 1833, where he became Professor of Natural Science in Hampden Sidney College, Virginia, in 1837, and Professor of Chemistry in New York University in 1839. When Daguerre gave to the world his discovery of photography, Professor Draper, who had long been interested in the chemical effects of light, determined to apply the discovery to the making of human portraits. Together with Professor Morse, the originator of the Morse Code, he erected a little glass studio on the University roof, and there he conducted experiments on photographic portraiture with the aid of his laboratory assistant, who acted as "sitter." The "camera" used in these early efforts consisted merely of a cigar box to which was fitted a spectacle lens. With this crude instrument Professor Draper succeeded in obtaining photographic images of brick buildings, a church spire and other objects, but the features of his laboratory assistant failed to impress themselves upon the plate.

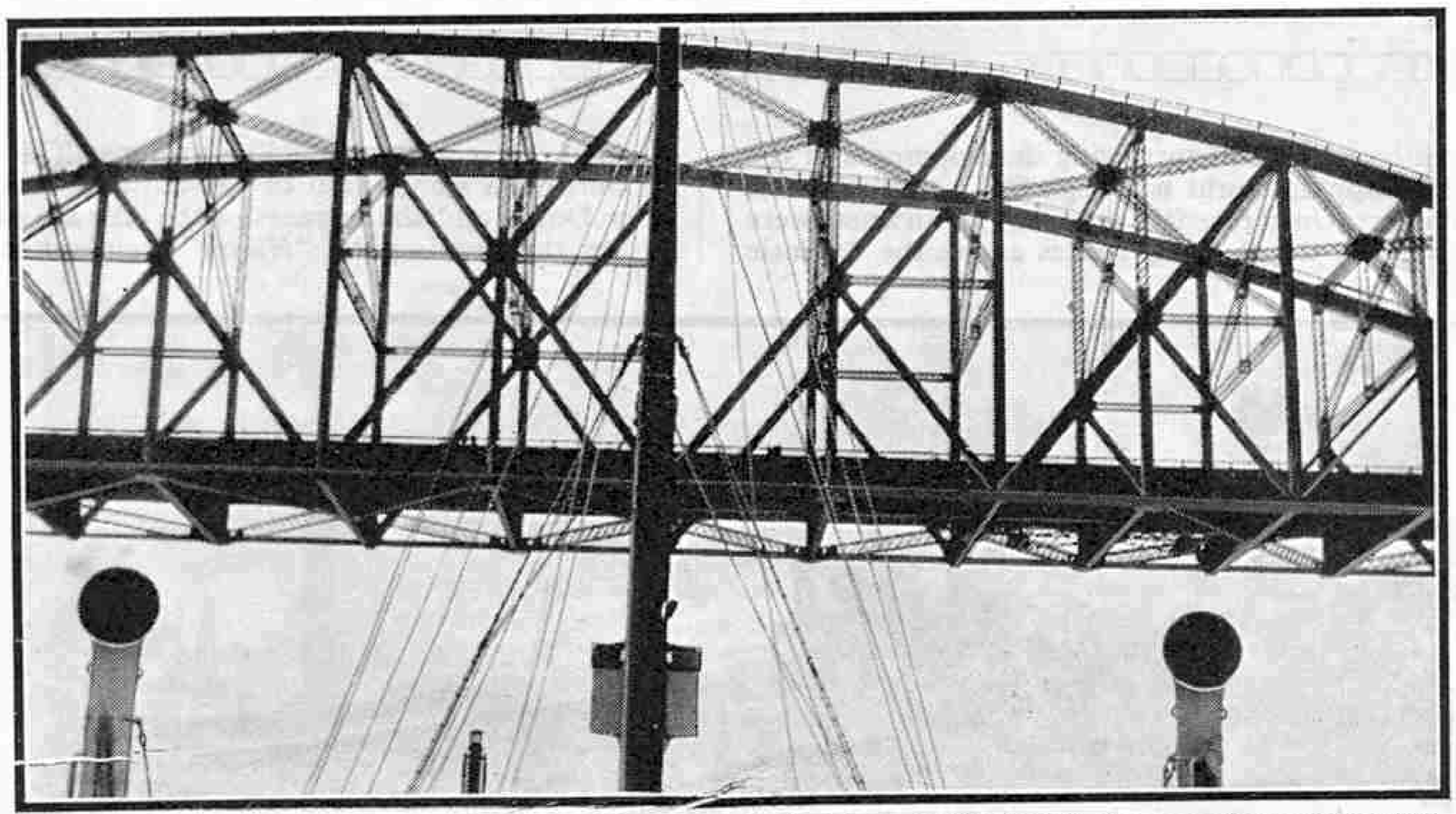
Shortly afterwards, acting upon the suggestions of a Mr. Towson, of Liverpool, an optician of some note, Professor Draper employed a more elaborate camera that was fitted with a wide aperture lens to admit more light to the plate. This lens was a huge affair, with a diameter of five inches and a focal length of seven inches. It proved effective, however, for with its aid Professor Draper towards the end of 1839 photographed his sister, Miss Dorothy Catherine Draper. This lady submitted to having her face carefully dusted over with white powder in order that her features would reflect as much light as possible, and to remaining absolutely motionless during an exposure of half an hour in bright sunshine! The portrait has been carefully preserved as a scientific rarity of fascinating and ever-increasing interest, and is reproduced on this page.

In the following year the daguerreotype process of photography was speeded up and applied commercially in most of the civilised countries of the world. In April, 1840, Professor Draper, in conjunction with his colleague Professor Morse, opened a portrait gallery on the roof of New York University, and the fashionable people of New York flocked to the studio in large numbers to have their portraits made by the wonderful new invention.

Scientific Hunt for Buried Treasure

Those of my readers who have revelled in *"Treasure Island"* and other stories of pirate hoards hidden on the islands of the Pacific will be interested in the expedition that sailed to Cocos Island in search of the vast treasure supposed to be buried there. The story of the chief hoard to be sought on that lonely island was told on the Editorial page of last month's *"M.M."* No less than nine different methods of detecting masses of metal underground are to be employed in looking for it. Some of these methods are as yet secret, but the general idea can be gathered from one of them, in which ultra high-frequency currents will be passed through measured portions of ground and their course followed by means of surface measurements. Naturally the conductivity will be greatest in areas where metals are buried, and it is hoped that the tracks of the high-frequency currents will reveal the presence of the gold and silver believed to have been buried by the pirates who made Cocos Island their headquarters.

Methods of this kind are now used by prospectors in the search for underground metallic deposits, and their employment on Cocos Island will go far towards proving or disproving the truth of the many legends of hidden gold that have been rife since the decay of piracy. Success will give an immense impetus to treasure seeking, especially in South America, where the greater part of the wealth of the Incas, the former rulers of Peru, is supposed to have been carried for safety into the Andes after the conquest of Peru by the Spaniards.

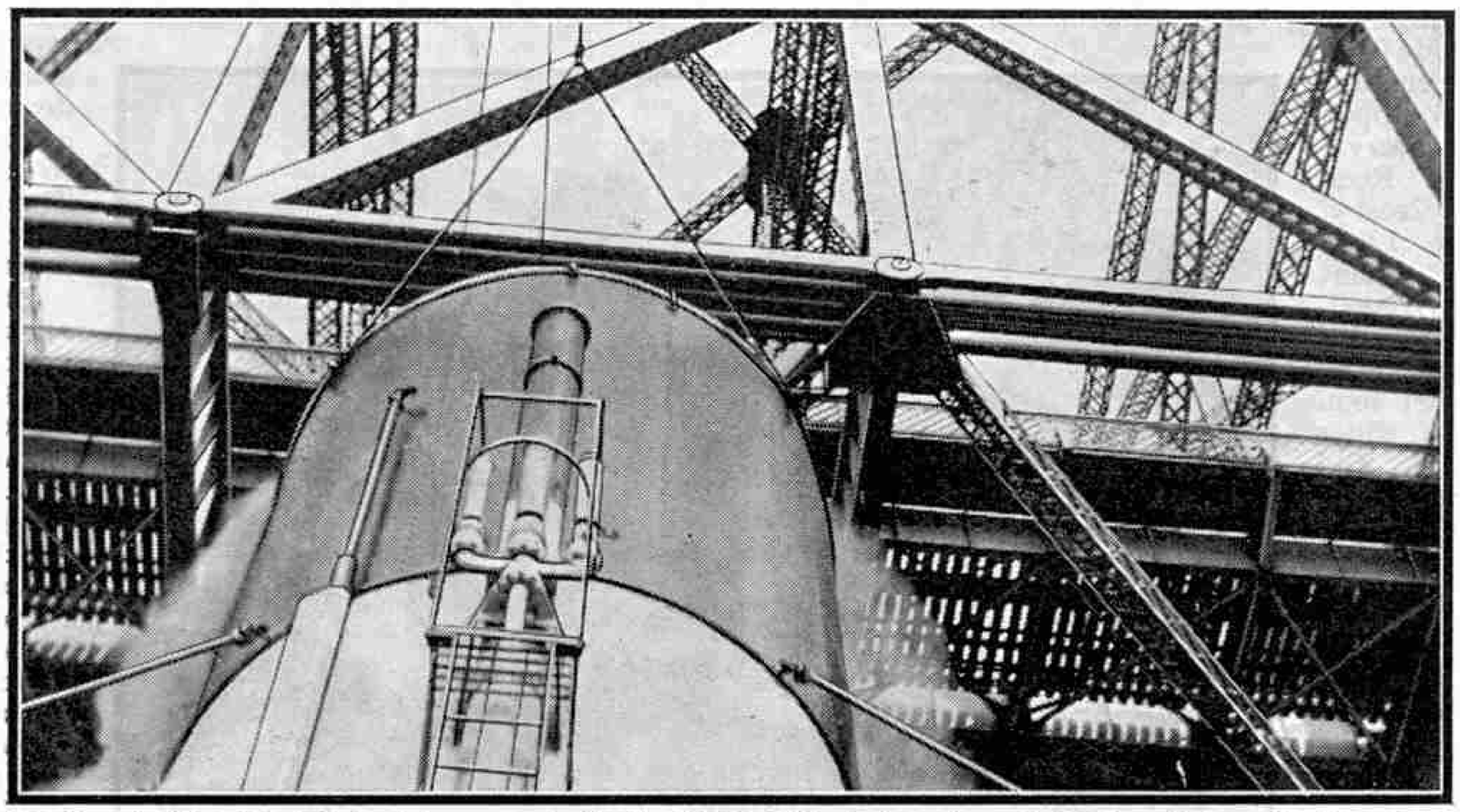


A novel view of the suspended span of the Quebec Bridge from the boat deck of S.S. "Doric." The photograph suggests that the mast of the vessel will collide with the steelwork of the bridge.

Tower Twice the Height of Snowdon

For many years the Eiffel Tower retained the proud distinction of being the highest man-made structure in the world, and it is only within recent years that two of the skyscrapers of New York have exceeded it in this respect. The Eiffel Tower is 984 ft. in height, and today the Empire State Building and the Chrysler Building hold the record with heights of 1,046 ft. and 1,030 ft. respectively. It has now been proposed to restore the distinction to the Old World by building in Paris a giant tower of reinforced concrete 6,540 ft. in height.

The new tower is planned in connection with a great Exhibition to be held in Paris in 1937, and will be nearly seven times the height of the Eiffel Tower and almost twice as high as Snowdon. Its base will be 650 ft. in diameter, and even at the top the gigantic structure will measure 130 ft. across. At different elevations platforms will be constructed from which aeroplanes can be launched through gigantic openings, and anti-aircraft guns mounted on the tower will help to protect the city from aerial attack.



The funnel of the "Doric" about to pass under Quebec Bridge. This photograph was taken immediately after the one reproduced above, and both are by Miss E. Wilson, Bowdon, Cheshire.

The World's Tallest Chimney

The tallest chimney in the world is that of the Anaconda Copper Company, at Anaconda, Montana, in the United States. It is built of brick and is 550 ft. in height, its inside diameter at the top being 60 ft. The summit of the chimney actually is 585 ft. above ground level, for the stack stands on a concrete base 30 ft. in height. It is interesting to note that this immense chimney is almost exactly three times the height of the Nelson Column in Trafalgar Square, London.

There is a chimney 510 ft. in height at the smelting works of the International Nickel Co. Ltd., in Ontario, Canada, and this is the largest and tallest in the British Empire. The tallest chimney in Europe is 492 ft. in height and was built in 1931 for a power house in Hamburg. Chimneys of such huge dimensions are of course only required in special circumstances and consequently are rare.

How to Treat Ducks

I was greatly interested recently to find that a Government publication insists on the necessity for tact and courtesy in the treatment of ducks! This publication is a bulletin on ducks and geese published by the Stationery Office, and in it the intelligence and highly strung temperament of the duck is emphasised and those who keep the creatures are warned that they will not stand bullying or bustling. A still more surprising suggestion in the same bulletin is that the duck pond should be abolished because exercise on the water, enjoyable as it may be to the ducks themselves, does not improve their quality. Needless to say, the judges of quality who make this pronouncement are not the birds themselves, but those who eat them!

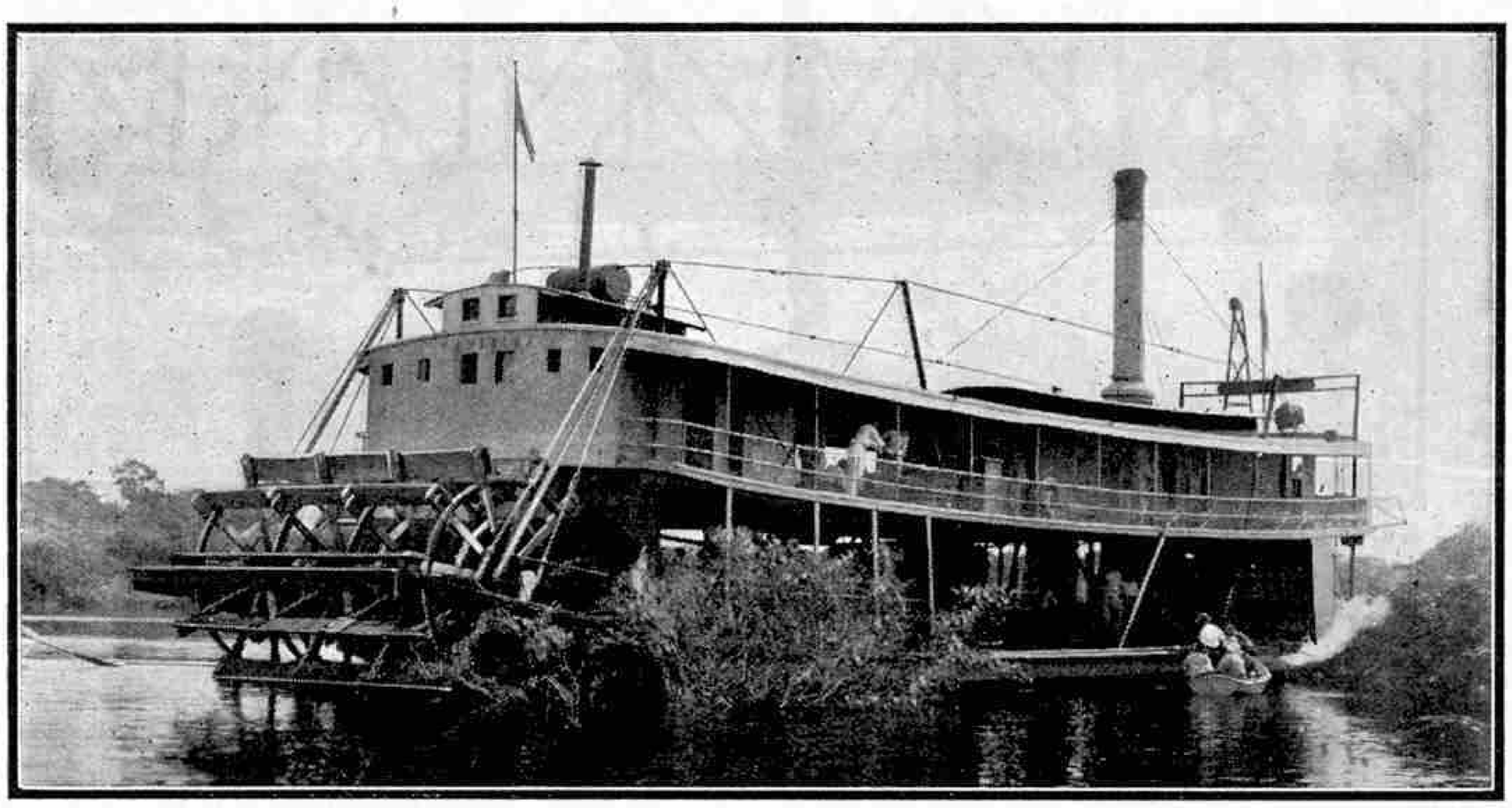
Colour in Industry

New machinery installed in the factory of the Armstrong Siddeley Company at Coventry is painted a pleasant shade of green, instead of black and grey in accordance with the usual custom. This is not the result of an effort to give a more picturesque appearance to the factory, but is the result of a careful study of the effects of colour. There is nothing irritating in the quiet tone of the green paint employed, and it is believed that its restfulness will cause less distraction and irritability on the part of the employees, who will therefore carry out their work much better. Another interesting reason for the innovation is that oil and dirt show up very prominently on objects painted in the new colour. Thus the experiment will help in the detection of oil leaks, and generally will encourage cleanliness, which invariably carries with it greater efficiency. This interesting experiment, if successful, may lead to a great change in the appearance of workshops generally.

One Thousand Miles up the Amazon

Thrills of a Brazilian Cruise

ONE of the most interesting and surprising developments of the depression in the shipping world has been the introduction of cruises for holiday makers. Until recently the giant ocean liners were used almost exclusively on the shipping routes across the Atlantic Ocean, or to South Africa, India, the Far East and Australia; to-day active employment is being found for many of them on pleasure excursions ranging in duration from a few days to several weeks. This policy has proved remarkably popular, and thousands of people are seizing the opportunity afforded them of seeing other lands in a convenient and easy manner.



The stern-wheel river steamer "Parahyba" at Taruma, near Manáos, Brazil. The illustrations to this article are reproduced by courtesy of the Booth Steamship Co. Ltd., Liverpool.

One of the most interesting of these excursions is the "Forest cruise" of the Booth Steamship Co. Ltd., that takes the holiday-cruiser on a wonderful voyage to Manáos, 1,000 miles up the Amazon River. This great trip is made from Liverpool, where we embark in the splendidly-equipped Booth liner *"Hilary."* After passing the Rock Light, and the Crosby, Formby and Bar Light vessels, we reach Point Lynas, where we say goodbye to the pilot, who embarked at Liverpool. The St. George's Channel soon gives place to the wider spaces of the Atlantic, and 36 hours after passing Land's End we see away on the horizon the lofty headland of Cap Villano. On the third morning a lovely vista of green hills and red-roofed villas facing a sunlit sea greets us, and by breakfast time the ship has dropped anchor in the harbour of Leixões, our first port of call.

A victim being shaved by King Neptune's Court during the "crossing the line" ceremony aboard the Booth liner "Hilary."

Going ashore by motor boat, we find cars in waiting to convey us seven miles along the coast road to Oporto. All the way we pass constant processions of women walking barefoot to market, and bearing on their heads enormous loads. In that country it looks as if women do all the heavy work, while their menfolk stand by and watch them. At Oporto a conducted tour around the city enables us to visit all the places of interest, including the Dom Luiz Bridge, shown in one of the accompanying illustrations. This bridge spans the River Douro in a single arch of 650 ft., and from it beautiful views of the Douro and the terraces of the city are obtained.

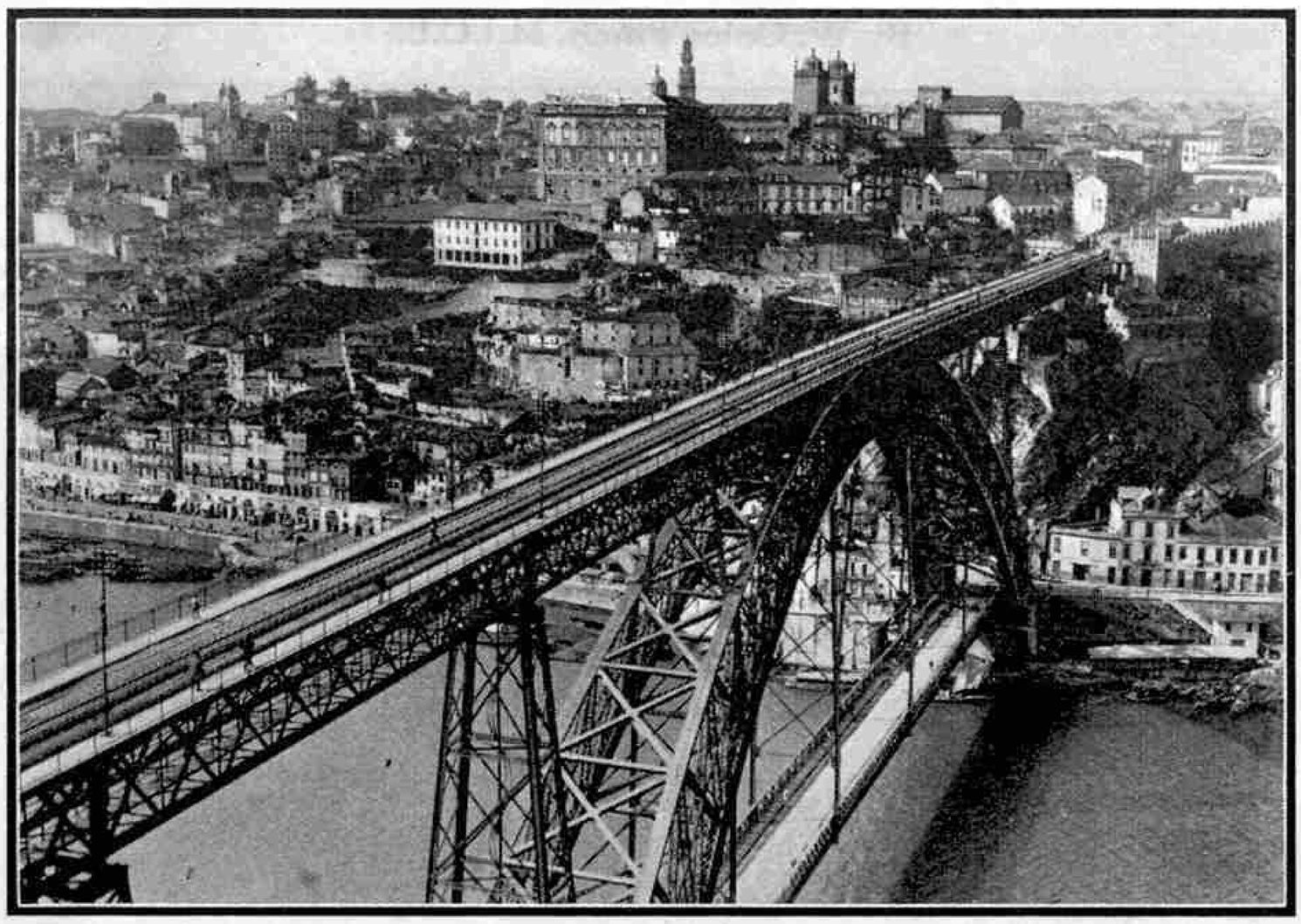
In the evening the *"Hilary"* weighs anchor and steams along the coast, and after passing the delightful Bay of Cascaes enters the River Tagus. Eight miles upstream is Lisbon, where we arrive early next morning. Lisbon lies on seven hills, and presents a magnificent picture of white churches, red-roofed houses with green balconies, and noble public buildings standing loftily on the heights. Motor cars take passengers through the capital, and out to the Cintra Hills to visit the old palaces of Moorish and Portuguese kings and queens, and to inspect one of the wonderful gardens that are to be found there. The return journey is made along the range of hills and down to the sunny sea coast of the Portuguese Riviera to the bathing resort of The Estorils. The way back to Lisbon is along a fine coast road.

The ship steams seaward again at sunset, and 1½ days later we come in sight of the island of Madeira. Funchal, the capital of the island, nestles at the foot of high mountains with green hills in the foreground up which climb terraces of villas among vineyards. Almost before the anchor has been lowered a dozen diving boys climb laughingly over the rail and demand with much gesticulation "sixpence to dive from the middle rail, a shilling from the top." These youngsters are bred and born to the water; there is no fear of their coming to harm, and they besiege every ship that anchors in the bay. After an interesting day ashore we return to the *"Hilary"* to commence the nine days' voyage to the tropics. With a farewell blast of the siren she glides gently out of the bay, and her course is set across the 2,000 miles of ocean that still separate her from the coast of South America.

The swimming bath is now filled, awnings are unfurled, and two

days after leaving Madeira tropical kit appears. All round is the sparkling sea, which seems to merge imperceptibly into the sky. Lovely, lazy days are these; days of rest and pleasure. Few, if any, ships are sighted, for this part of the South Atlantic is definitely away from the crowded trade routes; but shoals of flying-fish accompany us all the way. Nautilus, or Portuguese men-o'-war as they are often called, float by, and we sometimes see a whale. On the eighth day King Neptune and his Court come aboard, for the Equator is crossed before sighting the Amazon; and amid great amusement novices are initiated into the Ancient Order of Shellbacks with all the time-honoured ritual.

Soon afterwards we observe a curious change in the colour of the ocean. This is caused by the immense outflow of the River Amazon that for over 200 miles from its mouth tints with yellow the deep blue of the sea. From out of the haze there appears a low shore with tall palms silhouetted like starfish against the sky. Off Salinas a sailing ship rides at anchor; she is the pilot boat, and soon the pilot who is to take us up the Pará River puts off and comes aboard. Then full speed ahead westward along the Brazilian coast, passing many native craft with vivid blue and red sails. Away to starboard is Marajó Island where alligators abound, birds of brilliant plumage throng the marshes, and that big rodent, the Capibara, has its haunts. On the opposite side lies Salinas and a succession of jungle-fringed beaches. Farther upstream is the village of Mosqueiro, near Pará, off which the ship drops anchor.



The Dom Luiz Bridge, Oporto. This fine two-deck structure spans the River Douro in a single arch of 650 ft.

Here the Customs and Port Medical authorities come aboard to examine all passengers who intend to land permanently, but cruise passengers are exempt. When the examination is completed the ship draws up to the quay at the port. Pará is about 75 miles from the mouth of the Amazon River and a stay of two or three days is made there. A specially reserved electric tram enables cruise passengers to see at leisure the many interesting sights of the city and its environs, including the Governor's palace, with its floors of wonderful Brazilian woods, and the great park called the Bosque, which is an area of jungle that has been preserved in its natural state. Paths have been cut through the vegetation of the Bosque, and the ponds turned into ornamental lakes. We emerge from the Bosque to ride to the Zoological Gardens, where many denizens of the forest are kept. Numbers of strange trees and plants are pointed out en route, and we are particularly interested in the Brazil nut trees. Brazil nuts form one of the most valuable articles of export from the Amazon, 25,000 to 30,000 tons being shipped each season to Europe and the United States.

The Taruma Falls in the heart of the forest, near Manáos.

At the close of her brief stay at Pará the *"Hilary"* weighs anchor and soon after leaving the port enters the Narrows. For over 100 miles the route lies along winding lanes of yellow water. Here and there amid the jungle stands an Indian family's primitive shack, thatched with palm leaves and raised on poles so as to be out of reach of the water when this rises. On crude platforms outside these shacks groups of naked children watch the ship pass, while their elder brothers rush to their canoes and paddle out into the stream to prevent their frail craft from being dashed against the trees by the wash, or to ride up and down on the waves.

In the unexplored forest beyond the banks many interesting animals have their abodes. The jaguar, both the tawny and black varieties, the puma, the wild pig or peccary, and numerous members of the monkey family, including the "howler," whose roars we can hear clearly on a still night, may be met with by those adventurers who can spare the time to go in search of them. At dawn, and again at sunset, flocks of parrots and parrakeets fly screaming overhead as they pass to and from their feeding ground.

Beyond this section the river widens, and at Monte Alegre appears a range of flat-topped mountains. Soon afterwards we pass Santarem, where the Rio Tapajós joins the Amazon, the bottle-green water of the former and the yellow stream of the latter flowing side by side for a considerable distance. One hundred miles up the Tapajós is situated what a few years ago was a riverside hamlet bearing the prosaic name of "Boa Vista." To-day this place is a replica of an American town, with macadamised roads, concrete pavements, well-kept lawns and low-ceilinged houses. It is the capital of the 5,000 square miles of territory conceded by the Brazilian Government to Mr. Henry Ford, where he hopes eventually to grow sufficient rubber to make tyres for the cars produced in his factories throughout the world.

Some 80 miles beyond Santarem the little town of Obidos comes into view, situated on high cliffs. Here, 690 miles from its mouth, is the limit of the tidal waters of the Amazon. Marshes now appear, and numerous white egrets are seen perched on the trees. Farther upstream the ship turns into the Rio Negro, the water of which is black, as the name implies, and presents a vivid contrast to the yellow Amazon. A clearly defined line is perceptible where the two streams meet but do not mix. After sailing a few miles up the Rio Negro the ship arrives at Manáos where a stay of four or five days is made. This gives us an opportunity to explore the town, the markets, and the primitive native quarters where the huts are built of mud and thatched with palm-leaves, and where the inhabitants wear little except straw hats. *(Continued on page 848)*

The Story of the Second Dutch War

1. The Battle off Lowestoft

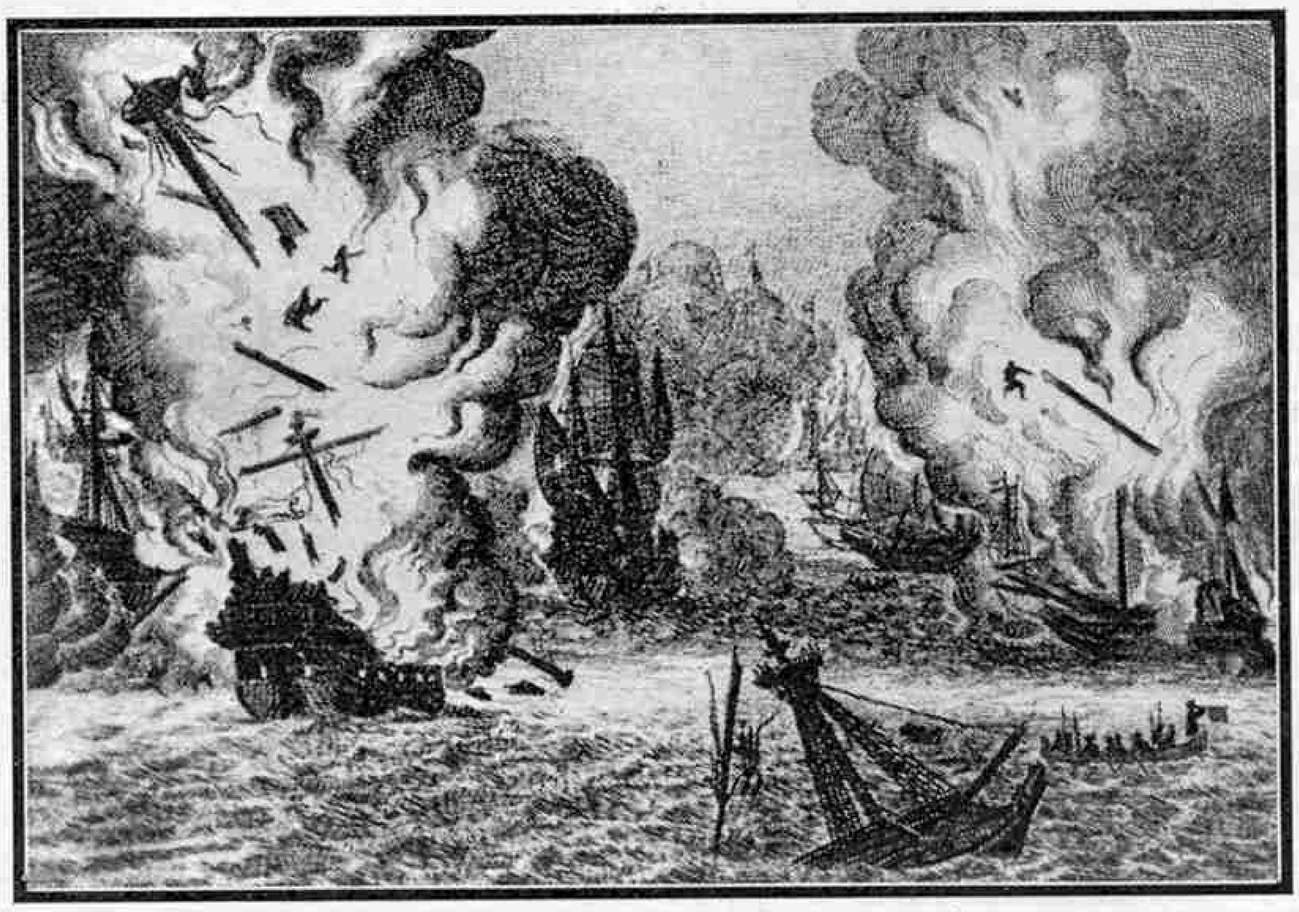
By W. Coles Finch, M.I.C.E.

DURING the second half of the 16th century and the early years of the 17th, Holland developed her sea commerce so successfully that by the year 1610 she owned nearly four-fifths of the merchant ships trading in European waters. England viewed the rise in power of her former ally with increasing mistrust and jealousy. This ill-feeling was intensified by incidents such as the Dutch massacre of English traders at Amboyna, one of the Spice Islands in the East Indies, to remove hindrance to the Dutch monopoly of the clove supply; the expulsion of English traders from the East Indies, and the unfair tactics of the Dutch fishing fleets which, protected by armed vessels, fished in English waters and did not pay any tax on the rich hauls they obtained. On the Dutch side there was great resentment when Cromwell's Parliament passed the Navigation Act of 1651, under which goods imported into this country either had to be brought in English ships or in the ships of the country producing the goods. Another aggravation was England's demand that her flag should be saluted by Dutch ships when in English waters.

A medal struck to commemorate the Duke of York's victory over the Dutch, off Lowestoft on 3rd June, 1665.

The situation was brought to a head about the beginning of 1652 when a Dutch convoy on the way home from Genoa met an English squadron and refused to give salute. The Dutch ships were fired upon, and were defeated in the fight that ensued. After this incident it was clear that only war could settle which country was to be acclaimed as the sovereign of the seas, and the First Dutch War began in June, 1652.

In the engagements that followed the English fleet was led by Admiral Blake, and the chief incidents of the war were described in our article on this famous British Admiral in the "*M.M.*" of January 1933. After victories on both sides the conflict ended in April 1654, when the Dutch accepted peace on Cromwell's terms, one of which was a repetition of the old demand that English ships should be saluted when encountered in home waters. Under these terms Holland agreed also to equal trading privileges in the West Indies, and undertook to pay a war indemnity of £1,000,000, and a further £250,000 as compensation for the massacres at Amboyna. Cromwell's severe terms did not encourage a spirit of peace, and although hostilities ceased ill-feeling continued.


The scene at the height of the battle off Lowestoft.

Admiral Blake died in 1657, and Cromwell about a year later, and the monarchy was restored with Charles II on the throne. The change of rule was an unfortunate one for the Navy, as the king appropriated for Court functions the funds necessary to maintain the fleet in efficient condition. In addition to lacking any interest in the welfare of the Navy, Charles disliked Holland, and was always ready to encourage discord between the two nations. There was also bitter rivalry between the English East India Company and the Dutch East India and West Indies companies, and stories of interference by the latter concerns with English traders in distant waters reached this country, and led to counter measures. Early in 1664 an English privateering expedition led by Commodore, later Admiral, Sir Robert Holmes, visited the coasts of Guinea and West Africa, and attacked and captured unprotected traders of the Dutch West India Company there.

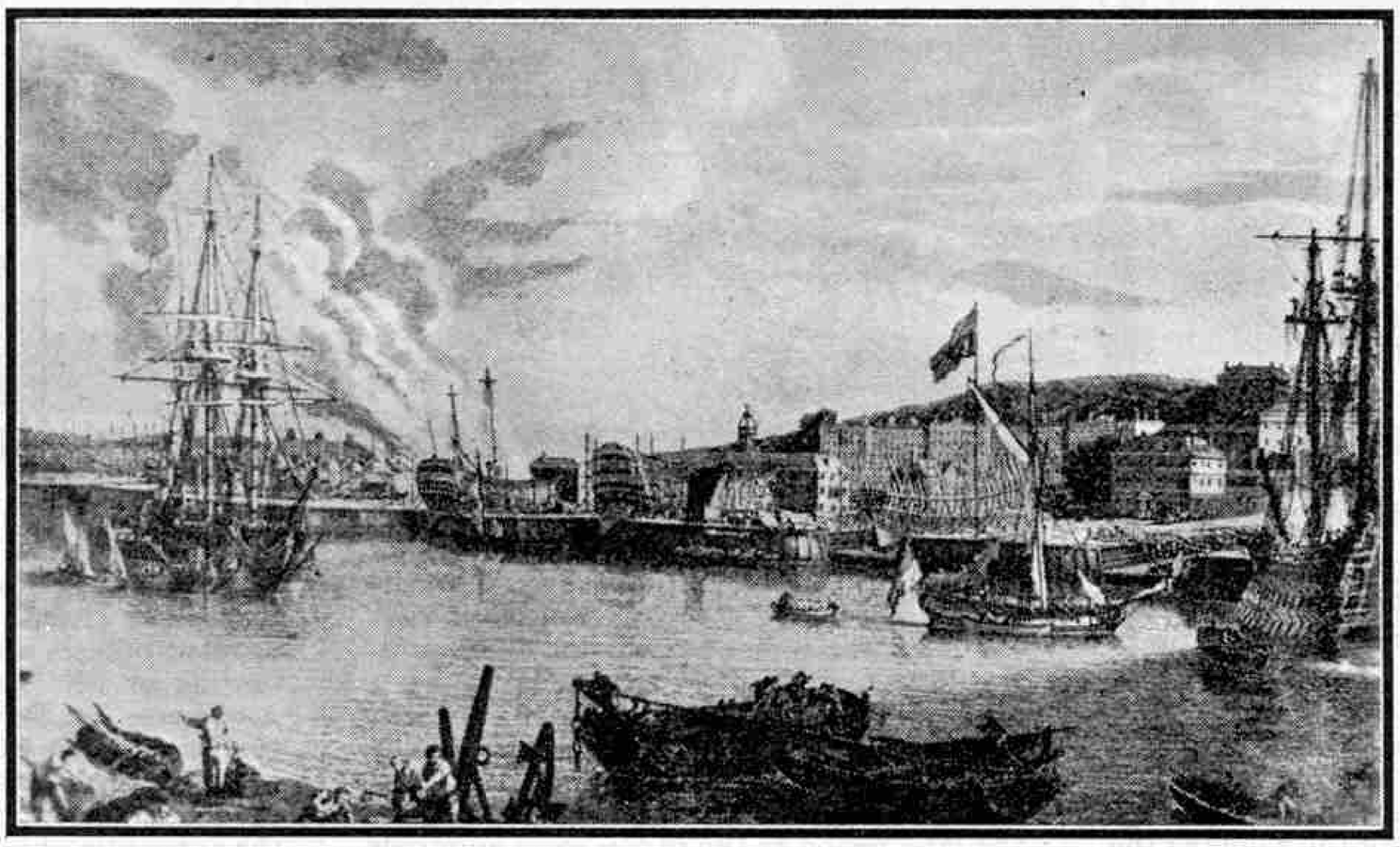
Holmes then sailed across the Atlantic and attacked and captured the Dutch city of New Amsterdam, now New York. This city was founded by Dutch settlers who emigrated to America about the beginning of the 17th century and established themselves on the shores of the Hudson River. Henry Hudson, the English explorer, had visited this region a few years previously, and on this account England regarded the Dutchmen as invaders. Holmes' action therefore was approved by Charles II, but in order to maintain a pretence of friendship with Holland the king caused Holmes to be imprisoned in the Tower of London. Pepys, the famous diarist, who at that time occupied a position similar to that of Secretary to the Admiralty to-day, refers to this "harsh" treatment of Holmes, and remarks: "I perceive it is made matter of jest only."

Holland was not deceived by Charles' bluff, and a scheme to capture the English port of Cormantyne was prepared, but it was discovered by the English before it could be carried out. Admiral de Ruyter, who was then in the Mediterranean with a squadron of 12 ships of the line and was about to begin war on Algerine pirates, was ordered to proceed secretly to the west coast of Africa and there recapture the Dutch settlements taken by Holmes, and this he accomplished. He then sailed across the Atlantic and captured many English merchant ships during the voyage.

This sort of conduct made a renewal of war between the two countries inevitable. Prince James, Duke of York, afterwards

James II, was then Lord High Admiral of England, and he began to prepare the English fleet for action. The manning of the ships proved difficult, as in those days the conditions of Naval service was very uninviting, both pay and food being very meagre. The effectiveness of the press-gangs by whom men were forced to serve in H.M. ships was counteracted by the wholesale desertion of the conscripted men after they had been taken aboard the ships.

About the 12th November 1664, Rear Admiral Tyddeman, with four or five ships, was sent into the English Channel to capture any Dutch merchantmen he could find. This preliminary thrust against Holland was very successful, and during a month's cruising between Plymouth and Dover Tyddeman captured a total of 150 Dutch merchant vessels of all sizes.

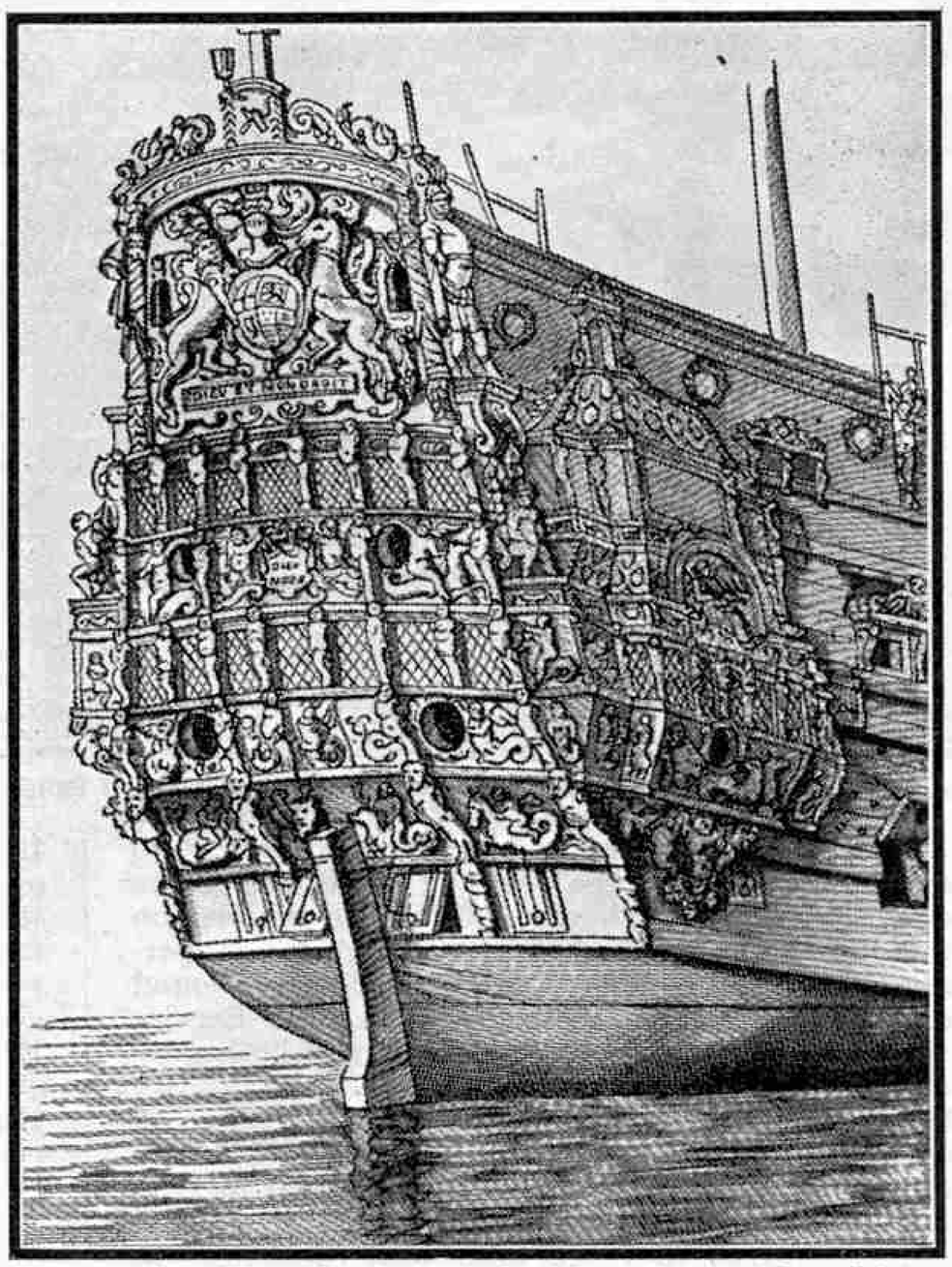


Chatham Dockyard in the 17th century, showing ships of the line in course of construction.

By late December 45 or 46 ships of the fleet were ready for sea. The fleet was under the supreme command of James, with Admiral Sir William Penn as Captain of the fleet, and the *"Royal Charles,"* of 80 guns, as the flagship. It was divided into three squadrons, the Red squadron under James, the White squadron commanded by Admiral Prince Rupert, and the Blue squadron under Admiral Earl of Sandwich. James was anxious to put to sea before the Dutch, and in spite of very rough weather the English fleet sailed from Spithead on 27th December 1664. A sharp lookout for the enemy was maintained but they did not appear, and after five days at sea James returned to port, leaving behind a small squadron to continue the search.

In the meantime an English squadron commanded by Capt. Thomas Allen had encountered off Cadiz a Dutch merchant fleet of about 30 ships from Smyrna, escorted by three frigates under the command of Capt. Brakel, who saluted the English flag. When Allen arrived alongside the frigates, however, he opened fire upon them, and a sharp action followed during which Brakel was killed, one of the frigates was sunk, and two of the merchant ships were captured. Details of this affair soon reached Holland, and on 14th January 1665 the States-General declared war on England. This was the official beginning of the Second Dutch War, but this country did not reply with a similar declaration against Holland until 23rd February of that year.

When England had officially entered the war, James again prepared the English fleet for action. Pepys, under date of 6th March 1665, says: "Great preparations for his speedy return to sea. I saw him try on his buff-coat and hat-piece covered with black velvet." On the day of which Pepys speaks the preparations were marred by the unfortunate loss of H.M.S. *"London,"* of 80 guns, which blew up near the buoy at the Nore, 300 of her crew being drowned. When complete the fleet totalled 109 ships, including ships of the line, frigates and armed hired merchantmen; and carried 4,192 guns and 21,006 seamen and soldiers, the latter acting as marines. It was again under the supreme command of James, in the *"Royal Charles,"* and was divided into three squadrons commanded by the Admirals already mentioned. The fleet sailed for the Dutch coast on 20th April 1665, and on arrival blockaded the Zuyder Zee for 10 days, capturing some homeward-bound Dutch merchantmen.



The stern of the "Royal Charles," with its elaborately carved Coat-of-Arms.

In the meantime Holland had prepared a powerful fleet, but this was in two portions, one in the harbour at the Texel and the other at Vlie. The English arrived off the Dutch coast before these two sections were able to unite, and the Dutch wisely remained in port until the enemy retired about the middle of May to revictual at Solebay. The Dutch vessels then left port, and after uniting cruised about in the North Sea on the lookout for the return of the English ships. The fleet was under the supreme command of Admiral Opdam, in the *"Eendracht,"* of 76 guns, and was divided into seven squadrons. It totalled 103 ships of the line, 11 fireships and a few smaller vessels, and carried 4,869 guns and 21,631 men.

On the sixth day Opdam met and captured nine English merchantmen homeward bound from Hamburg and escorted by a naval vessel of 34 guns. The cargoes carried by the ships included hemp, pitch, tar, iron and copper, and when news of the loss of these valuable stores reached England there was a great demand that the fleet should put to sea immediately, and avenge the attack. The fleet sailed on 30th May, and sighted the enemy two days later. The wind was then east-north-east but later it veered southward. Opdam sent an urgent message to the Dutch States-General to the effect that he did not think it wise to attack the English while they had the wind with them, but in reply he received a curt order to fight, "let the wind be as it would, on peril of losing his head."

The battle began about 14 miles off Lowestoft soon after dawn on the 3rd June. At first the two fleets were strung out in parallel, the English line consisting of Prince Rupert's squadron at the head or van, James' squadron in the centre, and the Earl of Sandwich's squadron in the rear. The efforts of the Dutch to gain the advantage of the wind eventually destroyed this formation, and the confusion was increased when Sandwich either deliberately or by accident broke through the Dutch centre. Opdam's flagship *"Eendracht"* engaged with the *"Royal Charles,"* and delivered some terrific broadsides that severely damaged the English ship, but about noon the *"Eendracht"* blew up, and only five of the 409 men on board were saved. Dutch historians attribute the disaster to various causes, one of which is that the ship's magazine was fired by a black man whom Opdam had punished.

The loss of their Commander-in-Chief unnerved the Dutch, and during the panic that followed three of their leading ships, fouled each other, caught fire and were destroyed. Three or four other ships also fouled each other and were caught by an English fireship and destroyed. The *"Orange of Zealand,"* of 75 guns, one of the Dutch East India Company's ships and carrying 400 men, captured the English ship *"Montagu,"* of 52 guns, but the latter was retaken an hour later by the *"Royal James."* The Dutch ship was then attacked by the *"Mary"* and set on fire, and was lost with all hands, as although her brave captain was rescued (*Continued on page 846*)

Famous Handley-Page Machine for Museum

The famous Handley-Page *"Gugnunc"* has been presented to the Science Museum in London. The *"Gugnunc"* was built to participate in the Daniel Guggenheim International Safe Aircraft Competition held in the United States in 1929, but it was not successful in gaining an award. Its special feature is that it is provided with Handley-Page automatic slots along the whole of the leading edge of its upper plane, giving it a very spectacular climb and enabling it to alight almost as steeply, and often with as short a landing run as an "Autogiro."

Police Work from the Air

Last month we published details of an experiment carried out in connection with the tracking from an aeroplane of criminals escaping by car. In this connection it is interesting to note that a Cierva "Autogiro" has been acquired by Scotland Yard for the use of police for chasing criminals and for dealing with traffic blocks from the air. This last work is in fact the more important of the two, and the machine has been regularly seen hovering over busy parts of London at a height of only about 200 ft. It is equipped with wireless, and when a traffic jam occurs it is able to locate the source of the trouble and communicate with the police. Sometimes a jam on the main road will affect traffic over an area of many miles.

Another instance of the value of aeroplanes for police work was given recently at Hamble, Southampton, when thieves stole a speed boat belonging to the famous air school, Air Service Training Ltd. Police and customs authorities were informed, and four or five A.S.T. aircraft flew over the creeks and harbours of the Isle of Wight and Beaulieu River trying to discover the whereabouts of the boat. Two days later the purser of the *"Nevasa,"* a troopship lying off the A.S.T. slipway, told the Commandant of the school that two of his men had seen the speed boat leave its moorings, start towards the Solent, and then turn round and proceed at full speed towards Southampton. It therefore appeared that the boat was somewhere about Southampton Water, and not in the Solent.

Next morning the proprietor of a hotel at Totton reported that he had seen a black speed boat going fast up the River Test, where location would be impossible from the land owing to the presence of hundreds of creeks all thick with high reeds. An A.S.T. instructor was immediately sent to reconnoitre the Test and he discovered the boat from the air and marked its position on the map. The police and A.S.T. personnel rushed to the spot and there found the launch, with the name "Air Service Training Ltd." obliterated from both sides and the propeller damaged.

An American all-metal twin-engined Boeing bomber flying above the clouds, with Mount Rainier, 14,408 ft. high, in the background. Photograph by courtesy of "The Aeroplane."

Vacancies in the Royal Air Force

The Air Ministry announce that in view of the programme of expansion in the Royal Air Force, additional vacancies will occur for boys to be trained as aircraft apprentices. Approximately 500 apprentices will be required in January 1935 for entry to the Schools of technical training at Halton, Bucks., and at Cranwell, Lincs. They will be entered partly by competitive examination and partly by "Direct Entry" on presentation of an approved first school certificate. Entry from both sources will take place in January 1935.

The competitive examination will be conducted at numerous local centres on 6th November next. The sons of officers, warrant officers and senior N.C.Os who are serving or who have served in the Royal Air Force, the Royal Naval Air Service or the Royal Flying Corps will receive special consideration. Full information regarding the examination, the methods of entry and the apprenticeship training scheme generally can be obtained upon application to the Secretary, Air Ministry (Aircraft Apprentices Department), Gwydyr House, Whitehall, London, S.W.1. Intending applicants may also apply for information and advice to the Headmaster of their school.

Examination candidates for whom vacancies as aircraft apprentices are not available may be invited by the Air Ministry to apply for consideration under the new "boy entrant" scheme for training as armourers, photographers or wireless operators.

Candidates who are accepted as aircraft apprentices will be required to complete a period of 12 years' regular Air Force service from the age of 18, in addition to the previous training period. At the age of 30 they return to civil life, but normally will be given an opportunity to enter the R.A.F. Reserve for four years and to draw a gratuity of £100. A proportion, limited by the requirements of the service, may be permitted to re-engage to complete time for pension.

Flying to Victoria Falls

It is now possible for passengers on the African service of Imperial Airways, who are proceeding south of Bulawayo, to break their journey at Broken Hill to go by air to see the Victoria Falls and then rejoin the Imperial Airways service at Bulawayo. This detour is carried out by Rhodesia and Nyasaland Airways, an associated company of Imperial Airways.

Capt. Barnard's Tour in India

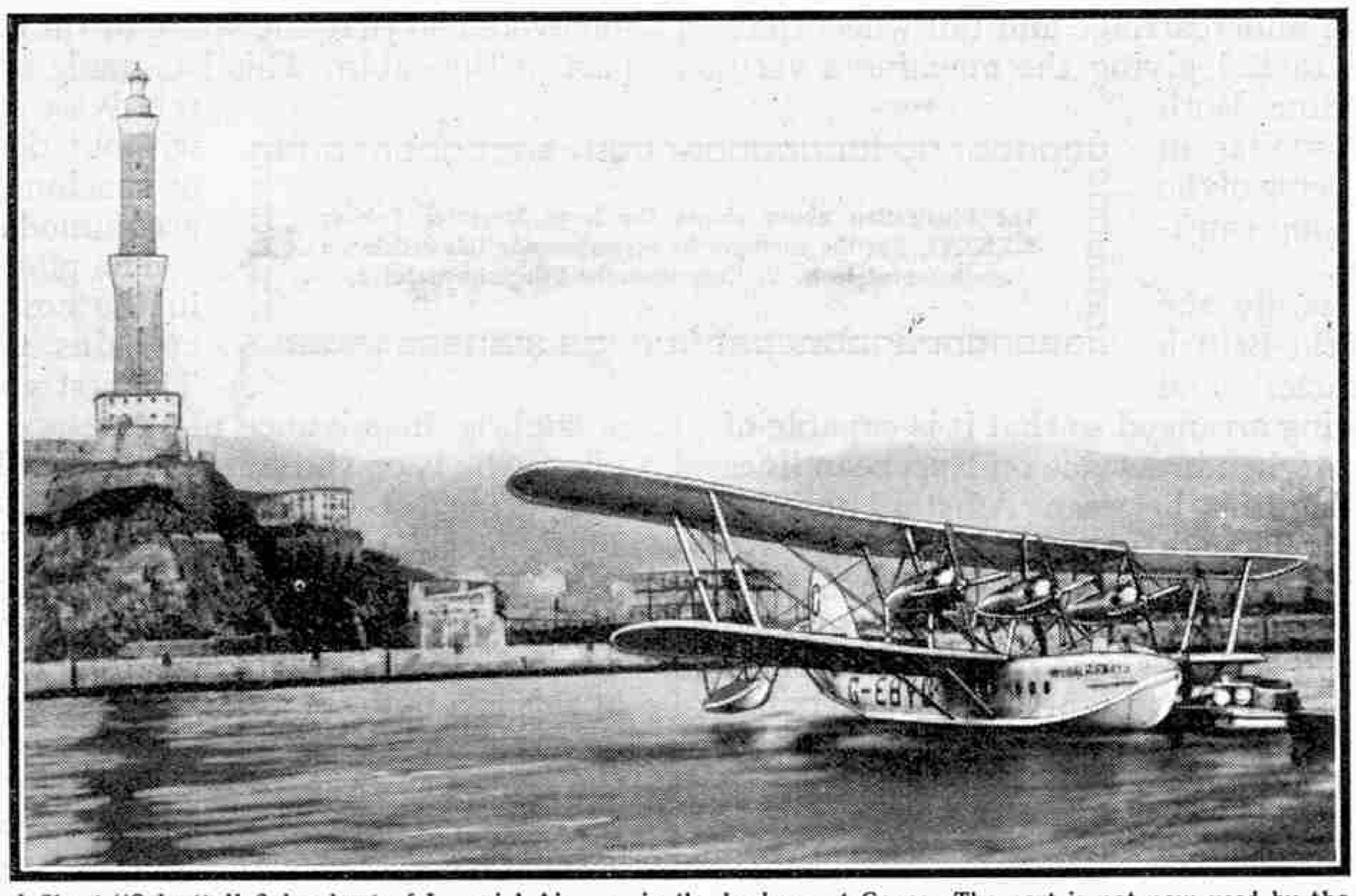
During the summer Capt. C. D. Barnard conducted a series of air pageants in India, during which 92 displays were given at most of the important towns. One of the objects of the tour was to demonstrate the latest machines to the Indian public and so give them some idea of the progress that has been made in civil aviation.

This machine, the Junkers JU.49, has been designed and built for high altitude flying and research work in the stratosphere. Photograph by courtesy of Junkers Flugzeugwerk, A. G.

The equipment taken on the tour included the Fokker "*Spider*" monoplane, which was piloted by Capt. Barnard. This machine, fitted with a Bristol "Jupiter" engine, has carried Capt. Barnard on all his famous record-breaking flights with the Duchess of Bedford, and is claimed to have broken more records than any other aeroplane in the world. Among these records are the flight from Karachi to London in four days; the journey from England to India and back in seven days; and the great flight from London to Capetown and back in 19½ days, which established eight records, including the first non-stop flight from Bulawayo to Capetown and the fastest flight from Capetown to Cairo. During the Indian tour the "*Spider*" carried 9,241 passengers and covered a distance of approximately 20,000 miles.

London Airport over the Thames

Consideration is now being given to a scheme for the construction of an airport in the heart of London by building a high concrete platform over the Thames in the neighbourhood of London Bridge and Tower Hill. The platform would be built either along the foreshore or above an existing riverside warehouse, and would have to be at least 200 ft. above the ground in order to avoid any danger of aeroplanes colliding with St. Paul's Cathedral and other tall buildings in the neighbourhood during bad weather. It is estimated that the scheme would cost at least £5,000,000, but this sum is not excessive when the great commercial benefit that the airport would give to the city is borne in mind. It would be particularly valuable in connection with the internal air services that are now increasing in number, and particularly those on which air mail are carried. At present airports are nearly always many miles from the centres of the towns that they serve, and the time spent in travelling from the towns to the aerodromes greatly counteracts the effect of the high speed of air transport. This is particularly the case in London, for most of the commercial aerodromes are nearly an hour's car ride from the centre of the city.



A Short "Calcutta" flying boat of Imperial Airways in the harbour at Genoa. The port is not now used by the Company's machines. Photograph by courtesy of Imperial Airways Ltd.

First Inter-City Air Mail Service

The air service between London and Glasgow that was mentioned in the "*Railway News*" of our last month's issue is the first inter-city air mail service in the British Isles. It is being operated by Railway Air Services Ltd. on behalf of the L.M.S.R., and as calls are made at Birmingham, Manchester and Belfast, it is also the first air mail service to link England with Ireland and Scotland. The new service is operated by machines of the D.H.86 type, which are claimed to be the fastest four-engined commercial machines in operation in the world, having a cruising speed of 145 m.p.h. It was decided to employ these four-engined machines in order to provide an adequate margin of safety while crossing the Irish Sea.

At present only one machine is operated in each direction every day. The northbound aeroplane leaves Croydon at 3.10 p.m., arrives at Birmingham an hour later, and at Manchester 30 minutes after leaving Birmingham. From Manchester the machine flies direct to Belfast, where it arrives at 6.20 and departs 20 minutes later to arrive at Glasgow at 7.30 p.m., having taken four hours and 20 minutes for the journey from Croydon. The reverse service is scheduled to leave Glasgow at 9.15 a.m. and arrive at Croydon at 1.35 p.m. A supplementary service for the conveyance of mails only is operated between Manchester, the Isle of Man and Belfast.

A second inland air mail service also has been put into operation by Railway Air Services Ltd. This is between Liverpool, Birmingham, Bristol, Cardiff, Plymouth, Southampton and the Isle of Wight. The new service speeds up the delivery of mails by several hours, and from the number of letters that have been carried on it so far it seems to be assured of a successful future.

Air Transport of Livestock

A specially interesting feature of airway traffic is the increase that continues to be recorded in the transport of livestock by air. More and more pedigree animals such as dogs and cats are being sent over to the Continent by air, and there is also a growing traffic in the air dispatch of day-old chicks from poultry farms in England to similarestablishments throughout Europe. From along the Empire routes tropical fish in tanks are now consigned to London by air, and not long ago a crate of live locusts was shipped from Africa for experiments in this country in connection with the extermination of the locust plague by chemical means. A particularly difficult cargo was a full-grown lion that was brought over from the Continent in a special cage. On another occasion the front compartment of an aeroplane was fitted up as a horse box in order to fly a valuable performing horse over from Paris.

A Veteran of the Airway

One of the pioneer airmen of Imperial Airways, Capt. F. Dismore, has just completed 21 years as a pilot. Capt. Dismore gained his license in August, 1913. After serving in the war he flew on the first commercial services to the Continent and has piloted air liners ever since.

Two New Fokker Aeroplanes

Interesting Dutch Commercial Machines

TWO Fokker aeroplanes that have been produced during recent months are respectively the largest and the fastest commercial aeroplanes yet built in Holland. These are the F.XXXVI and the F.XX, the first having a span of 110 ft. and an all-up weight of 35,260 lb., or very nearly 15 tons, and the second a maximum speed of 202 m.p.h. and being capable of operating at a cruising speed of about 170 m.p.h. A notable feature of the F.XX is that it has an undercarriage and tail wheel that can be completely retracted, giving the machine a very clean and bird-like outline. Both types are somewhat similar in external appearance, being of the normal Fokker high wing cantilever monoplane type.

The F.XXXVI is really the Dutch counterpart of the British Handley Page "Heracles" and "Hannibal" types, being arranged so that it is capable of carrying 32 passengers when in service on European lines and 16 when on the line between Amsterdam and Batavia. Under tropical conditions it is necessary for passengers to have very roomy accommodation if they are to be comfortable, and they are in fact each provided with a comfortable and spacious seat that can be transformed into a sleeping berth at night. In both versions the machine carries a crew of five, consisting of two pilots, a wireless operator, a mechanic and a steward. Sleeping accommodation is provided for two members of the crew.

The aeroplane is powered with four air-cooled engines of any type that develops about 700 h.p., two being carried in nacelles built into the leading edge of the wing on each side of the fuselage. The engines drive variable pitch propellers and are fed from four fuel tanks with a joint capacity of nearly 150 gallons, installed in the wing between the spars as is customary with Fokker aircraft.

The cantilever wing is built in the usual Fokker manner and is about 110 ft. in span. The wing is fitted with flaps along the trailing edge to reduce the speed of landing and, in addition to carrying the fuel tanks between the spars, it accommodates also two big compartments for the carriage of passengers' luggage.

The fuselage is of patented construction, being made up of seamless cold-drawn steel tubes welded together. It is 78 ft. 8 in. in length and is round in cross section. The under surface of the centre section of the wing is left uncovered so that the space in the wing forms the upper part of the cabin. This has made it possible to obtain a relatively small fuselage section without decreasing the comfort or spaciousness of the passenger accommodation.

The pilots' cockpit is situated in the nose of the fuselage and contains two sets of controls. The first set, for the senior pilot, is slightly in advance of those provided for the second pilot, who is on the starboard side. The wireless operator sits facing aft beside the first pilot but a little lower. This seating arrangement has been decided upon in order to facilitate communication between the crew.

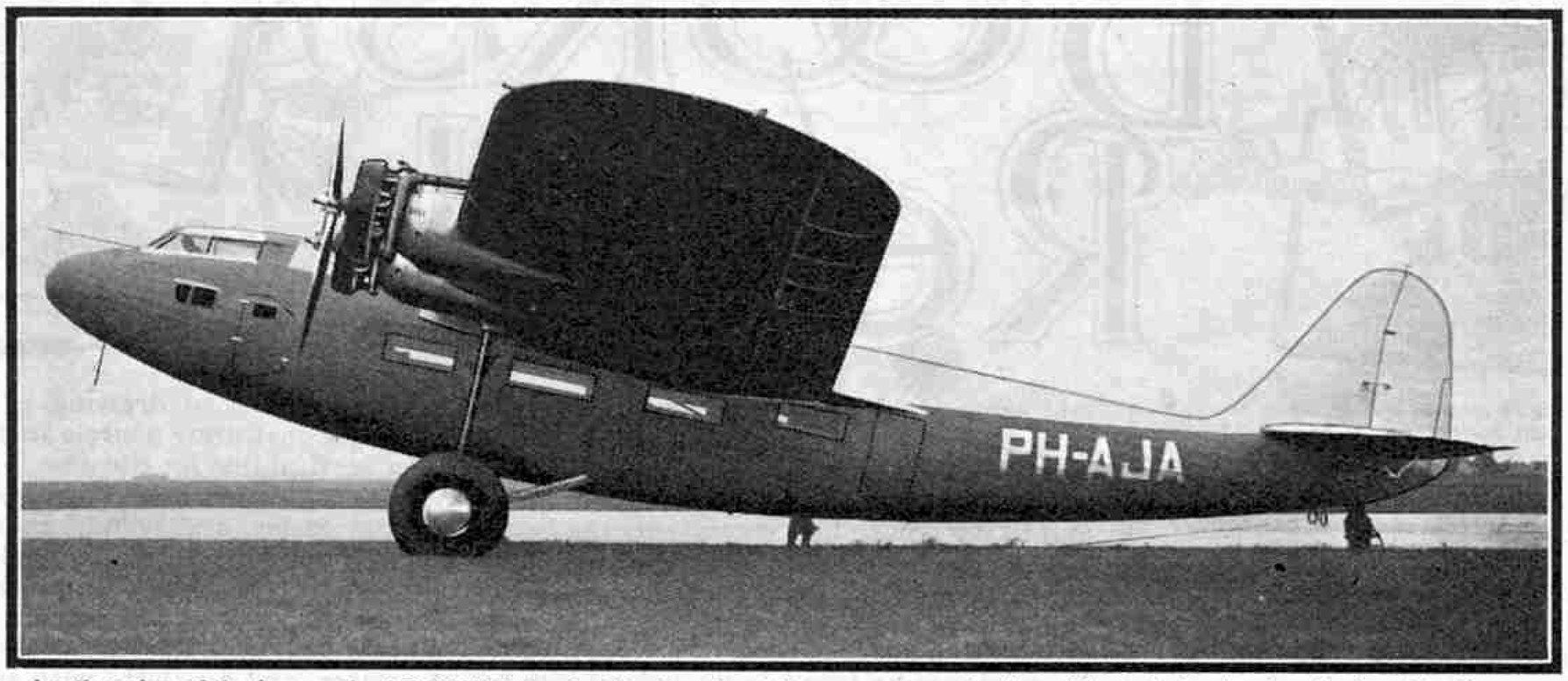
Behind the pilots' cockpit is a compartment for the mechanic, where there is also a chart table. To the rear of this is a buffet with an electric kitchen and a compartment for the steward. Room for two sleeping berths for the crew has been provided in the wing over the front part of the cabin. An interesting feature is that there is a separate entrance to the crew's quarters, on the port side of the fuselage, so that it is not necessary for the crew to enter or leave their positions through the passengers' cabin.

Behind the crew's quarters is the passengers' cabin, consisting of four compartments each of which has accommodation for eight or four persons, according to whether the machine is in service on European or Eastern lines. As the fuselage is not directly connected with any engine, and is covered with sound-proof material, it is possible for passengers to converse without raising their

The illustration above shows the huge 32-seater Fokker F.XXXVI. For the photographs accompanying this article we are indebted to N. V. Nederlandsche Vliegtuigenfabriek.

voices, and the sound of the engines does not disturb them if they wish to go to sleep.

When on the ground the machine is supported on an undercarriage that is made in two separate halves. In each case a vertical shock absorber strut runs from the front wing spar to the wheel axle, which is attached to the fuselage by a "V" strut. The tail wheel is fitted with a balloon tyre.

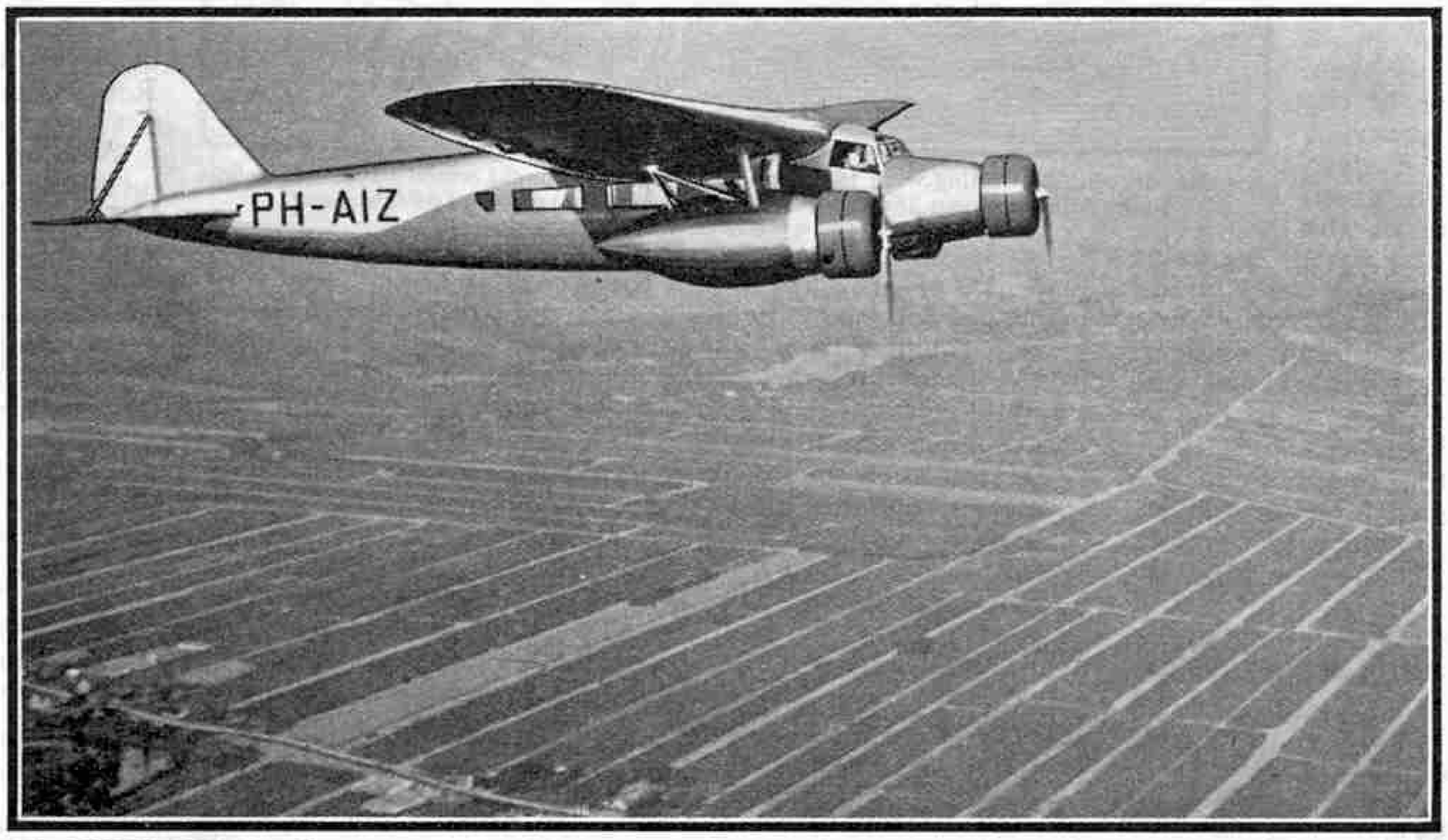


Another view of the four-engined F.XXXVI showing the door by which passengers enter the cabin, and also the door that enables the crew to take their places without disturbing the passengers.

The fin and rudder of the machine are made of welded steel tubes encased in fabric. The tailplane and the elevator are of wood construction, however, and are covered with plywood. They are of cantilever type. Both the elevator and the rudder are provided with trimming flaps.

The F.XXXVI is about 21,820 lb. in weight when empty and is capable of carrying a useful load of about 13,440 lb., making an all-up weight of 35,260 lb. In spite of its immense weight, the machine has an estimated maximum speed of 174 m.p.h. and a cruising speed of 163 m.p.h. The machine normally has a ceiling of about 16,400 ft., and with one engine out of action it is able to maintain an altitude of 9,840 ft. when carrying a full load.

The second of the new Fokker machines, the F.XX, is only capable of carrying 12 passengers, and has three engines, one carried in the nose of the fuselage and the other two in nacelles slung below the wings. The machine is of normal Fokker construction, typical Fokker wooden wings being employed. These are 90 ft. 2 in. in span and have flaps along the trailing edge, similar to those on the F.XXXVI, in order to reduce the landing speed. The wings are also specially finished to enable them to withstand the effect of both tropical and arctic conditions.



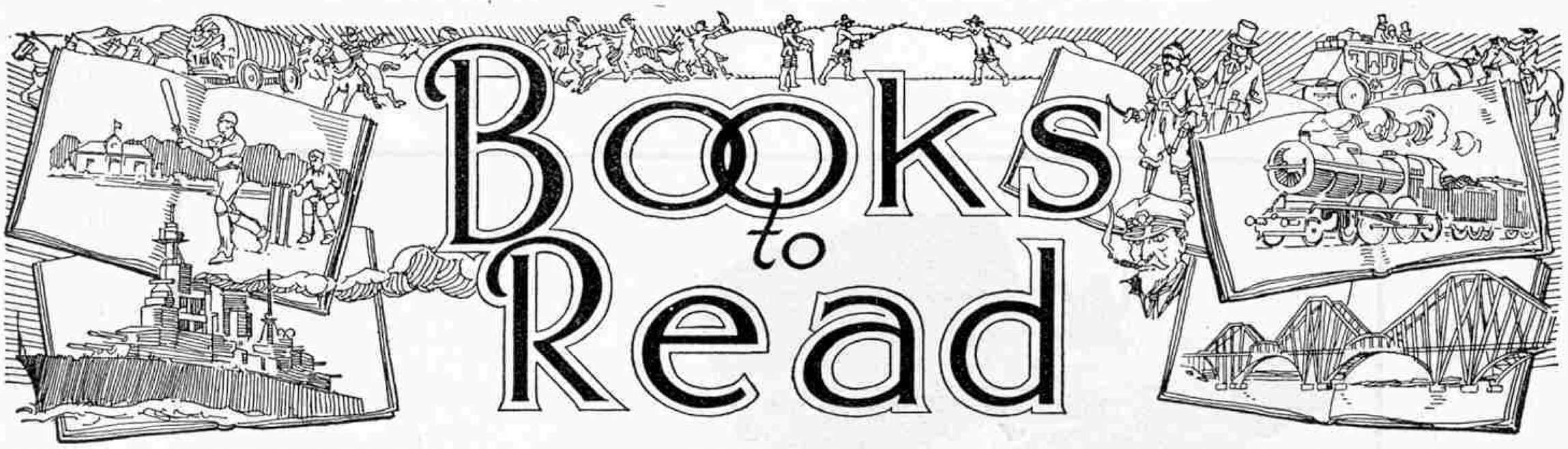
The F.XX in flight showing the undercarriage and tail wheel retracted. The absence of these parts gives the machine an extremely clean and bird-like appearance.

The fuselage is 54 ft. 9 in. in length and is elliptical in cross section. It is built of seamless cold-drawn steel tubes welded together under a special system of construction that has been patented by the Fokker company. The steel tubes are covered partly with special steel plates and partly with fabric.

The two pilots who are normally in charge of the F.XX are accommodated side by side in a cockpit that is entirely enclosed and is situated immediately in front of the leading edge of the wing. They are provided with dual controls, and also special seats that may be adjusted in height, inclination and position. A radio and instrument room is provided behind the pilots, but situated actually in their cockpit. The wireless operator is accommodated on a sliding seat. The main cabin for the passengers is about 16 ft. long, 5 ft. wide and 6 ft. 3 in. high, and the 12 passengers are seated in two rows of six. Great attention has been paid to comfort, and each passenger is provided with controls to regulate the condition of the air in his immediate vicinity. There is a large trapdoor in the roof to serve as an emergency exit. Access to the pilots' cabin can only be obtained through the passengers' compartment.

The tail unit of the machine is of normal monoplane type and is rigidly braced with streamlined tubes. It is built of welded steel tubes and covered with fabric, and the fin is welded to the fuselage. The undercarriage is of the divided type and has a track 19 ft. 8 in. wide. Each half is quite separate, and can be completely drawn up into the engine nacelle. The tail wheel also is retractable.

The engines employed in the F.XX may be of any type developing between about 600 and 700 h.p., but the machine usually employs three Wright "Cyclone" engines each of about 712 h.p. They give a maximum speed at about 5,900 ft. of 202 m.p.h., and a cruising speed of 171 m.p.h. The landing speed is 58 m.p.h.



Here we review books of interest and of use to readers of the "M.M." We can supply copies of these books to readers who cannot obtain them through the usual channels. Order from Book Dept., Meccano Limited, Binns Road, Liverpool 13, adding 1/- for postage to the price. Postages on different books vary, but any balance remaining will be refunded.

"The World We Live In"

By Gertrude Hartman. (Routledge. 10/6 net)

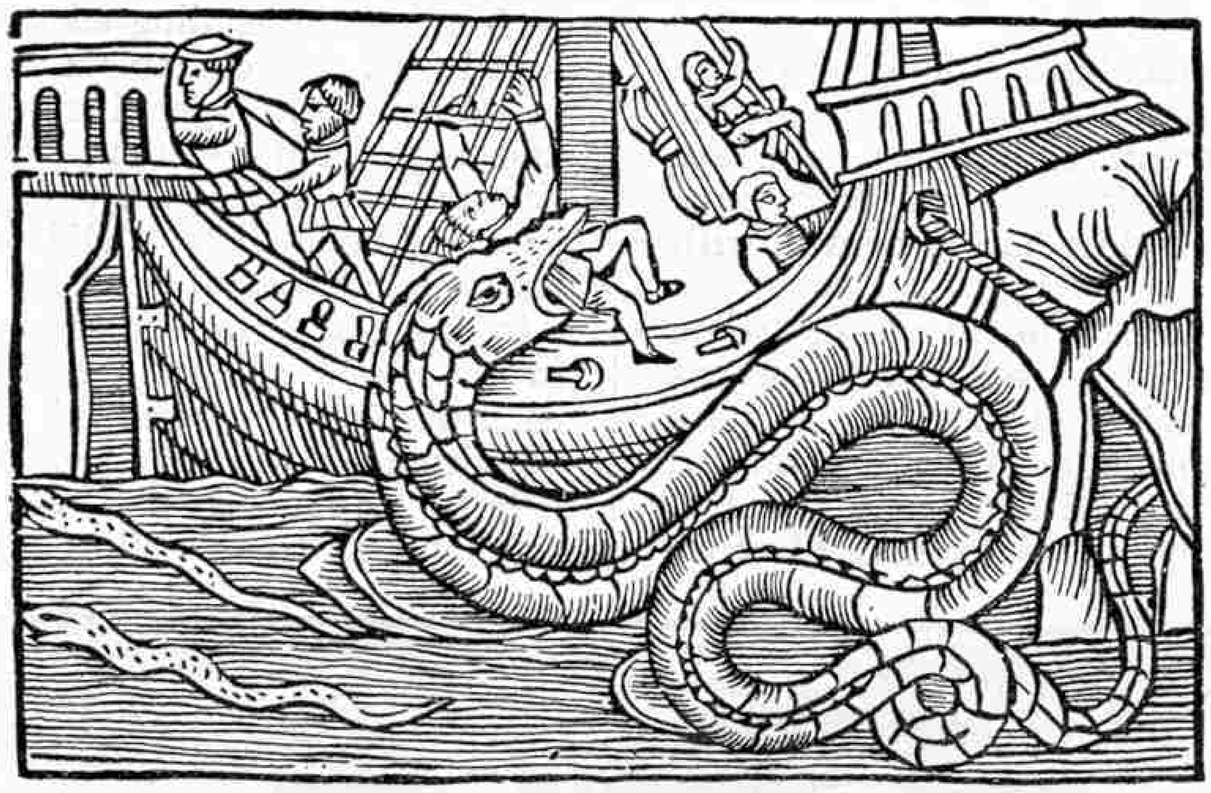
The object of this book, we are told, is to show "how this world of ours has become a great human beehive, seething with life and organised activity," and "how man first came to use tools, and how these tools have developed into great machines." To deal at all adequately with such a vast theme in a single volume is of course impossible. All that can be done is to select a few typical features here and there and describe them in such a manner as to give some idea of the whole story; and in this the author may be said to have succeeded.

In an introductory chapter the author outlines the reasons for the belief of scientists that the Earth originated in a whirling cloud of fiery gas, perhaps similar to one of the nebulæ revealed in the heavens by the powerful eyes of modern telescopes. Then we are given an interesting picture of the appearance of life on the Earth, beginning with plants and animals of the simplest form drifting about in the great oceans, and developing through millions of years to reptiles of almost incredible size, and finally to the smaller but more highly-developed creatures of to-day.

This brings us to the first main section of the book, dealing with "Man the Inventor," and in many respects the four chapters in this section are the most interesting of all.

We are shown how early man, surrounded by ferocious wild creatures far bigger than himself, nevertheless managed not only to survive but to increase in numbers. He was able to walk erect, so that his hands and arms could be used for purposes other than supporting his body. He was able to speak, and thus to communicate his ideas to his fellow men and to learn from them, and to pass on to his descendants the benefits of his life experience. Most important of all, he acquired the capacity of thinking, and of using his ingenuity to solve the many problems with which he was confronted. From stones he found lying around him he made weapons to defend himself against beasts of prey and to kill the creatures he needed for food. He also shaped the stones into rough knives, awls, and other tools. He discovered the use of fire, so that he could cook his food and illuminate his cave dwellings with torches and later with crude lamps. Then came his great discovery of metals, opening up entirely new and unlimited possibilities of progress. Passing on from those far-off days, we are shown how man domesticated animals for his use, and learned to till the soil.

An Egyptian scribe at work. (See above.)



A quaint drawing illustrating what 16th century Europeans thought would happen to sailors on the Atlantic Ocean. (From "The World We Live In" reviewed on this page.)

Few things in the history of man are more fascinating than the manner in which he learned to write, and this the author describes most interestingly. The first writings were merely little pictures. If a man wished to write "Sun," he drew a circle with a dot in the centre. He represented the Moon by a crescent, a star by a five-pointed picture, water by wavy lines, and so on. "But drawing a whole picture for every word was very slow. As man began writing more and more rapidly he learned how to give the idea he wanted to express just as well in a shorter way by leaving out parts of the picture. For instance, if he wanted to show a house, he would not trouble to draw the whole house, but would make only the peak of the roof; and instead of drawing a whole man he might just draw a circle with dots for eyes, a vertical line for the nose, and a horizontal line for the mouth. This was much quicker and easier, and people understood just as well as if the whole picture had been drawn." In early Egypt the writing was done by scribes, whose outfit consisted of two reed pens and a case, two little jars of water, and a palette with two round holes in which to make black and red ink. Black ink was made in one compartment by mixing lampblack with water thickened with a vegetable gum; for red ink iron oxide was used. The use of ink of two colours accounts for the two pens that are often seen stuck behind the scribe's ear.

The Phœnicians were the first people to arrange letters in an orderly manner to form an alphabet. Their alphabet consisted of 22 signs made up from pictures of familiar subjects, with every unnecessary detail omitted. It spread to the Greeks, who used 15 of the Phœnician signs and added others to make 24 letters. The Romans borrowed their alphabet from the Greeks, and spread it to the later nations of Europe, including our own.

The author provides a well-written account of the Middle Ages, with specially interesting sections devoted to the invention of printing, and the marvellous discoveries that were made by sea and by land. From there we pass on to the time when England became the workshop of the world and the hand tool gave way before the machine. The development of the steam engine by Savery, Newcomen and Watt is described, followed by the story of the conquest of the waters as the result of the work of Fitch and Fulton in America, and Bell and Symington in England. Special chapters are devoted to the steam locomotive and the utilisation of

Egyptian smith smelting metal. (See above.)

electricity for providing power and the means of long-distance communication by telegraph and telephone. Finally the author describes to us the making of the steel without which modern industry could not exist.

In conclusion the author reminds us how closely our life is bound up with the machines that man has fashioned from the materials of the earth to do his work for him. "Modern inventions have brought the different parts of the world closely together. When the nations of the world were separated by vast stretches of land and water, they did not know one another. But with the railway, the steamship, the telegraph, the cable and radio, man has put a girdle round the Earth that is swiftly uniting all the nations of the world into one great world-wide community, every part of which can be easily drawn upon for whatever resources it has. And so as a culmination of all man's work through the ages we have the possibility to-day, for the first time in history, of a single world-wide civilisation."

"The World We Live In" will be read with enjoyment by all boys who are interested in science and invention, and the history of the development of machinery. It is written in a straightforward, non-technical style, and a surprising amount of really practical information is packed into every chapter. The illustrations, of which there are 177, are excellent, both in regard to the ground they cover and the style of their reproduction.

"Snake Life Simply Told"

By J. Morewood Dowsett
(Bale, Sons & Danielsson Ltd. 5/- net)

It is evident from the outset that the author of this book is genuinely a snake enthusiast, and although he may not convert many of his readers to his own ideas, he certainly makes out a very good case for the harmless members of the snake fraternity. We do not remember to have read any other book in which the essential gentleness and grace of harmless snakes is so strongly emphasised, and we are in full agreement with the author that the slaughter of such snakes is strongly to be condemned, for they are extremely useful in many ways. They swallow yearly millions of small creatures such as frogs, rats, mice and small insects, which otherwise might become a plague; and in this manner, in addition to performing useful services for man, they play an important part in the preservation of the balance of nature.

In a series of short chapters the life history and habits of a wide variety of snakes are described in an interesting manner, and although one cannot feel anything but repulsion towards the big constrictors, or to such venomous reptiles as the cobra, the mamba or the rattlesnake, there is no doubt that the creatures are well worth careful study. The author gives various instances of snakes being kept as pets, but although he may be right about their attractiveness, most of us probably would prefer a more normal pet with four legs and a tail to wag.

An interesting illustration that indicates the docile nature of harmless snakes. (From "Snake Life Simply Told" reviewed on this page.)

"National Flags"

By H. E. Baxter. (Warne & Co Ltd. 3/6 net)

There is a special fascination about anything in connection with flags, but few of us have more than a smattering of knowledge of the subject. There are more States today than at any other time during the past century, and consequently there are more flags to engage the attention of the traveller, or of those who are interested in national flags for their own sake. Generally speaking flags are used more at sea than on land, for whereas the nationality of land is seldom in doubt, that of a ship at sea is often known only by the ensign it wears.

In this well-produced book Mr. Baxter surveys the flags of the world, commencing with those of the British Empire, and then passing on to foreign countries. A book of this kind is of comparatively small value without illustrations, and in this respect the present volume is well equipped. There are four excellent plates in colour, and in the black and white illustrations the colours are indicated by letters. Aircraft markings are thoroughly dealt with, and a mass of useful information is provided to enable an observer to ascertain the nationality of any strange flag. This book is definitely excellent value for the money.

"British Airways"

By C. St. John Sprigg. (Nelson & Sons Ltd. 2/6 net)

"British Airways" is an attempt to describe the working of all British air services, including the great Empire air lines and the recently-opened internal air services. The first part of the book deals with the coming of the airways, and then the author takes us with him by air liner to the Cape and Singapore, where we are left until the new Qantas air service between this port and Australia is inaugurated!

A general account of the construction of aeroplanes for service on our air lines follows, after which aerodromes and ground organisation and administration are surveyed. The chapters dealing with the meteorological department of the Air Ministry, and the airways that will span the Atlantic in the future, are particularly interesting. Photographs of most of the chief types of air liners used by British air transport companies are included, as also are fairly detailed specifications of them.

There is a great deal of useful information in this book and, although in parts it is written in a rather too "popular" style, it will be read with interest by any boy who is keen on aviation.

"Tragedy at Trinket"

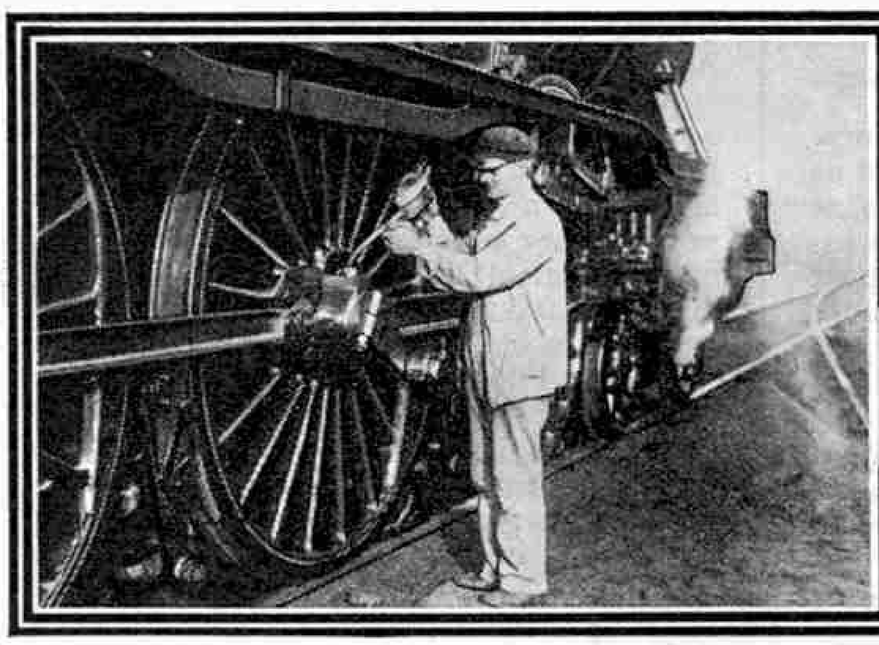
By Brian Flynn
(Nelson & Co. Ltd. 3/6 net)

Many school books deal with cricket, but this book strikes out a new line by interweaving with the cricket a thoroughly mysterious crime. The two heroes of this story are taken from their respective schools, greatly to their disgust, in order that they should both go to the more famous school, Trinket. The reason for this sudden change is made clear as the book proceeds, and lovers of cricket will find plenty to interest and thrill them in the sequence of events leading up to the great match at Lords. The crime develops with startling suddenness. One of the masters, returning to the school from the village one evening, hears a cry, and on investigation another master is found dead, entangled in the weeds at the bottom of a stream. It is apparently murder, but there is an utter absence of clues. A great part of the story is devoted to the ingenious manner in which one of the boys, outwitting the detective in charge of the case, solves the mystery in his own peculiar fashion, with most unexpected results. The story is well written, and even in the most exciting episodes the author never lets matters go beyond the bounds of reasonableness.

"A Hit for Six"

By T. H. Scott. (Warne & Co. Ltd. 2/- net)

During a keenly fought match between rival schools, the captain of the visiting team brings off a splendid hit for six, over a wall and into thick undergrowth leading to the open moor. "Bugs" Payne, so called on account of his fondness for collecting butterflies, climbs over the wall to retrieve the ball, but does not return. Others go in search of him, and to the general amazement it is found that both "Bugs" and the ball have disappeared completely! This is the beginning of an exciting school story in which a prominent part is played by two mysterious Indians who are seeking a stolen jewel that once formed the eye of a temple god. Matters are complicated by the presence in the school of a Burmese boy whose father is a wealthy Rajah living not far from the temple concerned, and altogether there are thrills enough for anybody in this readable story.



G.W.R. 2–8–2 Tank Engines

Interesting conversions are being carried out at Swindon as a result of which tank engines of a new type, having the 2–8–2 wheel arrangement, are appearing on the G.W.R. For some years past the 2–8–0 tank engines of the 4200 class have been dealing very competently with much short distance mineral and general freight traffic. Nearly 200 of them have been built, their serial numbers running from 4200 to 4299, and from 5200 to 5294. Now it is felt that an extension of the bunkers to enable them to carry more coal, and work for longer distances, would add to the usefulness of some of them and accordingly 20 of the "52" series are being altered to 2–8–2's. The trailing ends of the frames are being extended and a radial truck fitted similar to that of the "6100" class. The trailing wheels are of the same diameter, 3 ft. 8 in., as those of the "6100" class, but the radial box is a little larger. The eight coupled wheels are 4 ft. 7½ in. in diameter and the two cylinders, which are outside, have a diameter of 19 in. and a stroke of 30 in. The 20 converted engines are being renumbered 7200-19. Eight of them have already been completed.

New Locomotives for the L.M.S.R.

In the L.M.S.R. locomotive renewal programme for 1935 provision is made for the construction of 117 new locomotives, of which 55 will be built at Crewe and 62 at Derby. Among the Crewe-built engines will be 10 more of the 4–6–2, "Princess Royal," class and 10 very powerful 2–8–0 freight engines of a new design prepared by Mr. W. A. Stanier, the Company's Chief Mechanical Engineer. The remaining engines built at Crewe will be 30 three-cylinder 4–6–0 express locomotives of the improved "Baby Scot" class and five of the new 4–6–0 mixed-traffic locomotives. The new engines to be built at Derby will all be of the standard tank classes, and will comprise 54 of the 2–6–2 type and eight of the 2–6–4 type.

Of the new 4–6–0 mixed-traffic locomotives now being delivered by the Vulcan Foundry Limited, the first 10, numbered from 5020 to 5029, have been sent to Perth, chiefly for work on the Highland line. New taper-boilered "Baby Scots" are now at work on many parts of the L.M.S.R. system. About 20, starting with No. 5557, have been delivered by the North British Locomotive Company, and No. 5570, stationed at Crewe, was noted working the second portion of "*The Merseyside Express*" from Euston on 31st August. From Crewe works a further six, numbered 5612 to 5617, have been turned out. Five new "Baby Scots" have been sent to Bushbury shed and almost all London-Birmingham expresses are worked by engines of this class stationed either at Bushbury or Camden. There is general regret that these fine new engines have no names.

Now that the two 4–6–2 class engines are responsible for working the "*Royal Scot*" expresses between London and Glasgow in each direction every day, there are only two engines of the "Royal Scot" class shedded at Carlisle. They are No. 6136, "*Goliath*," and No. 6137, "*Vesta*."

Work on the third engine of the 4–6–2 class has gone forward only slowly. It is a turbine locomotive and many problems have had to be solved, not the least being that of keeping the machinery within the weight allowable.

The three Leyland rail-cars have been received into the L.M.S.R. stock and given the numbers 29950–1–2.

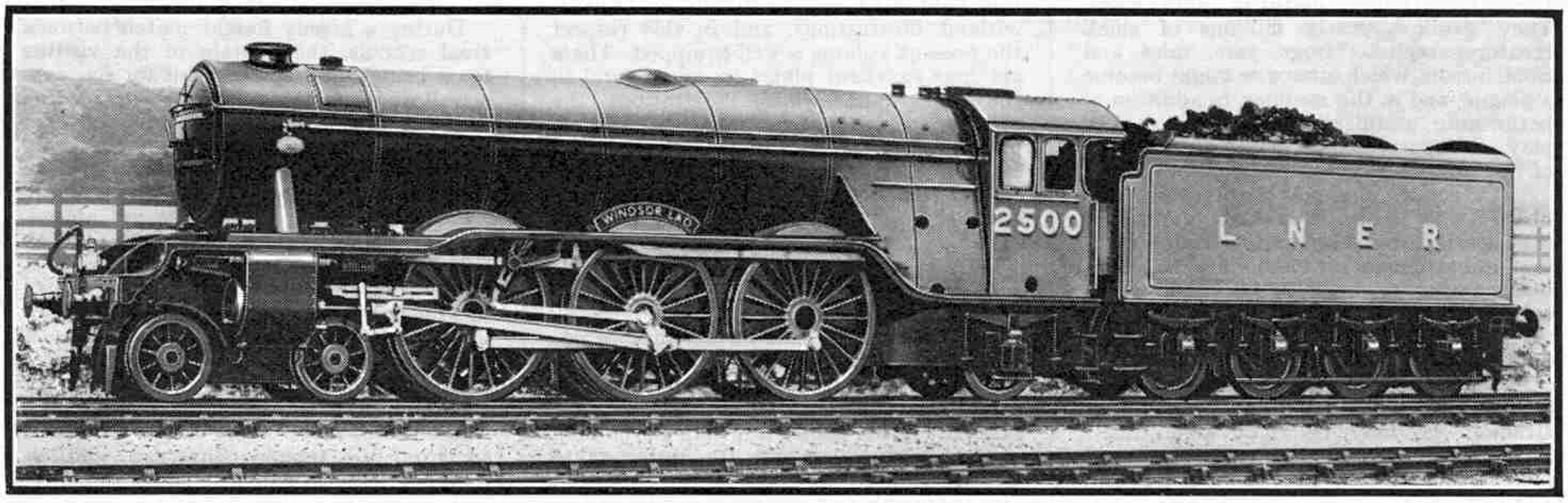
A start has been made with the scrapping of the 0–6–4 tank engines of the former Midland Railway. Two more L.N.W.R. 4–6–0 "Prince of Wales" class engines that have been withdrawn are No. 25619, "*Bulwer Lytton*," and No. 25651, "*Pluto*."

The photograph below shows one of the new L.N.E.R. "Pacific" locomotives No. 2500, "Windsor Lad." These engines are fitted with a steam collector extension to the dome, similar to that on No. 2001, "Cock o' the North." Photograph by courtesy of the L.N.E.R.

Express Trains for Bricks

On an average more than 4,000 tons of bricks are moved every day from Peterborough to London, a distance of 76 miles. They are collected from about 45 sidings and the daily forwardings often exceed 400 wagons. Some of these are marshalled and made up into special brick trains for various destinations in all parts of the country. In addition others are despatched by the regular freight services.

In order to expedite the transport of bricks from Peterborough to King's Cross and other parts of their system the L.N.E.R. have now 70 wagons of 50 tons capacity, each of which is capable of carrying 20,000 bricks, as well as one 35-ton wagon with a capacity of 12,500 bricks. A number of these wagons are fitted with vacuum brakes and can be run at express speeds. The number of 10-ton wagons required to carry a million bricks is 250 and a regular brick express train is arranged to cover the distance to London every day from Monday to Friday inclusive.



Names for New L.N.E.R. "Pacifics"

The latest engines of the three-cylinder 4–4–0 "Hunt" class to be completed at Darlington works are: No. 205, *"The Albrighton"*; No. 214, *"The Atherstone"*; No. 217, *"The Belvoir"*; No. 222, *"The Berkeley"*; and No. 226 *"The Bilsdale."* A further lot of 15 engines of this class is on order.

Further names chosen for the new batch of "Pacifics" now being turned out from Doncaster are: *"Hyperion," "Firdaussi," "Sandwich"* and *"Cameronian."*

The L.N.E.R. have placed an order with the "Sentinel" Waggon Works Limited for a steam locomotive of a new and unusual design, for use on branch line services. This locomotive, which will be the first of its type to be employed in this country, will be mounted on two six-wheeled bogies and provided with a Woolnough three-drum water-tube boiler having a working pressure of 550 lb. per sq in. from which steam is supplied to six separate compound two-cylinder engines, one engine being geared direct to each of the six axles. It is claimed that in addition to economy in fuel consumption, steam can be raised in less time than with other types of locomotives. Three locomotives of this new type have already been supplied by the "Sentinel" company to a railway in Colombia, S. America.

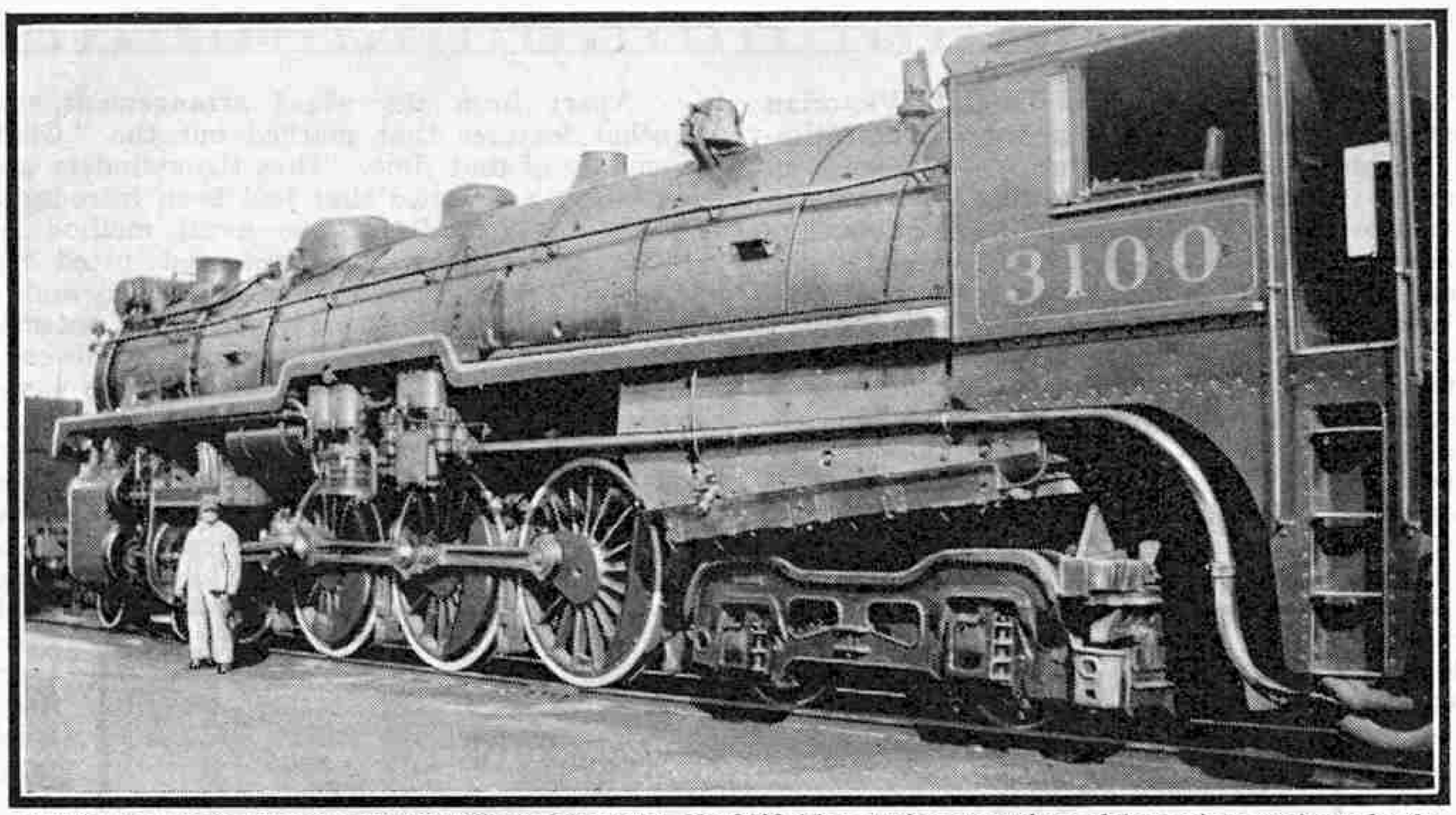
An arrangement has been made by the London Transport Board by which the steam locomotives of the former Metropolitan Railway that are used for passenger services beyond Rickmansworth and for freight traffic, will be taken over by the L.N.E.R.

S.R. Locomotive News

The latest engines of the "Schools" class have been allocated to Fratton shed for work on the London-Portsmouth expresses. The four engines of this class, Nos. 913 to 916, that formerly were stationed at Eastbourne have been transferred to Bricklayers Arms, London, to take their share in the working of the important services running to the Kent Coast. The expresses between London and Eastbourne are being worked by a variety of different engines, but mainly by "King Arthurs" and "Moguls" and the big 4–6–4 and 4–6–2 tanks formerly belonging to the L.B.S.C.R.

Busy Tourist Trains

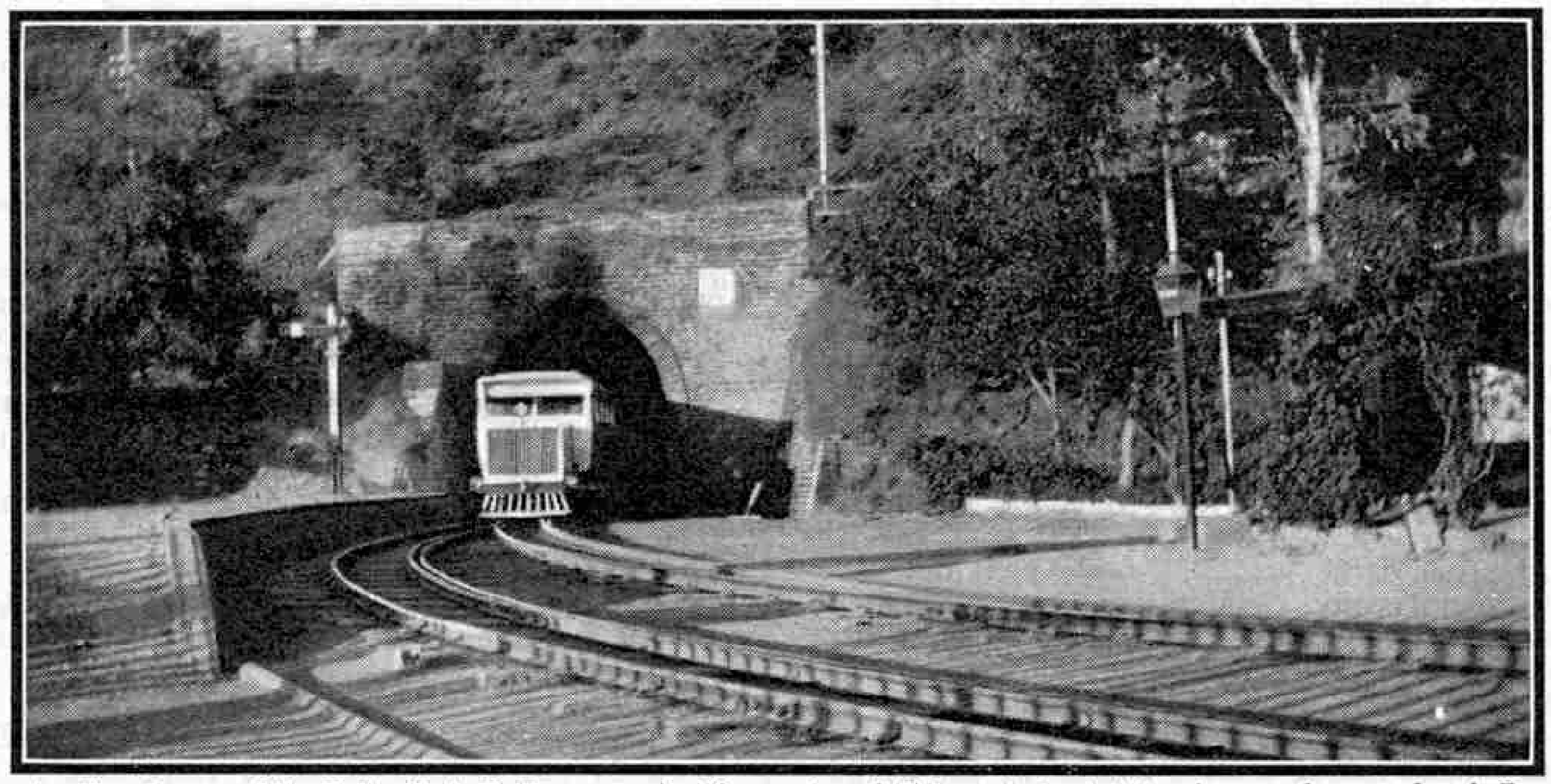
The two new "tourist" trains which the L.N.E.R. introduced in the North of England at the end of June have proved so popular that arrangements were made for them to travel on 130 trips, covering no less than 32,000 miles, by the end of September.



A striking view of a Canadian Pacific Railway locomotive, No. 3100. The massive proportions of the engine are shown by the size of the man standing alongside. Photograph by J. E. Simmons, Toronto.

These trains are equipped with bucket type seats and wide windows and each train includes two buffet cars. They are used on long distance half-day excursions and so varied are their itineraries that there is scarcely a line on the L.N.E.R. that has not been traversed by them. One novel excursion for which a tourist train was used was a 200-mile day "cruise" from Newcastle via Alnwick, Kelso, Hawick and Hexham back to Newcastle with stops at points of interest. Other trips have been from West Hartlepool to Windermere, Hull to Morecambe, Newcastle to Scarborough, and Leeds to Saltburn.

Five tourist trains have been in constant use in the Southern Area of the L.N.E.R. since last year and have proved very popular for half-day trips such as Leeds to Skegness, Bradford to London, Nottingham to Mablethorpe, Retford to Southport and other similar cross country journeys.



A rail motor car of the Kalka-Simla Railway emerging from a tunnel. This photograph, taken by one of our readers A. R. Bacon, of Deolali, India, was awarded first prize in a recent H.R.C. Photographic Contest.

The Solway Viaduct

The long iron viaduct that spans the estuary of the Solway between Annan and Bowness, and was for many years an interesting and useful traffic link between Scotland and north-west England, is now in course of demolition. Opened for traffic in 1869, its length of 1 m. 180 yds. gave it the distinction of being the longest viaduct in the British Isles. Since then it has been exceeded in length only by the Forth Bridge. It was constructed of cast iron and formed part of the Solway Junction Railway which ran from Kirtlebridge, on the Caledonian Railway main line, to Brayton, in Cumberland, where a connection was made with the Maryport and Carlisle Railway. The total length of the line was 21¾ miles, including 3¾ miles between Kirkbride Junction and Abbey Junction, on the English side of the Solway Firth, for which the metals of the North British Railway's Carlisle to Silloth branch were used. Passenger traffic on the line was never heavy but a considerable amount of mineral traffic, chiefly iron-ore and coal, passed over it.

The viaduct has had a somewhat troubled history. It suffered heavy damage through fierce storms in the winter, 1875-6, and many of its piers collapsed and some were carried away by ice floes during a great frost in January, 1881. So great was the havoc wrought in the latter disaster, that the viaduct had to be closed for three years and £30,000 spent on its reconstruction. In 1921, owing to its unsafe condition, the viaduct was closed. Schemes for its renewal have been considered but turned down on account of their prohibitive cost. Now the L.M.S.R. have arranged for its removal, including the foundations, which were made of sufficient size to allow for doubling the viaduct if ever that had become necessary.

Railway Purchases

The services of British railways by rail, road, sea, air and in docks and hotels affect every trade, and 50,000 different articles are included among railway purchases.

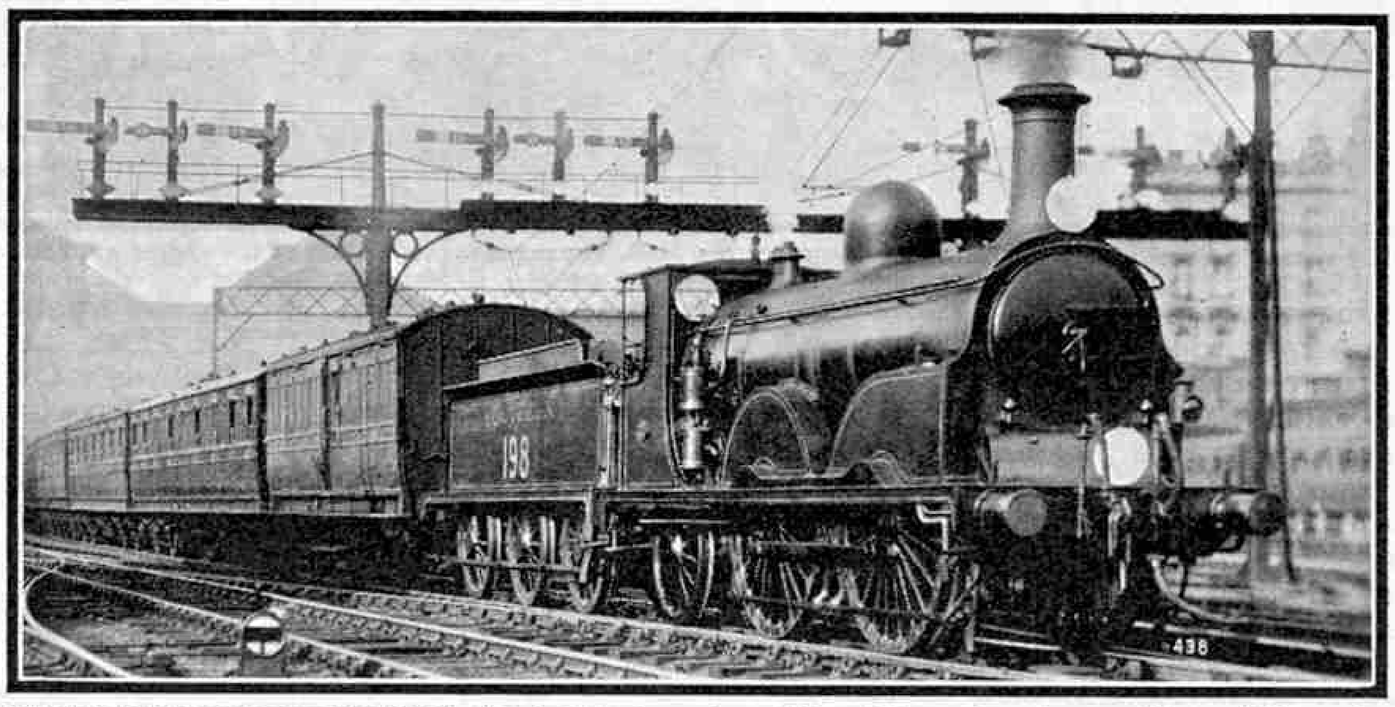
14,000,000 tons of coal, 21,000,000 bricks, 3,800,000 yards of cloth, 210,000 tons of rails and 296,000 tons of iron and steel are bought by the British railways every year.

Stroudley "Gladstones" of the L.B.S.C.

A Unique Class for Express Work

OF the few famous express locomotives of the late Victorian era that now remain, even in more or less honourable retirement, the brightly-finished L.B.S.C. engine "*Gladstone*" in York Railway Museum is one of the most interesting. No remarkable speed record stands to its credit, as to that of its neighbour the G.W.R. "*City of Truro*," whose 102.3 m.p.h. is still startling enough after 30 years; nor did it take part in any such excitement as the races to Scotland. Nevertheless "*Gladstone*" was the first of a remarkably capable and hard-working class of locomotive that even long after their prime were a great standby of the Brighton locomotive authorities. In its 44 years of active service, "*Gladstone*" covered 1,346,918 miles.

The wheel arrangement, as the illustrations show, is 0–4–2, and this appears somewhat strange in view of the strong hold elsewhere of the 2–4–0 plan at the period of the introduction of the class. The 0–4–2 wheel arrangement had been used, however, by Mr. William Stroudley—Locomotive Superintendent of the L.B.S.C.R. from 1871 until 1889—first in 1873, when the well-known "D1" class tanks of his design came out, and again in 1876, when similar tender engines for main line mixed traffic work appeared. The first application of the type for express work was seen in 1878 when the "Richmond" class with 6 ft. 6 in. coupled wheels were inaugurated. Thus as a result of considerable experience with the 0–4–2 formation in engines of his own design Stroudley led up to the actual "Gladstone" class by successive steps.



"Gladstone" class locomotive B198, showing the general condition of the engines in recent times. This engine was formerly named "Sheffield," and was fitted with oil-fuel apparatus for a period as an experimental measure. Photo, Railway Photographs, Liverpool.

The placing of large coupled wheels well forward, with the relatively large boiler pitched up above them, was regarded with alarm by many who believed in the more orthodox methods of the day. Stroudley's reasons for departing from accepted practice may best be gathered from his own words in a paper read in 1885 before the Institution of Civil Engineers. "By placing the coupled wheels forward, where the greatest weight is, the hinder part of the engine may have small wheels, the base be shortened, and the use of heavy cast iron weights at the back of the engine be dispensed with. It is found that an engine runs much more smoothly when the centre of gravity is kept well forward. The large leading wheels pass over the points, crossings, etc., very easily, causing less disturbance than the small ones. They pass round curves without shock or oscillation, which is no doubt owing to the small weight upon the trailing wheels . . ." A high centre of gravity was adopted in the belief that it made the engine travel more easily and safely on the road at speed, the slight rolling motion caused by the irregularities of the track being much less severe than the lateral oscillation peculiar to engines with a low centre of gravity.

Whatever the theoretical arguments for and against the design may have been, on the road the engines were a great success, and 36 of them were built between December 1882 and April 1891. "*Gladstone*" was the first engine built, and is now 50 years old. We give on page 788 a list of their names of the class in numerical order, and their building dates.

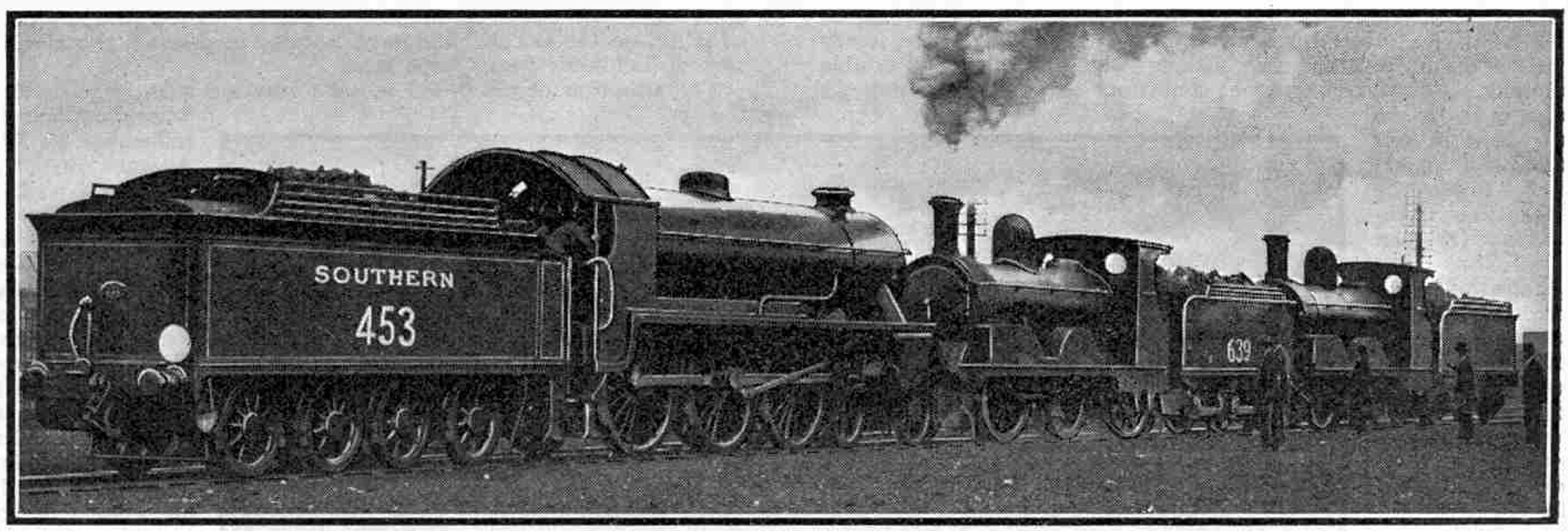
The arguments of Stroudley evidently impressed the Chemin de fer du Nord, for a 0–4–2 express engine with 6 ft. 6 in. driving wheels was built by them in 1886. The actual spacing of its wheels differed from the Brighton product, however. The engine was unsuccessful in its original form, and after about a year was converted to a 4–2–2 "single-wheeler" by the substitution of a four-wheeled bogie for the leading coupled wheels.

Apart from the wheel arrangement, there were numerous other features that marked out the "Gladstones" from other engines of that time. Thus the cylinders were formed in a single casting, a practice that had been introduced in this country in 1870 by Stroudley. The usual method was for them to be separate castings, machined and fitted together between the frames. This involved great labour and expense and if the joint between the two cylinders was not made truly steam-tight it was difficult to amend matters after the engine had been erected. The valve chests of the "Gladstones" were underneath, and as the valves were of the flat slide pattern they could drop from the port faces when running without steam. Thus there was a minimum of friction when the engine was drifting, and any water condensed in the cylinders had a ready exit.

In an age when large cylinders and small boilers were the usual rule, Stroudley gave his "Gladstones" a cylinder bore of 18¼ in. and a piston stroke of 26 in., and provided a relatively large boiler to supply them with steam. The heating surface totalled 1,485.4 sq. ft., and the fire-grate area of 20.3 sq. ft. was also notable. The boiler itself was constructed of "best Yorkshire iron," with the barrel arranged in three telescopic rings, the largest one being next to the fire-box and having a diameter of 4 ft. 6 in. This ring carried the dome, which therefore collected steam from the most favourable point. Mounted on top of the dome were two "Richards" safety valves with spring balances, and these were at first set to blow off at 140 lb. This characteristic position for the safety valves has also been favoured by other engineers.

The fire-box was of copper, 6 ft. 8¼ in. long, and was arranged with walls tapering inward from the foundation ring, so that the water space between the inner box and outer shell measured 3 in. at the bottom but 7½ in. at the top. The crown of the box was about 2 in. higher at the back than at the front, so that water was prevented from surging off the plate when the level was low. Of the total heating surface, the 333 tubes accounted for 1,372.9 sq. ft. and the fire-box for the balance of 112.5 sq. ft. The large number of small tubes 1½ in. in diameter was again characteristic of Stroudley. The L.B.S.C. was not a system of long mileages, and with the coal used there was little likelihood of the tubes becoming choked up on the relatively short runs. These engines were light on fuel, and in Stroudley's time an average consumption of 26 lb. of coal per mile was usual. A special mixture of smokeless Welsh and Derbyshire coal was used in proportions of 20 : 1 respectively, this being found to give a minimum of soot and ash.

Stephenson link motion was used to actuate the valves, and was governed by screw reverse gear in the cab. Power operation was applied by a patent of Stroudley's invention in connection with the compressed air from the Westinghouse brake reservoir. This arrangement was well liked by the men, and similar schemes were adopted by later authorities at Brighton. The engines could be notched up to a short cut-off, and the exhaust was notably soft even when working thus with fairly heavy trains. The connecting rods, forged from scrap tyres of Yorkshire iron, were of marine pattern and flat in section. Instead of the crank-pins being arranged opposite those of the outside rods they were on the same centre lines, this arrangement being adopted on the ground that the axle-boxes wore better. Larger balance weights were of course necessary, and the bending



The above illustration shows a locomotive "push-of-war"! "King Arthur" with the inside-framed "Drummond" tender mentioned in this article pushes backward two of the L.S.W.R. "Jubilee" engines that in certain respects resembled the "Gladstones."

moment on the crank axle was increased. Other engineers have tried this system from time to time, notably William Dean on the G.W.R.; and even such recent engines as the 10 G.E. type 4–6–0s built in 1928 with poppet valves for use on that section of the L.N.E.R. incorporate this arrangement.

The wheels were of wrought iron, and the driving wheels were of the usual 6 ft. 6 in. dimension, only exceeded once by Stroudley in the 6 ft. 9 in. wheels of his 2–2–2 single-driver "*Grosvenor.*" The wheels were notable for the substantial rims or tyres, which were 2 in. in thickness. Possible wear of the large leading wheel flanges to an extravagant degree was provided against by the incorporation of a device to lubricate these flanges when running on curves, but it must also be mentioned that Stroudley used tyres having a tensile strength of 47 to 48 tons per sq. in., at a time when tyres of 35 to 40 tons tensile strength were much more usual.

The trailing wheels of the engine and the tender wheels were identical, and as a matter of fact were interchangeable, as the tenders were built with inside frames. This was an economic and convenient arrangement, for these wheels were standard for eight different classes, and could be used on a tender "when it would not be judicious to use them under the engine," as Stroudley himself stated. The curious appearance of these tenders has a modern parallel in the double-bogie tenders running behind certain S.R. engines of to-day. These were designed by D. Drummond of the L.S.W.R., who for his eight-wheeled tenders seems to have followed the practice of his former chief in this respect as in numerous other matters. A disadvantage of the inside frame arrangement is that the springs are less accessible for inspection and repair.

Exhaust steam was employed to heat the feed-water, which was introduced to the boiler by crosshead-driven pumps. The system was apparently successful, for the water was raised to boiling point before delivery, the saving in fuel amounting to 2.9 lb. per mile on test. No. 172, "*Littlehampton,*" had injectors instead of pumps, however, and incorporated several minor differences.

The cab was of the typical Stroudley pattern which, modified more or less, was also used on the N.B., Caledonian, Highland, L.S.W. and G.S.W. railways as a result of the activities of the two brothers D. and P. Drummond, who had served under Stroudley and who perpetuated in their own engines many features originated by him. Its general contour is apparent from the photographs, and it will be seen that its leading edge projects at the bottom to form a splasher for the trailing wheels. "*Gladstone*" itself was the only member of the class with this splasher shaped with two curves, the other engines having it formed with a single radius, as is shown in the illustration of No. 198. The roof was of peculiar shape, for the spectacle plate of the Stroudley cab has a flat top edge. The cab roof was therefore flat along the front and along the sides, but as it was arched in the centre this accounts for its domed appearance at the front.

Inside the cab, which afforded good protection, the footplate arrangements were neat, the engines being driven from the left-hand side. The familiar double-handled Stroudley regulator was used, and there were two water gauges. Special gauges were used to indicate steam pressure and air pressure, showing respectively the pressure in the boiler and in the steam chests, and that in the Westinghouse reservoir and in the train pipe. The earlier engines of the class had a speed indicator devised by Stroudley, in which the height of a column of water in a graduated glass tube enabled the enginemen to read off the speed. This water was caused to travel up the tube by a small belt-driven fan housed in a casing, and the faster this revolved the higher the water went. After a few years' service, however, this device was done away with.

Among other details of note was the copper-capped chimney originally fitted, which gave the engine a unique appearance. This tapered from the base upward, the inward taper allowing for the condensation of the steam as it passed upward, with consequent decrease in volume. This form of chimney was greatly favoured at one time by the well-known locomotive builders Beyer Peacock & Co. Ltd., of Manchester. The large sand-box combined with the leading splasher was a favourite form of construction in those days, as was also the extension sideways of the front plate of the smoke-box to form what are usually known as "wings." In this case they joined up with the front edge of the sand-box, giving the "Gladstones" a curiously characteristic appearance when seen from the front. It is an interesting detail that the lamp brackets placed above the buffers were supplemented by others fitted to the front of the sand-boxes, owing to the multiplicity of head codes needed to denote the various routes of the L.B.S.C.

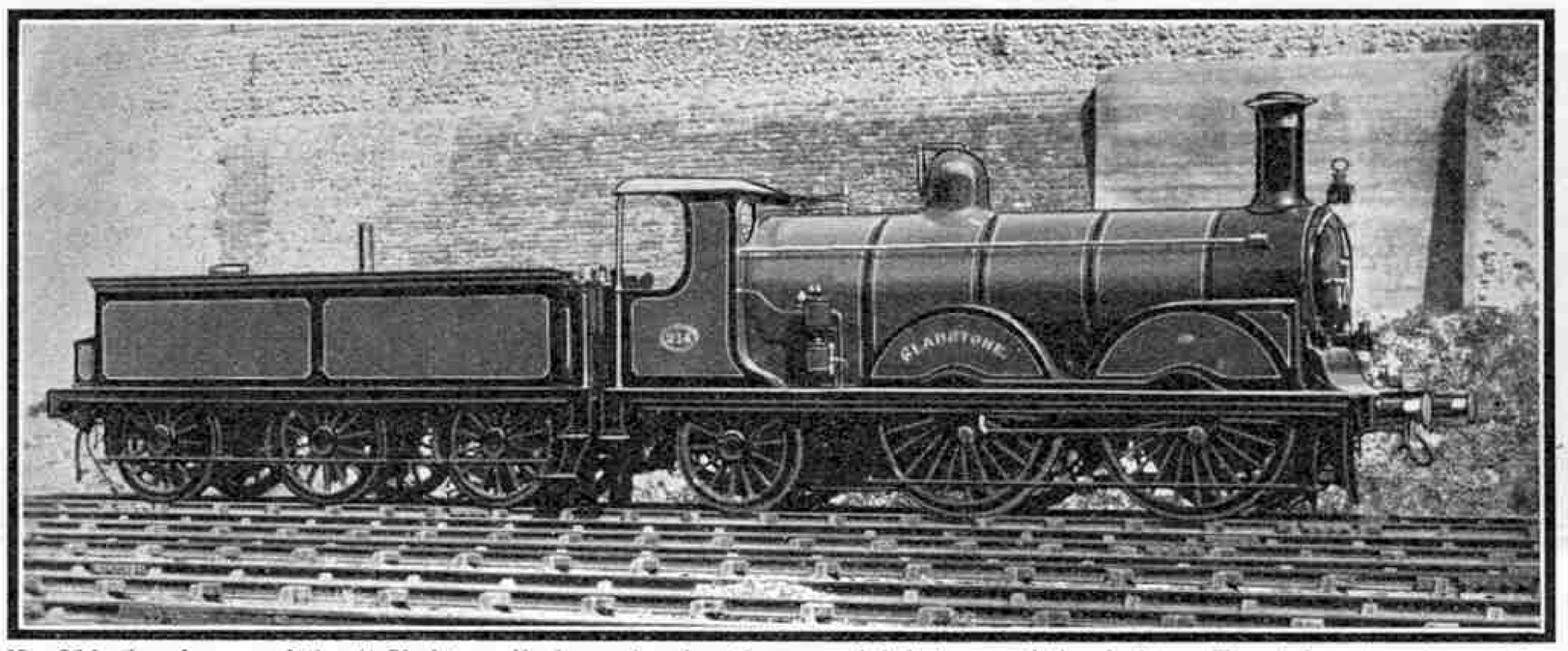
The upper portion of the tender presented some features of interest. The corners of the tank or body were rounded, and the upper edges provided with a coping tilted outward to an angle of 60 degrees. The height of the tenders was specially restricted, so that an engineman, even standing up on the tank, would not strike his head on any bridge or tunnel. In spite of the apparently small size of these tenders the coal space accommodated 3½ tons of fuel, and the water carried amounted to 2,250 gallons.

Extreme care was taken in the construction of these engines, so much so that, for example, red lead for boiler joints was displaced at Stroudley's express instruction by clarified oil. Their soundness has been well shown by the manner in which they have dealt with trains of increasing weight, and by their general freedom from trouble throughout their hard-worked existence.

No mention of these Stroudley masterpieces would be complete without a reference to the ornate system of painting favoured by him. The main colour was what was known as Stroudley's "improved engine green," which actually looked yellow. The dark border shown in the illustration was olive green, divided from the yellow ground by a black band, which on its green and yellow edges respectively had a fine red and a white line. The boiler bands were very ornamental, each consisting of a central black band edged on both sides with red. Next to these were olive green bands finished with white lines next to the yellow ground. The wheels were yellow, with olive green tyres and axle ends; and the footplate edging, steps and similar details were claret coloured, edged all round with black, on the outside of which was a fine yellow line and on the inside a fine red one. The claret colour was applied also to buffer stocks and buffer beams, except for a bright red panel in the centre of the latter, enclosed by a black stripe lined with yellow and red. The names were applied to the splashers by means of transfers in gold block letters, with white, green and black shading. The number plates were of polished brass, the actual number being on a blue ground, encircled by the company's name in black letters. The coupling rods were painted red with polished ends, and with the brightly burnished copper chimney cap completed a brilliant but none

the less effective colour scheme that became very well known.

It would be interesting to see how such an elaborate livery would stand up to modern conditions of long mileages and double manning. Completely different conditions obtained in Stroudley's day when he caused the driver's name to be painted up inside the cab of each locomotive. The men were thus encouraged to take a personal pride in their charges, which they felt were their own; and the greatest care was thus taken in the cleanliness and generally effective condition of the engines. The mileages between successive visits to the shops for repairs were also painted up in the cab, so that the men had constantly before them a record of work well done.



No. 214, the pioneer of the "Gladstone" class, showing the essential features of the design. The elaborate nature of the Stroudley livery is suggested by the illustration, for which we are indebted to the Southern Railway.

The pioneer of the class, as already mentioned, is now in retirement at York Railway Museum. At the time of its withdrawal from service it had assumed the appearance shown by No. 198, but in view of the historic interest of the class, and their many unique features, every effort was made to restore the engine to its original state. This was successfully accomplished, and it was exhibited at Victoria Station, together with the magnificent "*Lord Nelson*," in May 1927, thus showing in a very interesting manner the locomotive progress of 44 years.

No. 189, "*Edward Blount*," was exhibited at the Paris Exposition of 1889, and was awarded a gold medal, this distinction being commemorated on the driving wheel splashers underneath the name. Sir Edward Blount was then Chairman of the Western of France Company, and had been responsible for a great deal of railway work in that country. The engine took part in the locomotive trials on the P.L.M. after the function, but, being new, did not distinguish itself, as the coupling rods overheated and tube trouble developed. The latter possibly was caused by the use of unsuitable fuel, for, as we noted previously, a special diet was prescribed for these engines. In these trials a 30-year old French "Crampton" locomotive with outside cylinders proved the speediest, even though the S.E.R. representative, a "Stirling" 4–4–0, had its coupling rods removed and ran as a 4–2–2 in its efforts to maintain British prestige. Stroudley unfortunately caught a fatal chill during the trials, and died in Paris towards the end of the year.

In common with later engines of the series "*Edward Blount*" had larger steam ports to allow of freer running, an air-lock for the reversing gear, a displacement lubricator, and steam sanding apparatus connected to the valve chests so that sand could not be applied until after the regulator was opened. This same engine was fitted in 1908 with a special system for preheating the air supply to be taken to the grate.

No. 188, "*Allen Sarle*," was notable as being frequently selected to run the Royal Trains of that period, the scrupulous cleanliness and brightness of the engines of those days being carried to the extent of whitewashing the coal in the tender! The cylinders of No. 188 were experimentally bored out to a diameter of 19 in. by successive steps, but the change was only temporary, and the original diameter was subsequently restored.

It is interesting to note that No. 198, "*Sheffield*," which is shown in one of our illustrations as it appeared during its later days, was at one time provided with oil-burning apparatus. The experiment was a success technically, but the problem of securing satisfactory supplies of oil fuel settled the question as it did on the G.E.R., where oil-burning engines on the Holden system had some vogue for a time.

The adoption of the 0–4–2 wheel formation with large driving wheels apparently influenced Mr. W. Adams on the neighbouring L.S.W.R., for he designed an effective class of locomotives of that type, the first of which appeared in 1887. These employed wheels as large as 6 ft. 1 in. in diameter, and thus were not so essentially an express design as the "Gladstones." They were in fact intended for mixed traffic working. They were plain in external lines, with stove-pipe chimneys of severe shape, and were thus a direct contrast to the neat "Gladstones" with their handsome copper-capped chimneys. They carried out a large amount of useful work during their careers, and some of them are still in S.R. service. A point to be noted is that the first 30 of the 90 that were built had their cylinders cast in one piece, with the valves below them, as was the case with the "Gladstones." Subsequent engines retained the monobloc casting, but the valves were placed between the cylinders. These engines were somewhat heavier than the "Gladstones," weighing 42 tons 5 cwt. as against the 38 tons 14 cwt. of the Brighton engines.

List of "Gladstone" Class Locomotives

172	Littlehampton	April,	1891
173	Cottesloe	April,	1891
174	Fratton	Dec.,	1890
175	Hayling	Dec.,	1890
176	Pevensey	Nov.,	1890
177	Southsea	Nov.,	1890
178	Leatherhead	June,	1890
179	Sandown	May,	1890
180	Arundel	March,	1890
181	Croydon	Feb.,	1890
182	Hastings	Dec.,	1889
183	Eastbourne	Nov.,	1889
184	Carew D. Gilbert*	Sept.,	1889
185	George A. Wallis	Sept.,	1889
186	De la Warr	June,	1889
187	Philip Rose	June,	1889
188	Allen Sarle	April,	1889
189	Edward Blount	March,	1889
190	Arthur Otway	Dec.,	1888
191	Gordon-Lennox	Nov.,	1888
192	Jacomb-Hood	Oct.,	1888
193	Fremantle	Oct.,	1888
194	Bickersteth	June,	1888
195	Cardew	June,	1888
196	Ralph L. Lopes	May,	1888
197	Jonas Levy	May,	1888
198	Sheffield	Dec.,	1887
199	Samuel Laing	Dec.,	1887
200	Beresford	Dec.,	1887
214†	Gladstone	Dec.,	1882
215	Salisbury	Dec.,	1883
216	Granville	Dec.,	1883
217‡	Northcote	Dec.,	1883
218	Beaconsfield	Oct.,	1885
219**	Cleveland	Oct.,	1885
220	Hampden	Dec.,	1887

* Renamed Stroudley later.
† Renumbered 618 in 1920.
‡ " 620 "
** " 619 "

The 0–4–2 wheel arrangement of the "Gladstones" has several features in common with the "Atlantic" or 4–4–2 type. The coupled wheelbase is short —7 ft. 7 in.—and the trailing wheels occupy the same position under the cab, and offer practically no restriction to the fire-box. The rear pair of driving wheels are connected to the cylinders, which is the usual "Atlantic" arrangement, although the L.M.S.R. (L. & Y.) and many N.E. 4–4–2s are notable for driving on the leading coupled axle. Stroudley was engaged on a "Columbia" or 2–4–2 express design when he died, but his successor favoured the 4–4–0 type. The two were combined years later by D. Earle Marsh in the 4–4–2 wheel arrangement of the Brighton "Atlantics," the general design of which is so similar to the Ivatt creations of Doncaster, from where Marsh had been appointed to the L.B. & S.C.R.

The last of the "Gladstone" class to remain in service was the former No. 172 "*Littlehampton*," which as No. 2172 was the only member of the class to be renumbered under the new S.R. scheme. This was withdrawn in September, 1933. Among its last duties was the work described in the June, 1932, "*M.M.*," then being carried out by a fellow veteran No. 197 (once "*Jonas Levy*") scrapped in August, 1932. A daily mileage of 210 was involved, a return trip from Brighton to Ashford and back preceding a run to Tonbridge via Crowborough and Tunbridge Wells. Before working to Lewes to return thence light to Brighton, two trips were made to Uckfield and back from Tonbridge.

It is interesting to note that No. 2172 took part in the exhibition at Brighton station during the last week of 1932, immediately before the inauguration of the electric services to Brighton. In addition to No. 2172 there was one of the well-known "Nelson" class, No. 853 "*Lord Rodney*," and a full-size model of the famous "*Rocket*." A new six-coach electric train showed the rival power that has now ousted the successors of the "Gladstones" from the Brighton main line.

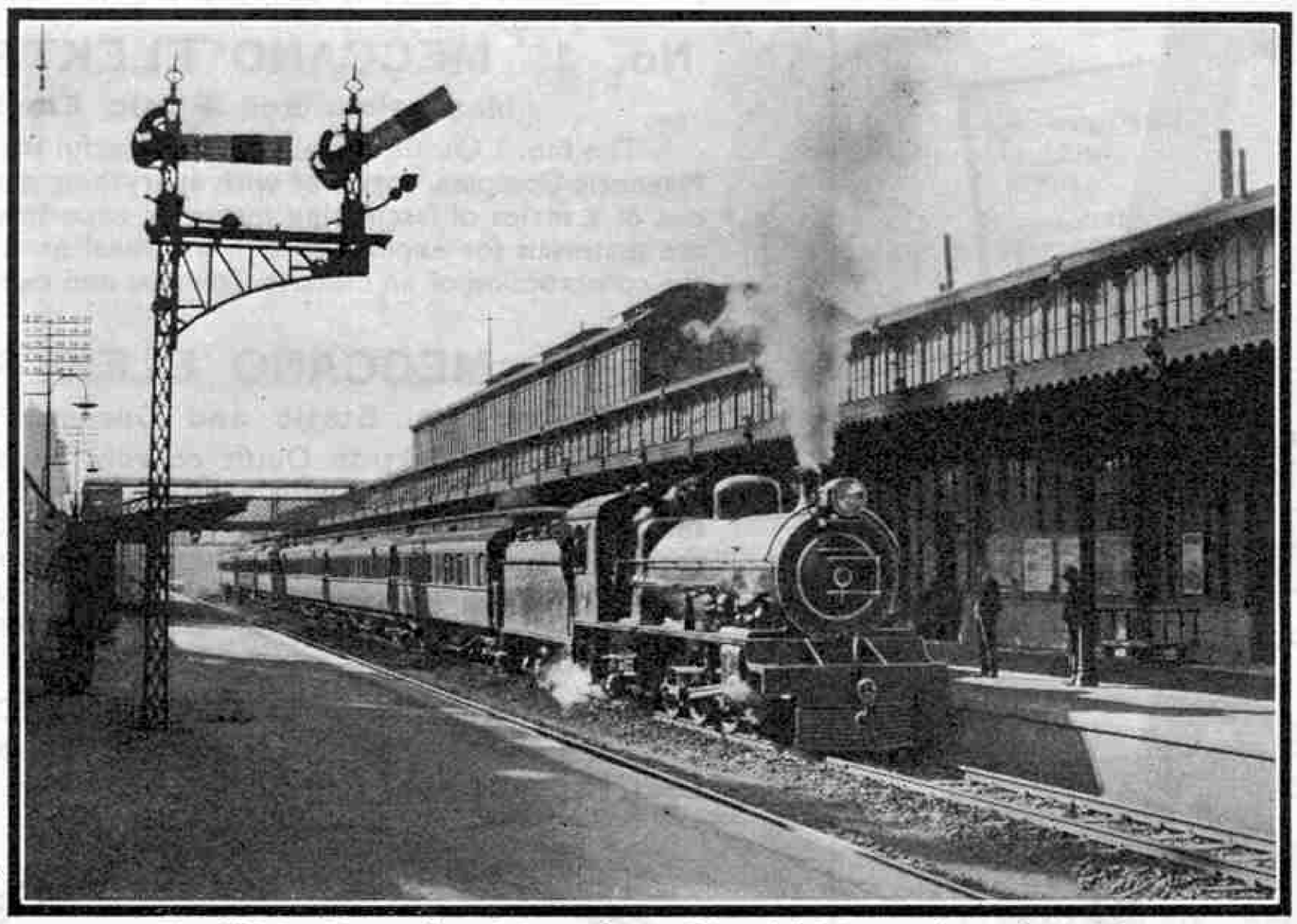
Tales of a South African Railway

By A. H. Betteridge

ANY railway line on which the supremacy of a locomotive is challenged by an animal must be interesting. But when a particular stretch of track is frequently used by wild animals trekking in search of pastureland, it is somewhat disappointing to find that the challenge was issued by a domesticated but decidedly irate bull. It happened between Mafeking and Bulawayo, and the consequences to the ambitious beast can be imagined—several cows mourned the loss of a mate.

The section of line Vryburg-Bulawayo, known as the Rhodesia Railways, is not owned by the South African Railways and Harbour Administration, but is manned and controlled by servants from the Union. In many respects the line north from Mafeking differs from other sections in the south. It meanders through dense bush, over wide expanses of arid veld and stretches of land similar to the Karoo, and is entirely unprotected by wire fences such as we are accustomed to see on each side of the railway line in the Union.

Hereabouts trains do not run so frequently as to unduly harass the staff at the small wayside stations; but though train working may not be heavy, other details keep busy these solitary station officials-in-charge. At a one-man station an average of nearly 6,000 single twopenny stamps are issued to individual natives monthly. It is a rare occurrence to be asked for more than one stamp by one of the numerous black customers.



The "Union Express" at Johannesburg with a 4-6-2 locomotive at its head.

Incidents such as a charging bull provide welcome interludes for members of the staff, and it is surprising to the average man in the Union why so many colleagues prefer to live in the quiet of these parts. One lone railwayman at an out-of-the-way pumping station was asked how he overcame the monotony. "By keeping busy," he replied; "there's plenty to do."

This pumper has been stationed up north three years, and ever since he arrived he has been pestered with snakes. "They're as common as sleepers on the track," he declared. After hearing his experiences I quite believe him. The reptiles seek warmth from the boiler and are often found in unexpected corners of the pump-house. One inquisitive snake caused the pumping engine to be stopped while the remains of its sinuous body were extricated from the machinery with which it had become entangled.

The pumper's cat killed many snakes, but the pet lost its life when it courageously tackled ten feet of black lightning, a mamba. Chickens owned by this railwayman tempted snakes which seemed to have a fancy for poultry. The pumper exercised his inventive skill and constructed two small-meshed wire cages which closed automatically when the victim had entered. The fowl-house was reconstructed and the cages placed at the only openings, so that the bait actually consisted of white leghorns on their perches, roosting in sublime ignorance of the fact that they were being used as bait.

More than a hundred snakes, an average of two a week, have been caught in the traps in twelve months. The victims are despatched by means of boiling water in a bath—no chances are taken by the pumper, who has learned to respect his unwanted callers. But the procession continues.

Among the official records of injury on duty cases in these parts one or two have been caused by snakes. A guard almost trod on a large cobra at a siding. He slipped when the snake reared up, fell and cut his head on the rail. Luckily the hooded death slithered into the veld without biting the startled man.

A train was once delayed at Palapye Road as the result of a mamba curling itself round the gate of a station foreman's garden. The man was going to the station to admit the train when he fortunately spotted a slight movement where he would have placed his hand a moment later. Horrified, he raced back to the cottage, borrowed a gun from his neighbour, returned and shot the snake which was still on the gate. It measured eleven feet.

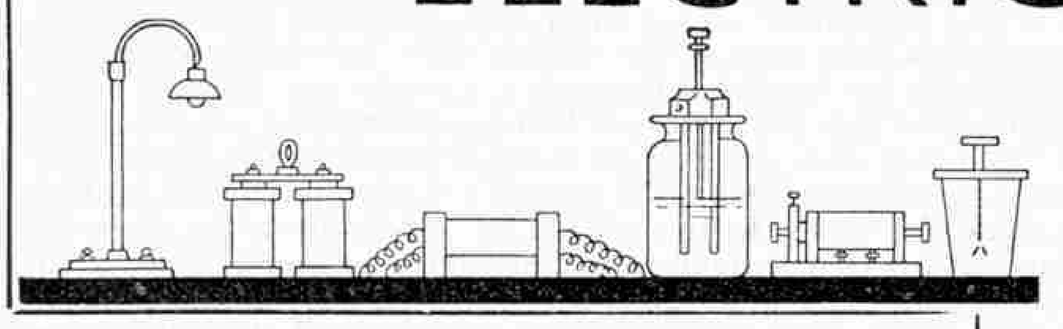
Some years ago a newcomer to the northern road was told some tall stories about wild animals at sidings. He honestly expected to see lions following the train. Of course, King Leo is only seen in these parts at very rare intervals now. This guard was left behind at a siding on his first trip in charge of a train, and missed the van. The driver, unaware of the guard's misfortune, ran on to the next station. It was dusk and, finding no guard, the driver detached his engine and ran back to the siding. He found the guard up a telegraph pole, half dead with fright. The fellow had to be helped down, as he swore that a troop of lions had been prowling round the pole for half an hour. I've not verified this story, but the name of a man still in the Service is mentioned, and he certainly went to that area about the time the tale was told.

One of the best stories concerning this section of line concerns the visit of the Prince of Wales in 1925. The facts were told to me by the District Inspector who travelled with the Royal train. When the train had stabled for the night at an almost uninhabited siding, the stillness of the night was broken by the strains of a loud gramophone and louder laughter. His Royal Highness asked the D.I. what it was all about. It appeared that the pumper's wife, a regular cockney, and renowned for her goodness of heart and her habit of calling a spade a spade, was celebrating in honour of the distinguished visitor. A ganger from another half-forgotten cottage along the line had been invited. The Prince said he would like to meet the party. He walked to the cottage. The D.I. asked the large, homely hostess if the Prince could come in. "God bless him, I'd like nothing better," she declared earnestly. In the small lamplit room the Royal guest was entertained in a manner such as likely enough he will never experience again. He sent for refreshments from the train. Mrs. X was induced to dance the cakewalk as she had done thirty years earlier in London. His Royal Highness positively cried with laughter. On more than one occasion later he averred he had never enjoyed himself so much in his life as at this pumper's cottage. Both the pumper and the D.I. are out of the Service now, but those who were present on this occasion will always recall it as the outstanding night for them. It is one of the loneliest sections for railwaymen, but things do happen to relieve the monotony.

This interesting article is reprinted from the "*South African Railways and Harbour Magazine*" by courtesy of the Editor.

MECCANO ELEKTRON

ELECTRICAL OUTFITS



In these days of radio, X-rays, and electric trams and trains, every boy should have a knowledge of electricity. The only way to gain this knowledge is by means of experiments, and the Meccano Elektron Outfits have been produced specially for this purpose.

These Outfits contain all the materials for carrying out a splendid series of fascinating experiments, commencing with Magnetism and passing on through Frictional Electricity to Current Electricity. In addition many interesting mechanisms can be constructed, including an Electric Bell, a Telegraph, and a Shocking Coil.

No. 1 Meccano Elektron Outfit Price 6/6

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No. 2 MECCANO ELEKTRON OUTFIT

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The No. 2 Elektron Outfit contains all that is included in the No. 1 Elektron Outfit, with additional parts that enable a splendid series of experiments in current electricity to be performed. Among these parts are a Horseshoe Magnet, and Coils and Yokes for the construction of Electro-Magnets that can be used in building a real Electric Bell, and a Buzzer for use in an electric telegraph system.

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An Accessory Outfit is also available that converts a No. 1 Elektron Outfit into a No. 2. Price **14/6**

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MAKING AN ELEKTRON CURRENT INDICATOR

OWNERS of Elektron Outfits will have realised that a coil of wire through which a current is passing is one of the most useful of all electrical devices. For convenience a coil of this kind is usually wound on a special bobbin, such as that of the Magnet Coil included in the No. 1A and No. 2 Elektron Outfits; and the passage of a current through it transforms it into an electro-magnet.

Electro-magnets of this kind are not only employed for lifting purposes, as in the case of the horsehoe electro-magnet illustrated on page 9 of the Elektron Manual No. 2, but also are used in such familiar devices as electric bells, buzzers, shocking coils and motors. Their uses for these purposes are illustrated by means of the devices of this kind that can be built up with Elektron parts, as explained in the Elektron Manuals. This does not exhaust the possibilities in this respect, and many interesting experiments can be carried out with the coils included in Elektron Outfits, and even with simple coils made by winding lengths of Connection Wire round cores of various sizes.

The magnetic effect of a coil of this kind is increased by giving it a soft iron core, and Magnet Cores are included in Elektron Outfits to enable the maximum effect to be obtained from the Magnet Coils. When no core is included, however, the coil is equally effective, whether it is one of a single winding, forming what is called a solenoid, or is one in which several layers of wire are wound on the bobbin or former.

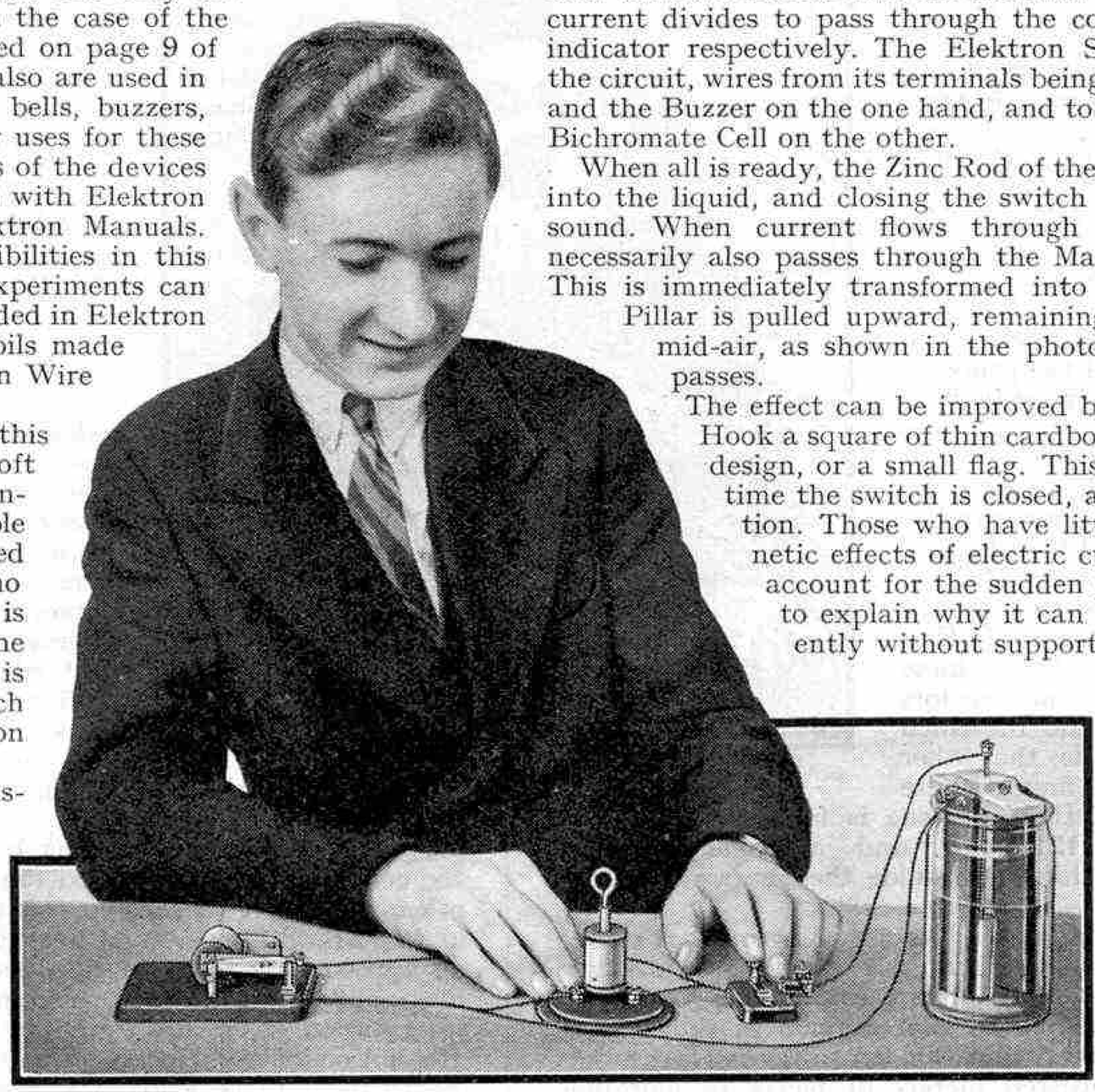
The interesting experiment illustrated in the accompanying photograph, shows how an Elektron Magnet Coil can be used to indicate automatically when an electric current is passing through a circuit. In this case the circuit to which the indicator is applied includes the Elektron Buzzer, which is fitted up exactly as described in the No. 2 Elektron Manual, with the exception that only one Magnet Coil is employed. The necessary alterations to the wiring should offer no difficulty, for in the normal Buzzer the two Magnet Coils are in series, that is the current flows through them in turn. When one Magnet Coil is removed, the wire leading to it therefore is connected directly to the free end of the second Coil. The current required to operate the Buzzer is taken from the Elektron Bichromate Cell.

The Magnet Coil removed from the Buzzer is employed as the coil of the indicating device. For convenience it is mounted on the Circular Base, as shown in the photograph, and the ends of its windings are connected to terminals mounted in the holes provided in the Circular Base, where they serve to hold the Magnet Coil in position. The Gong Pillar is then dropped into the bore of the Magnet Coil with its threaded end downward. The Gong Pillar is made of similar material to the Magnet Cores, and readily responds to the electro-magnetic attraction of the Coils. Its diameter is less than that of the Cores, however, and therefore it slips readily into the bores of the Coils. Before it is placed in position, the Magnet Hook is lightly screwed into the tapped hole at its upper end. This is too large to fit into the bore of the Coil, and the Gong Pillar therefore remains suspended with only the Magnet Hook showing.

This completes the indicator, and it is included in the circuit by means of wires arranged as shown in the photograph. It will be seen that the Buzzer and the indicator are in parallel, that is the current divides to pass through the coils of the Buzzer and the indicator respectively. The Elektron Switch also is included in the circuit, wires from its terminals being connected to the indicator and the Buzzer on the one hand, and to one of the terminals of the Bichromate Cell on the other.

When all is ready, the Zinc Rod of the Bichromate Cell is lowered into the liquid, and closing the switch then causes the Buzzer to sound. When current flows through the Buzzer, however, it necessarily also passes through the Magnet Coil of the indicator. This is immediately transformed into a magnet, and the Gong Pillar is pulled upward, remaining apparently suspended in mid-air, as shown in the photograph, as long as current passes.

The effect can be improved by attaching to the Magnet Hook a square of thin cardboard marked with a suitable design, or a small flag. This is waved in the air every time the switch is closed, and steadily attracts attention. Those who have little knowledge of the magnetic effects of electric currents will be at a loss to account for the sudden jump of the indicator, and to explain why it can be kept suspended, apparently without support, at the will of the experimenter.



An Elektron current indicator under test. The Gong Pillar in the Magnet Coil is suspended in mid-air when current is passing through the Elektron Buzzer.

In our illustration there is only one circuit, but there is no difficulty in adapting an indicator of this kind to each of two or more circuits connected with the Buzzer, in order to show in which of these circuits current is flowing at any time. Each circuit should have in it a switch, and a number should be given to the switch and also to its corresponding indicator. Similar arrangements can be made with the Elektron Bell, a thick nail of equal length forming a good substitute for the Gong Pillar, which is then required for the Bell itself. When used in this manner the indicator illustrates the principle followed in the case of household electric bell indicators, but in these the magnet coils simply attract small pieces of soft iron that swing on pivots.

The form of indicator used in this experiment illustrates a very interesting and useful property of solenoids, namely, their power of sucking a piece of soft iron or steel into their cores. This is readily seen when a Magnet Coil is held over a nail, the head of which is within the bore. When current from the Bichromate Cell is passed through the coil the nail is pulled up within it, and if a Switch connected in the usual manner is included in the circuit, the nail can be pulled up and allowed to fall alternately at will by switching the current on and off.

This property of solenoids is of great importance and is utilised in electro-magnetic signals and points and a great variety of other mechanisms.

How the Magnetic Compass Developed

Curious Experiments of Early Investigators

UNTIL a little more than a century ago, electricity and its related force, magnetism, were unexplained mysteries that from very early times had attracted the curiosity of a few enquiring minds. The story of the development of our knowledge of magnetism and electricity is a fascinating one, for it shows how the patient experiments of great men laid the foundation for the great electrical industry of the present day.

It is evident that the story of magnetism began in prehistoric times, for the strange powers of magnetic substances seem to have been well known to even the earliest writers. They are mentioned by Homer, the great Greek poet who lived about the 11th century B.C., and by Thales and Pythagoras, two famous Greek philosophers of about 600 B.C. The magnets they knew were not the pieces of iron and steel with which we are familiar, however, but were fragments of a mineral that was found in Magnesia in Asia Minor. It is generally believed that the word "magnet" is derived from the name Magnesia, but some accounts trace it from Magnes, a shepherd of Asia Minor, who is supposed to have been the first to discover the attractive power of the mineral by finding that he had difficulty in pulling away his crook when he allowed it to rest on a mass of rock composed of it. This mineral is a magnetic oxide of iron known as lodestone, or leading stone, on account of the property possessed by a piece of it of always setting itself in a north and south direction if free to do so.

The Chinese were familiar with the lodestone and its directive powers for centuries before the birth of Christ. The Emperor Hoangti, about 2,600 B.C., is supposed to have used it when pursuing the rebel Tchi Yeou, and we are told that about 1,500 years later another Chinese emperor presented certain ambassadors with an instrument, one side of which pointed to the north, while the other indicated the south. The first definite account of the polarity of the lodestone is found in a Chinese dictionary completed in 121 A.D., and a crude form of compass was used by the Chinese to guide their caravans in the deserts of Central Asia.

William Gilbert (1540-1603).

Knowledge of the lodestone and of its use as a compass spread gradually over the East, and was acquired by the traders whose vessels crossed the Indian Ocean in very early times. There is no doubt that the Arabs employed the compass at the time of the Crusades, and it is believed that this led to its use in Europe. These early compasses consisted merely of pieces of lodestone fixed to corks floating on water. It is said that an artist of Amalfi, an Italian seaport of great importance in the Middle Ages, marked the north point by a *fleur-de-lis*, the armorial bearing of the Kingdom of Naples; and ever since this has remained a feature of the card that marks the points of the compass.

In the earliest times the attractive powers of the magnet were regarded as supernatural, and as they became better known they were used for many strange purposes. For instance, it is said that in the year 370 A.D. certain pagans decided to consult an oracle in order to ascertain the name of the successor of the Roman Emperor of that time. The 24 letters of the alphabet were placed on a stool, and a ring suspended on a thread was held over the letters. Turning from one side to the other, and moving apparently of itself, the ring caused the letters to arrange themselves in the order TH, E, O, D, and it was unnecessary to proceed further, for this indicated quite clearly that the gods had appointed Theodosius to be the successor of the reigning Emperor! No definite explanation of this "miracle" is known, but it is believed that, for reasons of their own, those in charge of the oracle deliberately picked out these letters by means of a magnetised ring.

No real effort to study and understand the powers of the magnet was made until the end of the 16th century, when an English scientist named William Barlow published a book dealing with improvements in the method of mounting compasses at sea. Barlow was chaplain to Prince Henry, the eldest son of James I, and in 1614 was appointed Archdeacon of Salisbury. He was described by a well-known writer of his day as "a happy finder out of many rare and magnetic secrets," and in a book on "*Magnetical Advertisements*," published in 1616, he stated that soft iron was more easily magnetised than steel, but did not retain its magnetism so long as steel.

Barlow's name is not as well known as that of William Gilbert, born in 1544. Gilbert studied medicine at Cambridge and then spent three years in travelling through Europe in order to extend his knowledge before settling in London in 1573. There he practised as a physician, and quickly won a high reputation. He became a Fellow of the College of Physicians in 1576 and President in 1599, and from 1601 was physician first to Queen Elizabeth and then to James I.

Gilbert was interested in all scientific subjects, and spent his leisure in the study of magnetism and electricity, which formed the subject of his "*De Magnete*," a book that won him renown both in this country and abroad. In it he summarised all that was then known about the lodestone and the magnet, and his description shows that he thoroughly understood the concentration of attractive power at the two poles of a magnet, and knew that similar poles attracted each other, while unlike poles behaved in the opposite manner. Gilbert was particularly interested in the compass, and it is said that when he was trying to understand its mysteries he was helped by Sir Francis Drake, who told him how he had noticed that magnetic north varied from true north in the distant seas crossed during his voyage round the world.

Many strange explanations had been given of the action of the compass. Some believed the Pole Star to be a huge magnet; others said that the needle was attracted by a mountain of iron in the Arctic regions, and even declared that ships fell to pieces on approaching the mountain because the attraction of the great mass pulled out the bolts and nails! Gilbert thought over the information given him by Drake and other sailors, and saw that the action of the compass could be explained by supposing the Earth itself to be a gigantic magnet, the poles of which attract and repel the poles of the suspended magnet of a compass. In order to prove his theory he held a rod of iron in a position pointing north and south and hammered it, with the result that it became a magnet under the influence of the Earth's magnetism.

Gilbert realised the connection between electricity and magnetism, and in his book dealt at length with the only kind of electricity then known. This was frictional electricity, produced by rubbing certain materials with silk or flannel. The power of attraction possessed by objects rubbed in this manner had long been known. In Greece, for instance, it seems to have been known in very early times that amber when rubbed attracts light objects. The Chinese also were aware of the remarkable property of amber, for nearly 2,000 years ago a Chinese scientist wrote: "The attraction of a magnet for iron is like that of amber for the smallest grain of mustard seed."

Until Gilbert turned his attention to frictional electricity, the only knowledge of it that was available consisted of a few scattered fragments. These were collected by Gilbert, and became the nucleus of a new science to which he gave the now familiar name of electricity, which comes from the Greek word *elektron*, meaning amber.

Electrical science made great advances in the years following the death of Gilbert in 1603. One of those interested in it was Otto von Guericke, Burgomaster of Magdeburg, in the middle of the 17th century. Von Guericke is chiefly known as the inventor of the air pump. He used this invention for removing air from a great hollow ball formed by placing two hemispheres together, and showed that the pressure of the air on the outside of the ball was so great that the parts could only be separated when 25 horses pulled them in opposite directions. Some of the inhabitants of Magdeburg looked upon their Burgomaster as a magician, and they suspected him of dealings with the powers of darkness when he erected a great water barometer on the wall of his house. A figure floating on the surface of the water in one of the tubes of this instrument was raised into view as a warning of an approaching storm whenever the pressure of the atmosphere fell.

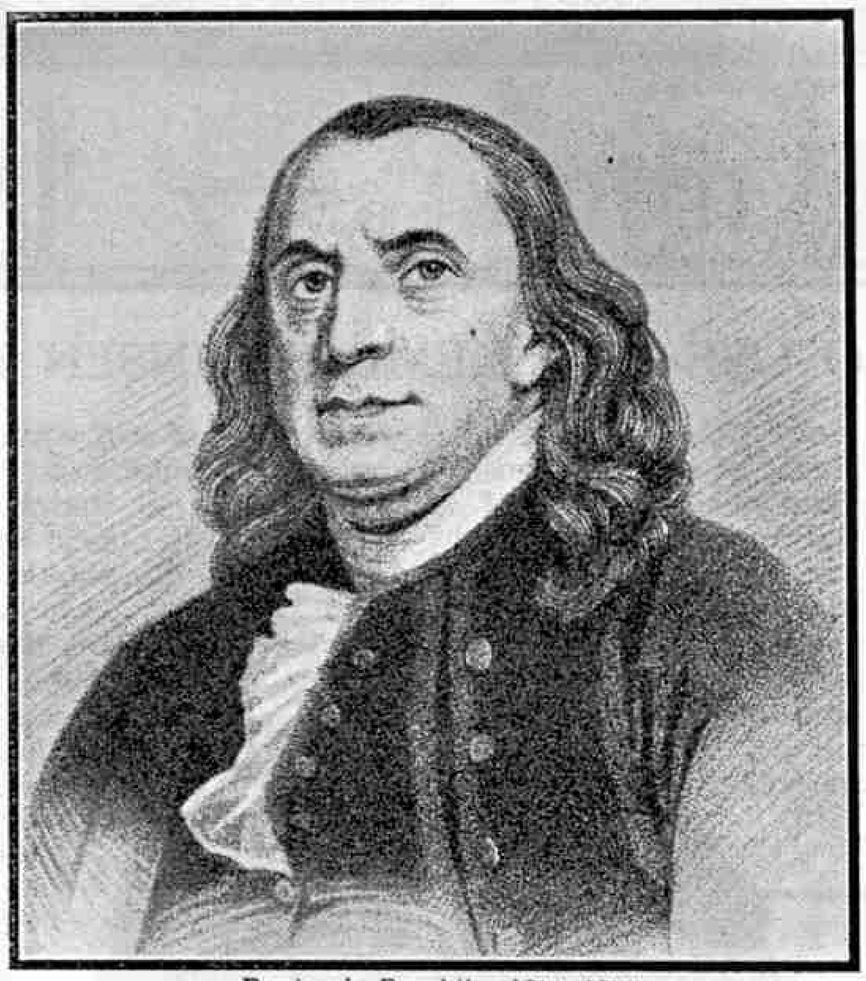
Von Guericke's contribution to the story of electricity took the form of the first electrical machine. This consisted of a globe of sulphur that could be rotated on its axis while a cloth was pressed by hand against it; and with its aid he produced electricity in greater quantity than had ever before been achieved. He then discovered that strong electrification was accompanied by a hissing noise and a gleaming light.

This pioneer work was extended by Stephen Gray, one of the most mysterious figures in the story of electricity. Gray must have been an old man when he began to "play about" with glass tubes and pieces of string. Little is known of his work, but it is certain that he discovered the difference between conductors and insulators. In his best known experiment he tied a piece of string to a glass tube and lowered the string from a balcony until an ivory knob on its end almost touched the ground many feet below. Then he rubbed the glass tube with a piece of silk, and the distant ivory immediately attracted tiny pieces of paper, showing that the electricity had passed down the string. Thus he proved that string was a conductor of electricity.

Gray did many curious things in further trials, and it is reported that on occasions he hung up boys by the neck and heels in order to find out if they would transmit electric currents! Apparently the boys objected, for in his later experiments he replaced them by roosters. His thoughts were on electrical problems even on his deathbed, for he then explained his unfinished experiments to the Secretary of the Royal Society and begged him to have them completed.

So far frictional electricity had been thought to be of one kind only, but about 1733 a Frenchman named Dufay discovered that the electricity produced by rubbing glass was different from that produced by rubbing resin. The two kinds of electricity were given the names of vitreous and resinous electricity respectively in accordance with their experimental origin. Further investigation revealed the interesting fact that the two were mutually attractive.

The interesting results obtained with Von Guericke's electrical machine led to many efforts to improve it, and Sir Isaac Newton and Hawksbee made experiments with a machine in which the globe was made of glass instead of sulphur. Later a glass cylinder was substituted, and the rubbing material was pressed against it by means of a wooden cushion instead of by hand. These improvements resulted in so great an increase in the power of the machine that one capable of giving sparks at the end of an iron wire 250 yds. long was constructed.



Benjamin Franklin (1706–1790).

In the year 1746 a very surprising discovery was made by Cuneus, a citizen of Leyden, in conjunction with Musschenbröck, a Professor in the University in that city. These scientists had noticed that electrified bodies quickly lost their charge, which, they thought, was taken away by the air itself. They decided to try the effect of electrifying water in a glass vessel, which they believed would insulate the liquid from the air and enable it to preserve its charge. Cuneus therefore held in one hand a glass jar full of water, while it was charged with electricity by means of a wire from an electrical machine. Then he took hold of the wire in order to disconnect it, and to his amazement, received such a shock that he dropped the jar. Musschenbröck then took his place, and in turn received such a violent shock that he did not recover from its effects until two days later. He was so greatly impressed by the severity of the shock that he said he would not repeat the experiment for the entire kingdom of France!

The glass jar containing water that Cuneus held in his hand had stored up the electricity derived from the machine, and was the first electrical condenser. It was improved by other experimenters, who replaced the water with shot and coated the glass jar inside and outside with sheet lead or tinfoil. In this form the condenser became familiar under the name of the Leyden jar. It excited the greatest interest throughout Europe, and many electricians travelled about from place to place to gratify the curiosity of ordinary people by selling them shocks!

The next great advance in electricity was due to Benjamin Franklin, the famous American statesman and scientist. As the result of his observations on thunderstorms, Franklin became convinced that lightning was a natural electrical discharge of the same nature as the sparks from electrical machines and the Leyden jar. To test his theory he prepared a large kite made of silk, flown at the end of a hempen string connected to the knob of a Leyden jar, and then waited impatiently for the next thunderstorm. When this arrived he flew his kite with an ordinary latch key attached to the string. He held the key by a silk thread that served as an insulator, and on touching the key with his knuckle he felt a distinct shock. The electricity from the clouds had reached the key by passing down the string. To his great delight the Leyden jar became charged in exactly the same manner as if it had been connected to an electrical machine. Franklin did not rest content with this discovery but applied the knowledge he had gained to the protection of buildings by means of lightning conductors.

Planets and Atmospheres—(*Cont. from p. 771*)

over that in which measurements are made upon the intensities of the superposed lines, but both methods have been used in the study of planetary spectra, especially those of Venus and Mars.

The second important means for investigating physical conditions on the planets is through direct measurements of temperature. Such methods have developed out of the remarkable improvements in the construction of sensitive heat-recording electrical instruments. Dr. Pfund and Dr. Coblentz were among the pioneers in this field, and Coblentz and Lampland of the Lowell Observatory made some of the first and most accurate observations of planetary temperatures.

Several different types of instruments are available, but that which has been used most extensively contains a thermocouple as the heat-sensitive element. It depends upon the fact that when the junction between certain metals is warmed, an electric current is set up that may be measured with a sensitive galvanometer. For most astronomical purposes bismuth and an alloy of bismuth with a small amount of tin have been used, and the dimensions of the thermocouple as well as of the receivers, the thin strips of metal upon which the image of the planet or the star falls, are made almost incredibly small. The entire weight of some of the compensated thermocouples used by Pettit and Nicholson in their observations at Mount Wilson, including the receivers and their connections, is about one thousandth part of that of a drop of water.

The thermocouple is placed in a high vacuum, which increases its sensitiveness greatly, and during the observations the image of the star or planet is thrown alternately upon one receiver and then upon the other, so that the effect of the measured heat is doubled. The receivers, which are about one-fiftieth of an inch in diameter, are so small that details of planetary surfaces, such as the polar caps and the dark and bright markings on the surface of Mars, can be studied individually.

With such an instrument, a rise in temperature of the receiver of three hundred-thousandths of a degree is measured without difficulty, and the heat of stars invisible to the naked eye has been determined with the aid of the 100-in. telescope.

When a planet receives radiation from the Sun, a part is reflected directly away in the form of reflected sunlight, and a part is absorbed and warms the planet and is re-radiated in the form of long heat waves. This radiation is that which determines the temperature of the planet. Accordingly two sets of measures are made, one through a thin plate of glass that absorbs most of the planetary radiation, and the other with the glass plate removed. In this way the amount of heat emitted by the planet itself is determined, and through application of the law connecting temperature with radiation, with due allowance for the absorption by the Earth's atmosphere, the temperature of the planet is calculated.

(To be concluded.)

Railways of Switzerland—(*Cont. from page 803*)

trains of 600 tons, and freight trains of 750 tons, at speeds of 38.5 m.p.h. and 31 m.p.h. respectively on the gradients of 1 in 37 on the St. Gotthard line.

The contrast between the present electrical working of the St. Gotthard line and that which prevailed prior to 1923 under steam traction is impressive indeed. The standard 4-6-0 compound steam locomotives were scheduled to take 120 tons at 25 m.p.h. on the steepest sections of the line, and it was necessary at times to employ three engines on a train, two pulling and one banking behind. Now with masterly ease No. 11851, and its sister No. 11801, can each take enormous express trains of 14 of the heaviest coaches at considerably accelerated speeds.

Experiments have been carried out recently with various systems of automatic train control, and as a result the Swiss Federal Railways have decided to instal inductive control apparatus on all their electrified lines. The Lötschberg Company have adopted a mechanical train-stop control system.

In the handling of freight traffic the most modern methods are used, and in the extensive marshalling yards hydraulic retarders, colour-light signals, and other new devices are to be found.

[Succeeding articles will describe the wonderful Berne-Lötschberg-Simplon route and the amazing mountain railways.]

HOW TO USE THE KEMEX BUNSEN BURNER

A GOOD source of heat is required for many chemical experiments and must form part of the equipment of every experimenter. The Kemex Spirit Lamp is a safe and reliable means of heating test tubes, flasks and other chemical apparatus, and its flame has a temperature that is sufficiently high for most experiments. It is also very convenient because it is self-contained and can be used practically anywhere with complete safety, for its design makes over-burning practically impossible.

For many chemical experiments a hotter and larger flame than that of the Spirit Lamp is an advantage, however, and for this reason experimenters will welcome the Bunsen Burner, Part No. K45, which, with a suitable length of Rubber Tubing, Part No. K37, is now included in the range of Kemex Parts and in the No. 2B and No. 3B Kemex Outfits. This burner is a handsome addition to a chemical enthusiast's laboratory. It gives a steady flame and can be adapted for any of the purposes to which the Kemex Spirit Lamp is put, and therefore is an ideal source of heat for those who have gas laid on in a convenient position, with a tap to which the necessary length of rubber tubing can be attached.

A few simple but fascinating experiments will show how the Kemex Bunsen burner can be used to the greatest advantage. Before lighting it for the first time the collar at the foot of the upright tube should be turned round so that the air hole is closed. Then, when the gas is turned on and a light is applied, a wavy yellow luminous flame is obtained. This flame should be adjusted to a suitable height by regulating the gas tap and slowly opening the air hole. It then becomes steadier, and its luminous portion gradually diminishes in size, until a stage is reached when it is blue throughout. This blue flame, obtained by burning a mixture of gas and air, is the one used for heating purposes, and is known as the Bunsen flame.

With the air hole fully opened the flame may roar slightly, and an inner cone can be distinguished by its bright green colour. The best results are not necessarily accompanied by the greatest noise, however, and if necessary the proportion of air should be reduced until a flame that gives only a faint sound is obtained. One in which the inner cone is well marked is the most satisfactory for use.

This inner cone really marks the beginning of the combustion of the gas, for the flame itself is hollow, its interior containing unburned gas travelling from the upright tube to the zone of combustion. This can be proved by several interesting experiments. For instance, if a match or a small piece of wood is held across the flame about ½ in. above the top of the upright tube, it will be charred at two points, the part held in the inner cone remaining unburned. Similarly a brown ring is scorched on a sheet of stiff white paper held horizontally and brought down upon the flame so as to occupy a similar position to that of the match of the last experiment. The paper should be held in the flame only for a second or two, and should be removed before it bursts into flames.

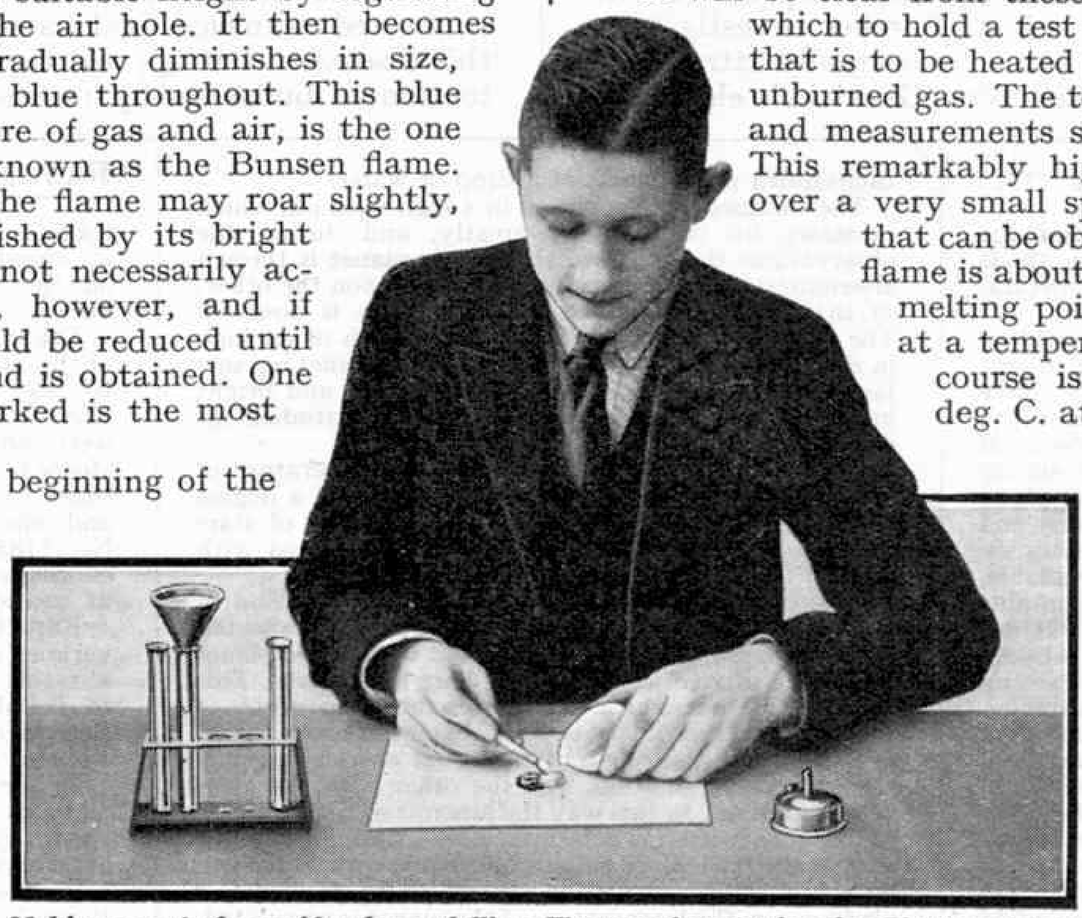
A miniature Bunsen flame obtained by tapping off the gas from the interior of the ordinary flame of the Kemex Bunsen burner and lighting it.

In an even more striking experiment that shows the flame to be hollow, a pin is passed through a match immediately below the head and at right angles to the stick. The match can then be hung vertically inside the upright tube of the Bunsen burner, the pin supporting it, with its head about ¼ in. above the tube itself and in the interior of the flame. When the gas is turned on and a light is applied above the match, the usual Bunsen flame is obtained, but the match head does not take fire, showing that it is not in contact with the flame. It does burn eventually, because heat radiated from the wall of flame surrounding it raises its temperature above ignition point.

The gas in the interior of a Bunsen burner can be tapped by holding a short length of glass tubing with one end inside the flame, as shown in the upper illustration on this page. On applying a light to the other end of the tube a miniature replica of the Bunsen flame is obtained. If the air holes of the Bunsen burner are closed while this experiment is carried on, the tiny flame at the end of the short piece of glass tubing immediately becomes the yellow luminous flame that is obtained when gas alone is burned.

It will be clear from these experiments that the best place in which to hold a test tube or any other piece of apparatus that is to be heated is above the tip of the inner cone of unburned gas. The temperature at this point is very high, and measurements show it to reach about 1,800 deg. C. This remarkably high temperature is maintained only over a very small space, however, and the temperature that can be obtained by heating a small object in the flame is about 1,100 deg. C. This is higher than the melting point of copper, which becomes molten at a temperature of about 1,060 deg. C., and of course is far above the temperature of 100 deg. C. at which water boils.

The lower illustration on the opposite page shows a burner being correctly used for drawing out a piece of glass tubing to form a jet. The point at which the tube is to be heated is in the hottest part of the flame, just above the tip of the inner cone, and the tube is held loosely in the hand so that it can be rotated rapidly, and thus heated regularly and evenly. The glass softens quickly, and usually gives a decided yellow tinge to the flame when it is ready for drawing out. The rotation is continued as the

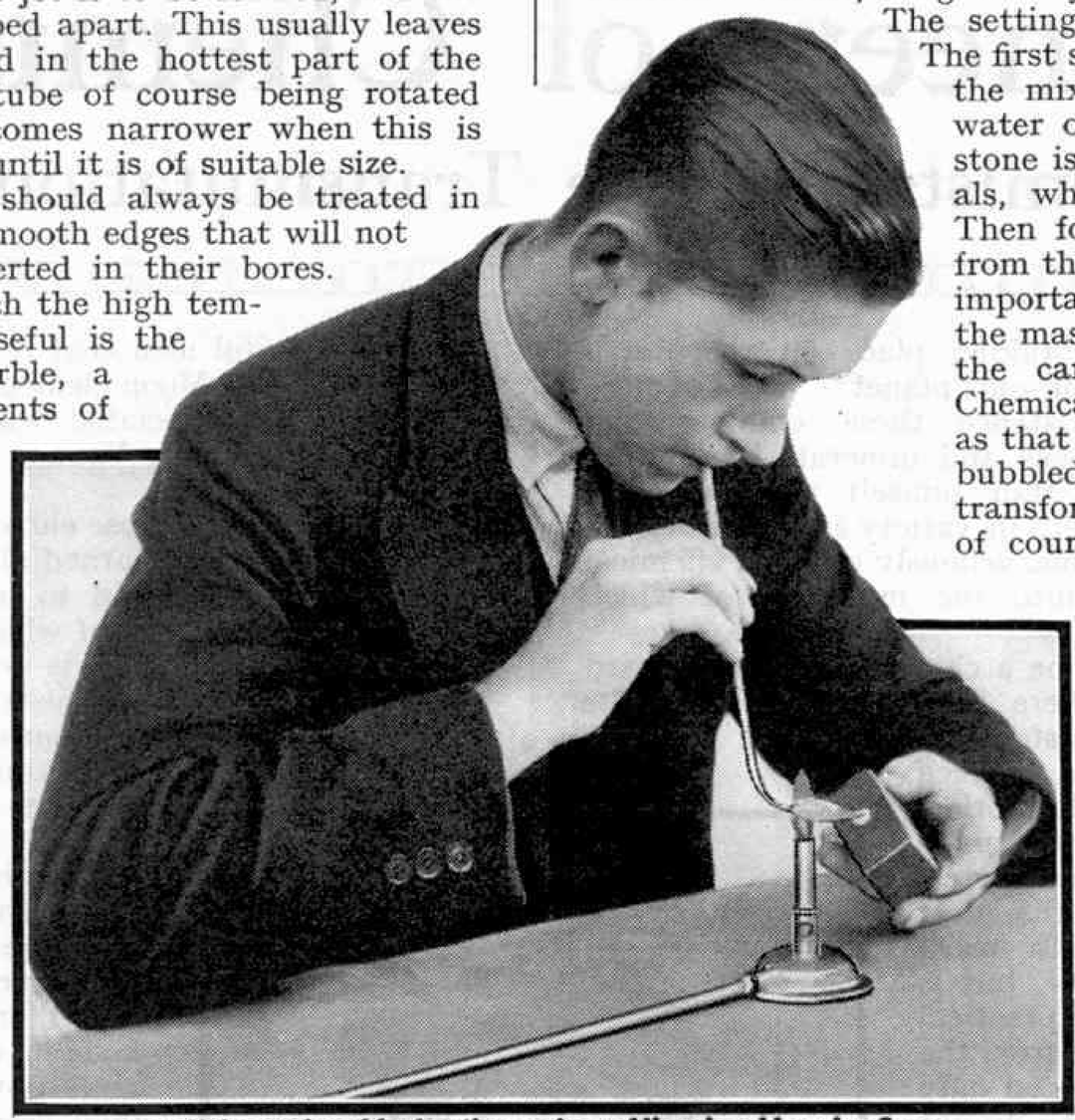

Making a cast of one side of a medallion. The experimenter is using Plaster of Paris prepared in the manner explained in the accompanying article.

tube is removed from the flame and the two parts are steadily drawn away from each other. A sharp cut is then made with the edge of a file at the point where the jet is to be formed, and the two halves of the tube can be snapped apart. This usually leaves a sharp edge, which should be held in the hottest part of the flame until the glass softens, the tube of course being rotated during this operation. The jet becomes narrower when this is done, and the heating is continued until it is of suitable size.

Glass tubes that have been cut should always be treated in this manner in order to give them smooth edges that will not tear corks when the tubes are inserted in their bores.

An interesting experiment in which the high temperature of the Bunsen flame is useful is the production of quicklime from marble, a form of calcium carbonate. Fragments of marble about the size of a pea are placed in a shallow tin, such as the lid of a cocoa or tobacco tin, and this is placed on the gauze square of the evaporating stand, with the lighted Bunsen burner beneath it. Kemex experimenters who have not obtained the Bunsen burner should heat the marble by placing the tin on the red hot coals at one side of an ordinary fire.

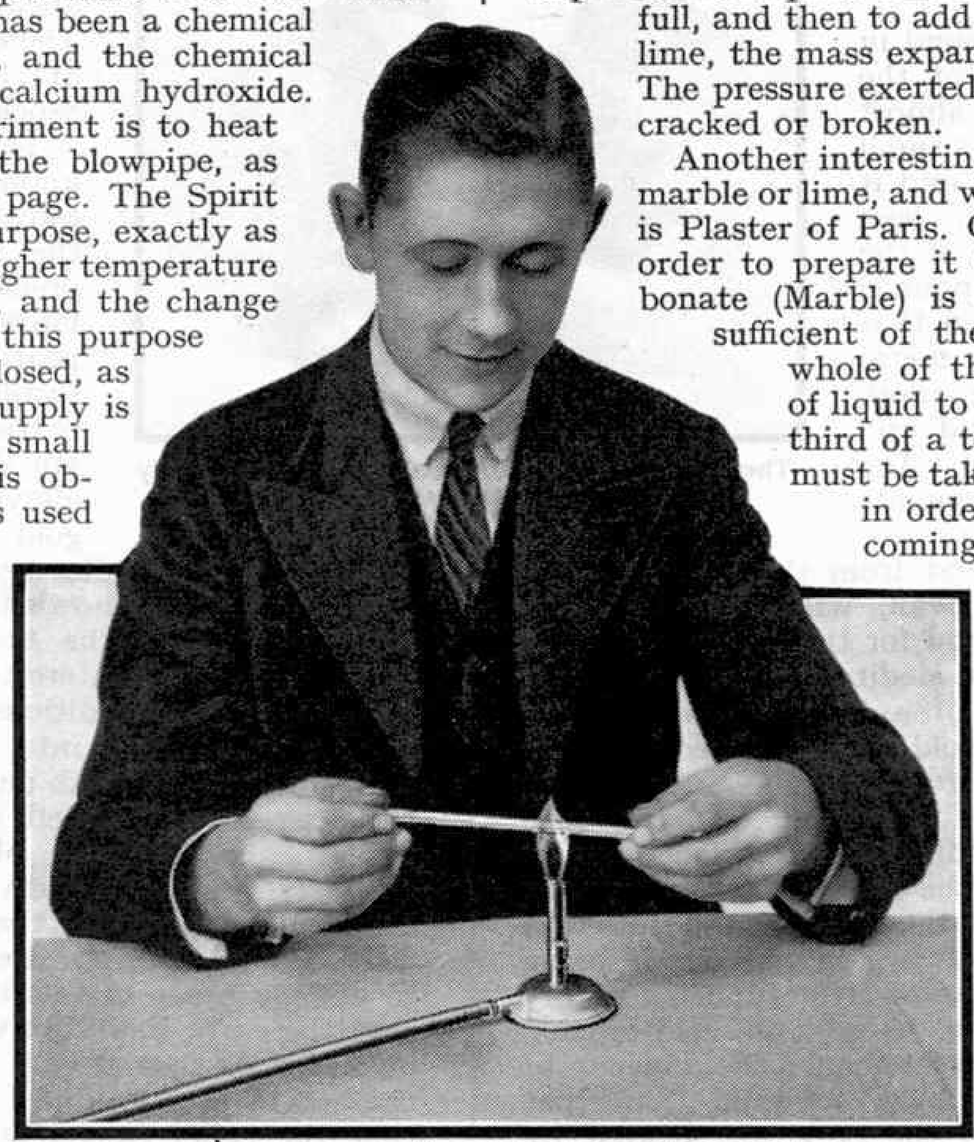
After about half an hour the tin lid and its contents are set aside to cool, and examination of the residue then shows that a change has taken place, for instead of fragments of glittering crystalline marble, the vessel contains pieces of dull white material. A few of these pieces are placed on a separate piece of tin or wood, and water is added drop by drop from a piece of glass tubing drawn out to a narrow jet at one end in the manner already described. The quicklime becomes so hot that steam rises from it, and finally it crumbles to a dry powder that is known as slaked lime. It is curious to find that the addition of the water to the quicklime does not wet it. The explanation of course is that there has been a chemical change in which the water takes part, and the chemical name of the new substance formed is calcium hydroxide.



Limelight produced by heating a piece of lime in a blowpipe flame.

An interesting variation of this experiment is to heat the marble on charcoal by means of the blowpipe, as shown in the upper illustration on this page. The Spirit Lamp flame can be employed for this purpose, exactly as described in the Kemex Manuals, but a higher temperature is obtained by using the Bunsen flame, and the change therefore is effected more quickly. For this purpose the air holes of the Bunsen burner are closed, as shown in the illustration, and the gas supply is reduced by means of the tap until a small luminous flame about 2 in. in height is obtained. With this flame the blowpipe is used in exactly the same manner as with the Spirit Lamp flame. When metals are being smelted from their compounds, the nozzle of the blowpipe is placed just outside the flame in order to give a reducing flame. In this experiment a high temperature only is required, and the nozzle therefore is placed just within the luminous flame.

By this means a miniature Bunsen flame is directed on to fragments of marble placed in a hollow scooped out in the charcoal block. The marble is rapidly converted into lime, and this glows brilliantly as the tip of the blowpipe flame plays upon it. The effect is greatly increased by carrying out the experiment in a dark room, for little illumination is obtained from the flame, and the intense glow of the lime is enhanced. This glow is called limelight, and formerly was largely used in projecting lanterns, in which a cylindrical block of prepared lime was heated strongly in the flame obtained by burning a mixture of coal gas and oxygen.



The hottest part of the Bunsen flame is just above the tip of the inner cone of unburned gas, and in the photograph a section of a glass tube is being softened by holding it in this position, in preparation for drawing it out in the form of a fine jet.

Newly slaked lime can be used in interesting experiments illustrating the setting of mortar, which is so largely employed in joining together bricks and stones. In order to make mortar, slaked lime is thoroughly mixed with an equal quantity of fine sand, and sufficient water is stirred in to convert the mixture into a thick slimy paste. This is spread out in a thin layer on a piece of tinplate, and slowly hardens if it is left undisturbed. It becomes solid on the surface in about two days' time, although is still soft beneath the crust, and gradually "sets," or becomes hard, throughout.

The setting of mortar takes place in stages. The first stage is similar to the drying of gum, the mixture simply losing water; and the water of mortar placed between bricks or stone is absorbed by these building materials, which are firmly cemented together. Then follows absorption of carbon dioxide from the atmosphere, and the sand plays an important part in this process, for it keeps the mass of mortar open and assists to give the carbon dioxide access to the lime. Chemically this change is exactly the same as that taking place when carbon dioxide is bubbled through lime water, for the lime is transformed into calcium carbonate, which of course is hard and insoluble in water. This chemical can be detected in old mortar by covering fragments of this material placed in a test tube with vinegar or dilute hydrochloric acid, for bubbles of carbon dioxide are then formed, as explained on page 16 of the No. 1 Kemex Manual or page 26 of the No. 2 Manual.

Fragments from the middle of a thick piece of old mortar sometimes give little or no carbon dioxide, because the layers of calcium carbonate formed round them have protected them from the atmosphere. This is the case with mortar from some of the buildings of the ancient Romans, the inner core having been preserved unchanged chemically for about 2,000 years.

The usefulness of mortar is partly due to the slight expansion that takes place when it sets. An interesting way of showing this expansion is to place lime in a small glass vessel until this is nearly full, and then to add water. As the water is absorbed by the lime, the mass expands slightly and oozes out of the vessel. The pressure exerted is so great that the glass may even be cracked or broken.

Another interesting compound that can be prepared from marble or lime, and which also sets when water is added to it, is Plaster of Paris. Chemically this is calcium sulphate. In order to prepare it Calcium Oxide (Lime) or Calcium Carbonate (Marble) is dissolved in dilute hydrochloric acid, sufficient of the solid being added to neutralise the whole of the acid employed. A suitable quantity of liquid to use in an experiment of this kind is one third of a test tube full, and if marble is used care must be taken that this is added in small quantities in order to prevent the effervescence from becoming too vigorous. The product of this action is calcium chloride, and to it is added a solution of Copper Sulphate prepared by dissolving as much of this chemical as possible in half a test tube full of water. The result is the precipitation of calcium sulphate, which is separated from the liquid by filtering, and is washed with successive small quantities of cold water until the liquid passing through the filter paper is colourless.

The white solid prepared in this manner is chemically the same as gypsum, a mineral that is found in the earth in many places, notably near Paris. It is dried by leaving the funnel containing it in a warm place, and is then carefully detached from the paper and placed in a small tin lid in which it is heated in exactly the same manner as in the experiment with marble already described. It loses water, leaving a white powder that is known as Plaster of Paris, because it was originally made by heating gypsum mined near the French capital.

When Plaster of Paris is mixed into a thick paste with a small proportion of water, it rapidly sets into a hard mass. The reason for this is that it absorbs the water to reform gypsum. It is largely used for making casts from moulds, and it owes its special value for this purpose to the fact that it expands (Continued on page 848)

Pioneers of Chemistry

The Alchemists and the Transmutation of Metals

CHEMICAL changes have been taking place on the Earth from the very earliest days of our planet. Long before any living things came into existence these changes had brought about the formation of rocks and minerals, water and air. When plants, animals, and Man himself appeared, the chemical actions increased enormously in variety and complexity, for living creatures of all kinds are marvellously efficient chemical factories, transforming foodstuffs into the materials of which they are composed.

Man cannot be said to have become a chemist until he learned to control chemical changes. There is little doubt that the earliest of these changes to be mastered was that of burning, and the man who discovered how to produce fire at will might almost be termed the world's first chemist. A great step forward was made when metals were discovered. A few metals exist in a free state in the earth, the most important of them being gold, which has a high value on account of its beauty, but is not particularly useful for every-day practical purposes. The more valuable metals from the practical point of view can be produced only by treating their ores in the fire. We do not know who first realised that a shining metal such as copper could be extracted from a particular kind of stone. Probably the first copper was produced accidentally when lumps of copper ore happened to be used as stones in building a fireplace.

The oldest known metallic objects found in Egypt which is probably the home of the world's earliest civilisation, were of almost pure copper. Metal objects containing a small proportion of tin were produced later, and it is thought that this mixture may have been first produced by accident as a result of the use of copper ores that contained compounds of tin. It would quickly be recognised that the addition of tin produced a harder metal than pure copper, and the resulting alloy, known as bronze, came into widespread use. This was the beginning of the Bronze Age when knives and other tools and implements were made of this alloy.

Theophrastus Bombastus von Hohenheim, usually known as Paracelsus (1493-1541).

Tin seems to have been obtained first from the Persian Gulf, but later it was obtained from Cornwall, which for centuries was one of the chief sources of the metal for the civilised nations that flourished at that time around the Mediterranean Sea.

Spain was another mining centre of ancient times, yielding gold, copper, tin and quicksilver. Gold was obtained in three ways—from running streams, in the form of fine grains; by sinking shafts into the earth, and by driving galleries into mountains. This last method, according to Pliny, the famous Roman writer, was said to surpass the labours of the giants. The miners worked by torchlight as they penetrated into the hearts of the mountains, and were always in danger of being crushed to death by the sudden collapse of their tunnels. Pliny tells us that vinegar was sometimes used to split the gold-bearing rock. If there is any truth in this statement, the vinegar of bygone days must have been much more powerful than that of to-day! It is more probable that the rock was heated by building fires against it and then cracked by throwing water on it. The rock barriers also were broken by swinging huge iron-shod beams against them and by driving wedges into cracks.

Iron also was known in very early times, and seems to have been used in Egypt as early as 2500 B.C. This metal could not be made into serviceable tools or weapons until it could be transformed into steel, however, and the Iron Age really began about 1500 B.C.

The most important metals known in Roman times were gold, silver, iron, copper, tin and lead. Gold was thought to be the most perfect, especially when in the form of dust or nuggets, because it does not rust and resists corrosion by vinegar. It was described as the noble metal and the Greeks and Romans had the fanciful idea that it was related to the Sun. Silver was regarded as the Moon element. Iron, the metal used for making weapons, was associated with Mars, the planet of the God of War; copper with Venus; tin with Jupiter; and lead with Saturn.

The chemists of those early days did not confine their attention to metals, for they learned also to produce glass, to colour fabrics with natural dyes, and to make use of soda, borax, and many other chemicals, some of which were found naturally while others were manufactured. It is not easy to follow the accounts of the processes the early chemists employed, however, as the writers who refer to them often mention chemicals that we cannot identify.

Unfortunately, reliable records written by chemists are scarce, for about 209 A.D. the Roman Emperor Diocletian ordered the destruction of all books on chemistry. He feared that these would lead to the discovery of means of making gold and silver and that the owners of riches amassed in this manner would organise revolts against him! The earliest chemical manuscripts known have come down to us in a romantic manner, for they seem to have been buried with their owner, an Egyptian chemist who lived at Alexandria, and in his mummy case they were safe from destruction by Diocletian's agents. Early last century they fell into the hands of the Swedish vice-consul in that ancient city and were brought to Europe. There were two of them, and one is preserved at Leyden, Holland, and the other at Stockholm.

The manuscripts display a remarkable knowledge of chemistry, and contain interesting recipes for dyeing, metal working, the making of alloys and the imitation of precious stones. Some of the ideas are very fantastic. For instance, it is said that a pearl may be whitened by causing a cock to swallow it and afterwards killing the bird to recover the jewel! In addition, means are described for making white and yellow alloys that cannot be distinguished from gold and silver.

During the Middle Ages chemistry was neglected in Western Europe, and the knowledge already gained might even have been completely lost if the Arabs who conquered Egypt and the East had not become interested in the science. The Arab chemists carried on the traditions of Egyptian and Greek science, and again introduced it into Europe in the form of alchemy, a word derived from the Arab name for chemistry. Those who practised the science were called alchemists, and were regarded to some extent as magicians. Many of them were industrious, practical chemists, concerned with mining, and others were interested in chemical problems for their own sake.

To-day alchemists are chiefly remembered for their efforts to change other metals into gold or silver. It should be noted that the early Egyptian chemists gave recipes for the production of materials that closely resembled gold, but they never claimed the actual production of gold from less valuable materials. In time the belief gained ground that this was possible, and many of the alchemists really believed that they had found how to bring about this transmutation. Their explanations are not very intelligible, however, possibly because of their wish to retain their discoveries as secrets. For instance, one alchemical writer concludes his account of transmutation as follows: "A serpent is stretched, guarding this temple, and he who has subdued it commences by sacrificing it, then roasts it, and after removing its flesh up to the bones, make of it a step to the entrance of the temple. Mount upon it and thou shalt find the object sought. For the priest at first a man of copper has changed color and nature and has become a man of silver; a few days later, if thou wishest, thou wilt find him changed to a man of gold." This fantastic description of chemical changes supposed to change

copper into gold could not have been a very useful guide to those who wish to become rich!

Needless to say, no alchemist ever changed copper or any other metal into gold, but for centuries greedy and incredulous people were easily persuaded that gold could be made in this manner, and the result was many frauds that lowered the repute of alchemists in general. The hopes of the victims of these frauds were encouraged by concealing a small amount of gold in the vessels in which the supposed change took place, but the experiments always came to an end for some plausible reason, when the victims had been reduced to poverty or showed signs of refusing to part with more money.

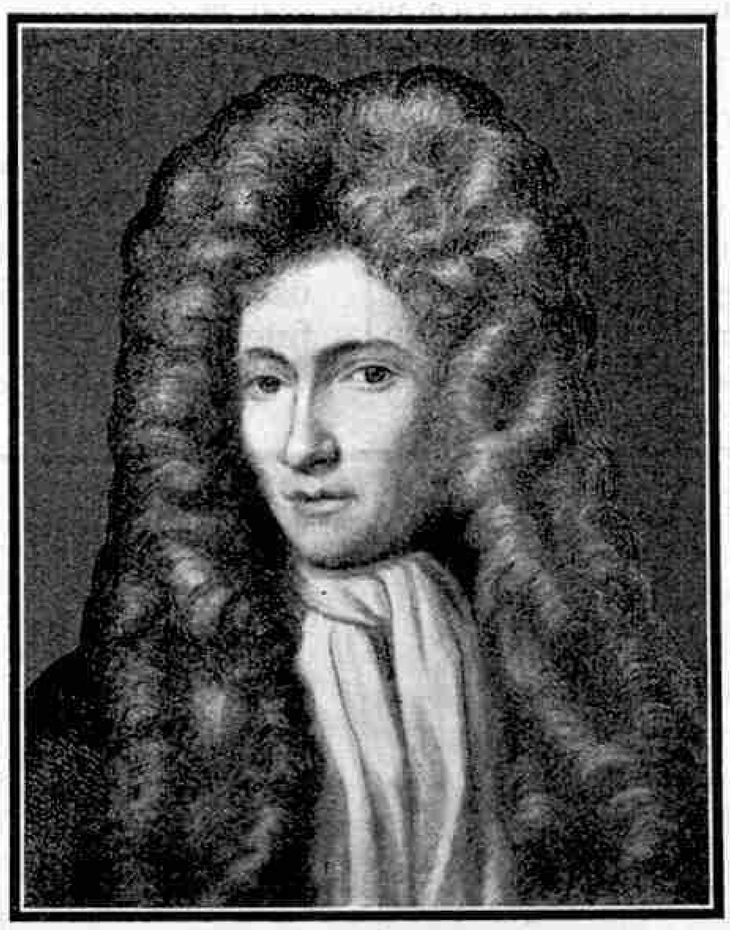
Refining metals in the 16th century.

One of the most notorious of the swindlers who pretended to have discovered the secret of making gold was Leonhard Thurneysser (1530-1596), the son of a goldsmith of Basel. Thurneysser began his career by selling to a Jew gilded bars of lead as pure gold. The fraud was discovered and he was compelled to flee from Basel. He then wandered through Europe and eventually settled down in Berlin, where in 1569 he bacame court physician to the Elector of Brandenburg. In Berlin he acquired great wealth by dubious methods, and pretended that he had obtained it by transforming base metals into gold. At length he was detected in swindling operations and was forced to leave the city. He then visited Italy, still posing as an alchemist, but apparently credulous victims became more difficult to find, for he returned to Germany and died in extreme poverty.

As the alchemists' dreams faded away, and their influence decreased, more attention was paid to the healing side of chemistry. Extravagant claims were made for newly-discovered chemicals, and also for many substances already known, and strange and weird medicines were compounded from them.

One of the greatest men of this period was Theophrastas Bombastus von Hohenheim, usually known as Paracelsus, who was born in 1493 at Einsiedeln in Switzerland, where his father was a practising physician. While he was still a boy, his family removed to a mining centre, and this gave him an opportunity of becoming acquainted with mining chemistry, while his father taught him the principles of medicine. He then served as an army surgeon in wars in Denmark, the Netherlands and in Italy, and even spent some time among Tartar tribes in the Ukraine before returning to Germany at the age of 32 to practise as a physician.

Paracelsus was a born rebel as well as a daring experimenter and was usually in violent opposition to all authorities. He employed metallic compounds freely in his efforts to cure diseases, and his unusual practices, together with his violent temper, caused trouble between him and the orthodox members of his profession. His success in curing important patients had led to his appointment as city physician at Basel, where he was also a professor in the University, but his aggressive temper led to so many quarrels and disturbances that he was compelled to make a hurried departure from the city in less than a year. He then became a wanderer, and died in wretched circumstances at Salzburg, in Austria, at the early age of 48.



Robert Boyle (1627-1691).

This quarrelsome physician and healer made many disciples during his short career, and after his death his principles continued to gain ground, for his adventurous methods were founded on daring experiments and appealed strongly to those in search of new ideas. He abandoned the belief that matter was built up from earth, water, air and fire, and reduced the number of elements to three, namely: sulphur, mercury or quicksilver, and salt. Sulphur he thought to represent the principle of combustion; the presence of mercury in a body imparted fusibility and liquidity; and salt was the earthy portion of matter, being non-volatile and incombustible.

Paracelsus was much more original in his ideas of disease, for he believed that shooting stars caused plagues, and that the positions of the planets influenced bodily health! He was convinced that there was a proportion of poison in all foods, and he pictured the stomach as a chemical laboratory in which there lived a spirit charged with the duty of separating the wholesome and unwholesome constituents from each other. Archaeus was the name of this wonderful spirit. So long as he carried out his work well, the body thrived because it was supplied with good food; and failure on his part was the cause of illness, the body then suffering from the effects of poisons.

One of the most famous of the followers of Paracelsus was Van Helmont, who was born in Brussels in 1577 and lived there until his death in 1644. Van Helmont was a physician as well as a chemist, but he was less quarrelsome and spectacular than his master, and was more interested in actual experiments. He was not satisfied with the current ideas about elements, and he reduced these to two, air and water. Water he thought to be by far the more important, for he had noticed that many substances, especially those of animal and vegetable origin, yielded water when distilled. He thought that the remaining so-called "elements," with the exception of air, could be made from water, and in order to prove this he planted a small willow weighing 5 lb. in a tub containing a weighed amount of soil. He tended the plant with great care for five years, watering it daily with either rain water or distilled water; and it grew so well that at the end of that time it weighed 169 lb. Yet the soil in which it was planted lost only a few ounces in weight, and Van Helmont triumphantly argued that the water given to the plant had been changed into the solid matter of which it was composed.

We now know that Van Helmont was wrong in this explanation, and that chemical processes change carbon dioxide from the air into the materials of the plant. In a similar manner, his lack of knowledge of the way in which fishes live and grow led him to believe that they were formed ultimately from the water in which they swam, another instance of the change of water into earth!

Although Van Helmont was an experimental chemist, he never threw off the mystical ideas of the alchemists, particularly in regard to diseases, for which he thought the influence of evil genii, the efforts of sorcerers, and the powers of magicians were sometimes responsible. He was also a believer in the transmutation of metals, and on one occasion solemnly related that with a quarter of a grain of a certain powder sent to him by an expert he had changed eight ounces of quicksilver into gold!

Chemical knowledge was greatly extended by the experiments of Van Helmont and others in the 16th and 17th centuries, but chemical ideas were still very confused and strange notions were held of the nature of chemicals generally. For instance, one chemist argued that an acid is composed of small pointed particles resembling very fine, delicate needles, and asserted that these needles pricked the tongue when applied to it, thus causing the sharp taste characteristic of an acid!

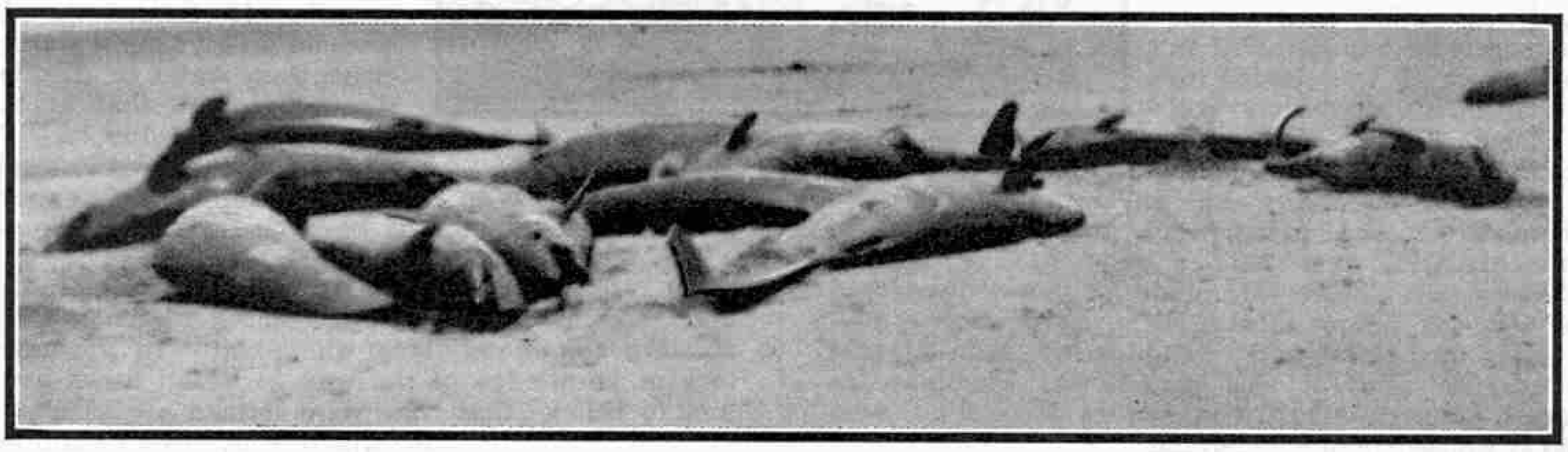
These and many other absurd notions were finally swept away by Robert Boyle, founder of modern chemistry. Boyle was born in 1627 at Lismore, Ireland. He was the seventh son of the Earl of Cork, who had gone to Dublin at the age of 22 with nothing but a handsome suit and about £27, and had built up so great a fortune that he was one of the wonders of the age. As a boy Boyle was sickly, and his stuttering speech and roving ways made him unattractive. He was sent to Eton when he was eight years old, and went abroad four years later. He visited France and Italy, and when he returned after an absence of six years, the uncouth boy had become a polished gentleman, with a keen and eager mind. He was particularly interested in chemistry, and it is said that he was led to this study by having been nearly poisoned by wrong medicine given him in mistake by a careless apothecary. In after life he dreaded doctors more than disease, and studied medicine in order to avoid having anything to do with them.

(*Continued on page 848*)

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

More Stranded Whales

Shortly after I had read the interesting account on page 383 of the May issue of the "*M.M.*" of the stranding of whales in Zanzibar, a similar event took place not far from my home in South Wales. The scene of this was Llanmadog, about 14 miles from Swansea, where 21 whales were left ashore by the receding tide. These creatures were false killers, and thus of the same type as those cast up on the African shore of the Indian Ocean.



Whales stranded at Llanmadog, on the South Wales coast. Photograph by S. C. Joscelyne, Swansea.

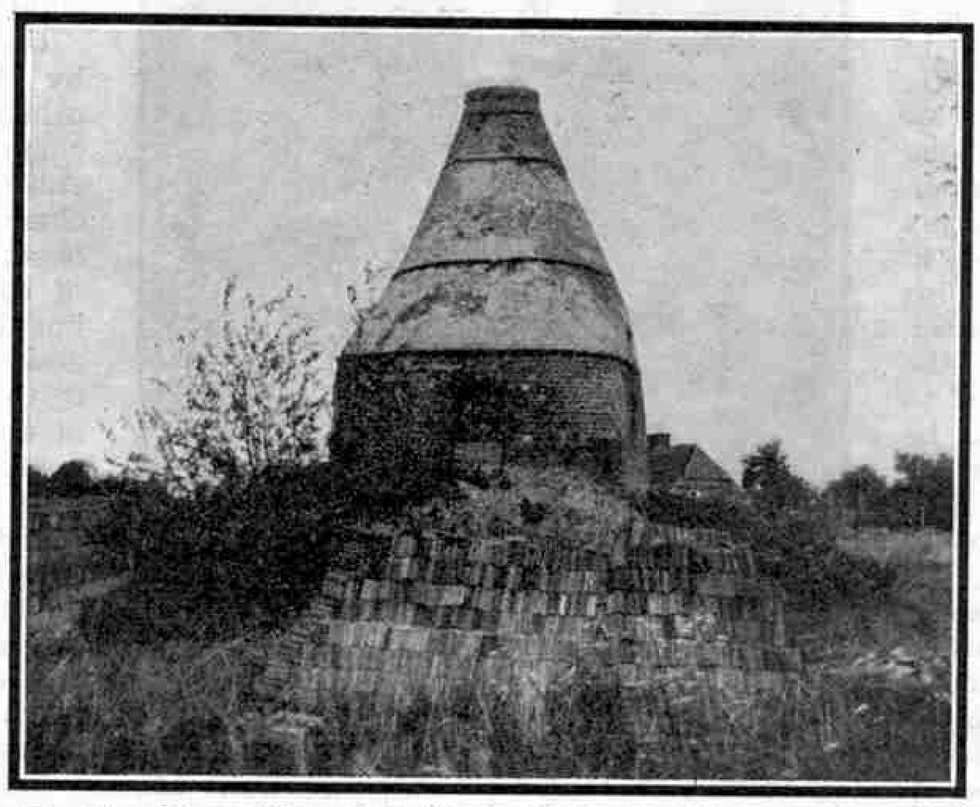
As soon as the news of the stranding spread, people eager to see the strange spectacle arrived from all quarters by motor car and cycle, and were not deterred by the walk of more than three miles over a dreary waste of marsh and sand hills that was the only means of approach to the beach where the whales lay.

After a few days of sunny weather the neighbourhood began to be distinctly unpleasant, and the disposal of the carcasses became an urgent problem. The local sanitary authorities disclaimed all responsibility, holding that the whales were the concern of the Receiver of Wrecks at Swansea. That official naturally failed to recognise carcasses as wrecks, but eventually agreed to act in the interests of public health, and arrangements were made for the burial of the bodies. Before this was completed another whale was washed up about two miles away. It is hoped that the complete skeleton of one of the creatures will be sent to the British Museum.

S. C. JOSCELYNE (Swansea).

A Kentish Tile Works

I often visit the old Naccolt Tile Works, near Ashford, Kent, where methods of production that have been followed for many years are still in use, all the work being carried out by hand. Tiles can only be made during the summer months because they have to be dried in the open before "burning," or heating in the kiln. The winter months therefore are devoted to digging clay from pits near the works, and this is left to temper until tilemaking begins, usually about the beginning of May. The clay is then finely ground, mixed with sufficient water to make it workable, and delivered to the tilemakers in pieces about 2 cu. ft. in volume. Usually there are two or three tilemakers at work. They mould the tiles by hand and dust them with dried sand before carrying them into the yard, where they are stacked to dry.



The kiln of the old Naccolt Tile Works, Kent, where tiles are still moulded by hand. Photograph by F. G. Imm, Ashford.

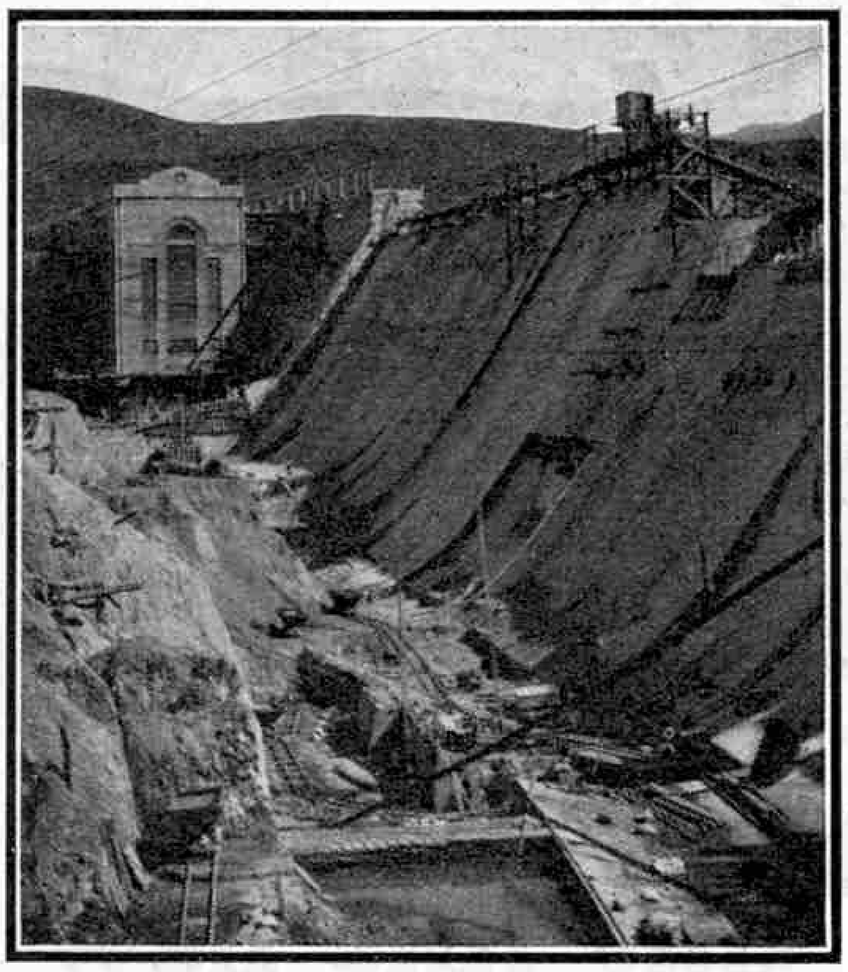
About a month elapses before the tiles are ready for the next process, and when they are considered dry enough for burning they are packed into the kiln, shown in the lower illustration on this page, which holds between 50,000 and 60,000 tiles. The fire is then lit and is kept going for a week, three men taking turns at stoking and using about 15 tons of coal during that period. The fire holes are then sealed with loam and the kiln is left to cool slowly. This process takes about three weeks and when it is completed the tiles are taken from the kiln and are stacked up in readiness for sale.

F. G. IMM (Ashford).

A Great New Zealand Dam

A great dam is being built across the course of the Waitaki River, in the South Island of New Zealand, in connection with a Government hydro-electric power scheme. Work has been in progress for about six years, and recently I and other pupils of the Waitaki Boys' High School visited the site, where we saw the dam during construction and were allowed to examine it thoroughly.

The Waitaki River is one of the largest in New Zealand. It is wide but bars of shingle make it unnavigable. At times it is swift and turbulent and on several occasions parts of the earlier works were carried away by floods, but to-day there is no danger from that source. An interesting feature is that the river itself has brought to the scene the gravel that is being used in building the dam, for I saw a dragline excavator at work digging out this gravel from the bed of the stream and delivering it to a grader from which it passed on to the concrete mixing plant.



The downstream face of the Waitaki River Dam, New Zealand. Photograph by J. Woodgate, Oamaru, N.Z.

The dam is a quarter of a mile in length and is being built of reinforced concrete behind cofferdams. The photograph reproduced on this page shows the space between the lower cofferdam and the curved downstream face of the great barrier itself, which is being constructed in such a manner that it will be immune to earthquake shocks. Three inspection tunnels run through it. One of these is below water level and it was very interesting to pass through it under the gigantic mass of concrete.

The power house also can be seen in the accompanying photograph. Two generators are installed in it and there is room for five more.

J. WOODGATE (Oamaru, N.Z.).

My Visit to an English Iron Mine

While in Middlesbrough recently I visited an iron mine in the neighbourhood. This is what is known as a "drift mine," one end of it being a tunnel driven into the side of the hill. We entered by this opening, outside which was a "devil," an apparatus for stopping a set of trucks by derailing one of them. The trucks are employed to carry ore out of the mine, and they are hauled by cables and by ponies, and run in trains of 21.

Inside the tunnel it was dark and damp. We walked downhill through it for about a quarter of an hour and then reached a barrier of heavy sacking employed to direct the air currents in the required direction. A little farther on was the working face. On our arrival the men were placing charges of powder in holes drilled to receive them, and we watched subsequent proceedings from a safe distance. Presently the charge was fired and we heard a dull report, the explosion being followed by a sudden rush of air that blew out two of the acetylene lamps we carried.

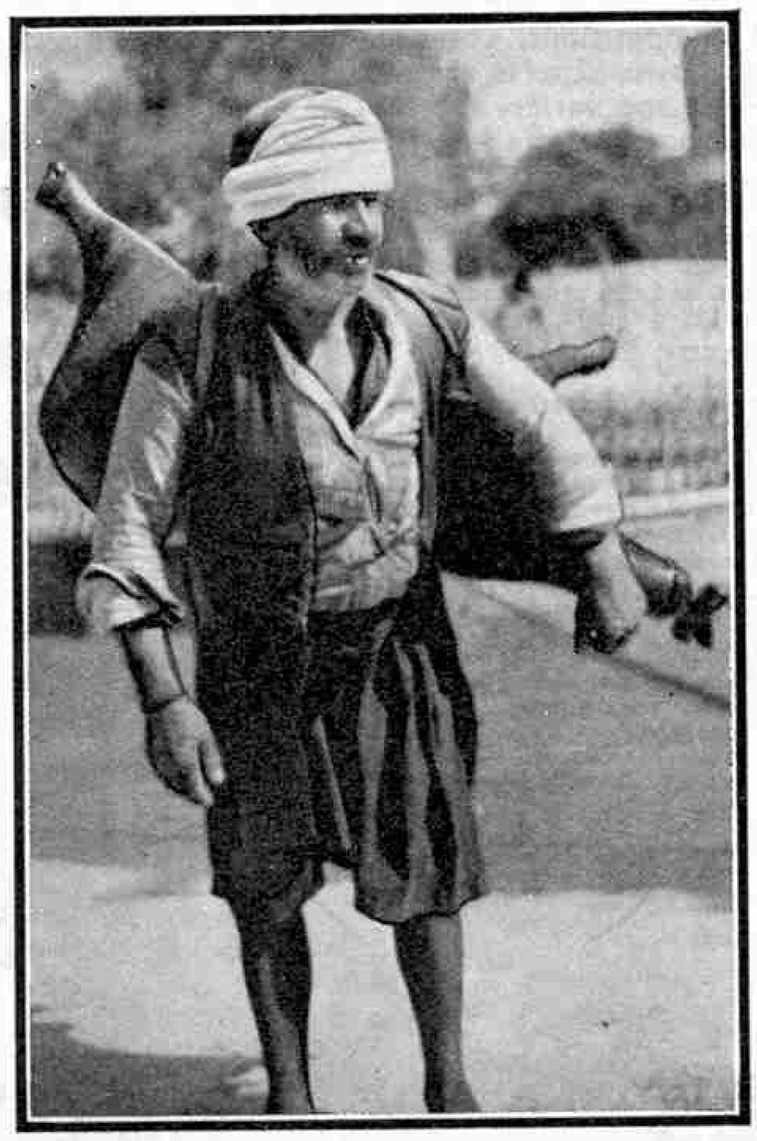
After watching operations at the working face for a time we went to the stables, which are very well kept. They accommodate 30 ponies, each having its name chalked above its stall. We also saw the pumping room, where two centrifugal pumps, driven by electric motors making about 6,000 r.p.m., were at work removing the water that finds its way into the workings.

The second entrance to the mine is a vertical shaft 540 ft. in depth, and up this we went in a cage that does not travel as quickly as that used in a coal mine. We found the electric winding gear at the head of the shaft very interesting. There are two cages and these are wound on one drum. Two safety devices prevent over-winding, and as a further precaution there is another automatic mechanism that would limit over-winding to 2 ft. if for any reason the usual devices failed to act.

A. C. U. KENDAL (Fovant).

Arab Water Carriers of Jerusalem

The Arab water carrier shown in the lower illustration on this page is a very important individual in Jerusalem during the hot summer months, and his coming is eagerly looked for by thirsty people to whom the well water he carries is a necessity. Every day he fills his goat skin with water from the wells in the Mosque area of the city, where scores of other men with similar skins await their turn, and with his heavy load then trudges to the houses of those who pay him well for his precious liquid. Moisture drips continuously from the primitive vessels in which the water is carried, and for this reason the carriers wear a hide cloak that protects their backs. The skins are emptied by untying the string that is wrapped tightly round one of the legs.



An Arab water carrier in Jerusalem. Photograph by H. H. Marsh, South Kirkby.

Water carriers are not as numerous in Jerusalem as they were formerly, for now the city obtains a regular supply of fresh water from a recently installed system that derives water from Wadi Kelt, near the Dead Sea, where streams are numerous. Although their services are not absolutely essential, they can still be seen on certain days of the week in both the Old and the New Cities, and, if only on account of their picturesque appearance, one would regret to see them disappear entirely. Another luxury that is greatly appreciated in the parching heat of summer is ice cream, which is sold in large quantities in the markets of Old Jerusalem.

H. H. MARSH (South Kirkby).

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A Remarkable Model Tramcar

Built to Scale from Wood and Cardboard

TO even the most critical eye the subject of the illustrations on this page appears to be a full-sized tramcar about to take to the road. Careful scrutiny reveals perfection in every detail, making it difficult to believe that it is really a model and not the actual thing. The model is the work of Mr. Leslie Rimmer of Liverpool, who has spared no effort to reproduce all the features of the original, down to the smallest detail. Both the interior and the exterior have been closely copied from the actual car, and the construction occupied 18 months of careful work.

The interior is fitted out exactly as in the prototype, the lower deck being provided with eight double seats arranged transversely and four longitudinal corner seats, all of which are correctly upholstered. The upper deck is fitted with 16 double seats, and with curved seats at each end. There is a pair of double sliding doors at each end of the lower compartment, and the stairs communicating with the upper deck are enclosed in vestibules that are also fitted with sliding doors as in the actual vehicle.

The floor of the lower deck was first cut from $\frac{1}{4}$ in. wood, and four corner pillars and six intermediate ones were erected. These were previously slotted ready for the insertion of the windows, which consist of clear celluloid. After the fitting of the sides and windows the interior work was carried out, the whole of this being done in cardboard. A dummy destination indicator was fitted in two opposite corner windows, and the doors were arranged to slide at each end. The entire interior was varnished to give the effect of light oak panelling as in the actual car. Some idea of the amount of work involved in the model may be gained from the fact that each seat contains nine separate pieces of wood. The seats are made of wooden frames covered with cardboard to represent the upholstery, which is painted dark blue, and the woodwork is varnished. Even the inclusion of the car number over each doorway has not been overlooked.

The platforms at each end of the vehicle were the next items to receive attention, and these are inclined upward slightly, as in actual practice. They are complete with miniature controller and brake handles, and have hand-rails and steps. A small box is provided for used tickets, and the usual notices have been included warning passengers not to board or leave the vehicle while in motion, prohibiting standing on the stairs, etc. The staircases were a source of great difficulty, and six were made before Mr. Rimmer obtained two that he considered satisfactory. The difficulty in building these was caused by the spiral, each step being the shape of a wedge. The handrails for the staircase are of brass wire and the platform handrails are cut from polished steel rods. Under one staircase on the platform is a miniature resistance, and under the other is the casing which, on real cars of this type, covers the air-brake compressor.

The upper deck was made in a similar manner to the lower one, the vertical pillars being slotted and placed in position first, and then the cardboard sides and ends. The inside is panelled in exactly the same manner as in the actual tramcar and varnished to represent woodwork. Small windows were made at each end for the route number and destination indicator, and the miniature boxes for these were reproduced inside. The indicators are complete, even to tiny winding handles. The sliding doors on the upper deck and also those on the lower deck are all provided with brass handles and are made to open and close.

The trolley is mounted on a small base cut from tinplate, and the trolley-pole consists of a $\frac{1}{8}$-in. diameter dowelling rod sandpapered to the correct taper and fitted with a bracket and a tiny dummy pulley. It is provided with tension springs to keep it in the raised position.

Meccano has been used for the making of the bogies, two four-wheeled bogies being fitted. These are made from Meccano Strips and Double Angle Strips, and $1\frac{1}{8}$ in. Flanged Wheels are used.

The model is provided with dummy lifeguards at each end, made entirely of cardboard; and on account of their delicate nature much time must have been spent in reproducing them. To finish off a very creditable piece of work the car was painted in correct colours, lettered, and lined in panels.

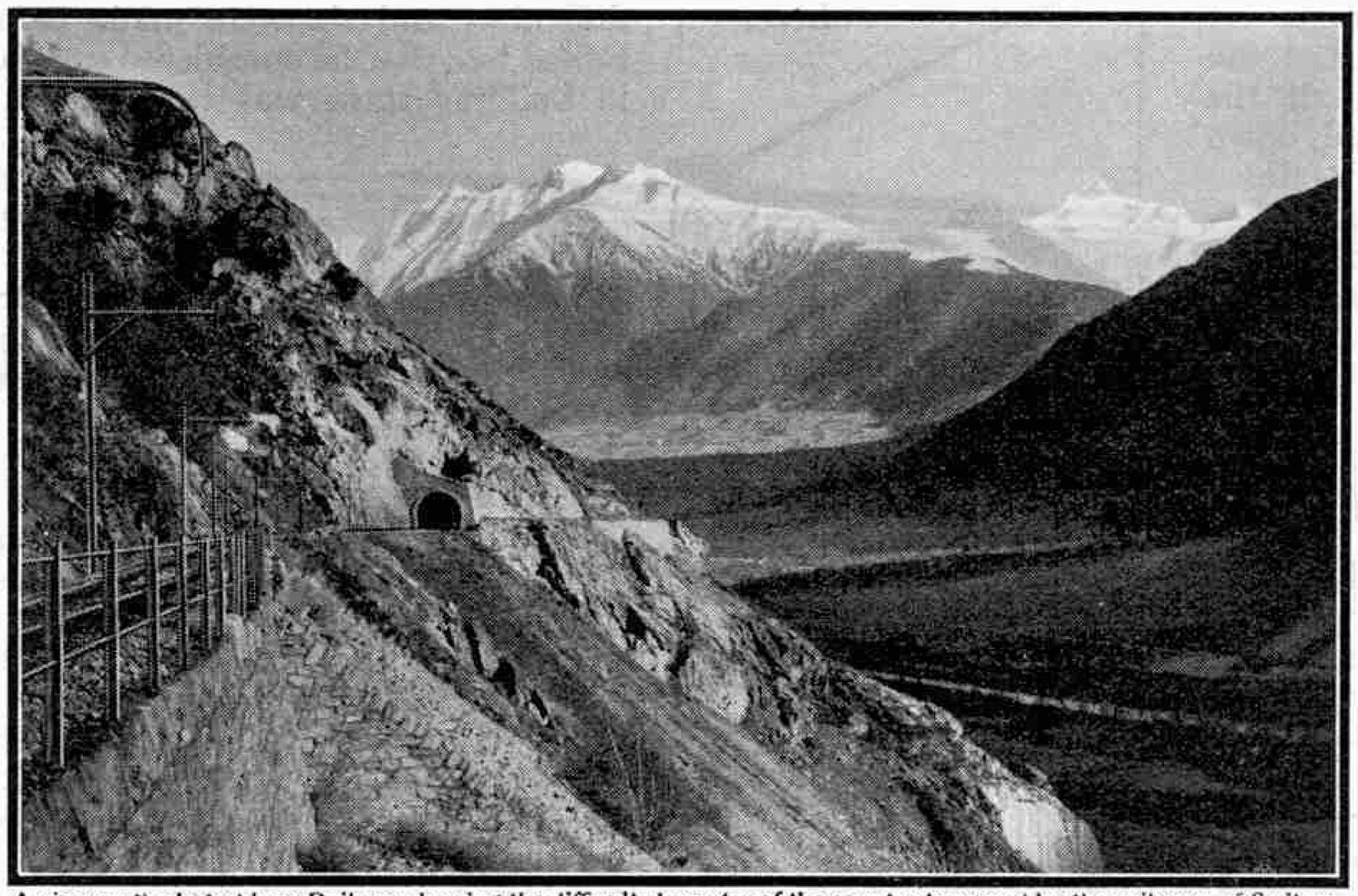
The Railways of Switzerland

I.—A General Survey

By "Observer"

IN no country of the world have railway engineers achieved greater triumphs than in Switzerland. Although the mountainous nature of that land makes railway construction unusually difficult, extraordinary skill has been displayed in overcoming the many natural obstacles, with the result that a network of railways has been brought into being by which all parts of Switzerland are linked together, and in addition valuable through routes are provided over which travel daily some of the most important international expresses.

Altogether there are over 3,700 miles of railway in Switzerland. By far the greater part of the mileage is comprised within the Swiss Federal Railways' system, but there are also several independent companies, of which the Lötschberg Railway in the Bernese Oberland is the most important. The principal main lines and many of the branches are laid to the standard European gauge of 4 ft. 8½ in., but there are some lines of considerable length that have the narrower metre gauge of 3 ft. 3⅜ in. On the numerous mountain railways a variety of gauges and methods of working have been adopted. Everywhere the track is of very strong construction, and it is invariably kept in excellent repair. Steel sleepers are now used extensively, and weed-killer cars are among the modern appliances used for keeping the permanent way in good order.



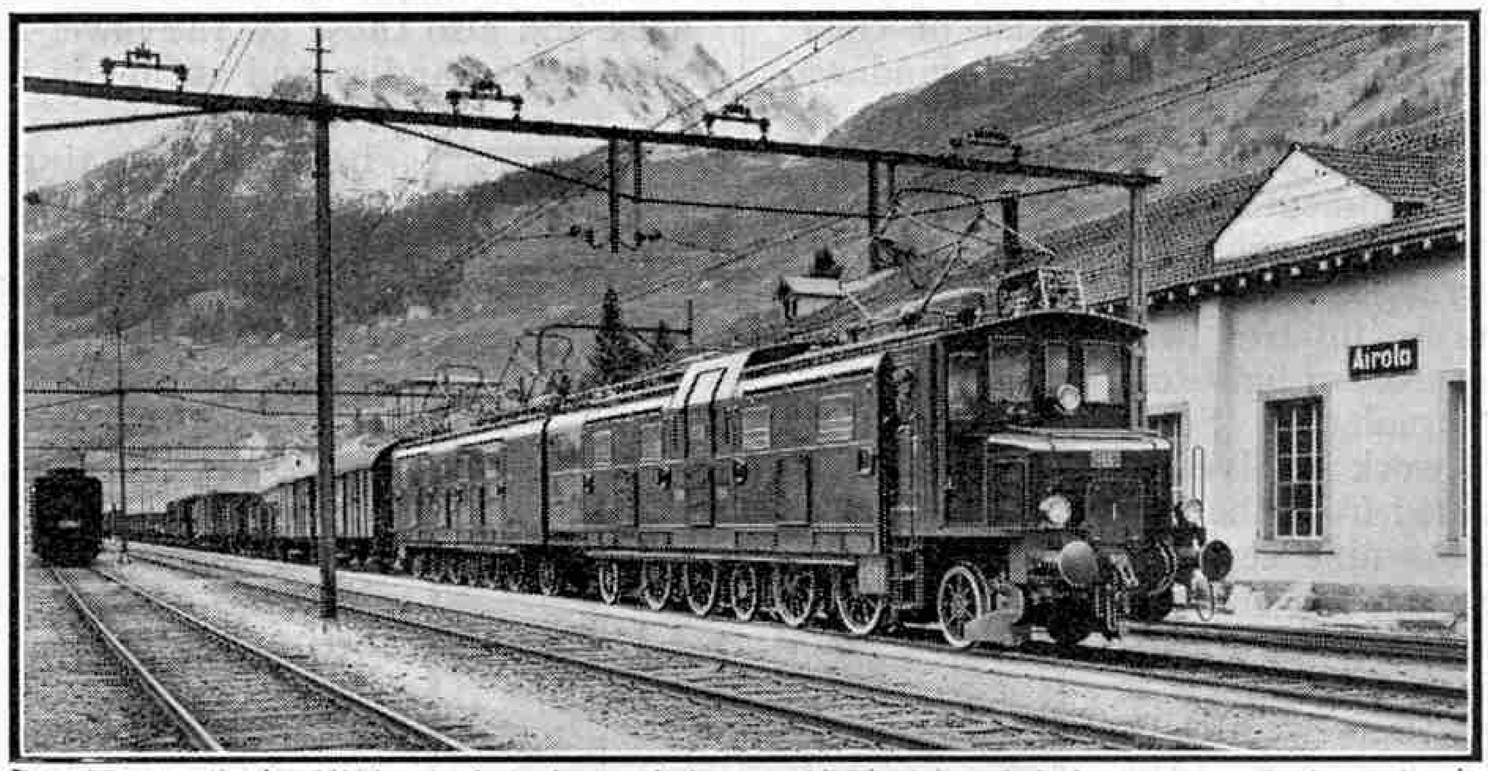
A view on the Lotschberg Railway showing the difficult character of the country traversed by the railways of Switzerland. This, and the two photographs on the opposite page are reproduced by courtesy of the Lötschberg Railway.

A notable feature on Swiss railways is the exceptional amount of tunnelling that has been necessary to secure a passage amid and through the mountains. On the electrified lines alone—totalling to about 2,300 miles—there are 320 tunnels, having an aggregate length of 134 miles. Of these tunnels 42 are over half-a-mile long, and on the main routes carrying international traffic there are six that exceed five miles in length. Two of them, the St. Gotthard and the Lötschberg, have each a length of over nine miles, and the longest of all, the Simplon, which is partly in Switzerland and partly in Italy, is over 12 miles long and is the longest tunnel in the world.

Another exceptional feature, also necessitated by the mountainous character of the country, is the severity of the gradients that have had to be employed. Some of the mountain railways are steeper than the proverbial house-top. The rack railway up Mount Pilatus, for instance, has an average rise of 1 in 3, while in places the grade steepens to 1 in 2! But mountain railways apart, on the ordinary standard gauge routes over which run the heaviest expresses there are long stretches at 1 in 37 and 1 in 40. On the Gotthard line, for the 14¾ miles from Amsteg to Goschenen, there is an average rise of 1 in 42; and in the course of the rival Lötschberg route similar grades occur.

These peculiar conditions all heighten the value of the great electrification scheme that has been carried through, whereby almost all the main railway routes and many of the subsidiary ones are now operated by electric traction. On the Swiss Federal Railways the electrified route mileage now totals 1,169, or nearly 70 per cent. of the whole system. But the relative importance of the electrified sections is such that nearly 90 per cent. of the Swiss Federal traffic, passenger and freight, is now hauled by electric power.

The benefits resulting from electrification are inestimable. Formerly, when steam power was employed, the noise of the locomotives puffing laboriously up the long gradients was excessive, while the smoke and dirt they made were particularly objectionable, especially in the tunnels. Electrification has brought a complete change. The noise and smoke have been abolished, and the speed has been appreciably increased. The longest and steepest gradients are easily surmounted by express trains at speeds of from 35 to 45 m.p.h.

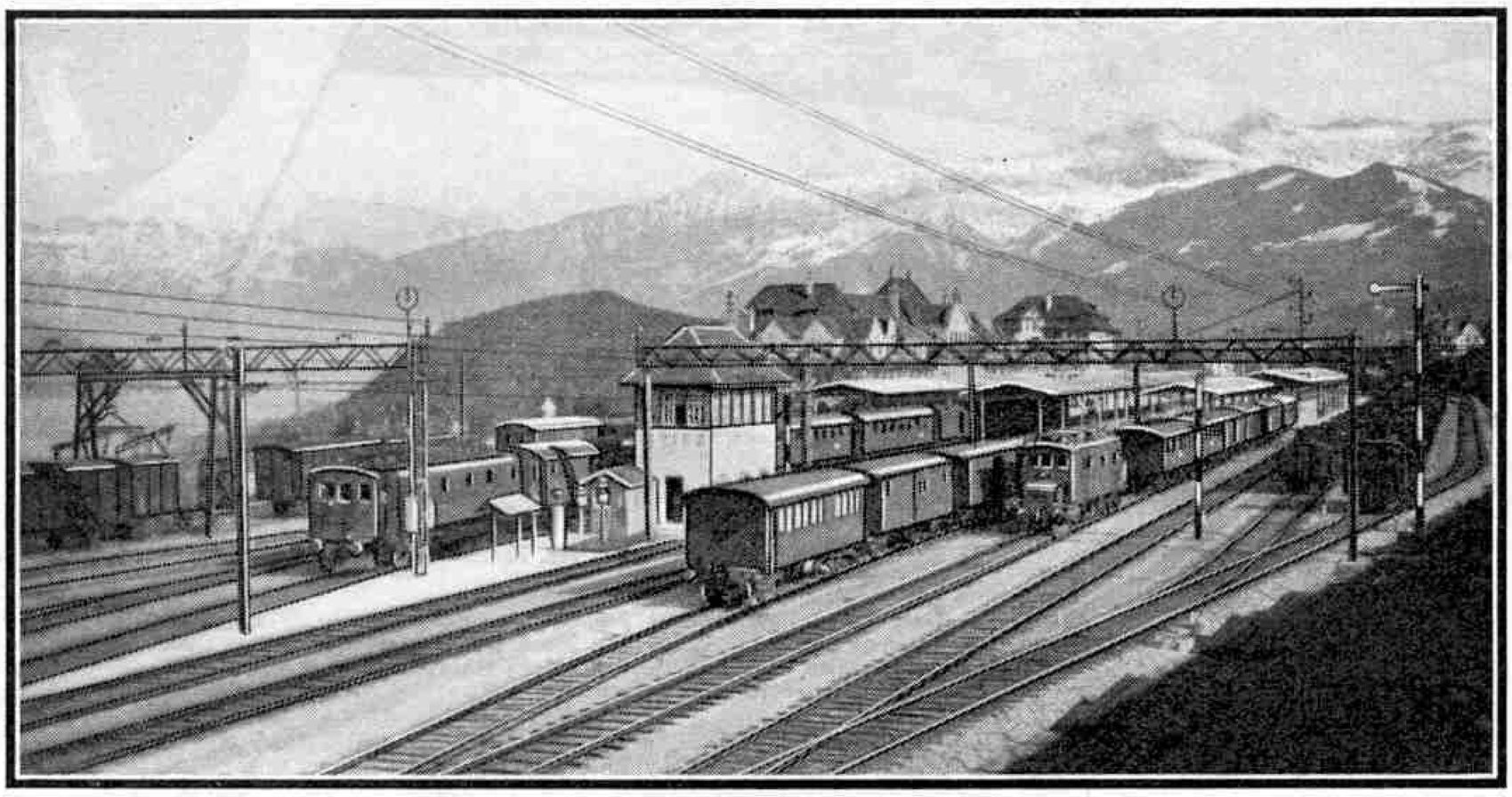


Electric locomotive No. 11851 of the Swiss Federal Railways, which is claimed to be the most powerful locomotive in the world. Owing to its great length it is formed of two similar articulated units each having the 2-4-2-4-2 wheel formation. Photograph by courtesy of the Swiss Federal Railways.

For producing the vast amount of electrical power required for working the railways the great natural supplies of water-power are utilised. Instead of running to waste as in former times, many of the mountain torrents, largely fed by glacier water, are now harnessed and their energy converted into electricity, an economy all the more desirable since Switzerland does not possess any natural supplies of coal and therefore must necessarily import all that is used.

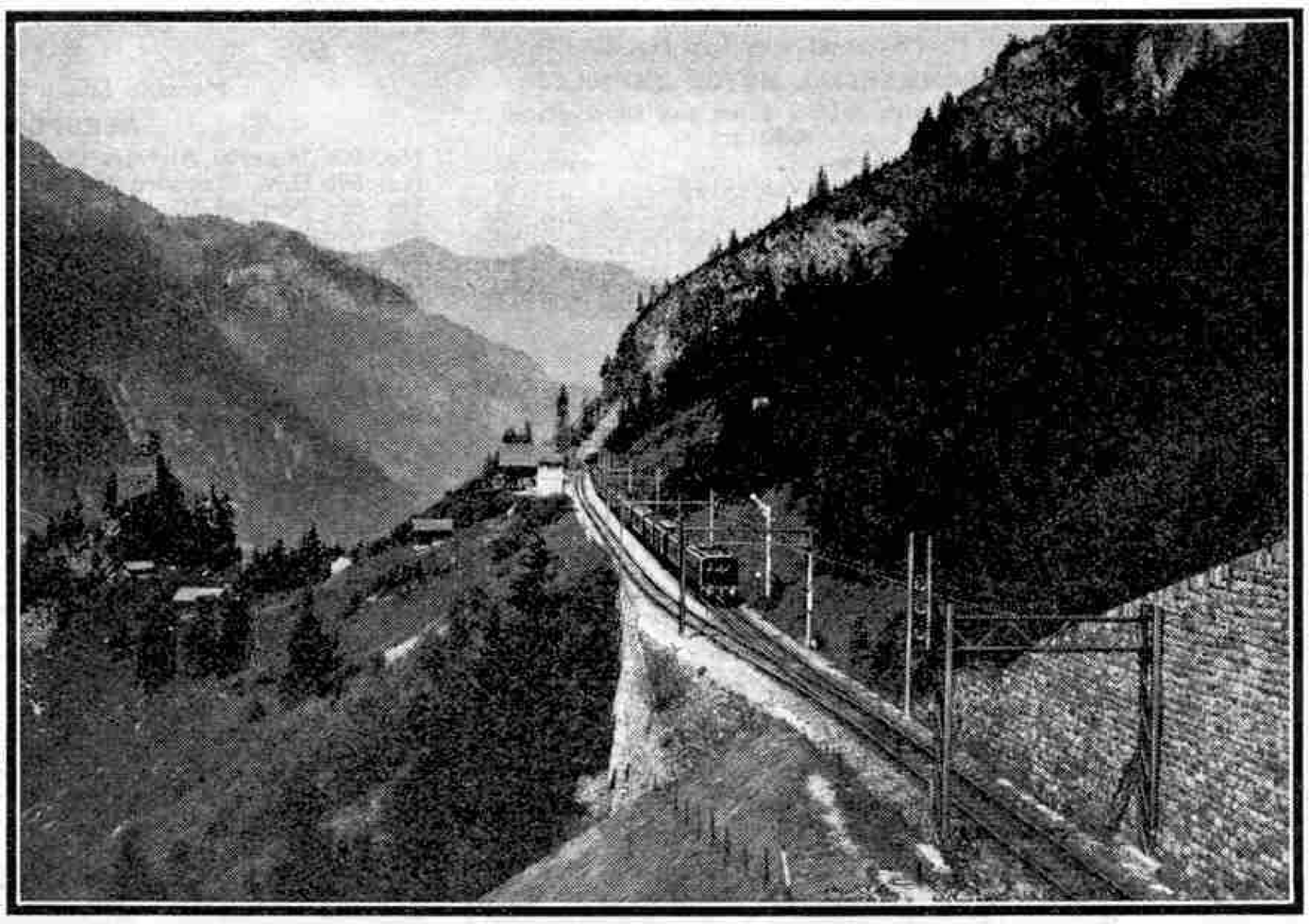
Owing to its central situation and the facilities it offers for international traffic, Switzerland has been aptly styled "the turntable of Europe." To all who are keen on "watching trains" its principal railway centres afford endless fascination. Basel, for instance, on the northern border, close to the point where the

frontiers of both France and Germany meet that of Switzerland, is a junction of extraordinary importance. It is, indeed, the hub of Continental traffic, and is considered by many to be the most interesting station in Europe. It is a gateway through which passes unceasingly a vast volume of traffic between north and south Europe. Passengers and freight arriving there from Britain, France, Belgium, Holland, Germany and Scandinavia are carried forward over the St. Gotthard and Lötschberg-Simplon routes, and so pass into Italy and other countries beyond. Among other strategic junction stations may be mentioned Berne, Zurich and Lausanne. At these and many other centres the working of traffic may be observed with unending interest. As showing the cosmopolitan character of Swiss stations, a writer in a recent issue of the *"Railway Magazine"* stated that at Zurich it was possible to see on two trains the rolling-stock of six nations and nine different companies within a period of seven minutes. Similarly at Spiez, the principal junction on the Lötschberg line, within five minutes, on two successive trains, rolling-stock has been noted belonging to five different countries and 10 different administrations.



The station at Spiez. At this important junction it is possible to see a remarkable variety of rolling stock belonging to several different countries and many different administrations.

Included among the many trains that travel over the Swiss Railways are to be found some of the world's most famous luxury expresses. Thus the *"Simplon-Orient Express,"* probably the most important of all international trains, enters Switzerland at Vallorbe, travels forward via Lausanne, and makes its exit through the Simplon tunnel. The *"Arlberg-Orient Express"* and the *"Riviera-Naples Express"* also pass over Swiss metals, while numerous other expresses that carry no distinctive names, are hardly less important, travelling long distances and linking great cities and nations, as their destination boards show. When the new train-ferry service between Dover and Dunkirk is opened next summer it will be possible for British rolling-stock to work over Swiss railways, travelling through, it may be, between London and Rome!



An electric train at speed on the Lötschberg Railway. This photograph shows the general character of the overhead wire equipment employed.

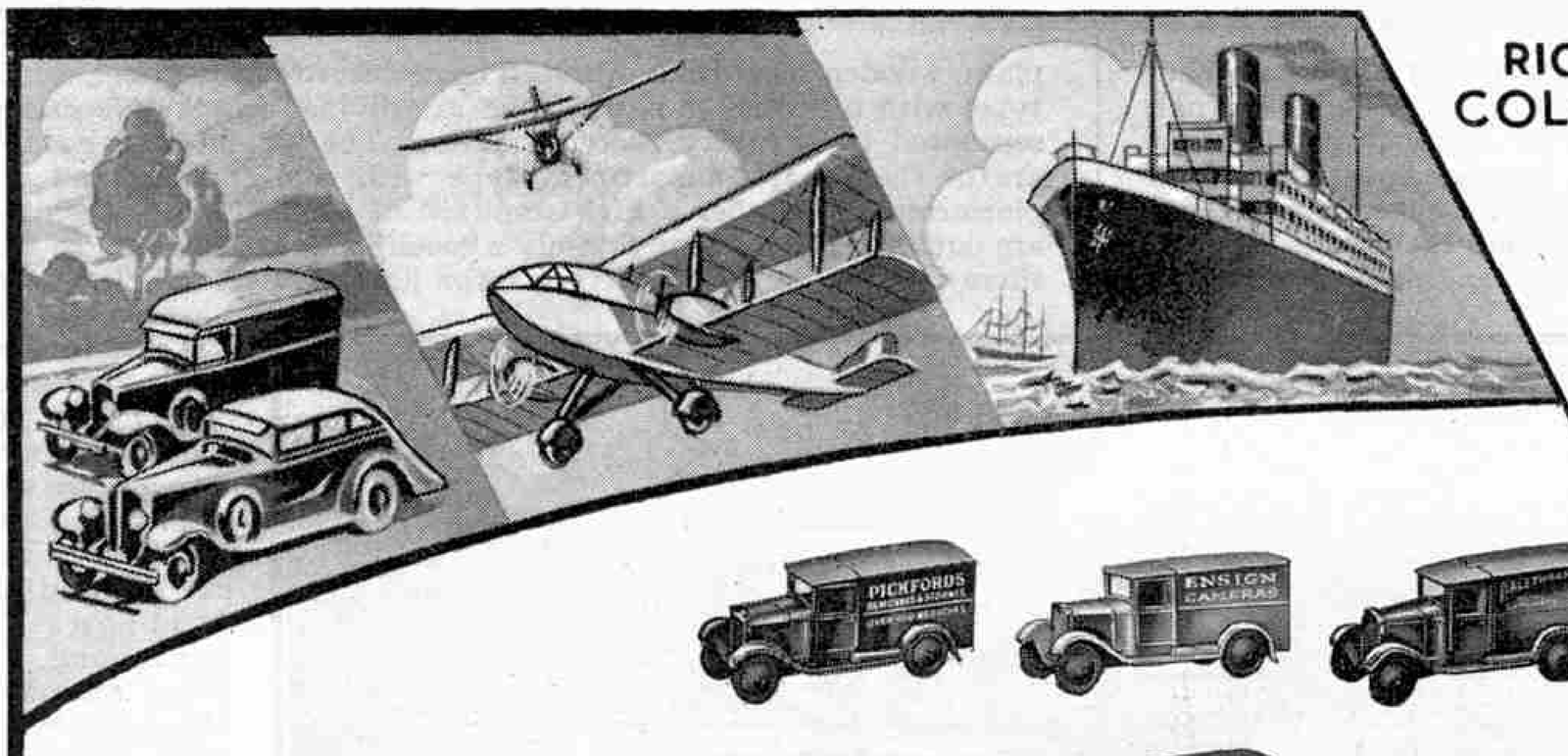
The rolling-stock provided for the international trains is generally of the most modern design. On the various routes may be seen the latest coaches of the French, Italian, German, Belgian, Netherlands, Austrian, Hungarian and Jugo-slavian railways, in addition to those of the Swiss railways and the special stock of the Pullman, International Sleeping Car, and Mitropa Companies. Almost all are heavy bogie-vehicles, constructed of metal, and with upholstery and fittings that conform to the most up-to-date standards.

On all the through international expresses first-class compartments are provided, but many of the Swiss trains are composed entirely of second- and third-class stock. The third-class coaches are roomy, clean and well kept, but devoid of upholstery, only plain, wooden seats being fitted. The newest are of the open saloon type, with a central gangway, and are divided into two portions, separated by lavatory accommodation. The second-class coaches are of the usual compartment type with side corridor and end platforms. They offer a high standard of comfort, and the latest are equal to the average first-class coach in Great Britain. In fact there is little to choose between the first- and second-class compartments on the international expresses. On many of the Swiss trains a post-office van is provided. As no tickets are collected at stations in Switzerland, a ticket examiner travels on every train. The train and station staffs are remarkably courteous and obliging, and their neat dark-blue uniforms gives them a distinctly smart appearance.

For the propulsion of the trains over the electrified sections it is the usual practice to employ separate electric locomotives, although to some extent motor coaches capable of drawing a number of trailing coaches are used. The locomotives are of various types and sizes. Some of the earlier ones are of quite modest horse-power, while the latest rank as the most powerful in the world. Wheel arrangements differ considerably, and whereas in the earlier locomotives it was usual to employ outside coupling rods, in the later types these are dispensed with and separate motors fitted to all driving axles.

Over the extensive routes of the Swiss Federal Railways most of the heaviest and fastest expresses are now drawn by locomotives having the 4–8–2 wheel arrangement. These efficient engines have a horse-power of 3,650 and are capable of hauling a train of 600 tons up a gradient of 1 in 500 at nearly 60 m.p.h., and up 1 in 83 at 40 m.p.h. On the steeper mountain sections the load is limited to 360 tons for a speed of 40 m.p.h. In regular service a speed limit of 62 m.p.h. is imposed on the Swiss Federal Railways, but during the official trials a speed of 74 m.p.h. was attained without difficulty—good running for driving wheels of 5 ft. 3½ in. diameter.

Although these fine locomotives were introduced only seven or eight years ago, and doubtless will continue to render good service for many years to come, they have been outclassed altogether by two giants recently put into traffic. These have the remarkable wheel notation of 2–4–2–4–2+2–4–2–4–2, and owing to their great length they are articulated, being divided into two similar halves closely coupled together. One of the new locomotives, No. 11851, is illustrated here, and its huge dimensions are well shown. With a horse-power of 8,800, it is claimed to be the most powerful locomotive in the world. It has a total weight of 244 tons and a length over buffers of 111 ft., and its 16 driving wheels have each a diameter of 4 ft. 5 in. It was designed to haul express *(Continued on page 793)*



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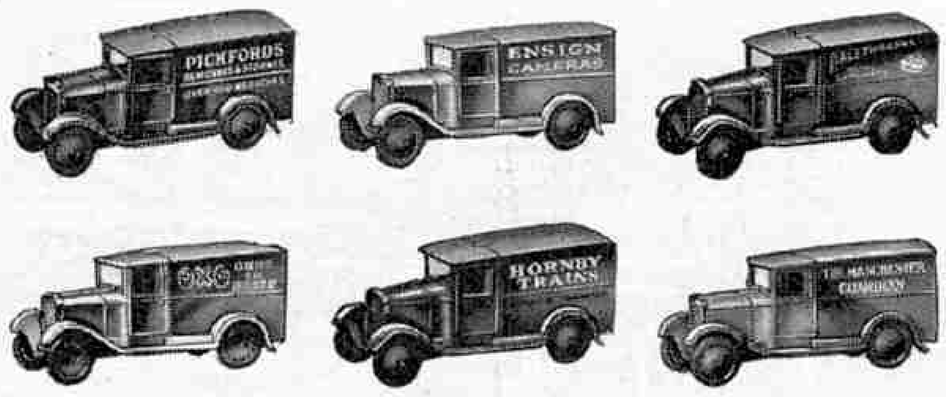


Meccano Dinky Toys No. 28/1

DELIVERY VANS

No. 28a Hornby Train Van ...	each 6d.	No. 28d Oxo Van	each 6d.
No. 28b Pickfords' Removal Van	,, 6d.	No. 28e Ensign Cameras' Van	,, 6d.
No. 28c Manchester Guardian Van	,, 6d.	No. 28f Palethorpe's Sausage Van	,, 6d.

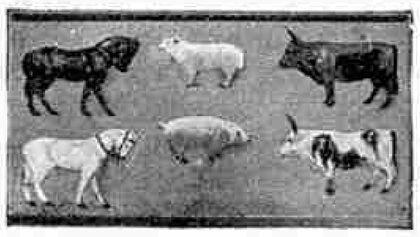
Price of complete set 3/–

Meccano Dinky Toys No. 1

STATION STAFF

No. 1a	Station Master	each 3d.
No. 1b	Guard	,, 3d.
No. 1c	Ticket Collector	,, 3d.
No. 1d	Driver	,, 3d.
No. 1e	Porter with bags... ...	,, 3d.
No. 1f	Porter	,, 3d.

Price of complete set 1/6



Meccano Dinky Toys No. 3

FARMYARD ANIMALS

No. 2a	Horses	each 3½d.
No. 2b	Cows	,, 3½d.
No. 2c	Pig	,, 2d.
No. 2d	Sheep	,, 2d.

Price of complete set 1/6

Meccano Dinky Toys No. 3

PASSENGERS

No. 3a	Woman and Child ...	each 3d.
No. 3b	Business Man	,, 3d.
No. 3c	Male Hiker	,, 3d.
No. 3d	Female Hiker	,, 3d.
No. 3e	Newsboy	,, 3d.
No. 3f	Woman	,, 3d.

Price of complete set 1/6

Meccano Dinky Toys No. 4

ENGINEERING STAFF

No. 4a	Electrician	each 3d.
No. 4b	Fitters	,, 3d.
No. 4c	Storekeeper	,, 3d.
No. 4d	Greaser	,, 3d.
No. 4e	Engine Room Attendant	,, 3d.

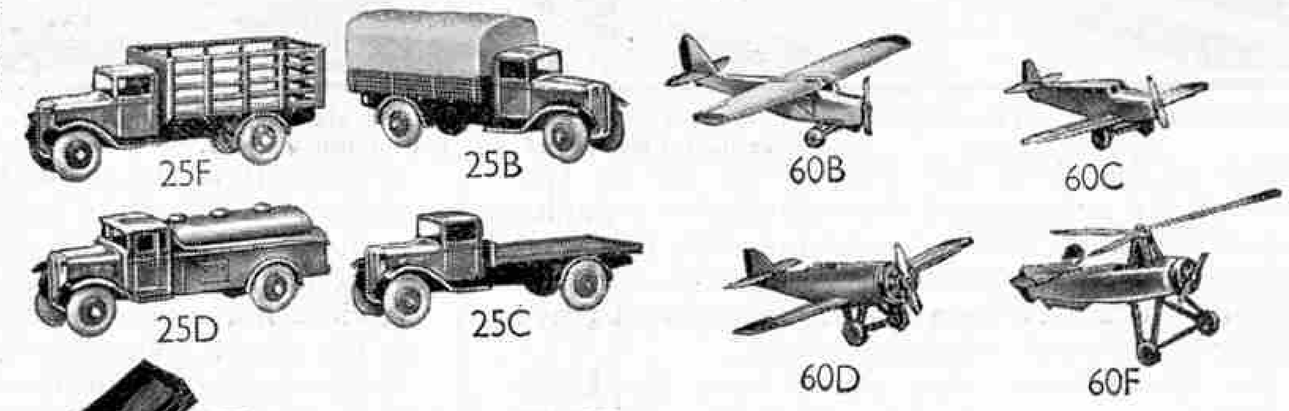
Price of complete set 1/6

Meccano Dinky Toys No. 5

TRAIN AND HOTEL STAFF

No. 5a	Pullman Car Conductor...	each 3d.
No. 5b	Pullman Car Waiters ...	,, 3d.
No. 5c	Hotel Porters	,, 3d.

Price of complete set 1/3



Meccano Dinky Toys No. 25

COMMERCIAL MOTOR VEHICLES

Fitted with rubber tyres and silver-plated radiators.

No. 25a	Wagon	each 9d.
No. 25b	Covered Van	,, 9d.
No. 25c	Flat Truck	,, 9d.
No. 25d	Petrol Tank Wagon ...	,, 9d.
No. 25e	Tipping Wagon ...	,, 9d.
No. 25f	Market Gardener's Van	,, 9d.

Price of complete set 4/6

Meccano Dinky Toys No. 60

AEROPLANES

No. 60a	Imperial Airways Liner	each 9d.
No. 60b	D.H. "Leopard Moth"	,, 6d.
No. 60c	Percival "Gull"	,, 6d.
No. 60d	Low Wing Monoplane	,, 6d.
No. 60e	General "Monospar"	,, 6d.
No. 60f	Cierva "Autogiro"...	,, 6d.

Price of complete set 3/–

Meccano Dinky Toys No. 17

PASSENGER TRAIN SET

No. 17a	Locomotive	each 9d.
No. 17b	Tender	,, 5d.
No. 20a	Coach	,, 7d.
No. 20b	Guard's Van	,, 7d.

Price of complete set 2/3

Meccano Dinky Toys No. 18

GOODS TRAIN SET

No. 21a	Tank Locomotive	each
No. 21b	Wagons	,,

Price of complete set 1/9

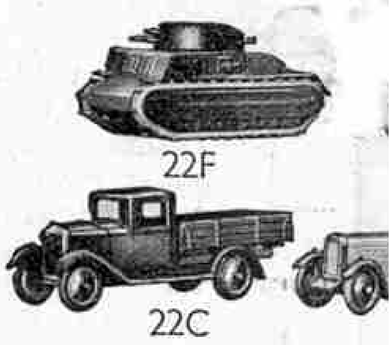
Meccano Dinky Toys No. 24

MOTOR CARS

Fitted with rubber tyres and silver-plated radiators.

No. 24a	Ambulance	each 9d.	No. 24e	Super Streamline Saloon	each 9d.
No. 24b	Limousine	,, 9d.	No. 24f	Sportsman's Coupé ...	,, 9d.
No. 24c	Town Sedan	,, 1/–	No. 24g	Sports Tourer (4 seater)	,, 1/–
No. 24d	Vogue Saloon	,, 9d.	No. 24h	Sports Tourer (2 seater)	,, 1/–

Price of complete set 6/6



Meccano D

MOTO

No. 22a	Sports Car ...	each 6
No. 22b	Sports Coupé ...	,, 6
No. 22c	Motor Truck ...	,, 6

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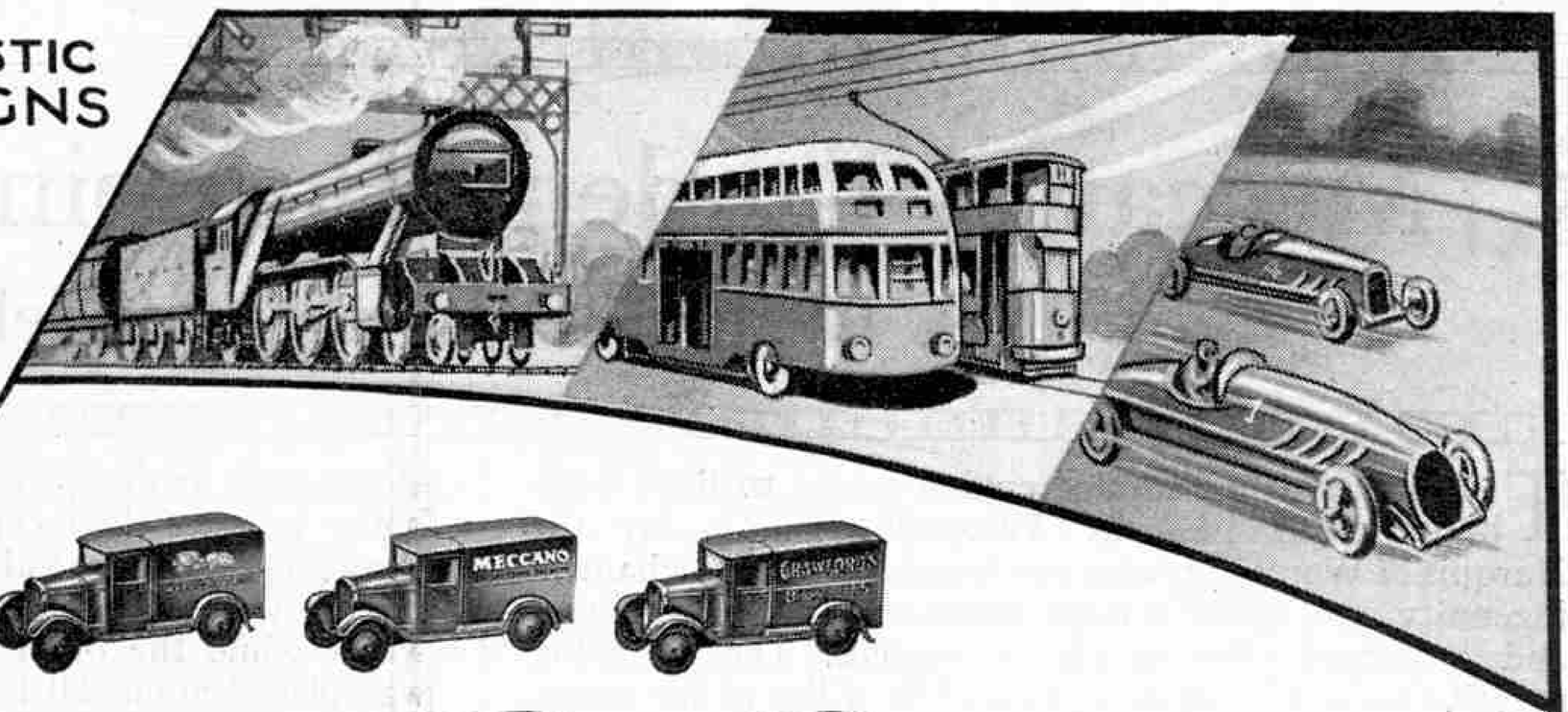

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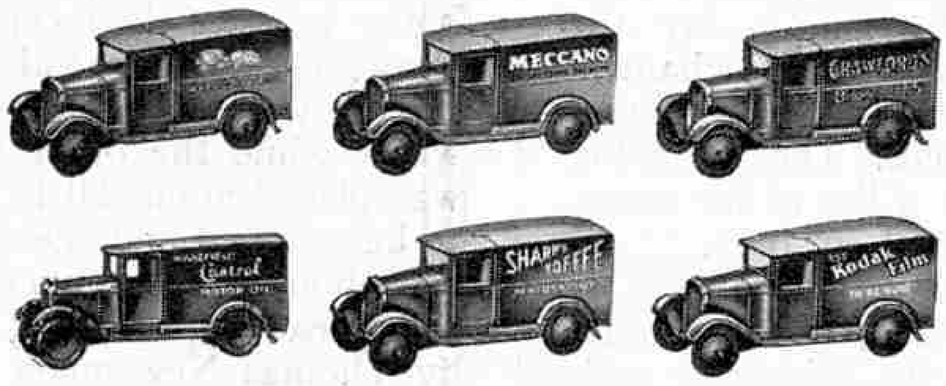
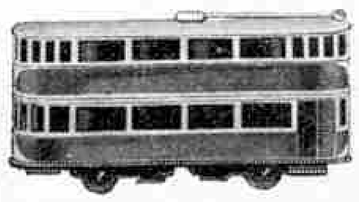


Meccano Dinky Toys No. 28/2

DELIVERY VANS

No. 22d Meccano Van ...	each 6d.	No. 28k Marsh and Baxter's Van	each 6d.
No. 28g Kodak Cameras' Van	,, 6d.	No. 28L Crawford's Biscuit Van	,, 6d.
No. 28h Sharp's Van	,, 6d.	No. 28m Wakefield's Oil Van	,, 6d.

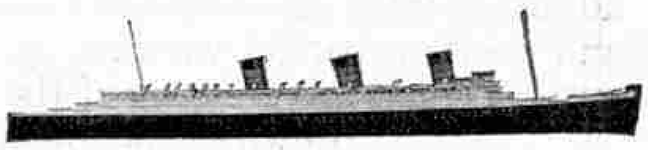
Price of complete set 3/–



Meccano Dinky Toys No. 27

TRAM CAR

Assorted Colours. Price 6d. each



Meccano Dinky Toys No. 52

CUNARD-WHITE STAR LINER "No. 534"

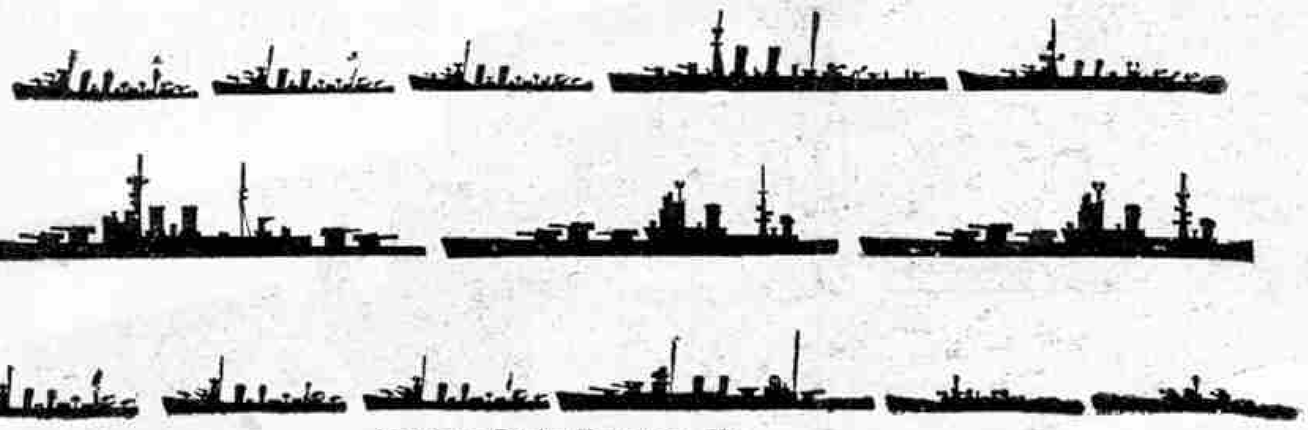
Price 1/– each

Meccano Dinky Toys No. 6

SHEPHERD SET

No. 6a Shepherd	each	3d.
No. 6b Dog	,,	2d.
No. 2d Sheep	,,	2d.

Price of complete set 1/–

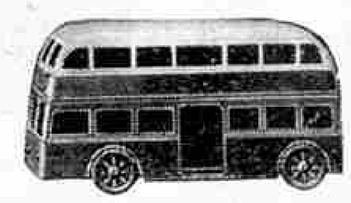


Meccano Dinky Toys No. 50

SHIPS OF THE BRITISH NAVY

No. 50a Battle Cruiser "Hood"	each 9d.	No. 50f Destroyers, "Broke" Class (3)	each 1d.
No. 50b Battleships, "Nelson" Class (2)	,, 6d.	No. 50g Submarine, "X" Class	,, 1d.
No. 50c Cruiser, "Effingham"	,, 4d.	No. 50h Destroyers, "Amazon" Class (3)	,, 1d.
No. 50d Cruiser, "York"	,, 4d	No. 50k Submarine, "K" Class	,, 1d.
No. 50e Cruiser, "Delhi"	,, 4d.		

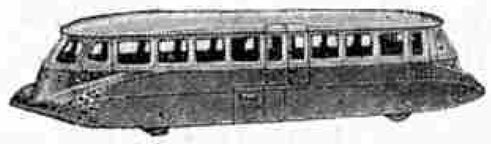
Price of complete set 3/6



Meccano Dinky Toys No. 29

MOTOR BUS

Assorted Colours. Price 6d. each



Meccano Dinky Toys No. 26

G.W.R. RAIL CAR

Assorted Colours. Price 6d. each

Meccano Dinky Toys No. 19

MIXED GOODS TRAIN SET

No. 21a Tank Locomotive	each 9d.
No. 21b Wagon	,, 4d.
No. 21d Petrol Tank Wagon	,, 6d.
No. 21e Lumber Wagon	,, 5d.

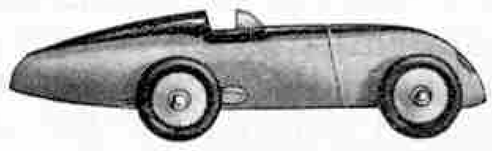
Price of complete set 1/11

Meccano Dinky Toys No. 20

PASSENGER TRAIN SET

No. 21a Tank Locomotive	each 9d.
No. 20a Coaches	,, 7d.
No. 20b Guard's Van...	,, 7d.

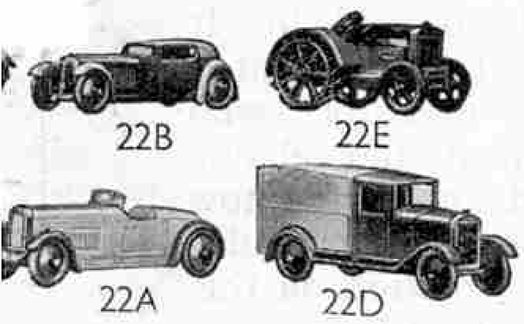
Price of complete set 2/6



Meccano Dinky Toys No. 23

RACING CAR

Assorted Colours. Fitted with rubber tyres. Price 6d. each



ano Dinky Toys No. 22

MOTOR VEHICLES

ıch 6d.	No. 22d Delivery Van ...	each	6d.
,, 6d.	No. 22e Tractor	,,	9d.
,, 6d.	No. 22f Tank	,,	1/–

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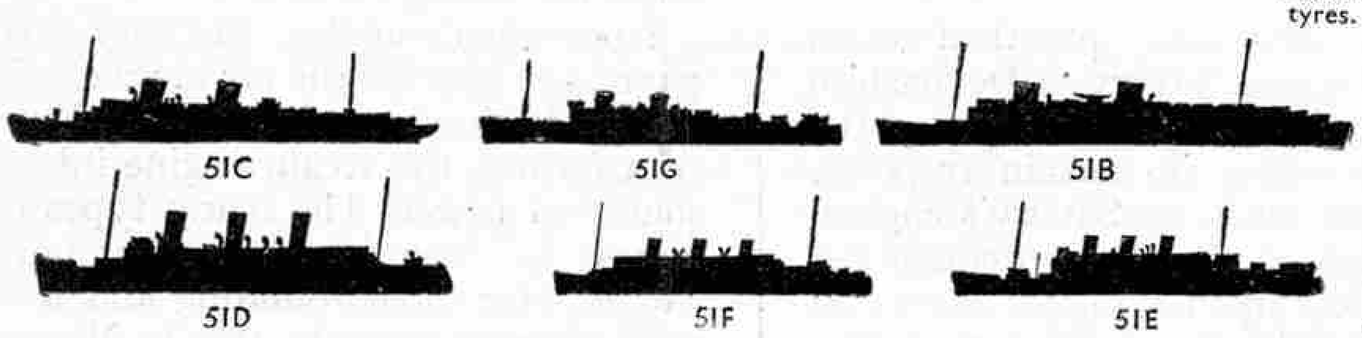
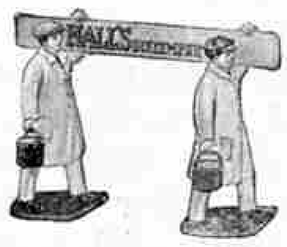


Meccano Dinky Toys No. 51

FAMOUS LINERS

No. 51b "Europa"	each 9d.	No. 51e "Strathaird" ...	each 6d.
No. 51c "Rex"	,, 9d.	No. 51f "Queen of Bermuda"	,, 6d.
No. 51d "Empress of Britain"	,, 8d.	No. 51g "Britannic" ...	,, 6d.

Price of complete set 3/6



Meccano Dinky Toys No. 13

HALL'S DISTEMPER ADVERTISEMENT

This miniature of a well-known lineside advertisement is intended to be placed in the fields adjoining a model railway track. Price 9d.

Meccano Tandem Pumping Engine

A Realistic Working Model

THE first steam pumping engine seems to have been built about 1663 at Vauxhall, London, by the Marquis of Worcester, who was famous for his mechanical ingenuity, and spent a large fortune in efforts to devise and construct efficient steam engines. The following description of his engine appeared in a list of his many ingenious inventions that he published in 1663.

"An admirable *most forcible way to drive up water by fire;* not drawing or sucking it upwards, for that must be, as the philosopher calleth it, 'infra sphaeram activitatis,' which is but at such a distance, *but this way be strong hath no bounder, if the vessel piece of a enough; for I have taken a* end was *whole cannon,* whereof the burst, and filled it three quarters full, stopping and screwing up the broken end as also the touch-hole, *and making a constant fire under it; within twenty-four hours it burst and made a great crack;* so that, having found a way to make my vessels so that they are strengthened by the force within them, and the one to fill after the other, I have seen the water run like a *constant fountain forty feet high.* One vessel of water, rarefied by fire, driveth up forty of cold water; and a man that attends the work is but to turn two cocks, that one vessel of water being consumed, another begins to force and refill with cold water, and so successively."

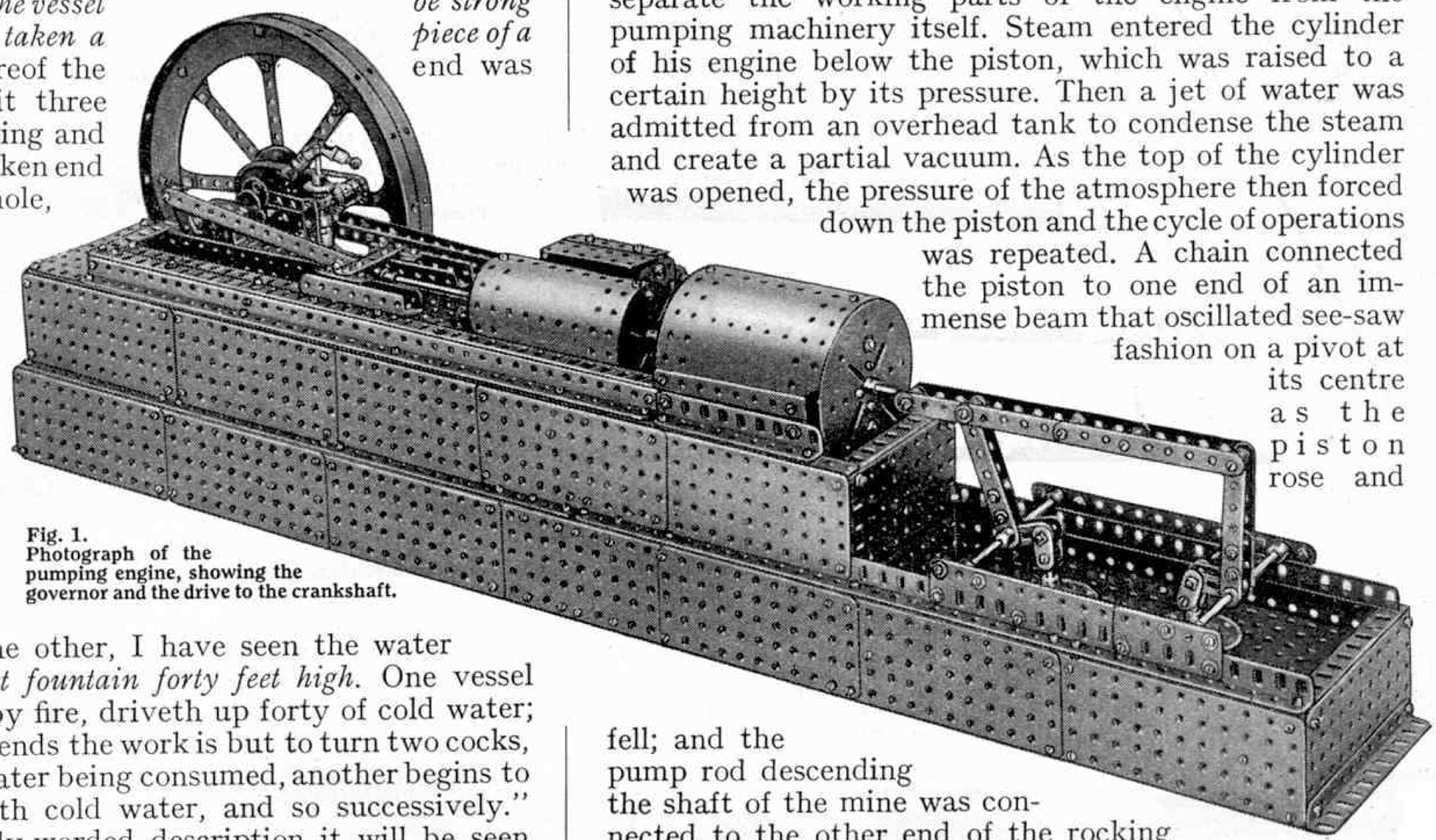


Fig. 1.
Photograph of the pumping engine, showing the governor and the drive to the crankshaft.

From this curiously-worded description it will be seen that the object of the engine was to raise water. Although the information given is very meagre, it appears that the engine had two cylinders, from each of which water was forced alternately by steam supplied from an independent boiler. The Marquis made many other experiments with steam vessels, but none of his schemes achieved any practical success.

The credit for making the first really practical steam engine belongs to Captain Thomas Savery, a Devonshire man who in 1698 patented an engine that resembled the Marquis of Worcester's invention in certain respects, but was a great improvement on it. In Savery's engine, steam from a boiler was admitted to a receiver connected through a valve with a suction pipe having its lower end in the water to be pumped. The steam inlet cock was then closed and a valve opened that allowed a stream of cold water to flow over the outside of the receiver, causing condensation of the steam within it. In this manner a vacuum was produced in the vessel and atmospheric pressure forced mine water into it through the suction pipe. The cold water was then shut off and the steam cock again opened, permitting the steam from the boiler to enter the receiver and force the water out of it through a delivery valve and discharge pipe. Two receivers were employed so that one could be filled with water while the other was being emptied. The engine was placed about 20 ft. above the bottom of the water to be pumped and the overflow from the discharge pipe was about 30 ft. above the receiver.

A great step forward was taken about the year 1712 by Thomas Newcomen of Dartmouth. Newcomen was the first to make use of a cylinder and piston and to separate the working parts of the engine from the pumping machinery itself. Steam entered the cylinder of his engine below the piston, which was raised to a certain height by its pressure. Then a jet of water was admitted from an overhead tank to condense the steam and create a partial vacuum. As the top of the cylinder was opened, the pressure of the atmosphere then forced down the piston and the cycle of operations was repeated. A chain connected the piston to one end of an immense beam that oscillated see-saw fashion on a pivot at its centre as the piston rose and fell; and the pump rod descending the shaft of the mine was connected to the other end of the rocking beam.

Newcomen's engine, like Savery's, was used only for pumping purposes—in some instances the water was used to turn water-wheels for driving other machinery. By 1725 the engine was in common use in collieries, and it held its place without any great alteration or improvement for nearly 75 years.

Newcomen's engine was very wasteful of coal, but it paved the way for the far more efficient engines of James Watt, Richard Trevithick and other inventors who transformed the steam engine into a cheap and reliable source of power. The many types of steam engine now in use for pumping and other purposes form splendid subjects for model-building and the illustration on this page shows a reproduction in Meccano of an interesting engine that has found extensive employment in pumping water from deep wells. It is a tandem compound engine, the single piston rod being common to the high-pressure and low-pressure cylinders.

Each side of the bed-plate of the model consists of two compound girders each built up of two 18½" Angle

Girders connected together by 3″ Angle Girders, and joined together by seven $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates. These are fitted as shown, some being overlapped in order to gain the correct length. The top compound girder is fitted with a further girder of similar design and dimensions, as shown, this being utilised to support five $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates forming the upper portion of the engine bed. When the two long sides of the model are complete they are connected together at the end fitted with the flywheel, by means of $5\frac{1}{2}'' \times 2\frac{1}{2}''$ and $4\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates, suitable Girders being used in order to add strength to the structure. The opposite ends are coupled by a $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plate and two $5\frac{1}{2}''$ Angle Girders, $2\frac{1}{2}''$ Angle Girders being used at the ends of the Plate to enable it to be attached to the side members.

The inner faces of the Flat Plates forming the cut-away portion of the bed-plate are fitted with two $9\frac{1}{2}''$ Angle Girders and these support the ends of four $5\frac{1}{2}''$ Flat Plates. The Plates carry the tops of the two water pumps, each of which is represented by a Boiler End. Two $5\frac{1}{2}''$ and two $2\frac{1}{2}''$ Flat Girders are now fitted to the upper girders of the bed-plate, and these carry four Double Arm Cranks as illustrated. The use of these will be described later. At the point where the bed-plate is cut away, the end of the model is fitted with a $4\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plate strengthened by means of two $4\frac{1}{2}''$ and two $2\frac{1}{2}''$ Angle Girders.

The cylinders can now be fitted. They are built up in the following manner. The low-pressure cylinder casing consists of two Boilers, without Ends, secured together so that they fit almost round the rim of two 4″ Circular Plates. Of these Circular Plates, the inner one is permanently fitted in place by means of two $1'' \times \frac{1}{2}''$ Angle Brackets, and the other is fitted to two similar Angle Brackets by means of two locked Bolts so as to be quickly detachable, the final holding Nuts being placed on the outer side of the Circular Plate. The centres of the Plates are fitted with Bush Wheels, and the complete cylinder is attached to the engine by means of two $4\frac{1}{2}''$ Angle Girders.

Before finally fitting the detachable cylinder end, the valve chest must be constructed and fitted. It consists of a $3'' \times 1\frac{1}{2}''$ Flat Plate carrying round its edge two 3″ and two $1\frac{1}{2}''$ Angle Girders, the $1\frac{1}{2}''$ Angle Girders being fitted with two similar Girders used to secure the valve chest to the cylinder. Washers are used to space the two units apart in order to bring the low-pressure valve chest into line with the valve chest of the high-pressure cylinder.

The top girders of the engine are now fitted with two double "L" section girders, one of these being attached as shown to each side of the model. Each of these girders consists of two $24\frac{1}{2}''$ Angle Girders, and the upper one of the two supports one end of a $3\frac{1}{2}''$ Angle Girder. This part is bolted between the two compound girders in order to keep them rigid. In addition a $3\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate is fitted as shown, and this carries the two cross-head slides. Each of these is built up from two $3\frac{1}{2}''$ Angle Girders, the end nearest the flywheel being supported by a $1\frac{1}{2}''$ Flat Girder.

The high-pressure cylinder consists of a Boiler, without Ends, bent round the outside of two Face Plates. These Face Plates are fitted with $1'' \times \frac{1}{2}''$ Angle Brackets by means of which the high-pressure cylinder is attached to two transverse $4\frac{1}{2}''$ Angle Girders.

The casing for the "cut-off" plates is built up from two $3'' \times 1\frac{1}{2}''$ Flat Plates secured together at right angles by a 3″ Angle Girder. The vertical Plate carries the high-pressure slide valve casing, the construction of which is shown plainly in Fig. 2. The complete valve unit is attached to the high-pressure cylinder and also to the engine frame by means of two pairs of $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Brackets.

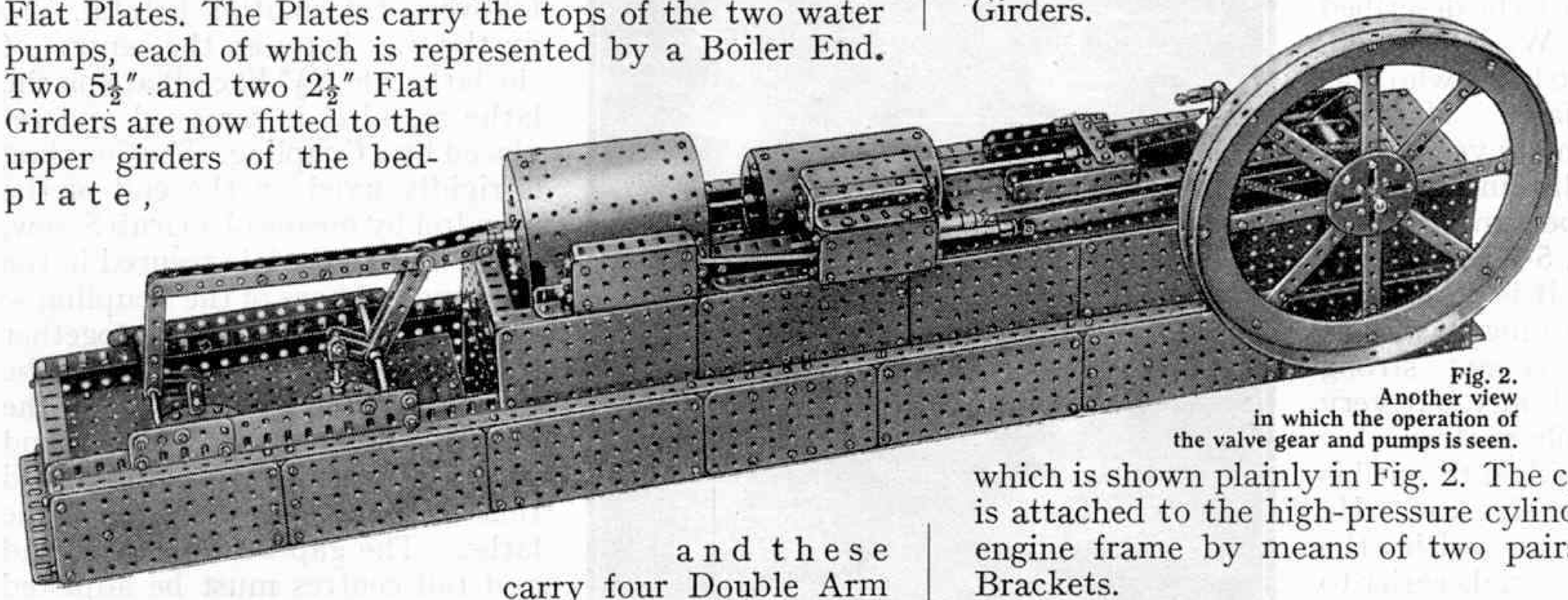


Fig. 2. Another view in which the operation of the valve gear and pumps is seen.

Two $\frac{1}{4}''$ Throw Eccentrics are fitted on the crankshaft, the inner one of which is coupled to the cut-off plates by two $5\frac{1}{2}''$ Strips overlapping three holes. The outer Eccentric is connected by two $5\frac{1}{2}''$ Strips, similarly arranged to those already mentioned, to an end Bearing that is carried on one end of the valve rod. This valve rod is represented by an $11\frac{1}{2}''$ Rod and runs through both valve chests.

In addition to the Eccentrics, the crankshaft carries a 2″ Sprocket Wheel that is connected by a short length of Sprocket Chain to a $\frac{3}{4}''$ Sprocket Wheel. This Sprocket, shown in Fig. 1, is attached to a Socket Coupling carrying a $\frac{7}{8}''$ Bevel Gear, the complete unit being mounted so that it is able to rotate on a short Rod.

A $4\frac{1}{2}''$ Rod, carrying at its upper end a governor as shown, is fitted with a $\frac{7}{8}''$ Bevel and passes completely through the Coupling, Socket Coupling and Double Arm Crank. The $\frac{7}{8}''$ Bevel meshes with the Bevel driving the flywheel, as already described. The $4\frac{1}{2}''$ Rod carries at its lower end a $1\frac{1}{2}''$ Contrate that is in mesh with a $\frac{1}{2}''$ Pinion. This Pinion is secured on a Rod journalled in the top end holes of the side plates of an E6 Electric Motor, and is connected to the armature shaft by three stages of gearing, each consisting of one 57-teeth Gear and one $\frac{1}{2}''$ Pinion.

Parts Required to Build the Meccano Tandem Pumping Engine

2 of No. 1b	6 of No. 9a	2 of No. 13	400 of No. 37	2 of No. 72	18 of No. 111	1 of No. 162
2 „ „ 2	6 „ „ 9b	2 „ „ 15	16 „ „ 37a	6 „ „ 73	4 „ „ 111a	2 „ „ 162b
11 „ „ 2a	9 „ „ 9c	4 „ „ 15a	110 „ „ 38	11 „ „ 94	3 „ „ 111c	2 „ „ 166
8 „ „ 4	12 „ „ 9d	4 „ „ 16a	4 „ „ 52a	1 „ „ 95	3 „ „ 116a	2 „ „ 167b
2 „ „ 5	4 „ „ 9e	1 „ „ 18b	3 „ „ 53a	1 „ „ 96a	2 „ „ 127	2 „ „ 170
8 „ „ 6a	9 „ „ 9f	2 „ „ 24	20 „ „ 59	2 „ „ 103	2 „ „ 128	2 „ „ 171
18 „ „ 7a	4 „ „ 10	3 „ „ 26	1 „ „ 62	1 „ „ 103e	18 „ „ 133a	1 E6 Electric Motor.
2 „ „ 8a	5 „ „ 12	2 „ „ 27a	9 „ „ 62b	4 „ „ 103f	2 „ „ 136	
4 „ „ 8b	2 „ „ 12a	1 „ „ 28	2 „ „ 63	6 „ „ 103h	2 „ „ 146a	
6 „ „ 9	6 „ „ 12b	2 „ „ 30	27 „ „ 70	4 „ „ 109	1 „ „ 147b	

Wax Modelling on a Meccano Lathe

A New Idea for Model-Builders

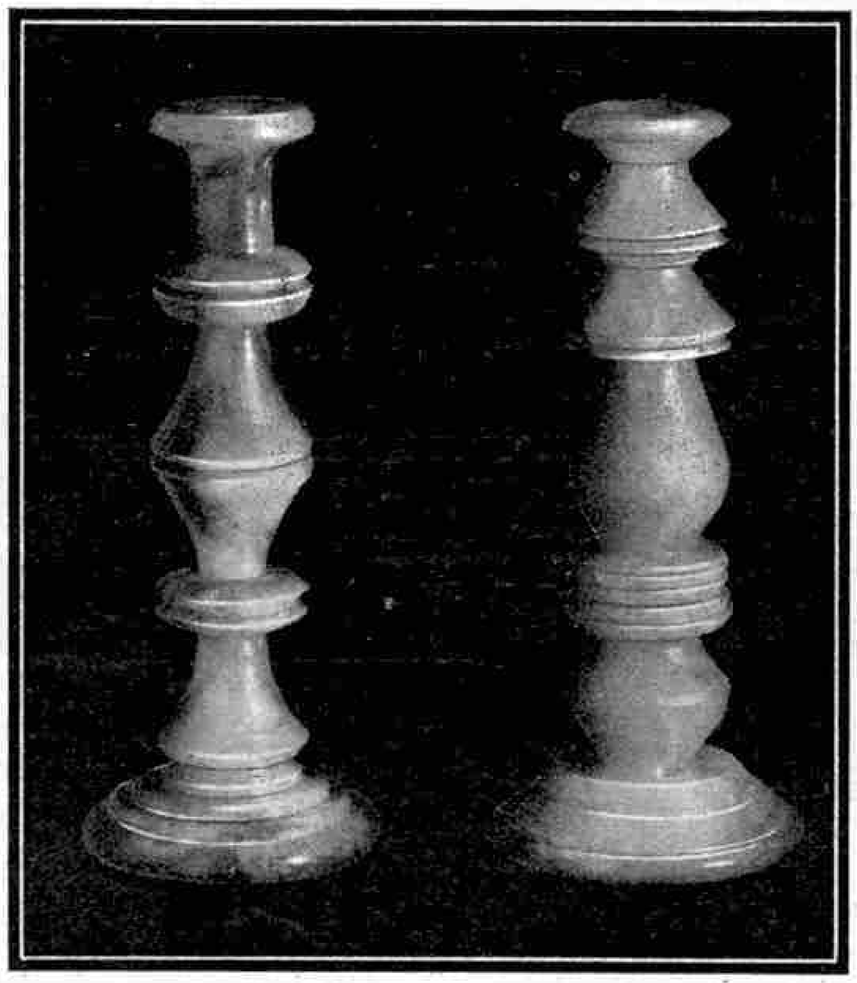
KEEN Meccano users are continually on the look-out for novel ideas that will enable them to obtain greater pleasure from their hobby, and therefore we feel sure they will be interested in the following details of an ingenious system of wax modelling that has recently come to our notice.

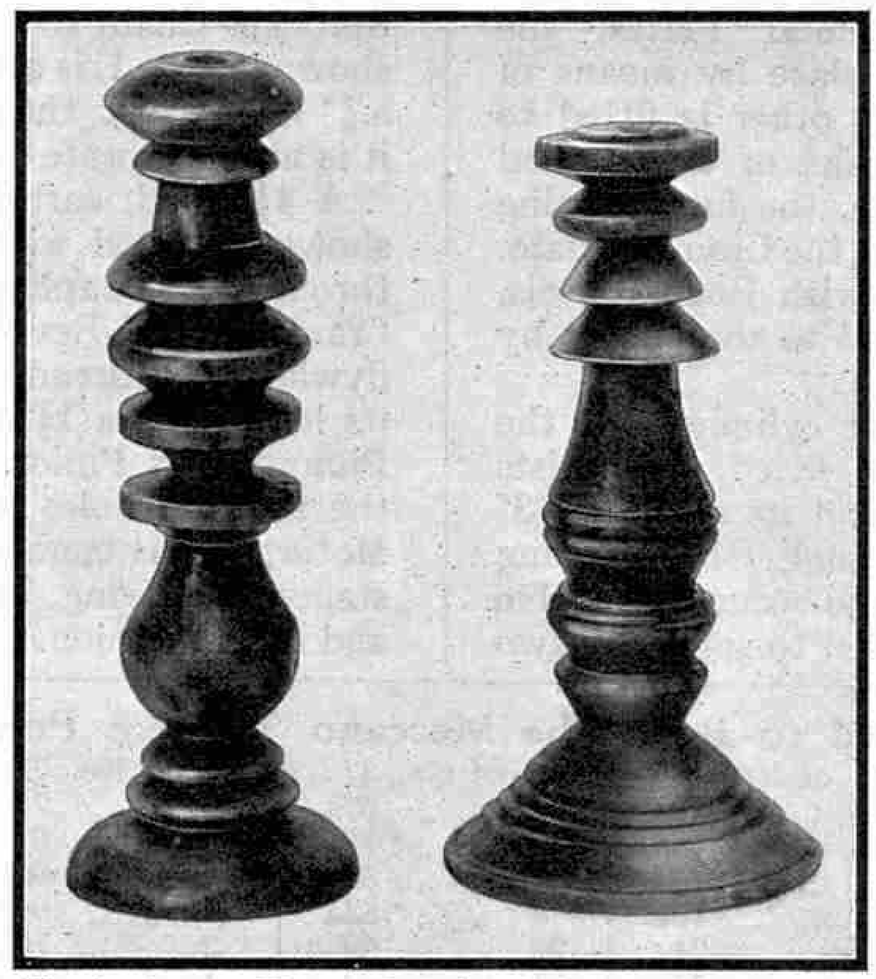
The novel scheme to be described is the idea of Mr. W. Robertson, Newmains, Lanarkshire, who has been an enthusiastic Meccano model-builder for many years ; and it makes use of the fine working model lathe described under Model No. 6.34 in the No. 5-7 Instruction Manual. Although it is possible to do actual wood-turning with this model, the lathe is not strong enough to deal with any but very small work of simple pattern.

Mr. Robertson wished to put his lathe to more extensive use. He began experimenting with the object of finding materials easier to cut than wood, and eventually the idea of using wax occurred to him. He obtained his raw material from ordinary wax candles, and by using this in place of wood he found that it was possible to make a variety of interesting articles, such as miniature vases and candlesticks.

Articles made of wax will not stand much rough handling of course, and are of no practical value; but there is a great deal of pleasure to be had simply in turning the wax, and when the articles made are no longer required they can be melted down and the wax used over again.

Some examples of wax ornaments made by Mr. Robertson are shown on this page, and they are so beautifully finished that at first sight they appear to be made of marble. Actually they are made from common wax candles, and the realistic marbled effect was obtained by mixing candles of different colours. The candles were first softened by gentle heat so that the wick could be withdrawn, and pieces of different colours were then pressed and rolled together so as to obtain a veined or streaky effect. Afterwards the wax was pressed into a lump of a suitable size for the article to be made, and then placed in the Meccano lathe and turned to the shape required. For the turning tool an ordinary pocket penknife did duty. Pure wax candles were used, and as the material is quite hard when cold, it can be handled without damage, but it must be kept in a cool place. Tallow candles do not give satisfactory results.





Wax turning on a Meccano Lathe is a fascinating pastime, and the illustrations on this page show some beautiful candlesticks that were made in this manner from ordinary wax candles by Mr. W. Robertson, Newmains, Lanarkshire.

Readers who have built the Meccano lathe and wish to try this fascinating pastime will find the following information helpful. To fix the wax between the centres of the lathe, the $2\frac{1}{2}''$ Face Plate on the lathe mandrel is removed and replaced by a Coupling. The Coupling is rigidly fixed on the end of the mandrel by means of a Grub Screw, and a Centre Fork is secured in the longitudinal bore of the Coupling so that it is made to revolve together with the mandrel. The wax to be turned is then pressed on to the prongs of the Centre Fork, and supported also on the pointed Rod that forms the tail centre of the lathe. The gap between the head and tail centres must be adjusted very carefully so that the pivot dents in the ends of the wax are not unduly enlarged through too much pressure.

An assortment of cutting tools can easily be made from small pieces of mild steel. These should be about $\frac{1}{8}''$ thick and $\frac{1}{4}''$ wide, and each piece should be filed to a sharp angle at one end and shaped to give the required outline to the wax. With a simple set of tools consisting of two straight-ended cutters and one or two round-nosed and V-shaped tools, almost any kind of ornamental work can be done after a little practice ; but quite good results can be obtained with nothing better than a penknife or a piece of tin.

To produce a vase or a candlestick with a twisted stem, the screw-cutting attachment of the lathe is brought into use. If the gear ratios shown in the No. 5-7 Manual are used, the twists will be right-handed ; and to produce left-handed twists it is necessary to insert an idle pinion somewhere in the gear train. Twists of various pitch can be produced by altering the gear ratios between the lead screw and the lathe mandrel.

We shall be glad to hear from any Meccano users who experiment with this modelling system.

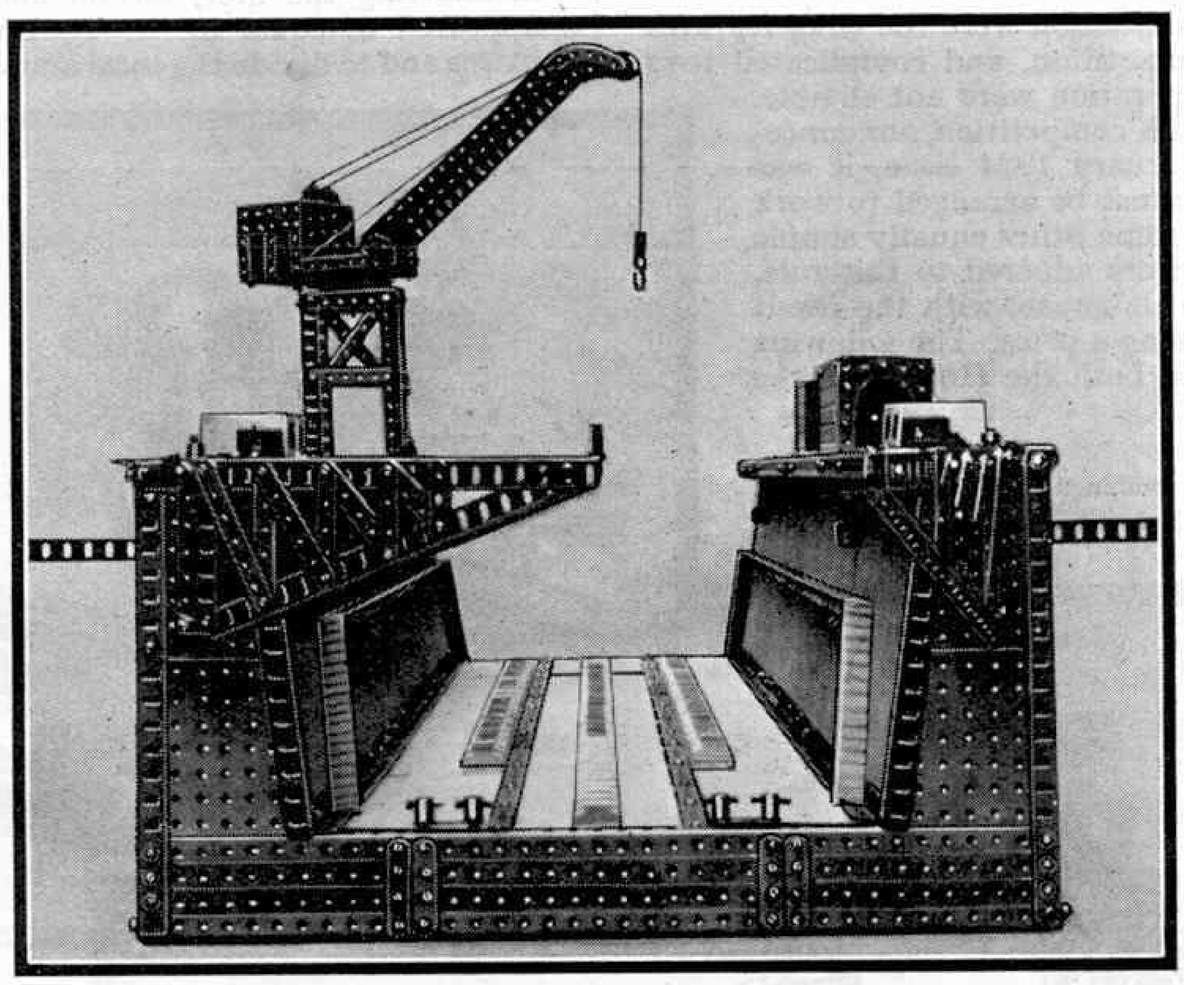
"Autumn" Model-Building Contest

How to Win Prizes with Your Meccano Models

The fine set of prizes listed at the foot of this page is offered to readers of the "*M.M.*" in the free competition announced here. In this contest every owner of a Meccano Outfit is eligible to compete.

All a competitor has to do is to build a realistic new Meccano model, and then send a photograph or a clear drawing of it to Meccano Limited. Ideas for novel and original models can easily be obtained by looking through back issues of the "*M.M.*", in which hundreds of interesting machines and mechanical devices of all kinds have been described and illustrated from time to time. Photographs or drawings need not be the competitor's own work, but the model must be the result of his or her own unaided efforts. It is also advisable to send a brief description of the main features of the model along with the drawings or photographs.

More than one model may be submitted for consideration, but all entries must be enclosed in the same envelope. No competitor can win more than one prize, and if two or more models are entered they will be considered jointly.



The fine floating dock shown here is a good example of the kind of models that win prizes in Meccano Competitions. It was built by K. van Dommelen, Antwerp.

The Contest will be divided into three Sections, as follows: Section A, for readers living in the British Isles and over 14 years of age; Section B, for readers living in the British Isles and under 14; Section C, for readers of all ages living Overseas.

The competitor's age, name and address must appear in block letters on the back of each photograph or sheet of paper submitted, together with the name of the competition ("Autumn") and the Section (A, B, or C) in which the model is entered. Failure to comply with these instructions will result in the disqualification of the model. Envelopes containing entries are to be addressed to "Autumn" Model-Building Competition, Meccano Ltd., Old Swan, Liverpool 13.

The closing dates for the Competition are as follows. 30th November, 1934, is the last day on which entries may be received in the Home Sections (A and B). Overseas readers must forward their entries so that they reach Liverpool not later than 31st January, 1935.

Competitors should note that any number of parts or size of Outfit may be used in building models, but they are reminded that it is not necessarily the largest and most elaborate models that will win the prizes. Very often, indeed, the reverse is the case, and a simple model that is well-proportioned and displays sound constructional features, secures a prize in preference to a large and complicated model that is badly designed and carelessly built. That is the reason why so many apparently simple models have appeared among the successful entries in recent "*M.M.*" contests.

In making the awards, the judges of the competition will allot points according to the merits of each entry when considered under the following heads:—

Construction: Models should be built on correct mechanical principles and should be strong and cleanly designed. It is best to use standard Meccano parts throughout, and the parts should not be altered or mutilated in any way. Maximum number of points obtainable under this head: 40. **Originality:** Competitors should be as original as possible, either with respect to the choice of subject or to the method of construction of their entries. Models should not be merely variations of those illustrated in the Meccano Manuals of Instructions. Maximum number of points: 25. **Realism:** Points up to a maximum of 25 will be awarded to models according to the degree of realism with which they reproduce the appearance and movements of the prototypes. That is, models should resemble as closely as possible the actual machines on which they are based. **General Interest:** Preference will be given to those models that are likely to prove most interesting to Meccano boys throughout the world, and a really good entry may earn a maximum of 10 points under this head.

Photographs or drawings of unsuccessful models will be returned to the senders, provided that a stamped addressed envelope of the necessary size is sent. Prizewinning entries will not be returned.

1934 "Autumn" Model-Building Contest

The Prizes

The prizes in Sections A and C are as follows:—

First Prize: Meccano or Hornby Goods value £3-3s.
Second Prize: Meccano or Hornby Goods value £2-2s.
Third Prize: Meccano or Hornby Goods value £1-1s.
Eight Prizes of Meccano or Hornby Goods value 10/6.
Eight Prizes of Meccano or Hornby Goods value 5/-.
Certificates of Merit.

In Section B the prizes are:—

First Prize: Meccano or Hornby Goods value £2-2s.
Second Prize: Meccano or Hornby Goods value £1-1s.
Third Prize: Meccano or Hornby Goods value 10/6.
Eight Prizes of Meccano or Hornby Goods value 5/-.
Eight consolation awards of Meccano or Hornby Goods value 2/6.
Certificates of Merit.

Model-Building Competition Results

By Frank Hornby

Meccano "Toy" Contest

Competitors in this contest were asked to submit simple toys constructed entirely with Meccano parts. Judging from the entries received it appears that many model-builders are experts at this kind of work, for the toys submitted are brimful of ingenious and amusing ideas, and in many cases Meccano parts have been used in a strikingly clever manner.

The contest provided a pleasant change from the ordinary type of model-building competition, and I was glad to find among the prizewinners several boys who were taking part in a Meccano competition for the first time.

Ingenuity and simplicity of construction were the chief features that made for success in this competition, and complicated toys that required a motor for their operation were not eligible. Readers will remember that in the competition announcement, which appeared in the February 1934 issue, it was stated that all models submitted must be arranged to work by pulling strings or wires, or by some other equally simple method. The majority of competitors adhered to this rule, but a few of the models were too elaborate, with the result that they lost their chance of winning a prize. The following is a complete list of the awards in both the Home and the Overseas Sections.

Section A (Home competitors).

First, Second and Third Prizes were combined and the total (£6-6s.) divided equally between the following six competitors, each receiving Meccano or Hornby Goods value £1-1s.: W. Edwards, Aldershot; J. Espir, London, N.W.6; C. Hudson, Doncaster; D. Rawles, Taunton; G. Riley, Wallasey; C. Spencer, Warsash, Hants.

Six Prizes of Goods value 10/-: R. Carswell, Clacton-on-Sea; H. Cunningham, Belfast; C. Lynch, York; A. Rennie, Aberdeen; R. Watts, Peterborough; D. Whiting, Newport, Mon.

Six Prizes of Goodsvalue5/-: A. Bolshaw, Macclesfield; K. Bottomore, Sherwood, Nottingham; J. German, Yelverton, Devon; T. Grieve, Edinburgh; L. de Lancastre, Baildon, Yorks.; K. Russell, Leeds.

Prizes of "*Famous Trains*" by C. J. Allen: B. Bolton, Brightlingsea, Essex; B. Buck, Cambridge; J. Dobbins, Manchester; K. Durham, Christchurch, Hants.; M. Durham, Jarrow; K. Elworthy, Exeter; S. Evans, Bosham, Sussex; A. Gater, Bridport; G. Goddard, Sutton; H. Jones, Sutton; J. Morling, Ipswich; J. Sheldon, Spilsby; L. Slater, Portsmouth; W. Stanley, Brighton.

Certificates of Merit: J. Ansell, West Hampstead; C. Bannatyne, Windsor, Berks.; L. Barker, Ripon, Yorks.; J. Cole, Hayes, Middx.; E. Cooper, Basingstoke; R. Dale, St. Helier, Jersey; K. Davies, Manchester, 15; K. Ewles, Norwich; C. Goodwin, Hull; J. Goss, Exeter; S. Griffiths, Liverpool 15; R. Hilton, Cowes, I.O.W.; G. Holt, Exmouth; P. Horwood, London, S.E.18; T. Hunt, Cardiff; A. Millar, Timperley; J. Murray, London, S.W.3; S. Murray, Leeds 5; K. Neal, Burton-on-Trent; J. Phillips, Cinderford; L. Prickett, Stockport; G. Reeves, Wolverhampton; V. Robins, Eastleigh, Hants.; T. Steer, Hayes, Kent; L. Tickner, Jersey, C.I.; P. Trolley, Wellingborough; E. Watkins, Thornbury, Nr. Bristol.

Section B (Overseas competitors).

First Prize, Meccano or Hornby Goods value £3-3s.: A. Coppola, Sliema, Malta. Second Prize, Goods value £2-2s.: M. de Wilde, Antwerp, Belgium. Third Prize, Goods value £1-1s.: T. Murdoch, Invercargill, New Zealand.

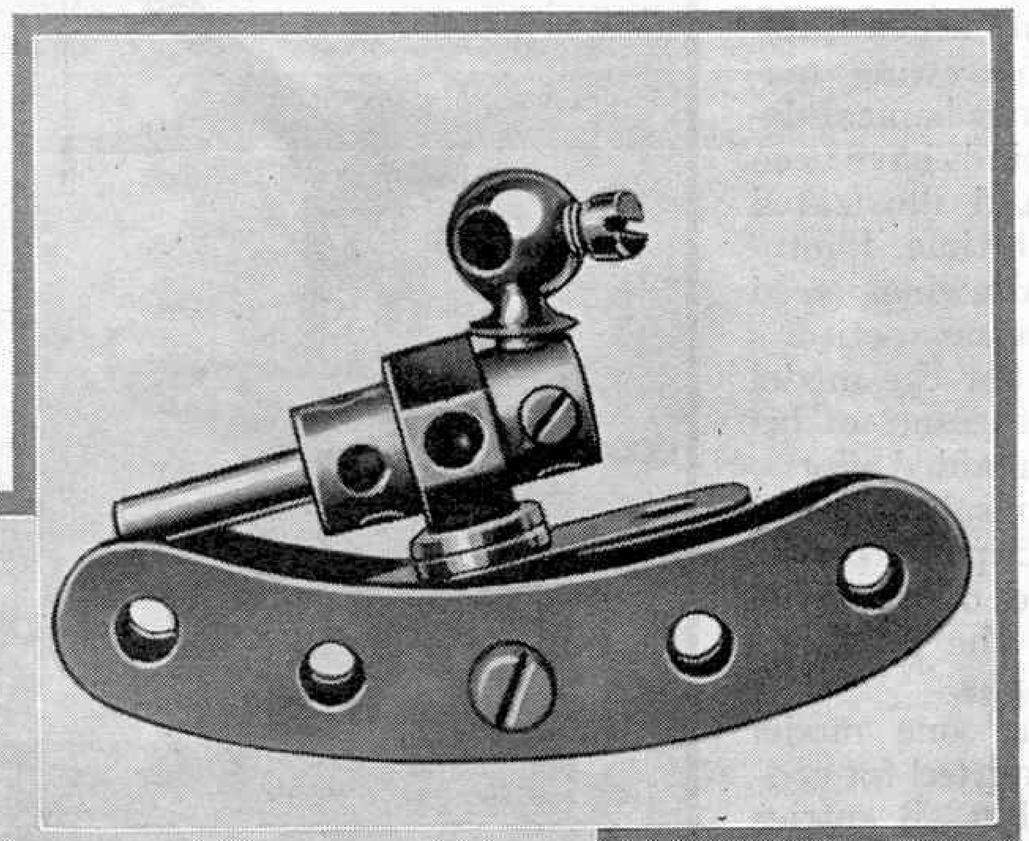
Six Prizes of Goods value 10/-: L. Muller, Bethal, Transvaal, S. Africa; C. Richards, Reuil, France; R. Latimer, Rangoon, Burma; R. Kennedy, Christchurch, New Zealand; K. McCullough, Dargaville, New Zealand; J. Natzke, Te Awamutu, New Zealand.

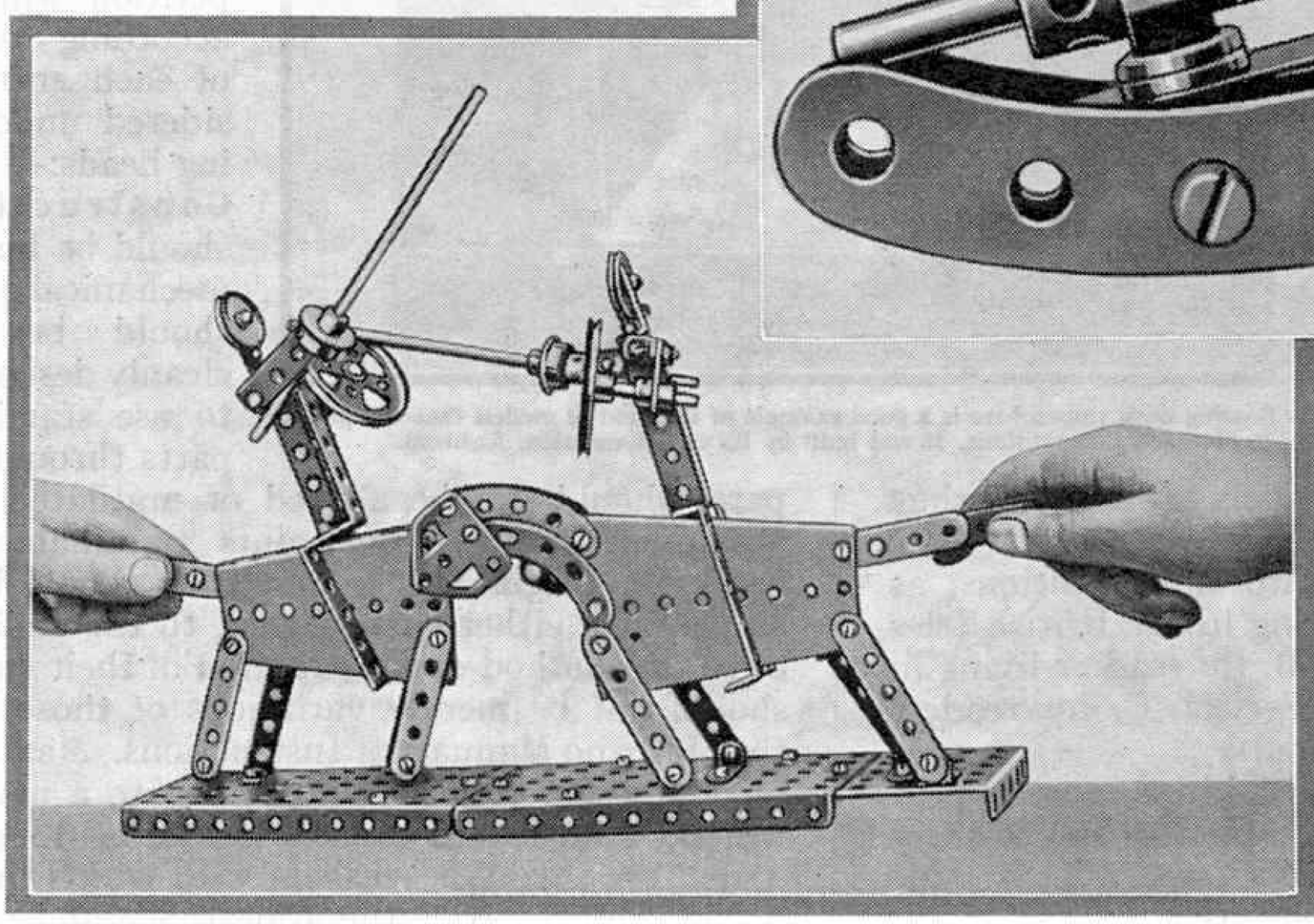
Six Prizes of Goods value 5/-: N. St. Quintin, Salisbury, S. Rhodesia; B. Trott, McLarenvale, S. Australia; H. Carpenter, Timmins, Ontario; E. Aquilina, Misida, Malta; D. Ambler, Waikato, New Zealand; M. Walbridge, Dargaville, New Zealand.

Consolation Awards of "*Famous Trains*": J. Pienaar, Johannesburg; D. Waugh, Johannesburg; R. Piper, Eglinton, N.S.W.; G. Hicks, Jamaica, B.W.I.; J. Cesak, Winnipeg, Canada; D. Berkin, China; M. Delima, Bombay, India; S. Kurlawala, Bombay.

Certificates of Merit: S. Desai, Bombay; N. Burt, Murchison, New Zealand; L. Griffith, Murchison, New Zealand; N. Hardy, Woodville, New Zealand; S. Russ, Nelson, New Zealand; H. Burt, Murchison, New Zealand.

In the "Home" Section of the Contest the judges had difficulty in allotting the first, second and third prizes, as several models appeared of equal merit. They decided finally to combine these prizes and to divide the total amount equally between the builders of six models that they considered the best. One of the tying models is illustrated on the next page, and is an amusing caricature of a terrier dog. It is named "Gyp" by its builder, C. Spencer, Warsash, and although the animal may lack the fidelity for which dogs are beloved by man, he more than makes up for it with agility, for his body is hinged so that he is able to perform the most comical contortions!





The fore part of the body consists of two $3\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plates, to which are bolted six $5\frac{1}{2}''$ Strips that represent legs. The Plates are held together by their flanges, and the space between them is filled in at the front by a $3\frac{1}{2}''$ Angle Girder. A $2\frac{1}{2}''$ Flat Girder and a $2\frac{1}{2}''$ large radius Curved Strip are then bolted to each side of the body to form the neck, and between their upper ends support the dog's head, which is made with two Flanged Sector Plates. The poor animal's ears are Flat Trunnions, and his eyes merely Washers, which are held in place by Bolts. Reversed Angle Brackets are bolted to the end of this section of the body to form part of the hinges.

The centre section of this weird creature's body is constructed similarly to the first portion, and is fitted with two pairs of hinges, by means of which it is connected to the first section. One end of each hinge is made from $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Brackets bolted to Double Brackets, and at the other end $\frac{1}{2}'' \times \frac{1}{2}''$ Reversed Angle Brackets are used. Two further $3\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plates provide the rear portion of the model, and to each Plate are bolted two $5\frac{1}{2}''$ Strips, a 3″ Strip and an Architrave. The tail is made from three $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips.

To complete the model Rods are pushed through the pairs of legs as shown in the illustration, and are fitted with 1″ fast Pulleys, the animal's legs being held in position on the Rods by means of Collars. A length of Sprocket Chain attached to the front axle is used to draw the model along the ground.

A model accordion-player, which is the work of C. H. Hudson, also is illustrated on the next page. The body of the musician consists

of two 3″ Flat Girders bolted together, with 2″ Strips pivotally attached to their lower corners. To the free ends of each of these 2″ Strips is then pivoted a 2½″ Strip and a 2½″ Curved Strip. The Strips represent the legs, and the feet are ½″×½″ Angle Brackets.

The arms and hands are represented by 3″ Strips and Hinges, the Strips being pivoted on a locknutted Bolt in their second holes. The accordion is made from a piece of brown paper, and its ends are clamped between two 1½″ Strips, which are bolted to the Hinges representing the hands. The head is a 1½″ Pulley Wheel fastened to a Flat Bracket.

The figure's legs are joined together and also connected to the ends of the 3″ Strips by means of cord. When the figure is pressed downward its knees move outward, and so cause the ends of the Curved Strips to move in a downward direction. This movement pulls the arms upward, thus extending the accordion. The figure assumes its original position when the pressure is removed, this action being effected by a length of Spring Cord arranged between the ends of the arms and the boss of the Pulley Wheel that forms the head.

An amusing representation of a mediæval tournament won a prize for J. Espir, London. It consists of two mounted knights jousting. The body of each horse is a Flanged Sector Plate, to which four 2½″ Strips are pivoted to form the legs. The horses' necks are composed of 2½″ small radius and 2½″ large radius Curved Strips, and their heads of Flat Trunnions.

Each of the "knights" is made from three 2½″×½″ Double Angle Strips, and similar parts represent the legs, these being held in place by a 1½″ Strip. Their spear arms are 1½″×½″ Double Angle Strips, which are held in position by Angle Brackets and carry 5½″ Rods for lances. The Rods are each fitted with a ¾″ Flanged Wheel and a Coupling. The shields, 2″ Pulley Wheels with 1½″ Rods secured in their bosses, are held to Flat Brackets by means of two Collars, and the Flat Brackets in turn are bolted to Angle Brackets attached to the model. The knights are prevented from sliding off their horses by ½″ Bolts.

Another model of outstanding merit in this section is a "Bucking Bronco" by G. Riley. This consists of a horse made from a Sector Plate with Strips fitted to represent the legs, and a strong base constructed from Braced Girders and Plates. The horse's fore legs are 2½″ Strips pivoted to the body and mounted on the end of a Crank Shaft. The hind legs are made in two portions, 2½″ Curved Strips being used for the upper parts and 2½″ Strips for the lower parts. The hind legs also are mounted on a Crank Shaft, which is caused to rotate with the first Crank Shaft by means of two 57-teeth Gear Wheels and three ½″ Pinions. By turning a handle that operates the Crank Shafts the horse is made to "buck."

The rider is constructed from Strips and is pivoted to the horse by his feet, in such a manner that when the horse "bucks" the rider jogs up and down quite realistically.

Other models in the Home Section are the "Knife Grinders" by W. S. Edwards, and a fairground side-show by D. Rawles.

In the Overseas Section First Prize was awarded to A. Coppola, Sliema, Malta, who submitted a toy representing two boxers in the ring. The operation of the model is very simple, and will be clear from the accompanying illustration. A piece of cord passes round two 2″ Pulley Wheels underneath the model, and then over 1″ fast Pulleys mounted on the side of the ring in a framework of Strips and Double Angle Strips. After passing over the Pulleys the cord is attached at one end to one of the boxers, and the other end is tied to his opponent. The boxers themselves are also connected by another short length of cord, and by moving the string underneath the model from side to side, the men are made to fight in a very amusing manner.

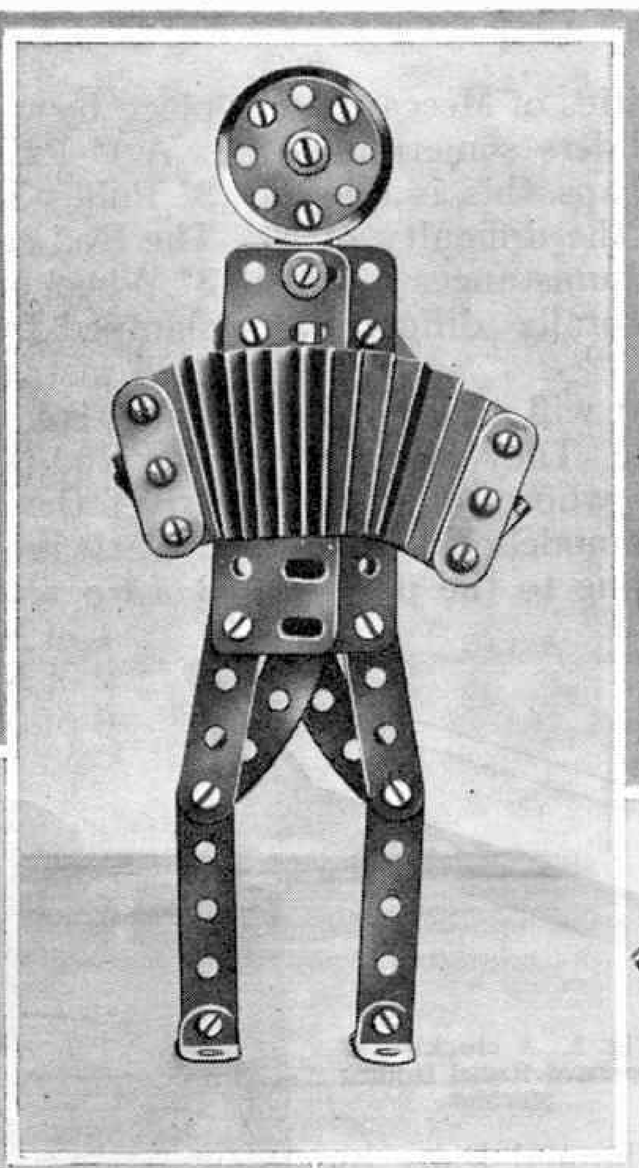
Marcel de Wilde won Second Prize with four small but interesting toys comprising a rocking bird, a climbing monkey, an aeroplane toy and a skittle alley. The rocking bird toy is perhaps the best effort and is made as follows. The rockers on which the bird is mounted are two 2½″ large radius Curved Strips connected across their centre holes by means of a Double Bracket. The bird is represented by a Hexagonal Coupling, in which is inserted a 1½″ Rod for the tail. The head is a Handrail Support secured in one of the end holes of the Hexagonal Coupling and fitted with a Bolt to form the beak. A Bolt through the Double Bracket passes into the Coupling and holds the bird in place.

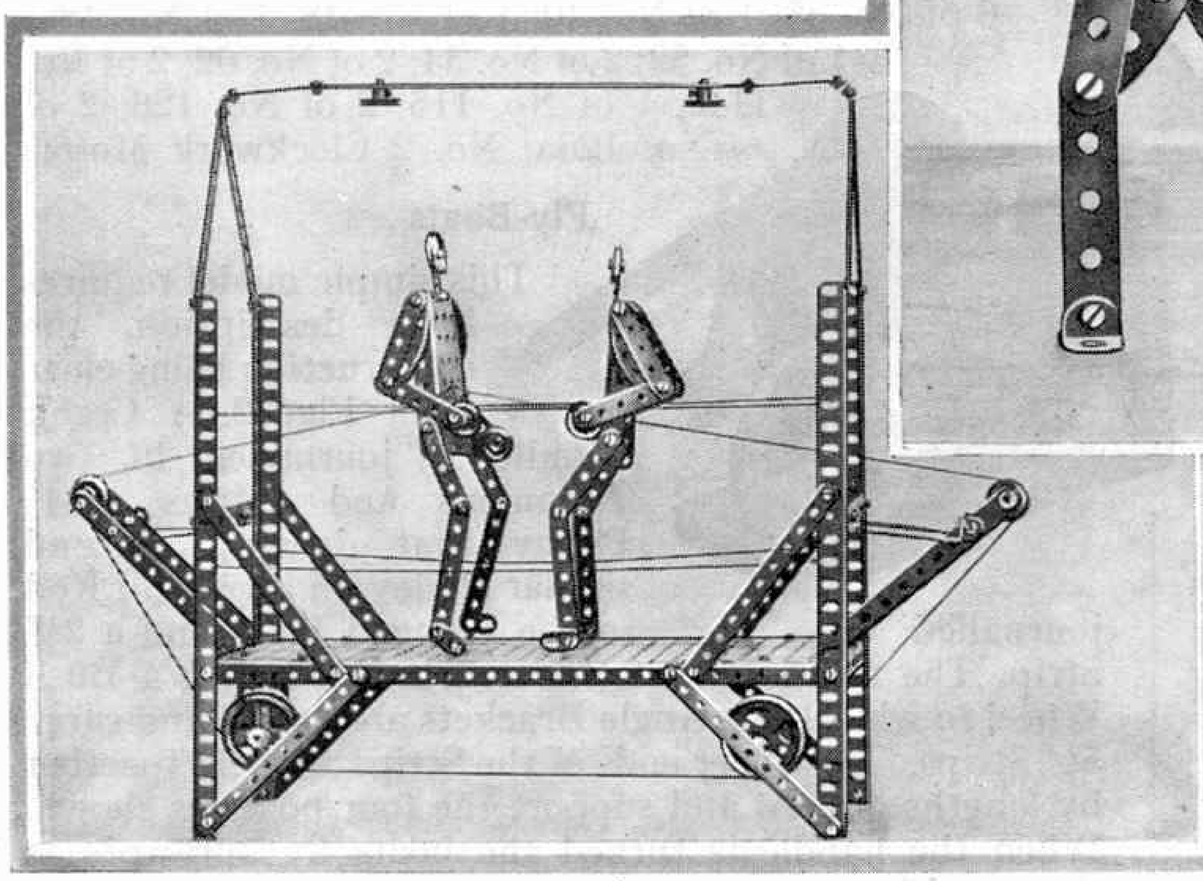
Third Prize was awarded for a small toy reproducing a carpenter at work, and an amusing effort entitled "Two in a Boat." The latter model is the better of the two, and is built as follows. A 9½″ Strip, two compound 10½″ and an 8½″ Strip, are all pivoted at their ends to two 2½″ Curved Strips that form the bow and stern of the boat. Two 3″ Strips bolted to the hull serve as the bodies of the rowers, and are fitted with 2″ and 1½″ Strips for arms and legs, and Pulley Wheels for heads. A 2½″ Strip is pivoted to the end of each arm and also to the third Strip down from the gunwhales of the boat. By pulling the Strips that form the boat in opposite directions, the men move backward and forward and give a good impression of rowing.

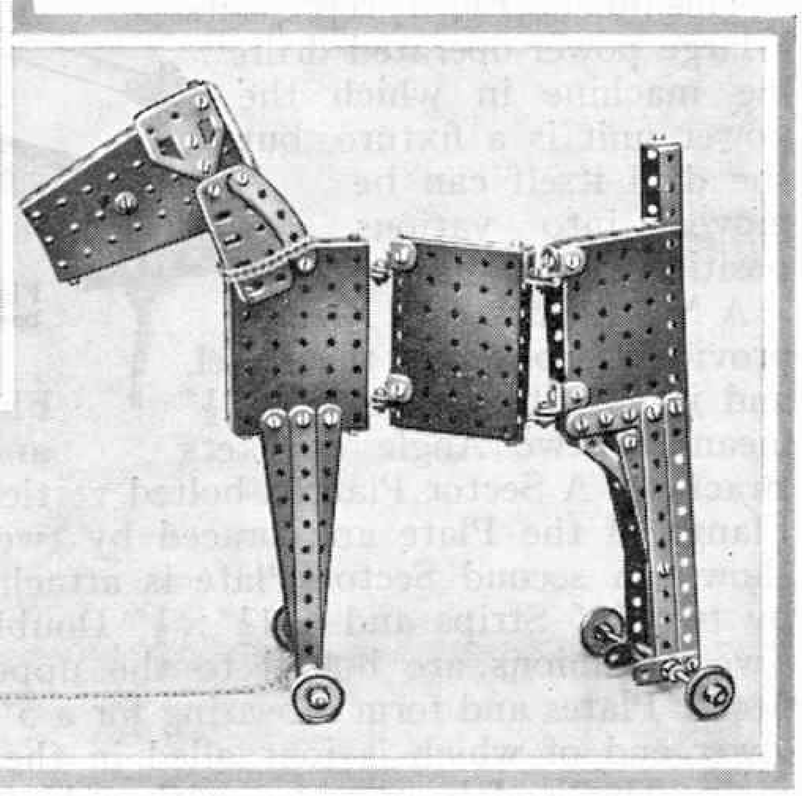
The toy carpenter is standing at his bench busily planing a piece of wood. The model is operated by two 9½″ Strips pivoted in their first and third holes to Flat Brackets.

The legs of the bench are 2″ Strips bolted to one of the 9½″ Strips, and two 5½″ Strips are then bolted across them. The 5½″ Strips are spaced apart by Washers so that a plane made from two 1½″ Strips fitted with a projecting Flat Bracket, is able to slide between them. The carpenter also is made from Strips, and he has a Pulley for his head. When the 9½″ Strips are moved from side to side the carpenter works busily.

A simple and amusing model of a clown secured a prize for J. Natzke. The clown's body is a 3″ Pulley Wheel with 3″ Strips for arms and legs. The Strips are pivoted to the body on ¾″ Bolts, the pivot Bolt of the arms also being used to hold the neck, a 2½″ Strip, in place. The head is a Bush Wheel and is fitted with a 2½″ Strip and a Flat Trunnion to represent a hat. Lengths of cord connect the clown's limbs and by pulling the strings his arms and legs are made to move quite realistically.







Three simple toys that won prizes in the Meccano "Toy" Competition; (left) "The Boxing Match" by A. Coppola; (centre) "The Accordion Player" by C. H. Hudson, Doncaster; (right) A novel jointed dog, which performs amusing antics when drawn along the ground. It was built by C. Spencer. The composite illustration on the opposite page shows a model rocking bird, by M. de Wilde, Antwerp, and a mediæval tournament, by J. Espir, London.

New Meccano Models

Radial Drill—Fly-Boats—Biplane—Lift Bridge, etc.

IN spite of the almost limitless possibilities of Meccano, even the most enthusiastic model-builders sometimes run out of ideas for new models. Perhaps this is due not so much to the lack of ideas as to the difficulty of choosing between them, and in such circumstances it is often advisable to try modelling a totally different subject from those usually chosen.

We illustrate here six new models that will give some idea of the range of subjects available. They can be built with the smaller Outfits, and boys whose range of parts does not permit them to copy the models exactly, should try making modifications according to the parts available.

Radial Drilling Machine

This model (Fig. 1) represents a large power-operated drilling machine in which the power unit is a fixture, but the drill itself can be moved into various positions for working.

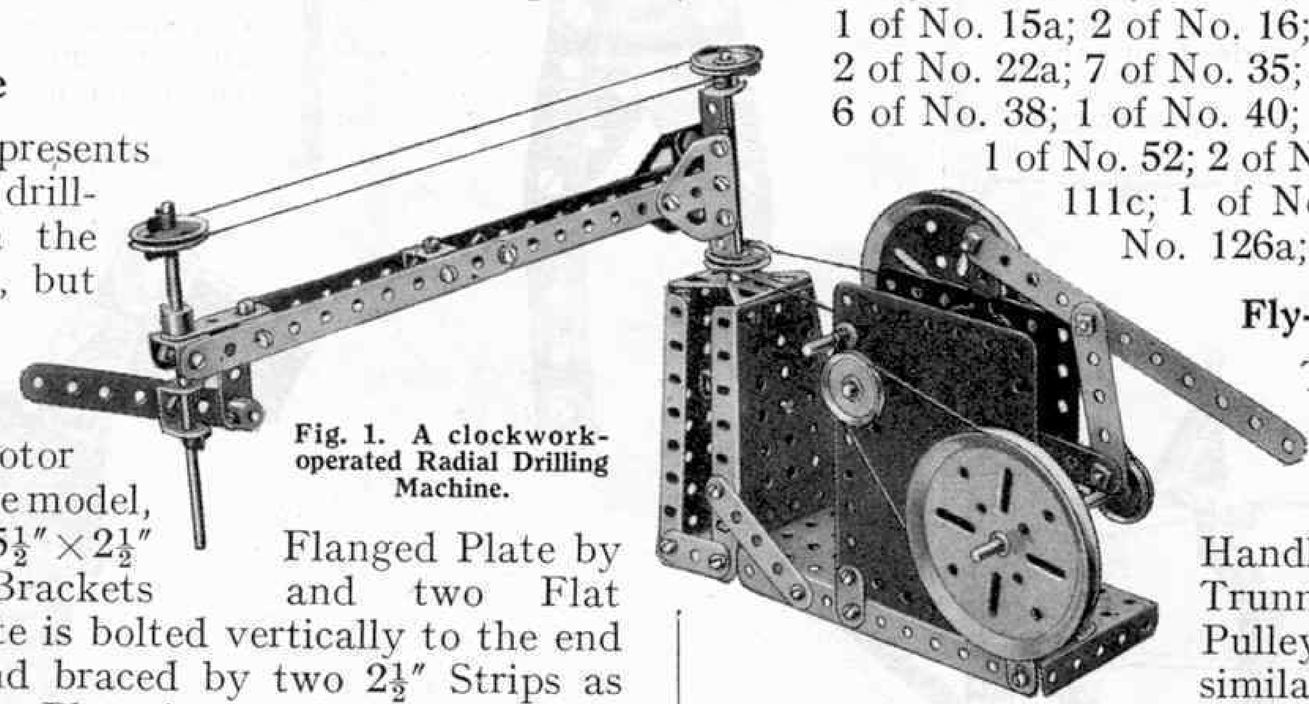


Fig. 1. A clockwork-operated Radial Drilling Machine.

A No. 2 Clockwork Motor provides the power for the model, and is mounted on a $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate by means of two Angle Brackets and two Flat Brackets. A Sector Plate is bolted vertically to the end Flange of the Plate and braced by two $2\frac{1}{2}''$ Strips as shown. A second Sector Plate is attached to the first by two $1\frac{1}{2}''$ Strips and a $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip. Two Trunnions are bolted to the upper ends of the Sector Plates and form a bearing for a 5″ Axle Rod, the lower end of which is journalled in the Double Angle Strip. The Rod is provided with a 1″ fast Pulley and passes through a $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip before being fitted with a second 1″ Pulley.

Two Double Brackets, bolted to the Double Angle Strip, carry Flat Trunnions to which $5\frac{1}{2}''$ Strips are bolted. The Strips are extended by further similar Strips, and are spaced apart by a Double Bracket at the outer end and two pairs of Angle Brackets. One of these carries a Crank as shown. The boss of the Crank is placed over the end Double Bracket and carries an Axle Rod that is free to slide. The Rod represents the drill, and is driven by means of a 1″ loose Pulley firmly clamped between two Spring Clips. This construction is to enable the model to be built with a No. 2 Outfit, but if an extra 1″ fast Pulley is available it should be used here instead.

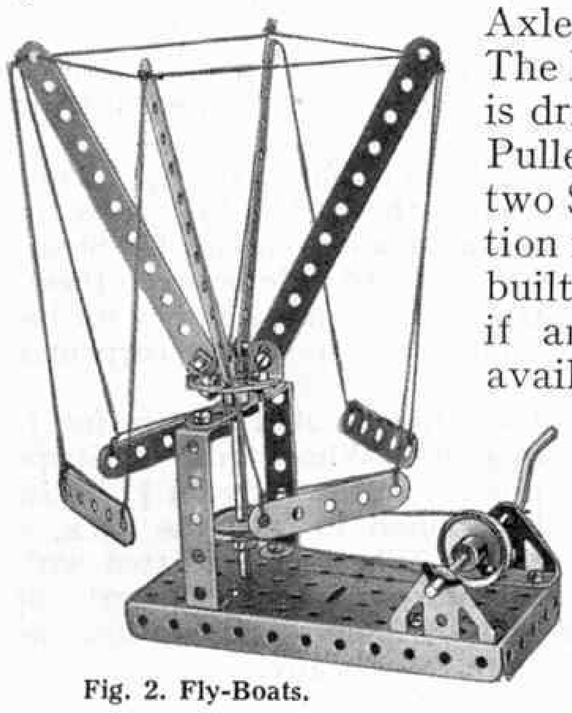


Fig. 2. Fly-Boats.

The sliding movement of the drill is controlled by a lever that is pivotally attached to a Double Bracket carried on the Axle Rod and retained in place by a Spring Clip above and below.

A 1″ Pulley is carried on the Motor shaft and drives a 3″ Pulley Wheel on a Rod journalled in the side plates. The Rod carries a second 1″ Pulley, and drives a further 3″ Wheel on the Rod of which a 1″ loose Pulley is firmly clamped by a Spring Clip. A 1″ fast Pulley should be used instead, if available. This Pulley drives the lower Pulley on the vertical Rod supporting the drill arm. The Rod is free to rotate in the Double Angle Strip and drives the drill through the upper 1″ Pulley.

Parts required for Radial Drill :—5 of No. 2; 1 of No. 3; 3 of No. 5; 2 of No. 10; 4 of No. 11; 6 of No. 12; 1 of No. 15; 1 of No. 15a; 2 of No. 16; 2 of No. 19b; 4 of No. 22; 2 of No. 22a; 7 of No. 35; 47 of No. 37; 6 of No. 37a; 6 of No. 38; 1 of No. 40; 1 of No. 48; 1 of No. 48a; 1 of No. 52; 2 of No. 54; 2 of No. 62; 2 of No. 111c; 1 of No. 115; 2 of No. 126; 2 of No. 126a; No. 2 Clockwork Motor.

Fly-Boats

This simple model requires little description, the construction being clear from Fig. 2. A Crank Handle is journalled in two Trunnions and carries a 1″ Pulley that drives a second similar Pulley on a vertical Rod journalled in the Flanged Plate and a $2\frac{1}{2}''$ Strip. The upper end of the Rod is fitted with a Bush Wheel to which four Angle Brackets are bolted and carry $5\frac{1}{2}''$ Strips. The upper ends of the Strips are held together by lengths of cord and support the four boats as shown. When the handle is turned the boats fly outwards as the speed increases.

Parts required for Fly-Boats:—4 of No. 2; 5 of No. 5; 4 of No. 12; 1 of No. 16; 1 of No. 19s; 2 of No. 22; 1 of No. 24; 3 of No. 35; 16 of No. 37; 1 of No. 40; 2 of No. 48a; 1 of No. 52; 2 of No. 126.

Goal-keeper

Some amusing results can be obtained from models representing figures in action. In designing such models a figure that can be quite easily identified should be chosen. For instance, there can be no doubt that the unfortunate individual in Fig. 3 is a Goal-keeper, and that his efforts to make a "save" have resulted in failure!

The goal is composed of a Flat Plate carrying two Flat Trunnions to which $2\frac{1}{2}''$ Strips are bolted and extended by further similar Strips. A $5\frac{1}{2}''$ Strip is secured across the top, and a further $5\frac{1}{2}''$ Strip is fixed

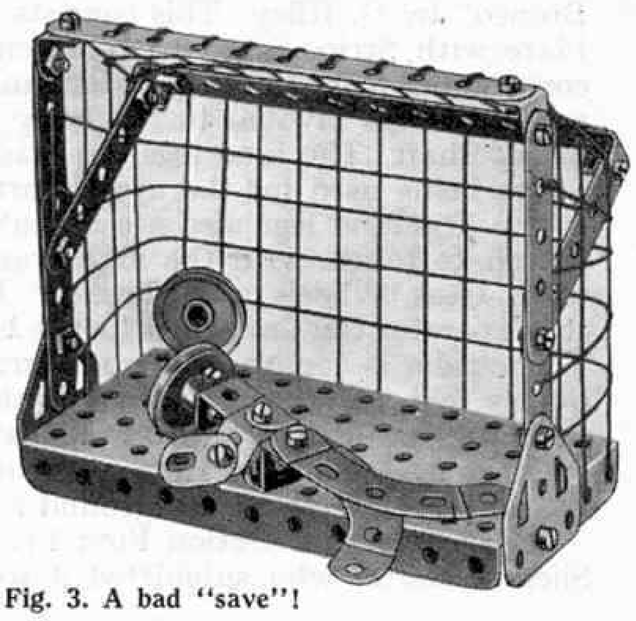


Fig. 3. A bad "save"!

as shown by means of two $2\frac{1}{2}''$ Strips and Angle Brackets. The net is made from cord.

The figure is composed of a $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip to which two Curved Strips are bolted as shown, the same securing Bolt carrying a Reversed Angle Bracket that fixes the figure to the Plate. Two Angle Brackets carry Flat Brackets representing arms, and a 1″ Pulley is fixed in position for the head. The ball is represented by a 1″ Pulley Wheel.

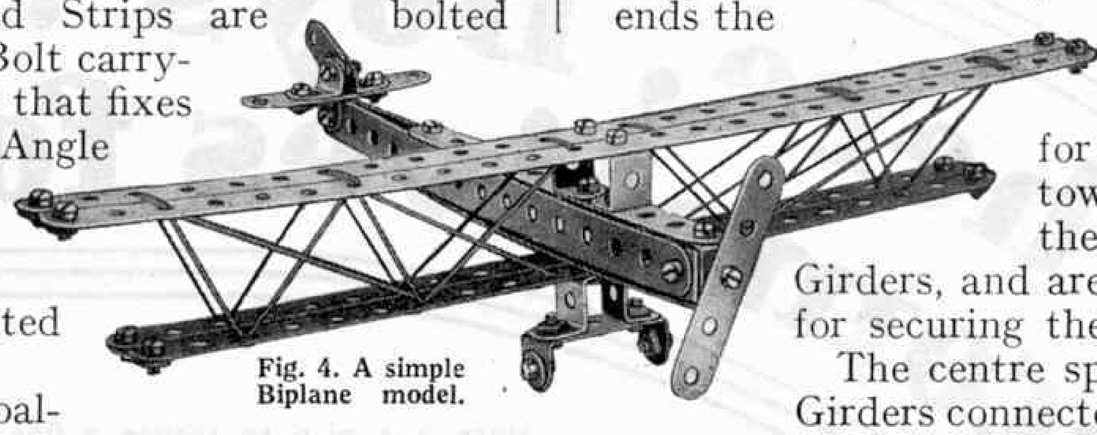


Fig. 4. A simple Biplane model.

Parts required for Goalkeeper:—2 of No. 2; 6 of No. 5; 2 of No. 10; 6 of No. 12; 2 of No. 22; 19 of No. 37; 1 of No. 40; 1 of No. 48a; 1 of No. 52; 2 of No. 90a; 1 of No. 111c; 1 of No. 125; 2 of No. 126a.

A Simple Model Biplane

The fuselage of the model biplane illustrated in Fig. 4 is made up of $5\frac{1}{2}''$ Strips extended by $2\frac{1}{2}''$ Strips to form the sides, and with additional $5\frac{1}{2}''$ Strips for the top and bottom. At the front the Strips are bolted to Angle Brackets, and the upper Strip carries two Double Brackets to which two $12\frac{1}{2}''$ Strips are bolted for the upper mainplane. The ends of the Strips are connected by Flat Brackets. The lower mainplane is composed of two pairs of $5\frac{1}{2}''$ Strips with Flat Brackets bolted across the ends.

The tail unit consists of a $2\frac{1}{2}''$ Strip secured in place by Angle Brackets, and carrying further Angle Brackets that hold a Flat Bracket forming the fin and rudder. An undercarriage is formed from a Double Bent Strip and $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip. To complete the model a $2\frac{1}{2}''$ Strip is pivotally attached to the nose for the propeller, and cord is added to represent bracing struts and wires between the upper and lower mainplanes.

Parts required for Biplane:—2 of No. 1; 4 of No. 2; 4 of No. 5; 5 of No. 10; 2 of No. 11; 8 of No. 12; 27 of No. 37; 4 of No. 37a; 6 of No. 38; 1 of No. 40; 1 of No. 48; 3 of No. 111c; 2 of No. 125.

Vertical Lift Bridge

In bridging navigable rivers and canals sufficient height must be allowed for the masts of vessels passing under at high water mark. To construct the usual type of bridge to meet these conditions involves making long approaches, which are costly to produce and are also an inconvenience to traffic. To obviate these a type of bridge is generally employed that opens to allow vessels to pass. Swing bridges and bascule bridges are common, and another type of bridge is the vertical lift bridge in which the entire centre span across the waterway can be lifted bodily to sufficient height for the vessels to pass under.

Fig. 5 shows a model of this type of bridge. Two vertical towers are each made from two $12\frac{1}{2}''$ Angle Girders bolted to the end flange of a $3\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate, and connected across the top by a $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip to which two $12\frac{1}{2}''$ Strips are bolted. At their lower ends the Strips are secured by Angle Brackets to the Flanged Plate, and $5\frac{1}{2}''$ Strips are used for bracing purposes. The two towers are connected together at the base by a pair of $12\frac{1}{2}''$ Angle Girders, and are provided with Angle Brackets for securing them to a baseboard if required.

The centre span is made of two $12\frac{1}{2}''$ Angle Girders connected across the ends by $2\frac{1}{2}''$ Strips, between which three $12\frac{1}{2}''$ Strips are bolted for the roadway. Two $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips are bolted vertically in the centres of the side Girders, and each carries a $1\frac{1}{2}''$ Strip to which two $5\frac{1}{2}''$ Strips are bolted to form arch girders. The outer ends of the Strips are secured to the Angle Girders by Flat Brackets and Angle Brackets. The spaces between the arched Strips and Angle Girders are interlaced with Cord to represent bracing struts and ties. Thus the complete centre span is in the form of an arch bridge.

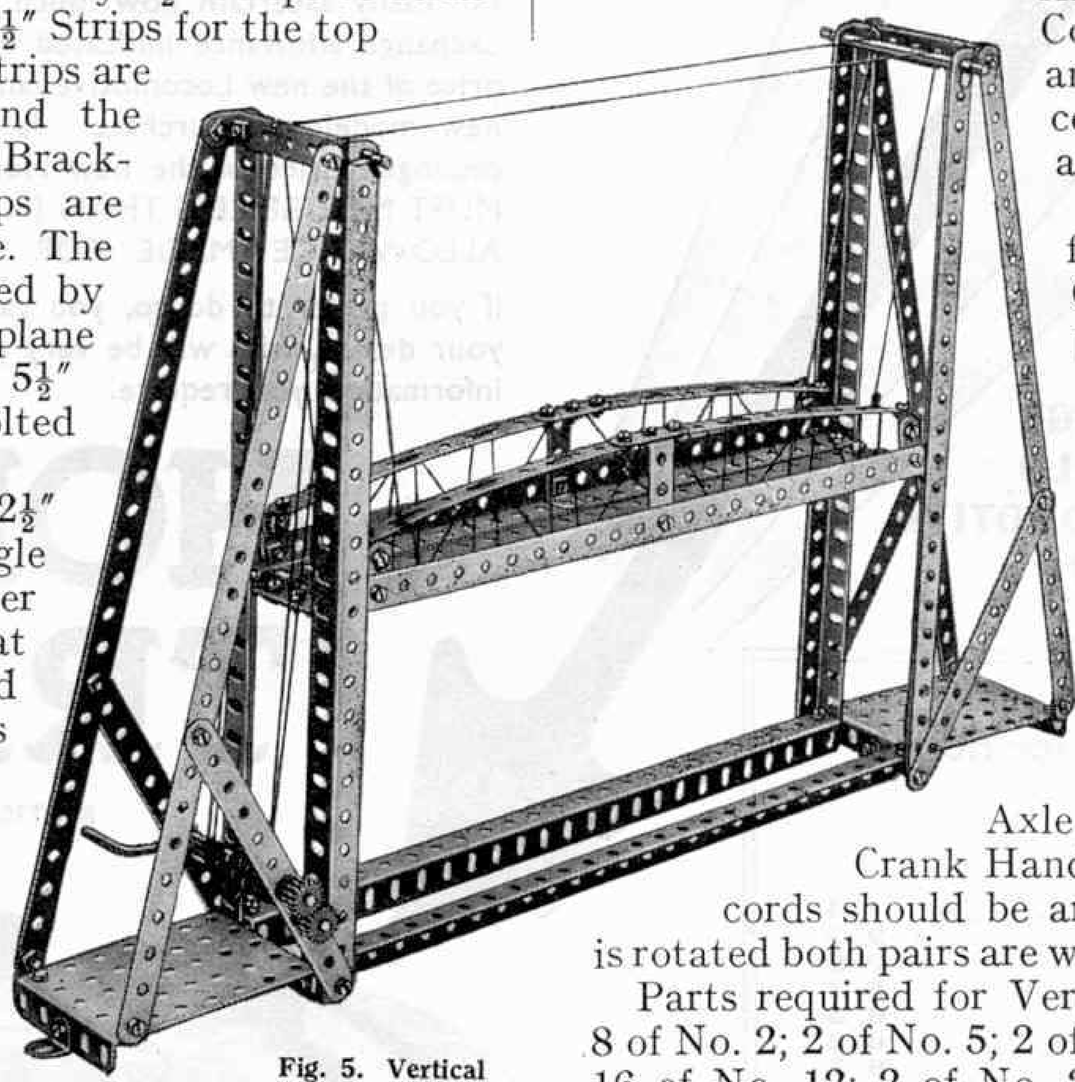


Fig. 5. Vertical Lift Bridge.

The ends of the centre span fit between the vertical Angle Girders of the towers, and if properly constructed the entire span should be free to slide up and down. Two cords are attached to each end and passed over $3\frac{1}{2}''$ Axle Rods journalled at the top of the Angle Girders. One pair of cords is tied to the Crank Handle that can be seen on the left of the illustration, and the other pair to a $3\frac{1}{2}''$ Axle Rod that is driven from the Crank Handle through two $\frac{1}{2}''$ Pinions. The cords should be arranged so that as the Handle is rotated both pairs are wound in, and the bridge is raised.

Parts required for Vertical Lift Bridge:—7 of No. 1; 8 of No. 2; 2 of No. 5; 2 of No. 6a; 8 of No. 8; 4 of No. 10; 16 of No. 12; 2 of No. 26; 6 of No. 35; 67 of No. 37; 1 of No. 40; 2 of No. 48; 2 of No. 48a; 2 of No. 53; 2 of No. 59; 2 of No. 125.

Aircraft Carrier

The neat model shown in Fig. 6 represents the type of vessel used for carrying aircraft at sea. The upper deck is designed to form a runway to enable aeroplanes to alight and take off, and space below decks is allotted for use as hangars. Such vessels are provided with large and well equipped workshops for carrying out repairs to machines, and in addition to accommodation for the usual personnel of the ship, there are quarters for the officers and men of the aircraft squadrons.

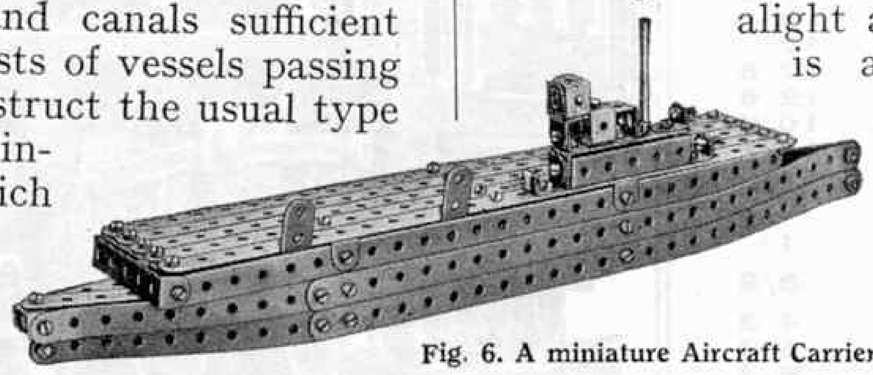


Fig. 6. A miniature Aircraft Carrier.

The construction of the model can be seen quite clearly from the illustration, and description is not necessary.

Parts required for Aircraft Carrier:—10 of No. 1; 6 of No. 2; 6 of No. 5; 2 of No. 6a; 7 of No. 10; 4 of No. 11; 7 of No. 12; 2 of No. 12a; 1 of No. 16; 1 of No. 35; 60 of No. 37; 3 of No. 37a; 2 of No. 38; 1 of No. 48; 6 of No. 48a; 3 of No. 111c.

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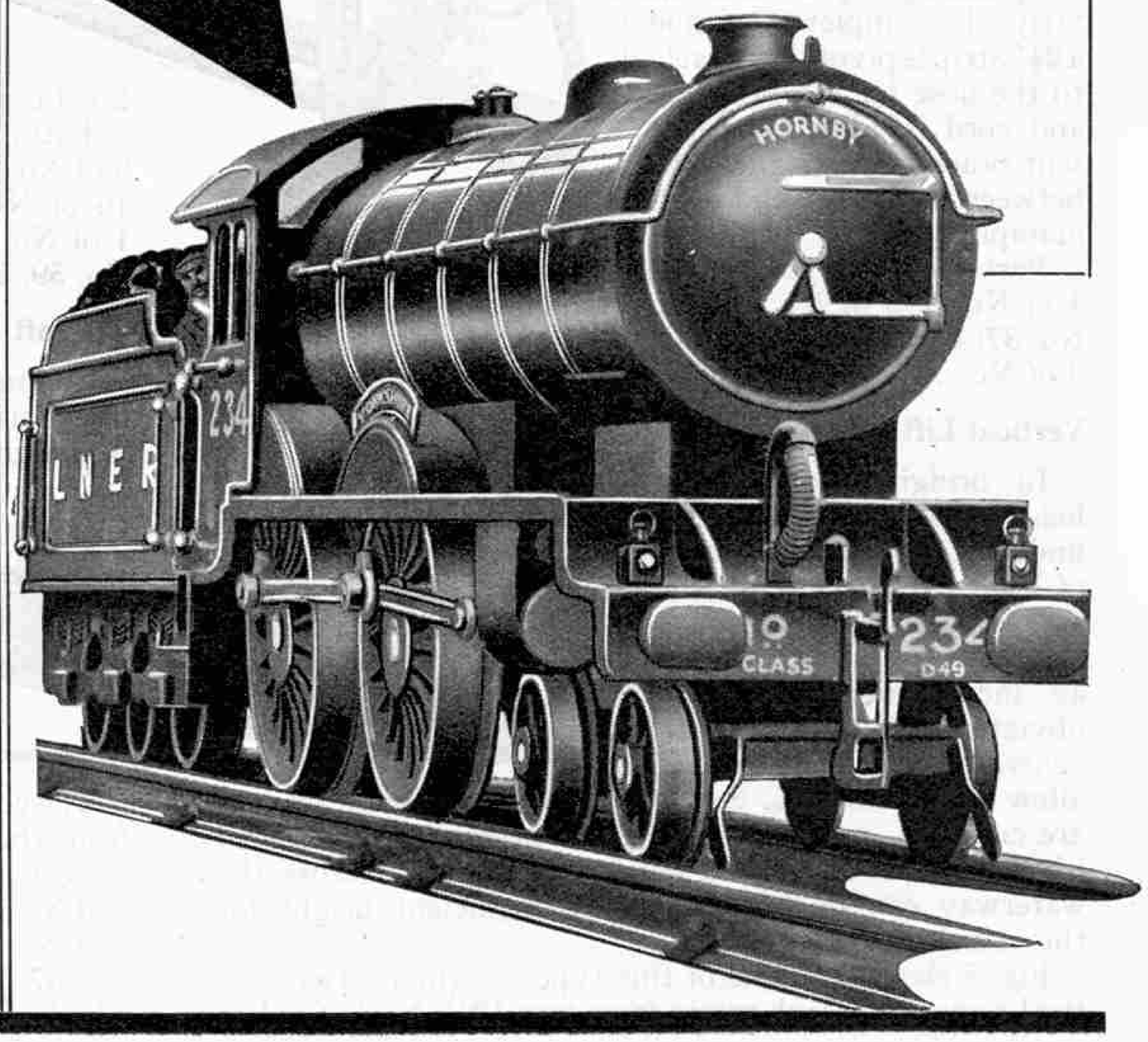

Part Exchange Allowances for Hornby Locomotives

CURRENT TYPES

MO Locomotive	1/4
M1/2 Locomotive	2/3
M3 Tank Locomotive	3/9
No. O Locomotive	5/3
No. 1 Tank Locomotive	6/3
No. 1 Locomotive	6/3
LEC 1 Locomotive (Swiss Type)	6/3
No. 1 Special Locomotive	8/3
No. 1 Special Tank Locomotive	8/3
LST M3/20 Tank Locomotive (20-volt)	8/3
No. 2 Special Locomotive	11/3
No. 2 Special Tank Locomotive	10/6
No. 1 Electric Tank Locomotive, Permanent Magnet	7/6
LST 1/20 Tank Locomotive (20-volt)	12/–
LST 2/20 Tank Locomotive	12/6
LE 1/20 Locomotive (Swiss Type), 20-volt	12/6
LE 2/20 Locomotive (20-volt)	16/6
No. 2 Electric Tank Locomotive	15/–
No. 3E Locomotive	16/3
No. 3E Riviera "Blue" Locomotive	16/3
No. 3C Locomotive	12/–
No. 3C Riviera "Blue" Locomotive	12/–
E3/20 Locomotive	12/6
E3/20 Riviera "Blue" Locomotive	12/6
Metropolitan C Locomotive	10/6
Metropolitan L.V. Locomotive	15/–

OBSOLETE TYPES

M2930 Locomotive	1/–
George V Locomotive } These models were identical	3/3
No. OO Locomotive } These models were identical	3/3
M3 Locomotive	4/3
Zulu Locomotive	5/3
Zulu Tank Locomotive	6/3
No. 2 Locomotive	10/–
No. 2 Tank Locomotive	11/3
No. 1 Locomotive, fitted for Hornby Control	7/6
No. 1 Tank Locomotive, fitted for Hornby Control	7/6
No. 2 Locomotive, fitted for Hornby Control	11/3
No. 2 Tank Locomotive, fitted for Hornby Control	12/6
Metropolitan H.V. Locomotive	20/–

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Preparing for a Record Year

The work of the first winter session is now in full swing in every Meccano club, except of course in Australia, New Zealand, South Africa and other southern countries where winter activities have been brought to a successful conclusion. My correspondence shows that worthy efforts are being made in all quarters to celebrate in fitting style the Guild's 15th birthday, to which I referred last month, and I should like to thank those who have written to forward their congratulations on this interesting event and to express their satisfaction with the continual growth of the organisation.

This year should see the creation of new records, and I am looking forward to receiving even more interesting and attractive reports than in previous years. Secretaries who are in need of report forms should let me know immediately of their wants, and I trust that these forms will be well used throughout the coming winter sessions, for the regular report of proceedings to Headquarters forms an important part of routine work, without which it is impossible to give due credit in the Guild Pages of the "*M.M.*" to the excellent work carried on.

Every member of an affiliated Meccano club should have both a Membership Card and a Subscription Card and I shall be glad to forward supplies of these where necessary. They are useful for providing members with copies of the programme and for keeping records of subscriptions, but they also serve to impress on them the fact that they belong to a properly organised club.

How to obtain New Members

The beginning of the winter sessions is perhaps the best time of the year to make special efforts to increase club membership, for recruits gained at that time quickly lose the feeling that they are newcomers and settle down to become useful members. At this time of the year personal effort on the part of officials and existing members is the best means of gaining adherents and they should invite any of their friends who possess Meccano Outfits to join them. One advantage of this method of recruiting is that the newcomers are introduced personally by a member, a plan that ensures their being made thoroughly at home from the very commencement of their association with the club.

The importance of recruiting has been brought home to me very forcibly by the fate of a club that has been active and successful for several years. In recent months there has been a decline in interest, entirely owing to the fact that older members have left the district or have been prevented by their work from taking their former share in club management. It is now realised by the officials that this trouble could have been avoided if a constant succession of young recruits had been obtained, for these would now have been able to take up the responsible positions vacated by older members. As it is, no real progress can be made until there has been a revival of interest following the initiation of new members. Recruits are the life blood of a Meccano club. Those in charge of clubs that have been outstanding successes have always taken care to bring in as many young new members as possible and to provide attractive programmes for them.

Meccano Club Secretaries

No. 30. I. L. Scott

I. L. Scott is secretary of the Marlborough (Mont Albert) M.C., Victoria, Australia. The club has made great strides since its affiliation with the Meccano Guild in February, 1933, and the reports of its proceedings appearing in the local press have aroused great interest. Special attention is given to the provision of an attractive programme of Model-building Contests for members of the Junior Section.

Forming New Clubs

Many new members of the Guild have written to me recently to ask for details of the nearest available Meccano club. I have given the required information wherever possible, but there have been cases in which no suitable club existed. For this reason I strongly urge all members of the Guild who live in populous districts where no club has been established to give serious thought to the possibility of forming one. It is almost certain that in the same neighbourhood will be other Meccano boys in similar positions, and it is only necessary for these to be brought into contact to enable a successful club to be formed.

I shall always be glad to give support to any enterprise of this kind by publishing the details in these columns, and thus bringing them to the notice of boys who wish to enjoy Meccano club life and to whom at present the opportunity of doing so is denied. Even if these measures result only in the formation of small clubs not qualified for affiliation, this effort will be worth while, for it is from small beginnings of this kind that many of the largest and most successful Meccano clubs have grown.

An Attractive Exhibition

The 15th Annual Exhibition of the Holy Trinity (Barnsbury) Meccano Club will be held on Thursday, Friday and Saturday, the 18th, 19th and 20th of this month. On the first two days the Exhibition will be open from 5.30 p.m. to 10 p.m. and on the final day proceedings will commence at 2 p.m. and continue until 9.30 p.m. The charge for admission will be 6d., and those under 14 years of age will be admitted at half price.

The Exhibitions arranged by the Holy Trinity M.C. are always attractive, and this year a special effort is being made in celebration of the completion of the 15th year of its existence. For the first time the Exhibition is to be open for three days, and the attractions include Cinematograph and Lantern Shows and a fine art gallery. There will be the usual comprehensive display of working Meccano models and a particularly attractive feature will be the Hornby Railway layout, consisting mostly of Hornby Double Track, both clockwork and electric, and incorporating a large model aerodrome that will be complete in every detail. All interested in Meccano will receive a hearty welcome and a cordial invitation is given to officials and members of other Meccano clubs.

Proposed Clubs

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

BRISTOL—E. R. Pritchard, 17, Brentry Road, Fishponds.
CATFORD—Mr. F. B. Graves, 133, Bromley Road, S.E.6.
DONCASTER—Mr. C. W. Hughes, "Mowbray," Armthorpe Road, Wheatley Hills.
INDIA—K. D. Kohli, Kote-Kesher Chanel, Jullundur City.
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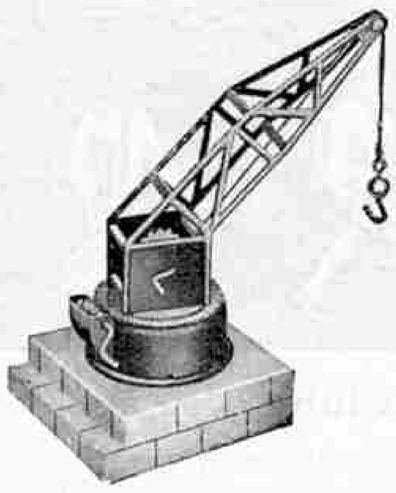

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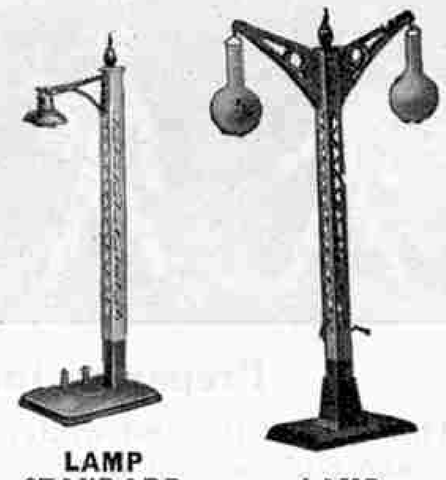

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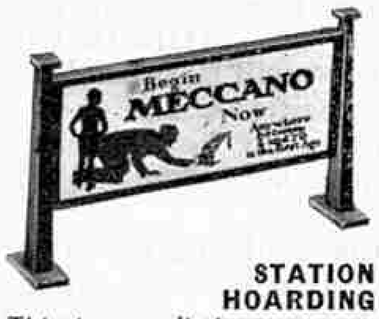

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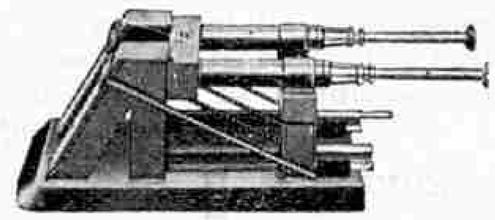

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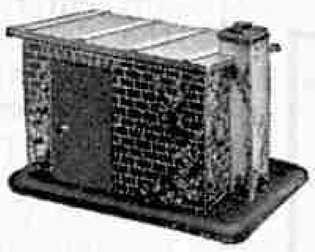

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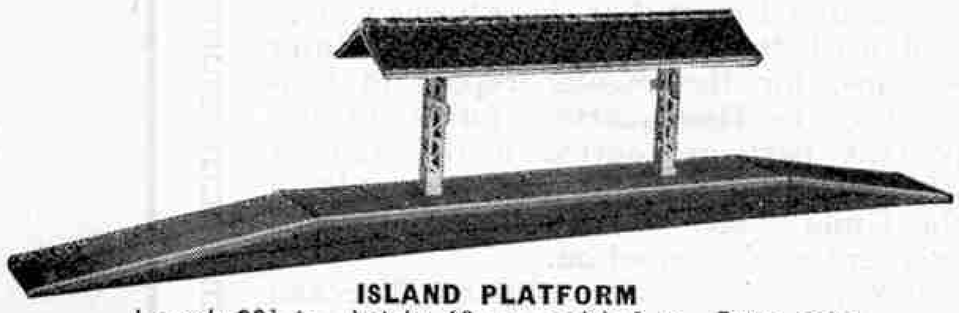

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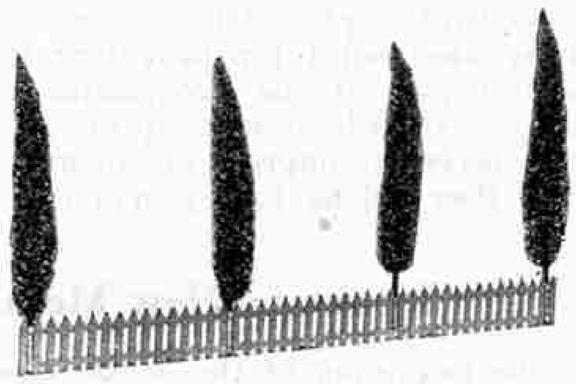

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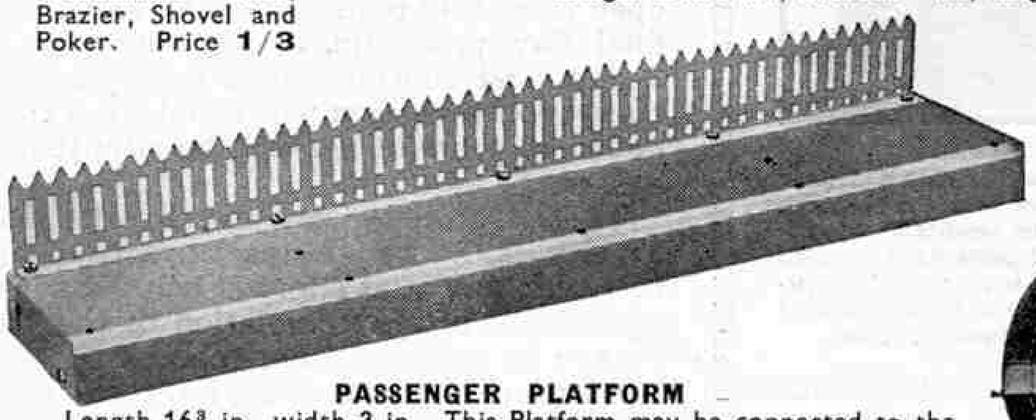

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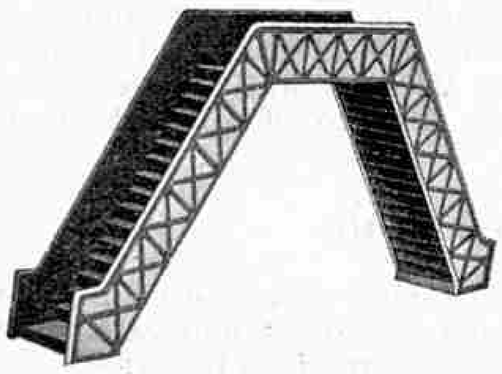

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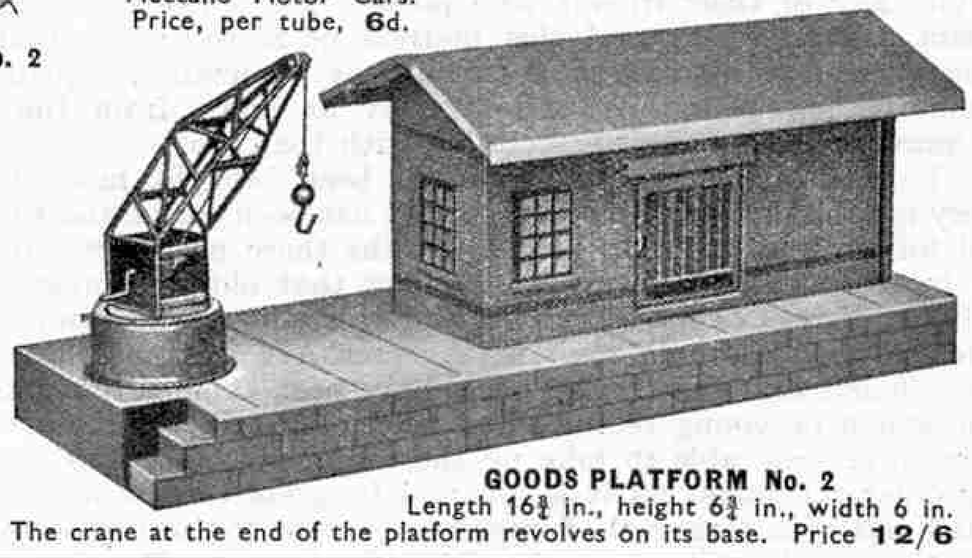

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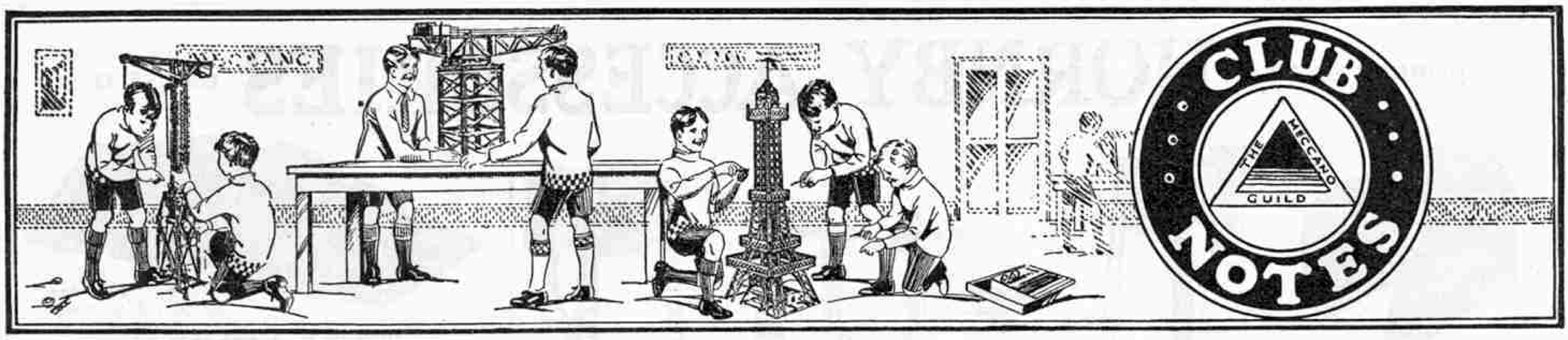
Length 16¾ in., height 6¾ in., width 6 in.
The crane at the end of the platform revolves on its base. Price **12/6**

MECCANO LIMITED, BINNS ROAD, LIVERPOOL 13



Hornsea M.C.—The Fourth Anniversary of the club was celebrated by a Party at which a concert was given by members. The final talks in the series on Industrial Chemistry have been given and Lantern Lectures on the "*Locomotive*," kindly given by Mr. Macreth of the L.N.E.R., and "*Railway Signalling*" by Mr. Bloomfield, were greatly appreciated. Cricket has been played regularly throughout the summer, and non-members have been allowed to take part in the games and practices. Club roll: 75. *Secretary:* L. Chapman, "Cleveleys," Hull Road, Hornsea.

Bridport Grammar School M.C.—During the summer members spent pleasant evenings in outdoor pursuits and in sea trips of various kinds. Interest in model-building is developing and indoor meetings have been resumed. One member of the club has won a prize in a contest announced in the "*M.M.*" and others are endeavouring to follow his example. The club is in a sound condition financially and enjoyable times are expected at meetings during the coming winter sessions. Club roll: 20. *Secretary:* H. M. Dommett, West Allington, Bridport, Dorset.

Macclesfield Grammar School M.C.—Affiliation to the Meccano Guild has now been secured and members are keen and enthusiastic. Model - building Evenings have been held regularly and special attention is paid to order and tidiness in handling material. A Library has been formed, copies of the "*M.M.*" being in great demand, and a Hornby Railway, to be laid down in the school gymnasium, is being planned. The club's first Exhibition was visited by the Bishop of Chester and the Mayor of Macclesfield. Club roll: 20. *Secretary:* D. Warburton, 57, Church Street, Marple, Cheshire.

Mall School M.C.—During the outdoor season members played cricket regularly, and the club was strong enough to arrange matches against the rest of the school. The Annual Sports Meeting was very successful. Club roll: 26. *Secretary:* K. W. R. Rubin, Mendip Lodge, 33, Clifden Road, Twickenham, Middlesex.

Sid Vale M.C.—A Cricket Match, a Treasure Hunt and Rambles among the surrounding hills and on the cliffs have been the chief items of the summer programme. A Paper Chase also was very enjoyable and a novelty was a Whistling Chase, in which two members giving occasional clues to their whereabouts by whistling are hunted by the rest of the club. A special event was a visit from members of the Exeter M.C. who had cycled to Sidmouth. Tea was provided for the visitors, who were then shown round the district. Club roll: 20. *Secretary:* L. R. J. Gliddon, Sheffield House, Sidmouth.

Sutton Valence M.C.—Members of this newly affiliated club meet in a class room of the school, in which they can read or build models whenever they have time to spare. At regular meetings models for the club's Exhibition at the School Show were planned and built, and discussions were held on new models described in the "*M.M.*" Interesting visits have included a tour of Maidstone Zoo, and a cycle run to Chatham Dockyard. Club roll: 16. *Secretary:* C. G. Ledger, Little Belringham Farm, Sutton Valence, Nr. Maidstone.

Bexleyheath Boys' Central School M.C.—Summer meetings have been held out of doors, the most notable being a visit to the Science Museum, South Kensington. On the way members were fortunate in being given an opportunity to inspect a "Schools" class engine from the footplate. Members of the club assisted in the production of a play by the School Operatic Society. New members are now being recruited to take the places of those who have left school, and an interesting programme has been arranged. Club roll: 25. *Secretary:* D. Choppen, 29, Marlborough Road, Bexleyheath, Kent.

Colfe's Grammar School M.C.—Recent interesting events have included a Model-building Contest for road vehicles, the winning model representing a supercharged motor cycle; and a Lecture by Mr. D. G. Terrington on "*Streamlining*" that was illustrated by means of the epidiascope. The secretary was put on trial for conduct detrimental to the welfare of the club, but was found not guilty, apparently because he was supported by Mr. L. V. T. Praeter, Leader of the club and Boxing Instructor in the school! Club roll: 16. *Secretary:* H. H. Renyard, 74, Fernbrook Road, Lewisham, London, S.E.13.

Middlesbrough M.C.—The Swimming Section has had a successful season and other summer activities have included cricket and scouting, a Scout Troop having been formed in connection with the club. Members visited Saltburn for the Annual Outing and thoroughly enjoyed themselves. On Model-building nights Bridge-building Contests have been held, the new vertical lift bridge across the Tees being a favourite subject with competitors. Club roll: 40. *Secretary:* L. Weighell, 42, Bishopton Road, Middlesbrough.

Corner House (Corsham) M.C.—There is keen competition in the Model-building Contests, in which marks are awarded to members for each model submitted, the prize being awarded for the largest aggregate of points. At some meetings members build models selected by themselves, and at others special subjects are set, recent meetings being devoted to the construction of fairground models and military models respectively. Special interest is taken in aeroplanes and members build Meccano reproductions of famous machines. Hornby train meetings are held at regular intervals. Club roll: 18. *Secretary:* R. Bidmead, High Street, Corsham.

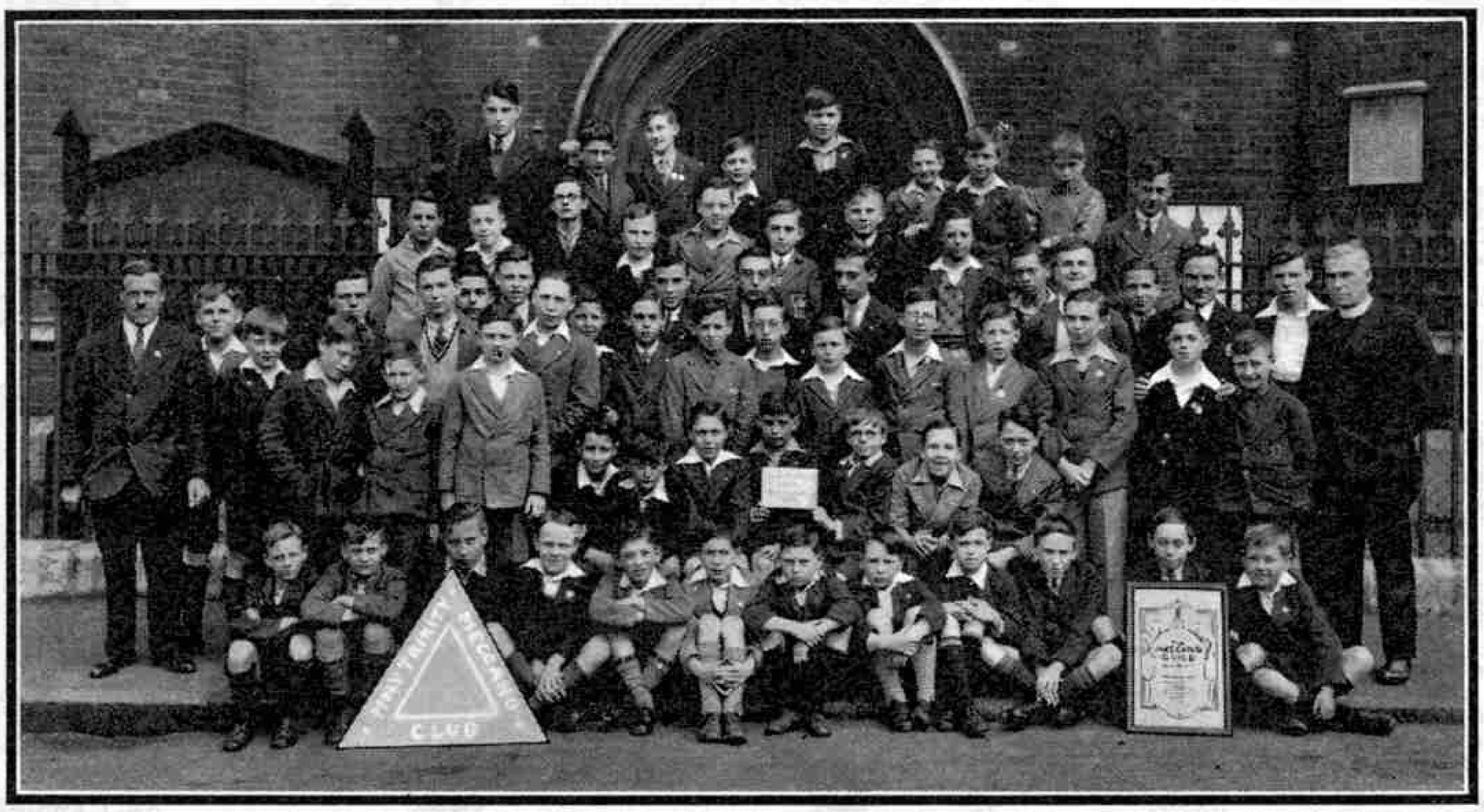
Wednesbury and District M.C.—Model-building continues to be the chief activity of members, who are constructing large club models. A lecture on "*The Life of I. K. Brunel*" was given by K. Hitchman, and other meetings have been devoted to games, chiefly table tennis and cricket. Club roll: 10. *Secretary:* A. L. Morgan, 17, Cobden St., Fallings Heath, Wednesbury.

Old Charlton M.C.—Special interest has been taken in "Talks" Competitions, and other meetings have included a demonstration of a short wave wireless receiver, an Electrical Evening and a Mock Trial. At recent model-building meetings members were asked to construct models of Stationary Steam Engines and Motor Chassis respectively. Club roll: 24. *Secretary:* B. Stevens, 53, Mount Street, Charlton, London, S.E.7.

Plymouth M.C.—New sections have been formed for Fretwork, Chemistry, Stamp Collecting and Reading. Members are allotted to each section, in which they remain for a month before being transferred to another. A tour of the Plymouth Gas Works was very interesting, and members greatly enjoyed a day on the moors, when a cricket match was played against a team of members of the associated Branch of the H.R.C. Club roll: 70. *Secretary:* P. C. Frizzell, 85, Beacon Park Road, Swilly, Plymouth.

King's Lynn M.C.—The Summer Session was spent in boating, playing tennis and camping. The club possesses a sailing boat that has been fitted with a new sail, and enjoyable week-ends have been spent in the club camp at Hunstanton. A billiard table has been presented to the club by Mr. I. J. Thatcher, President. As in previous years, the club is entering a team in the King's Lynn and District Table Tennis League. *Secretary:* G. D. V. Dey, The Laurels, Wootton Road, Gaywood.

Gate House School M.C.—The Exhibition was remarkably successful. The principal exhibit consisted of a wharf with appropriate Meccano models, and the Hornby Train Section made an excellent display, running a new service of trains on a layout that passed through a tunnel consisting of paper covered with sawdust dyed green to represent grass. A model theatre was built by the Fretwork Section. Members are now designing and constructing a Meccano Mechanical Man. *Secretary:* F. Melville, 131, Wilmot Street, Bethnal Green, London, E.2.



Members of the Holy Trinity (Barnsbury) M.C., with Rev. T. Darlington, Patron, on the right, and Mr. Stuart Wilson, Leader, on the left. This club was the first to be affiliated to the Meccano Guild on its formation in 1919, and this month is holding its 15th Annual Exhibition, full details of which are given on page 815.

AUSTRALIA

Marlborough (Mont Albert) M.C.—Senior and Junior Sections have been formed and special Model - building Contests are arranged for both sections. Members of the Senior Section are constructing a permanent Hornby train layout and have spent interesting evenings in trials of locomotive speeds and power. A visit was paid to the office of the "*Reporter*," where modern printing machinery at work was inspected. Full reports of club meetings appear in this weekly journal. Club roll: 21. *Secretary:* I. L. Scott, 76, Victoria Crescent, Mont Albert, E.10, Victoria, Australia.

NEW ZEALAND

Christchurch M.C.—A feature of a Recruiting Campaign was a request to former members to support the club and suggest means for improving the programmes. Interesting meetings arranged have included a talk by Mr. D. Cox, President, on his visit to Australia, and a Cinematograph Entertainment. Visits have been paid to a local signal cabin and the Wigram Aerodrome, which was reached by cycle. At the Aerodrome members were shown how aerial mapping is carried out and inspected a new D.H. "Fox Moth" about to depart on a passenger flight to Franz Josef Glacier, in the New Zealand Alps. Club roll: 25. *Secretary:* R. F. Worsley, 50, Opawa Road, Opawa, Christchurch, New Zealand.

SOUTH AFRICA

Pioneer (Pietermaritzburg) M.C.—Good progress is being made by this newly organised club. Meetings for model-building are held on Saturday evenings, and Thursday evenings are spent in physical exercises, drill and games. At model-building meetings a special feature is made of contests in which models must be completed within a specified time, and this practice is helping to develop speed and skill. Club roll: 14. *Secretary:* A. H. Alley, 461, Burger Street, Pietermaritzburg, South Africa.

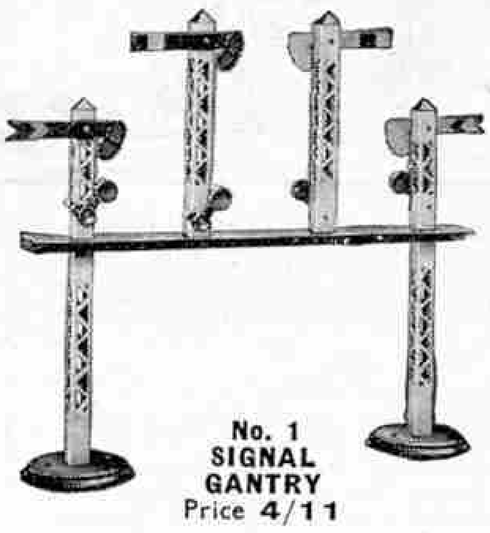
HORNBY SERIES

HORNBY ACCESSORIES

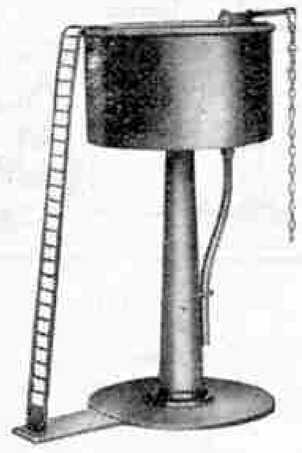
GAUGE O

TUNNEL No. 0 (Straight)
Length 6 in., width 6⅛ in.
Price **1/3**
TUNNEL No. 1 (Straight)
Length 7 11/16 in. Width 6¼ in.
(as illustrated). Price **1/9**
TUNNEL No. 2 (Straight)
Length 15⅝ in. Width 9½ in.
Price **3/6**

No. 1 WATER TANK
Fitted with flexible tube and valve lever.
Stands 6½ in. high.
Price **3/-**



No. 1 SIGNAL GANTRY
Price **4/11**



No. 2 WATER TANK
Fitted with flexible tube and valve lever.
Stands 8½ in. high.
Price **5/9**

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

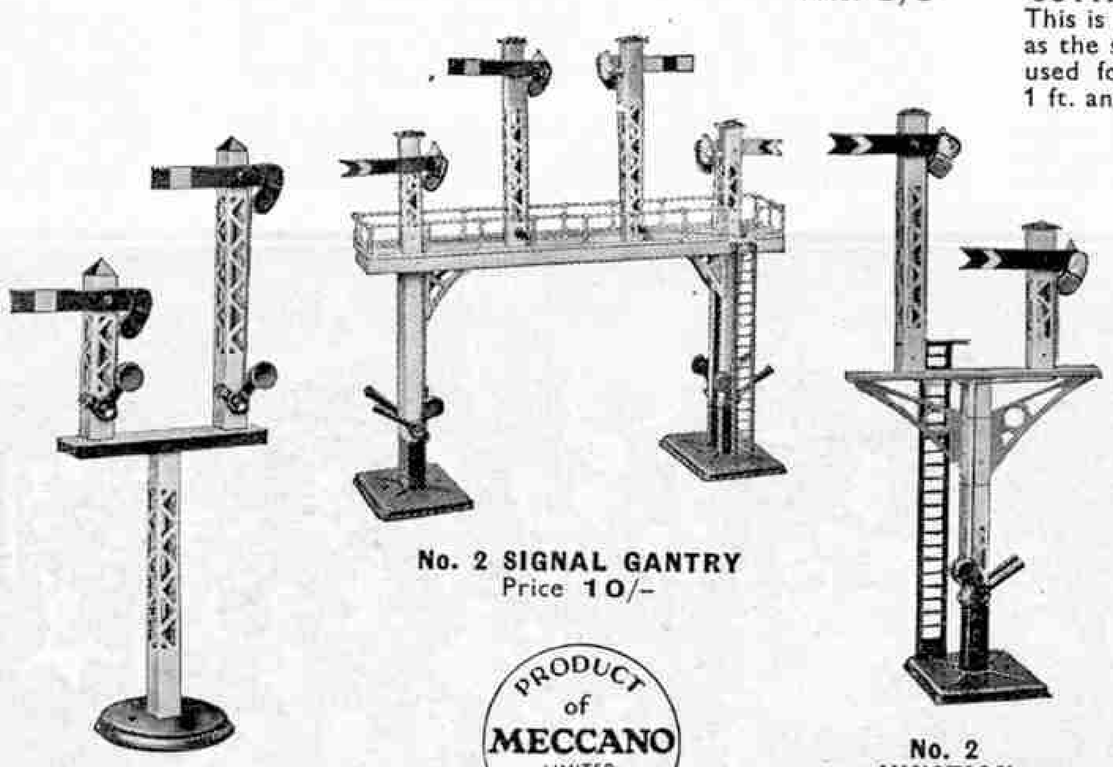
CUTTING No. 1 (END SECTION)
(illustrated)
Base measurement: Length 7 11/16 in., width 6 in.
Price, per pair, **3/-**

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/-**

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 **6/9**

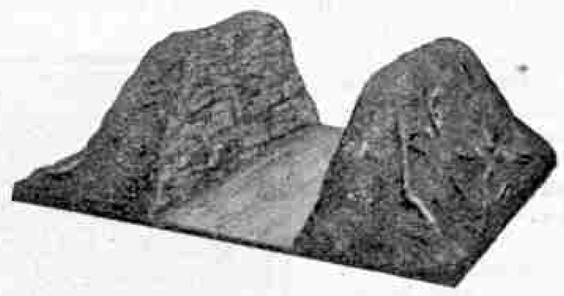
TUNNEL No. 6
(RIGHT-HAND, CURVED)
Similar to No. 5 Tunnel, but with track in the reverse position. For 2 ft. radius tracks only. Base measurement 15⅞ × 14¾ in.
Length of track 17¼ in. Price **6/9**



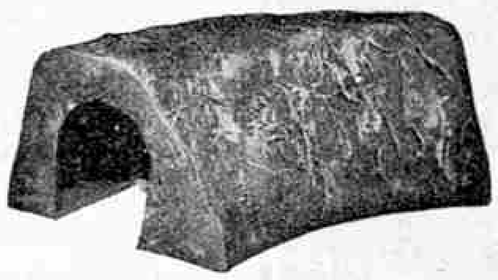
No. 2 SIGNAL GANTRY
Price **10/-**

No. 1 JUNCTION SIGNAL
Price **2/9**

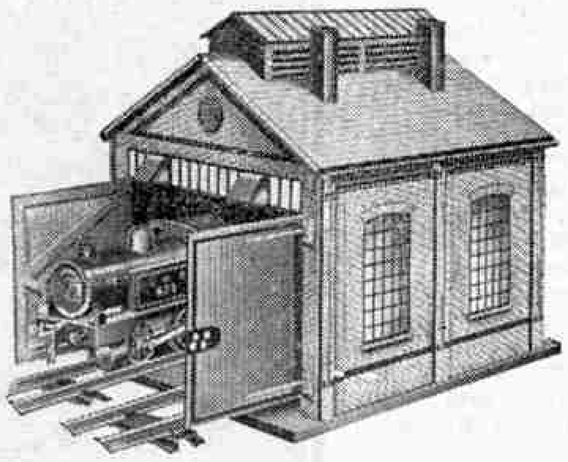
No. 2 JUNCTION SIGNAL
Price **4/9**



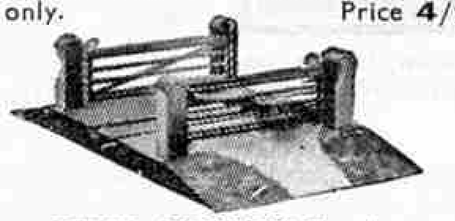
CUTTING No. 4 (STRAIGHT)
This is a double cutting, mounted on a base over which the railway track is laid.
Base measurement: Length 15⅜ in., width 15 in. Price **6/-**



TUNNEL No. 3 (Curved)
Length 13 in. Price **4/-**
TUNNEL No. 4 (Curved)
(as illustrated)
Length 20 in. For 2 ft. radius tracks only. Price **4/9**

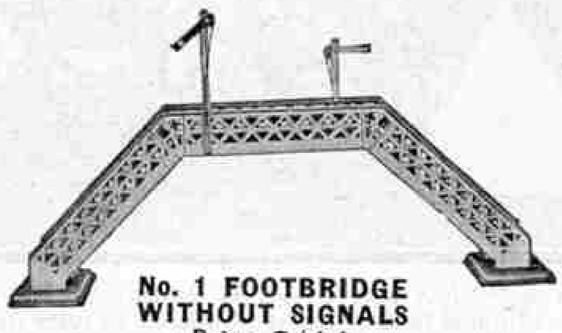


No. 1 ENGINE SHED
This Shed will accommodate any Locomotive and Tender with an overall length not exceeding 8¾ in. ... Price **15/-**
No. 2 ENGINE SHED
This Shed will accommodate any Locomotive and Tender with an overall length not exceeding 17½ in. ... Price **22/6**



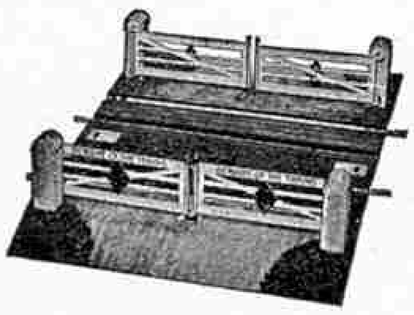
LEVEL CROSSING No. 1
Suitable for a single track only and has Gauge O rails in position.
Price **2/11**

No. 1 SIGNAL CABIN
Price **2/9**
No. 2 SIGNAL CABIN
(illustrated)
Dimensions: Height 6½ in., width 3½ in., length 6½ in. Roof and back open to allow Lever Frame to be fitted inside cabin if desired.
Price **4/6**



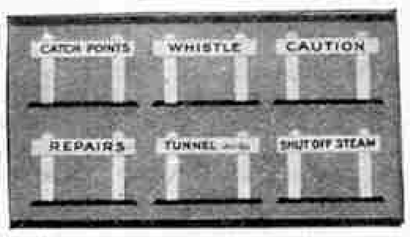
No. 1 FOOTBRIDGE WITHOUT SIGNALS
Price **2/11**
No. 1A FOOTBRIDGE, COMPLETE WITH SIGNALS. Price **4/6**

SHUNTER'S POLE
Price **2d.** each

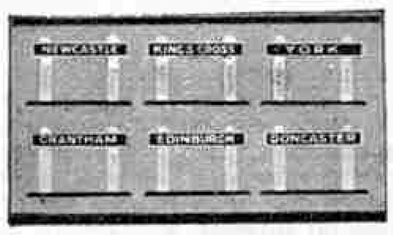


LEVEL CROSSING No. 2
Measures 13½ x 10¼ in., with two tracks of gauge O rails in position. Price **5/6**
LEVEL CROSSING No. E2
(Electrical)
Similar to Level Crossing No. 2 excepting that a third rail is fitted in each of the two tracks. Price **7/6**

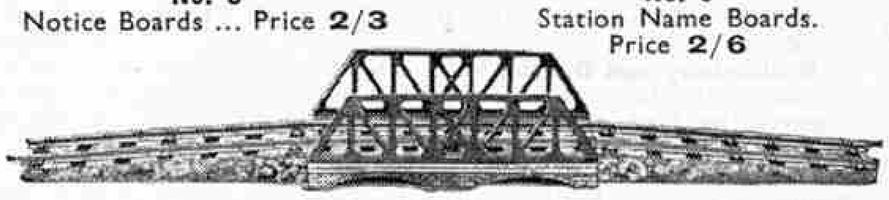
M TELEGRAPH POLE No. 2
Price **4d.** each



RAILWAY ACCESSORIES
No. 8
Notice Boards ... Price **2/3**

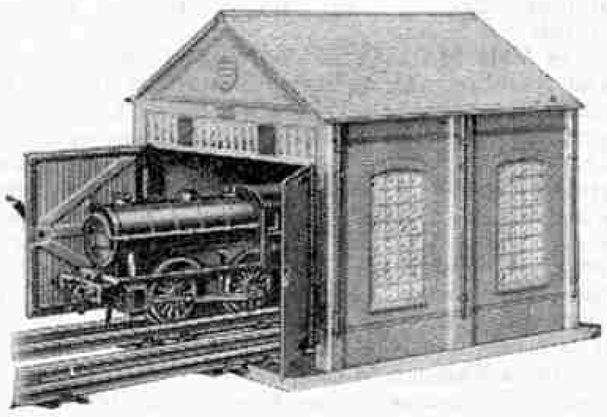


RAILWAY ACCESSORIES
No. 9
Station Name Boards.
Price **2/6**



VIADUCT. Price **6/6** **VIADUCT ELECTRICAL.** Price **7/6**
VIADUCT. Centre Section only. Price **4/-**
VIADUCT (electrical). Centre Section only ... Price **4/6**

TELEGRAPH POLE
Price, per pair, **3/6**



No. 1A ENGINE SHED
This Shed is of the same dimensions as the No. 1 Shed described above, but is of simpler design, and has doors at one end only ... ... Price **10/6**
No. 2A ENGINE SHED
This Shed is of the same dimensions as the No. 2 Shed described above, but is of simpler design ... ... Price **17/6**

PRODUCT of MECCANO LIMITED LIVERPOOL

MECCANO LIMITED — BINNS ROAD — LIVERPOOL 13

Branch News

ALFRETON.—Members of the Branch are keen and enthusiastic and their operations are not confined to running to timetable, but include careful track laying and repairs to the permanent way and rolling stock. These operations are carried on under the direction of the Chief Engineer and the Locomotive Superintendent. During the summer excursions have been made to places of railway interest, members endeavouring to see as many famous trains as possible during their journeys. Some of the members have been as far afield as York. Secretary: A. T. Reid, 5, King Street, Alfreton.

HARLESDEN.—Separate tracks are usually laid down at each meeting, but those of special interest are retained for further operations. At one meeting a high level main track was supplemented by a lower level line, stations at the point where one track crossed the other being connected by steps. A Railway Breakdown Crane and other useful models have been built from Meccano parts and have found useful application in Hornby Train operations. Secretary: J. Summers, 11, Radcliffe Avenue, Harlesden, London, N.W.10.

BURTON MODEL RAILWAY.—Owing to a change of Branch room, recent meetings have consisted chiefly of visits. The L.N.E.R. Locomotive Depot at Colwick has been inspected and the L.M.S.R. water softening plant at Loughborough has been examined, members being allowed to climb to the top of the water tower and to see chemical tests of the purity of the water supplied to locomotives. At track meetings a temporary layout has been used, and the Branch track will be rebuilt and extended as soon as a new room has been secured. Secretary: R. E. Trotter, 2, Radmoor Road, Loughborough.

SHEFFIELD.—The first anniversary of the Branch was celebrated by a successful outdoor track meeting. Steady progress has been made with the overhauling of track and rolling stock in preparation for coming activities, and timetables are being tested on a temporary track. During the summer members have played cricket and visited the swimming baths regularly, and an engine shed, stations and other accessories have been constructed and painted. Secretary: W. B. Hutchinson, 35, Linden Avenue, Sheffield, 8.

STREATHAM PARK.—The Annual Exhibition attracted 47 visitors, all of whom were interested in the working of the colour light signals on the Branch track and in the use made of the Hornby Control System, which has been applied to 16 points on the layout. The Branch track has been altered and extended in order to give better running, and a double continuous track is now available throughout. Talks on *"Famous Expresses"* and on different types of locomotives have been greatly appreciated by members. Secretary: J. B. Cass, 161, Ribblesdale Road, London, S.W.16.

A group of members of the Hillplace (Crawley) Branch, No. 252, which was incorporated in October, 1933. Mr. J. S. Kennard-Davis, Chairman, and Mr. B. M. Delaney, General Manager, are second and third from the left in the second row. The Branch track is double throughout and operations are controlled by means of colour light signals.

BELFORT (CATFORD).—Summer visits have been paid to the Science Museum, South Kensington, the Imperial War Museum, and the S.R. Marshalling Yard at Hither Green. Preparations are now in progress for the winter sessions, for which an excellent programme has been arranged, and the secretary will be glad to hear from local enthusiasts who wish to join the Branch. Secretary: F. B. Graves, 133, Bromley Road, Catford, London, S.E.6.

SANDHURST.—A new club room has been secured and a permanent layout now enables excellent track meetings to be held. Many summer meetings have been held out of doors, and a particularly enjoyable excursion was a long ramble during which an interesting light railway journey was made. Secretary: F. Y. Fairhall, "Canterbury Bell," Sandhurst, Kent.

DAGENHAM.—In conjunction with the associated Meccano club, a very successful Exhibition was organised, part of the proceeds being devoted to an enjoyable excursion. Recent events have included cycle runs, rambles and other outdoor activities. A camp was organised for members of the Cycling Section and a Branch trip to the seaside was exceedingly enjoyable. The official organ of the Branch is *"The Spanner,"* which is well supported by members. Secretary: Mr. P. Bush, 121, Church Elm Lane, Dagenham.

AUSTRALIA

PERTH (WESTERN AUSTRALIA).—The main line of the Branch track is now nearing completion. It consists of a double circuit, 22 ft. in length and 15 ft. in width, with two signal boxes placed at a double junction and a crossing respectively. Two stations have been incorporated and others will be included when branch lines are developed. Realistic surroundings are being provided and a novelty is the use of pieces of sponge gathered on the beach as trees. These are dyed a suitable colour. Secretary: J. Stanbridge, 285, Lord Street, Perth.

Branches in Course of Formation

The following new Branches of the Hornby Railway Company are at present in process of formation and any 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 apply.

DERBY—Messrs. Orton Bros., 35, Friar Gate, Derby.

JOPPA—J. Duncan, 21, Abercorn Terrace, Joppa.

HOLLAND—L. L. Th. Huls, Muirhuizen 87b, Amersfort, Holland.

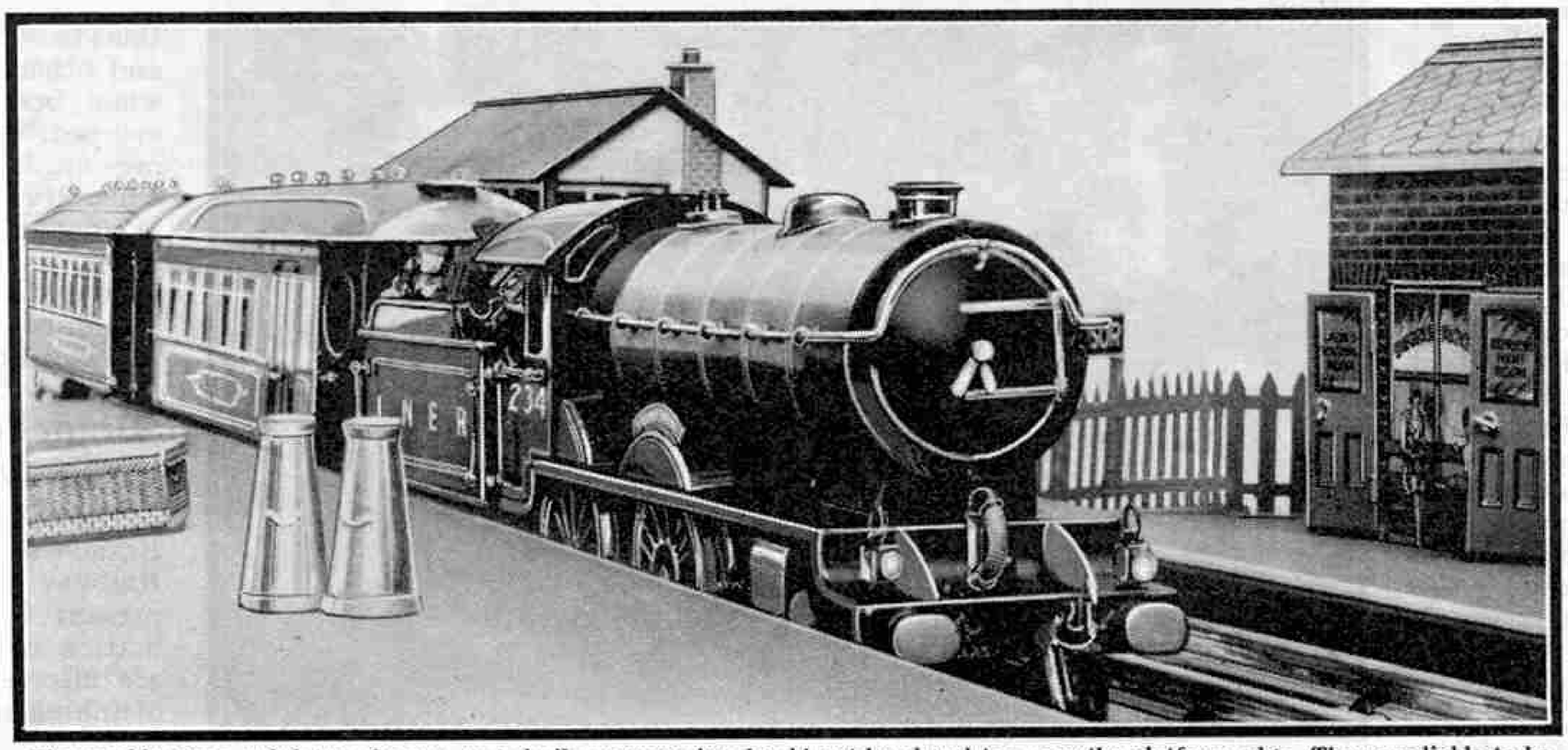
Branches Recently Incorporated

267. OTTAWA—Mr. E. R. Gray, 251, Flora Street, Ottawa, Canada.
268. BON-ACCORD (Aberdeen)—J. S. Rowand, 1, Adelphi, Aberdeen.
269. ST. THOMAS (Exeter)—A. Adams, 24, Holland Road, St. Thomas, Exeter.
270. DAGENHAM—P. Bush, 121, Church Elm Lane, Dagenham.
271. 2ND SHEFFIELD—A. N. Blackhurst, 93, Cookes Road, Sheffield, 10.
272. ST. GILES'—Mr. R. Croall, 16, Bangholm Avenue, Leith, Edinburgh.

MODEL RAILWAY RULES

IN the operation of a miniature railway system there are various principles that must be observed if the running of the trains is to be carried out with smoothness and efficiency. This does not refer to the particular instructions sent out with Hornby locomotives and train sets, which of course must be carefully attended to, but to the methods that are adopted automatically by the miniature railway owner as his operating experience widens with the development of his system.

At this time of the year, when many turn to the miniature railway hobby for the first time, and the older enthusiasts redirect their attention to it, it will be useful and interesting to give what we may term operating hints or rules that apply more or less to all systems, according to conditions. It will show the younger railwayman what to avoid generally in the running of a train service, thus eliminating mishaps that cause a great deal of annoyance and often result in damage to locomotives, rolling stock and equipment. It will probably recall to the older reader early mishaps that he experienced and, in addition to refreshing his memory on points that may have been forgotten, it may offer further suggestions that will result in improving even an already efficient system.



Pieces of luggage, miniature figures, and similar accessories should not be placed too near the platform edge. They are liable to be disturbed by the vibration of passing trains, and may even fall on to the line and cause derailments.

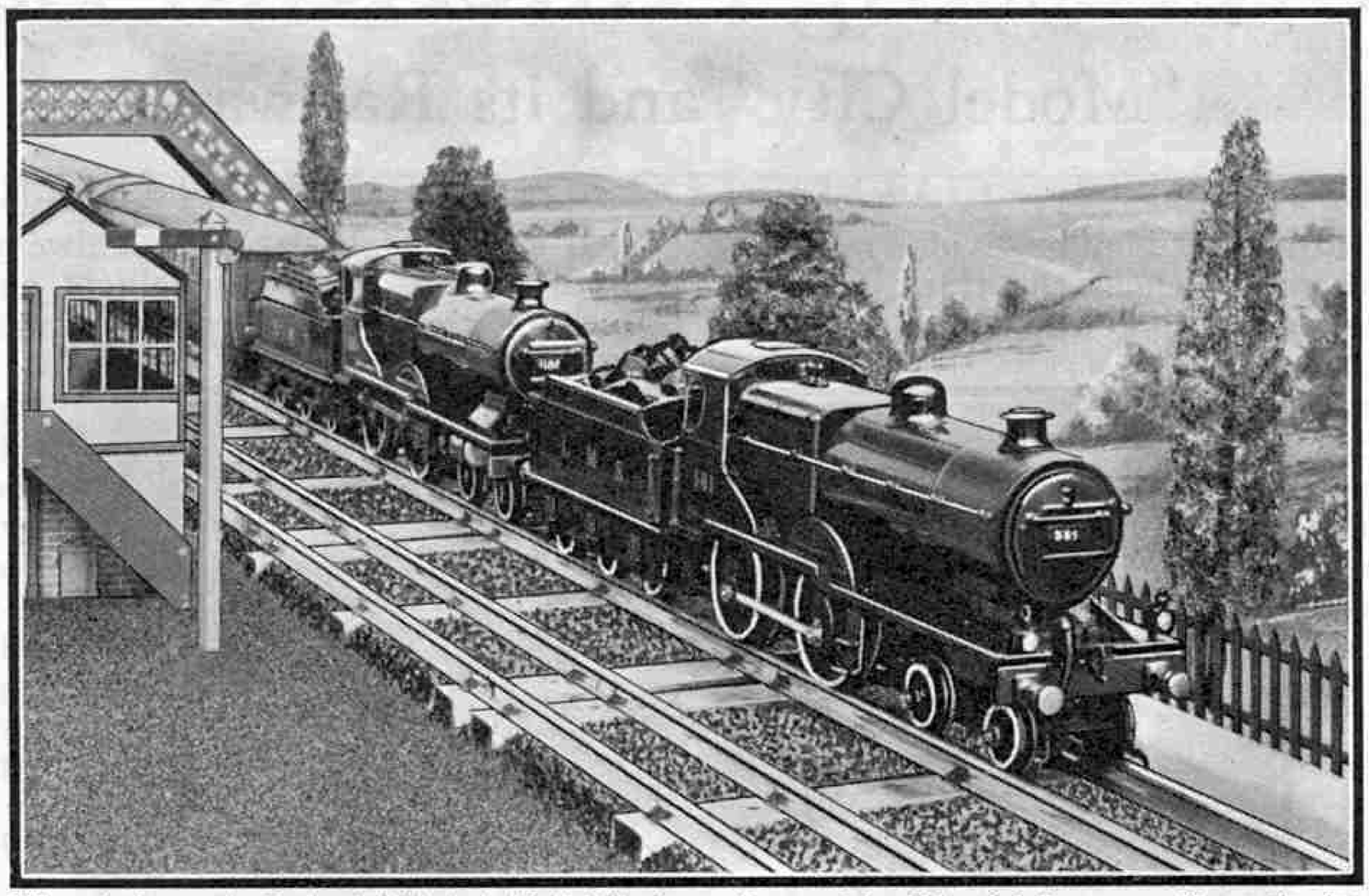
As all readers know, the operation of real trains is closely guarded by the "Book of Rules and Regulations." The various hints about to be given may be considered in the light of a "Hornby Railway Rule Book," and those keen on detail may even prepare a set of rules on similar lines for particular application to their own systems.

We will assume that the elementary precautions with regard to the track and stock, as mentioned in the various instruction leaflets, have been carried out. Taking then the assembly of a suitable train as a necessary step before it runs, it is desirable that the vehicles forming a train should be similar in size and type, according to whether they are bogie stock or four-wheelers. A favourite scheme is to include four-wheeled vans for milk, parcels, or other urgent traffic in a passenger train. Frequently such vehicles are attached next to the engine for convenience, and in front of more or less heavy bogie vehicles. When passing smartly round curves, and particularly over reverse or complicated curved formations, there is a tendency for the light four-wheeled vans to be overturned by the pull of the heavier vehicles behind them. Again, if the engine is retarded suddenly in an emergency, the light vehicles will be "nipped" between the heavy stock and the engine, and may even be lifted off the track.

In order to avoid such possibilities, which are irritating when they become actual occurrences, it may be laid down that any light four-wheeled vehicles such as milk vans must be conveyed at the tail of a train of bogie stock. They may of course be weighted by placing heavy substances inside them, but this is not realistic. A much more satisfactory scheme is to fit such vehicles with Hornby solid die-cast "Mansell" or spoked wheels. In general "Mansell" wheels should be fitted to vans and spoked wheels to ordinary wagons. This makes them more free running, and also adds to their weight below, so that they become much more stable when running. The suggested "rule," therefore, may have an exception that four-wheeled stock fitted with die-cast wheels may be run behind the engine of a heavy bogie train.

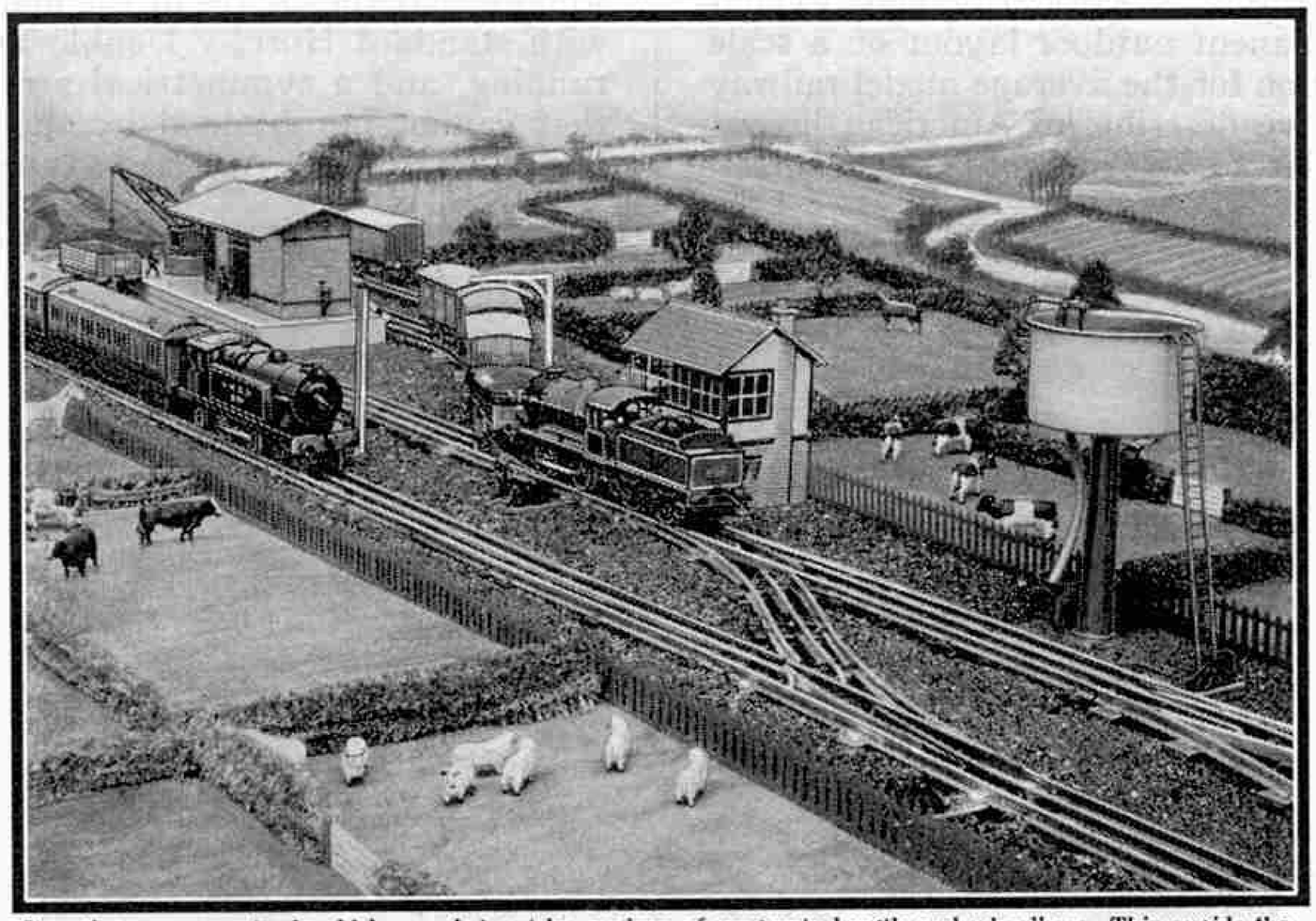
The loading of miniature freight trains is a popular and interesting part of model railway operation, and here again restrictions on the marshalling of loaded wagons must usually be observed. For convenience in working the traffic it is often necessary to arrange several empty wagons next to the engine, the loaded ones forming the rear of the train. Here the empty and light vehicles

between the engine and the heavy ones may get pulled over on curves if the train is a long one. Die-cast wheels again will aid matters, or alternatively care must be exercised in marshalling the train. It is very disappointing to have a long and heavy goods train approach a curve and then suddenly find the first few wagons have derailed. The trouble with a derailment is that in a long train it seems to spread from wagon to wagon until the whole train more or less is off the track. Derailments, therefore, are things to be avoided.



Where trains are double-headed it is desirable that the two engines used should be of similar power. Here a Hornby No. 2 Special Midland Compound Locomotive is being piloted by a similar engine, rebuilt as described in the "M.M." for February 1933 to represent a "2P" class locomotive with inside cylinders.

Trouble is frequently experienced in attempting to carry out shunting operations, owing to the neglect of various precautions. In the first place the speed of the locomotive, where clockwork engines are used, is usually much too high. This is because the engine is invariably fully wound before starting a series of shunting movements, and as a result it puts much more vigour into the operations than is necessary where one or two wagons at a time are to be shifted a few feet. Real shunting operations are not carried out at high speed, and some attempt should be made to reproduce actual practice. This may be done by making use of a method frequently advised in these pages—that of winding the engine to an extent just sufficient for each particular movement that is to be made. This may sound difficult, but after a few experiments it is easy to gauge closely what is necessary in the way of winding. The frequent winding up is scarcely noticed in the excitement, and where two operators are available it may be performed by the "driver," while the "shunter" is engaged in moving points or in dealing with the trucks. Where electricity is employed as the motive power the regulation of the speed is an easy matter.



Shunting movements should be carried out by engines of moderate length and wheelbase. This avoids the trouble frequently experienced when it is attempted to push wagons over reverse curves by means of bogie-fitted locomotives which are not suitable for such work.

Another frequent cause of trouble is the use of an unsuitable type of engine for shunting. A yard layout includes curves, and where a bogie locomotive is in use, the displacement of its front end on curves may be considerable. Such an engine is therefore unsuitable for pushing, chimney first, a train over curved track, especially reverse curves where the direction of travel is suddenly changed. Attempts to do so will invariably result in the wagon next to the engine being pushed off the track. Where the movements are carried out tender first, there is no reason to expect trouble, but engines having bogies or pony trucks should not be made to perform shunting duties with the bogie or pony truck end next to the wagons. The best engines for the work are those of moderate length and with fixed wheelbases, the overhang of the buffer beams at each end being then reduced to a minimum.

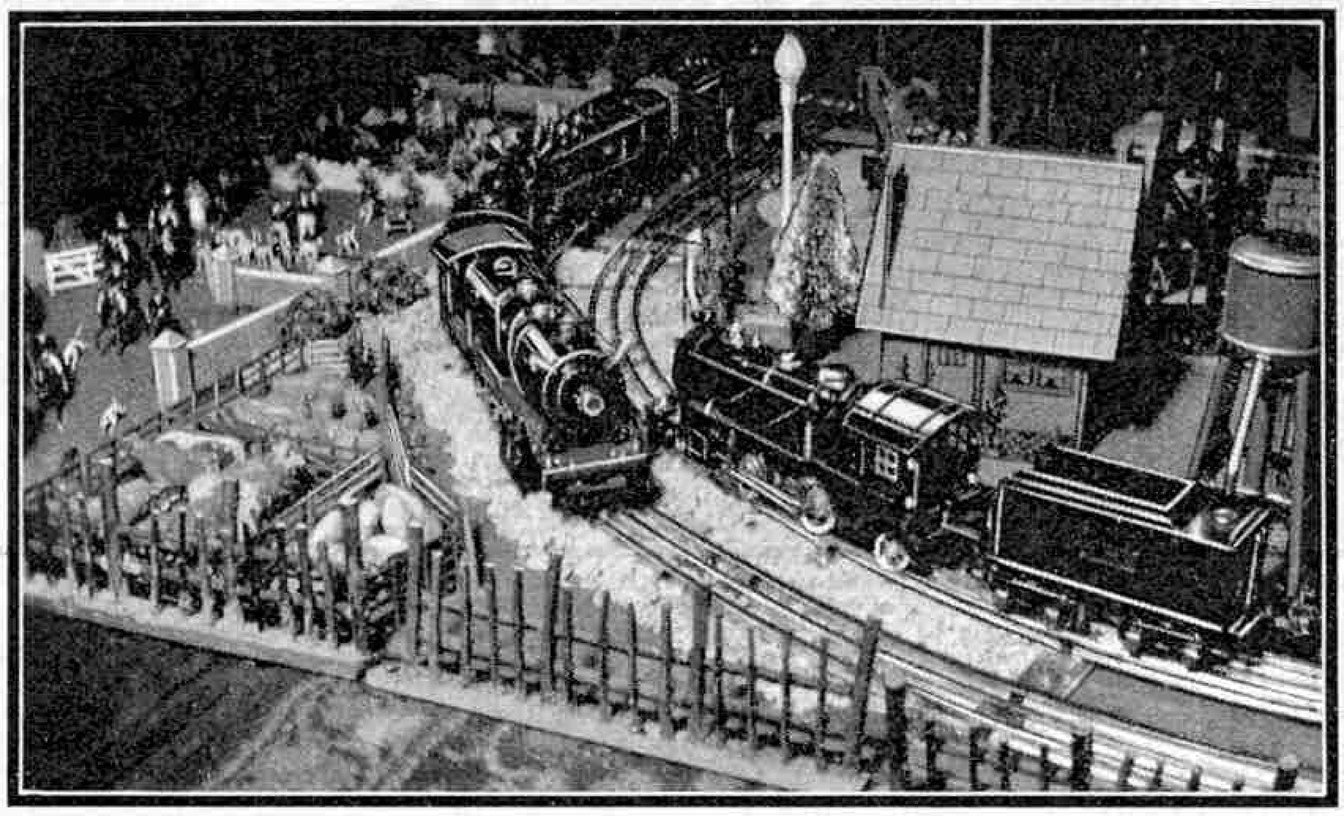
The running of a heavy train may necessitate the provision of a pilot locomotive to assist the train engine. It is desirable that the two engines should be of similar power and running characteristics, otherwise trouble may be caused by the bigger engine tending to overrun the smaller one. The capabilities of clockwork engines vary, so that the model railway Running Superintendent must exercise his own judgment in arranging piloted workings.

Trouble is frequently caused by an inexperienced miniature railway owner attempting to run locomotives and rolling stock over curves that are too sharp for them. It is therefore useful to remember that the smallest radius curves of the Hornby Series, those of 9 in. radius, are only suitable for MO stock. The M3 and No. O components and similar items such as four-wheeled rolling stock of moderate wheelbase will run satisfactorily on 1 ft. curves. For the remainder of the engines and vehicles in the Series, however, 2 ft. radius curves are essential, and it would be impossible for the bogie engines and coaches, or six-wheeled tenders, to negotiate smaller curves.

An Interesting American Layout

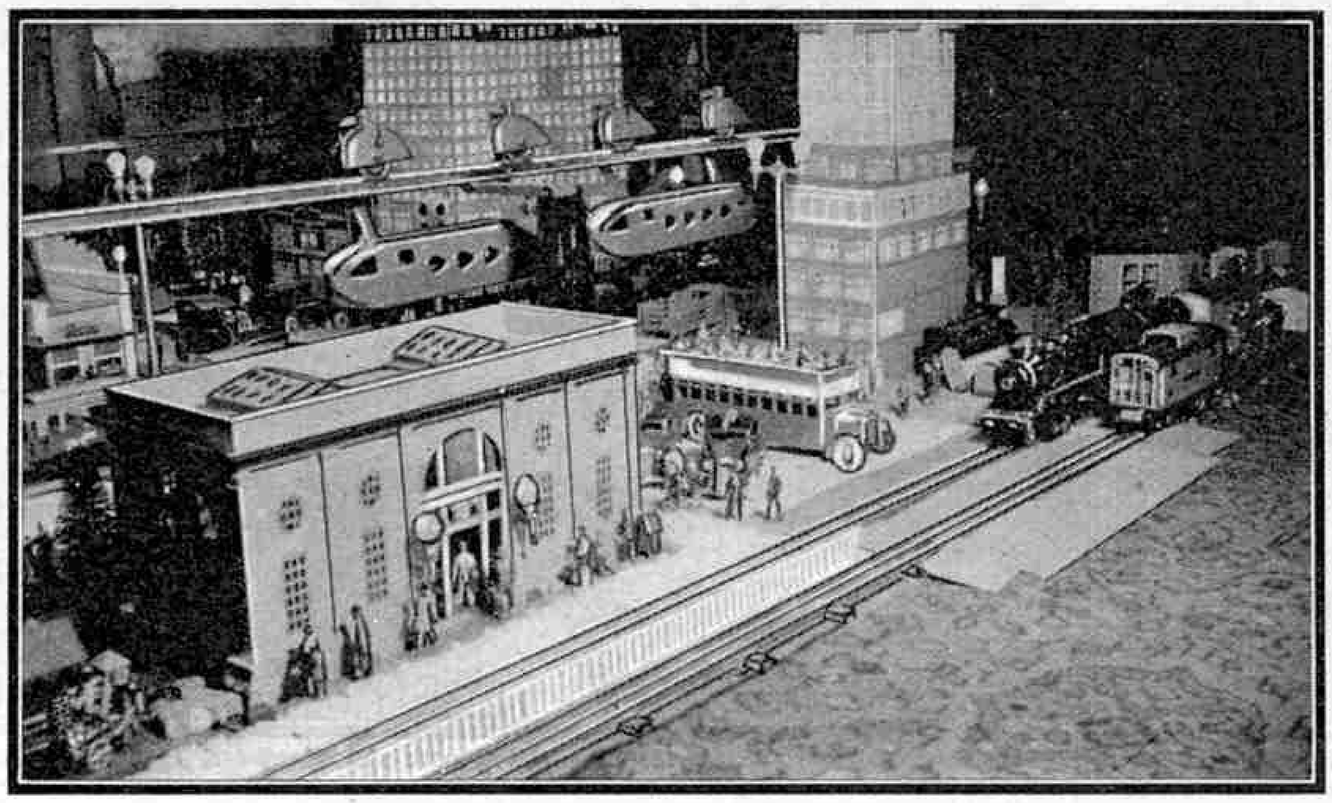
"Model City" and its Railway

MODEL railway enthusiasts may be divided into two main classes—those to whom the track and the trains are everything, and those who prefer to make their railway form part of a scenic system. Enthusiasts of the latter class are comparatively few, because in order to carry out their ideas on any but the smallest scale they must have the necessary space available for developing a permanent layout. We have described from time to time various permanent layouts in which the railway formed part of a country scene with a more or less complete village, and in some cases also a harbour and ships. The most elaborate village layout that we know of is the "Bekonscot" model railway developed by Mr. R. Callingham at Beaconsfield in Buckinghamshire, and described in the "*M.M.*" for April last. The "Bekonscot" railway is a permanent outdoor layout on a scale that is out of the question for the average model railway owner. In this article we describe an American layout that is somewhat similar to "Bekonscot," but is much smaller, is indoors, and is laid down for only some three or four months each year.



An interesting glimpse of "Model City" railway. A train of 18 vehicles hauled by two locomotives, is passing a locomotive engaged in "taking in water" at the wayside tank.

"Model City," as the layout is named, is at Buffalo, U.S.A., and its owner, Mr. Hamilton H. Jones, to whom we are indebted for our information and illustrations, has been a keen follower of the model railway hobby for many years. The chief activities of "Model City" centre about its "Main Street" and "Broadway," and by the busy corner where these two meet is situated the "Railroad Terminal." The station is thus conveniently placed, and is in direct communication with the other systems of local transport, which include an electric street car system and an interesting monorail elevated railway, the cars of which are suspended. In addition there are numerous bus lines and a fleet of taxis, so that dwellers in "Model City" have no reason to complain of any lack of means of getting from place to place in and around their City.



A view showing all the various transport systems used in "Model City." There is the surface railway, the Monorail elevated railway and the roadway with motor and tramcar traffic.

The station is a typical American structure, and serves one track of the double track main line that encircles "Model City." Close by the station there is a "grade crossing" that enables road traffic to cross the line, and in order to warn such traffic there is placed by the crossing one of the usual "Stop, Look and Listen" signals. The railway is necessarily at street level, and its station is typical of the conditions found in many places in the United States where, as for instance at Syracuse, the trains actually run down the centre of the street.

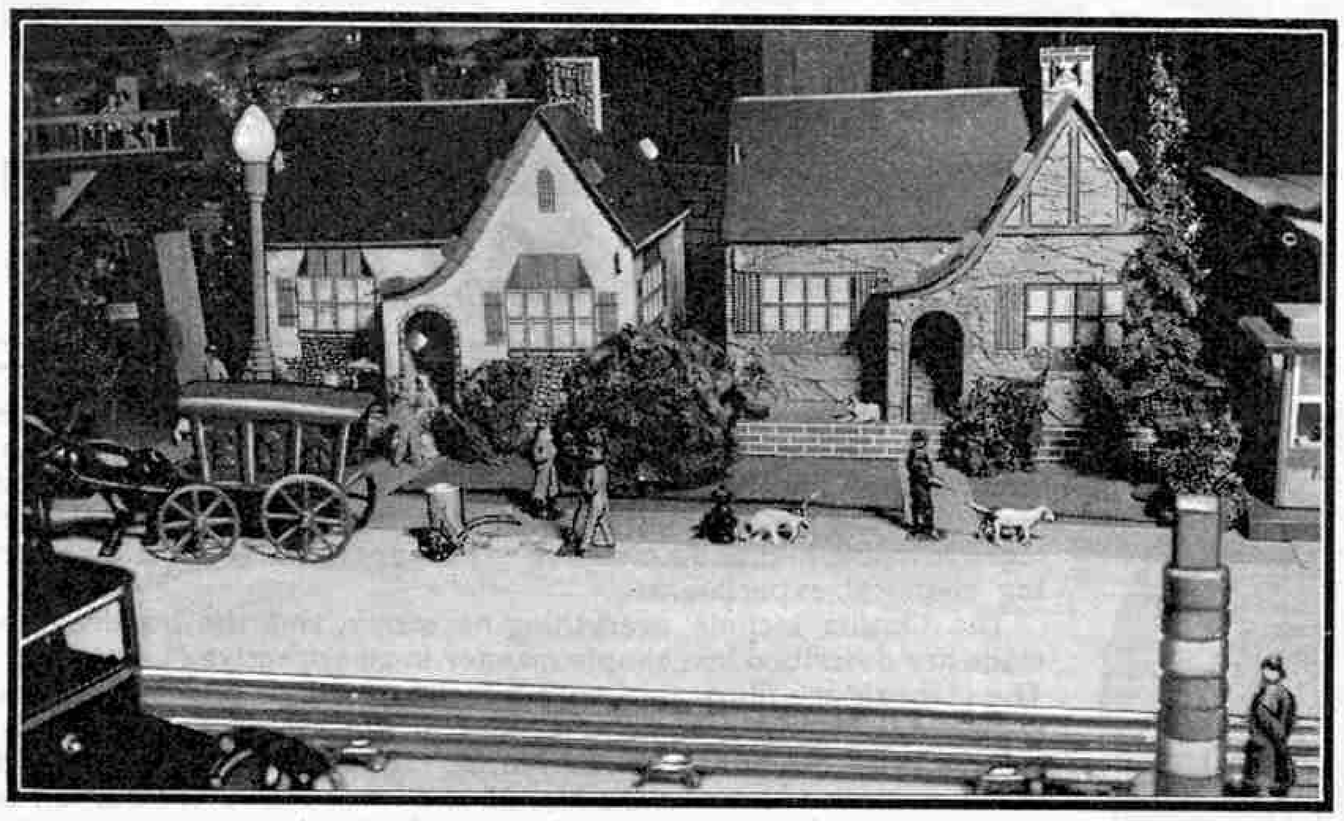
The railway is electrically operated, and it is interesting to note that the curves of the main line are all laid down with standard Hornby Double Track. This gives better running, and a symmetrical arrangement of the tracks that cannot be obtained by the use of standard single track curved rails. American-type equipment is naturally employed, and some idea of the locomotives is shown in the upper photograph on this page, where an 18-car freight train, double-headed, is about to pass another locomotive that is "taking water."

As the result of an inspection of the L.M.S.R. "Royal Scot" at the Chicago World's Fair last year, a Hornby "Royal Scot" locomotive and five Pullman coaches were obtained, thus adding to the variety of the stock, and enabling the American tour of the "Royal Scot" to be reproduced permanently in miniature. The engine and train have handled all the passenger traffic on the system since their introduction, and have been favourably commented upon by many visitors to "Model City."

A point that has attracted the attention and interest

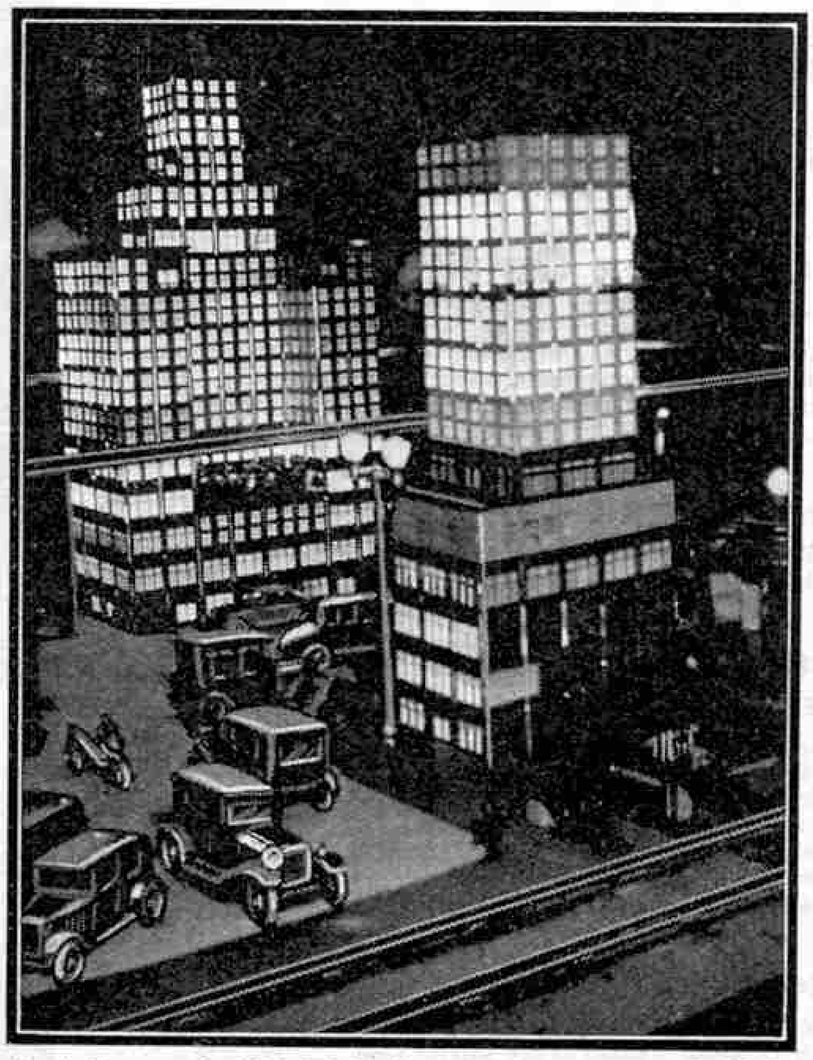
of visitors is that on various occasions Mr. Jones has made his trains observe the British practice of keeping to the left, whereas the American practice is the opposite. It is suggested that this left-hand running tends to make the miniature "Royal Scot" feel more at home! Any possible loneliness of this train is to be removed shortly, however, as it is proposed to add a Hornby "Flying Scotsman" to the equipment in the near future.

The "down-town" area of "Model City" centres about the Terminal or railway station, but in addition to the city "blocks" that characterise this quarter there is a most attractive residential district "up-town." Miniature roads are laid out here in a most effective manner, and although the styles employed for different houses and buildings naturally vary, they harmonise remarkably well. In this part of the layout is situated "Elizabeth Manor," the design of which is based on the timbered type of English residence. At this point a "Hunt" has regular meets, the complete assembly of miniature riders, horses, huntsmen and hounds having a remarkably attractive appearance.



Some of the attractive houses in the residential district of "Model City." Particular care has been taken in their design and construction and the miniature figures add considerably to the effect.

Beyond the "Manor" property is a miniature church, which is one of three buildings on the layout provided with sound equipment. Choir or organ music can be made to issue from the church in an appropriate manner. The other two sound-equipped buildings are the hotel in the "City," which is the large skyscraper shown in the illustration featuring a night scene on this page, and the railway station. Dance music, apparently from the terrace of the hotel, is to be heard at times, while from the railway station the actual noises of a big terminal with trains arriving and departing are reproduced. The sound effects which, as might be expected, add a great deal to the attractiveness of the layout, are obtained by mounting in the buildings miniature loud speakers connected to an amplifier wired to an electrically-operated turntable from which phonograph records are played.



A night scene in "Model City" at the busy corner of "Main Street" and "Broadway." The "sky-scraper" in the background accommodates a loud speaker that causes music to issue from the building.

A splendid variety of miniature figures and accessories is used. In addition to the special people such as the Hunt members, there are numerous examples of the ordinary "man in the street." The corner at the junction of Main Street and Broadway has a policeman on point duty, while the negro street sweeper with his brush and barrow, shown in the upper photograph on this page, is another busy man. Various miniature figures in appropriate attitudes are placed on the platform of the railway station. There are also road vehicles of numerous types, including a breakdown lorry and crane, all of which contribute to the realism and interest of the layout as a whole.

To serve the "City" still better, and to make the railway of even greater interest than at present, extensions are proposed that will give a four-track main line. Another up-to-date item, a reproduction in miniature of the "Zephyr," the streamlined train of the Chicago, Burlington and Quincy line, is ready to commence service as soon as "Model City" springs into being again this winter.

It is hoped that this account of the layout will stimulate the interest of "*M.M.*" readers and Hornby Railway owners, and induce them to pay great attention to the scenic and line-side effects of their own layouts. It is not so much in the actual items of scenic interest, as in their disposition, that errors are made, chiefly owing to lack of thought. It is a good plan, therefore, to endeavour to copy some actual situation when puzzled as to the best course to pursue.

With regard to scenic details, the Hornby Series includes a considerable amount of material that can be used with advantage. There are the well-known Countryside Sections, which are surprisingly adaptable, and always look particularly attractive. There are the lengths of Paled Fencing, obtainable with or without suitable miniature trees attached to them. Then there are the Trees themselves, obtainable either as poplars or oaks. Special die-cast stands are made for them, enabling them to be "planted" as required anywhere on the system without the necessity of drilling holes to receive them.

For buildings, much may be done in cardboard or thin wood. Work of this kind is a change from ordinary railway planning and construction, and once the enthusiast has got used to the material he will be constantly adding fresh buildings in order to improve still further the general air of realism of the system. Another method is to make use of the various sets of constructional blocks that are available. Some of the buildings included in the layout described on page 576 of the "*M.M.*" last July were made up in this way. An advantage of this method is that some attractive architectural features may be included with the minimum of trouble. The solid character of such buildings is an asset, particularly as they can be altered as required.

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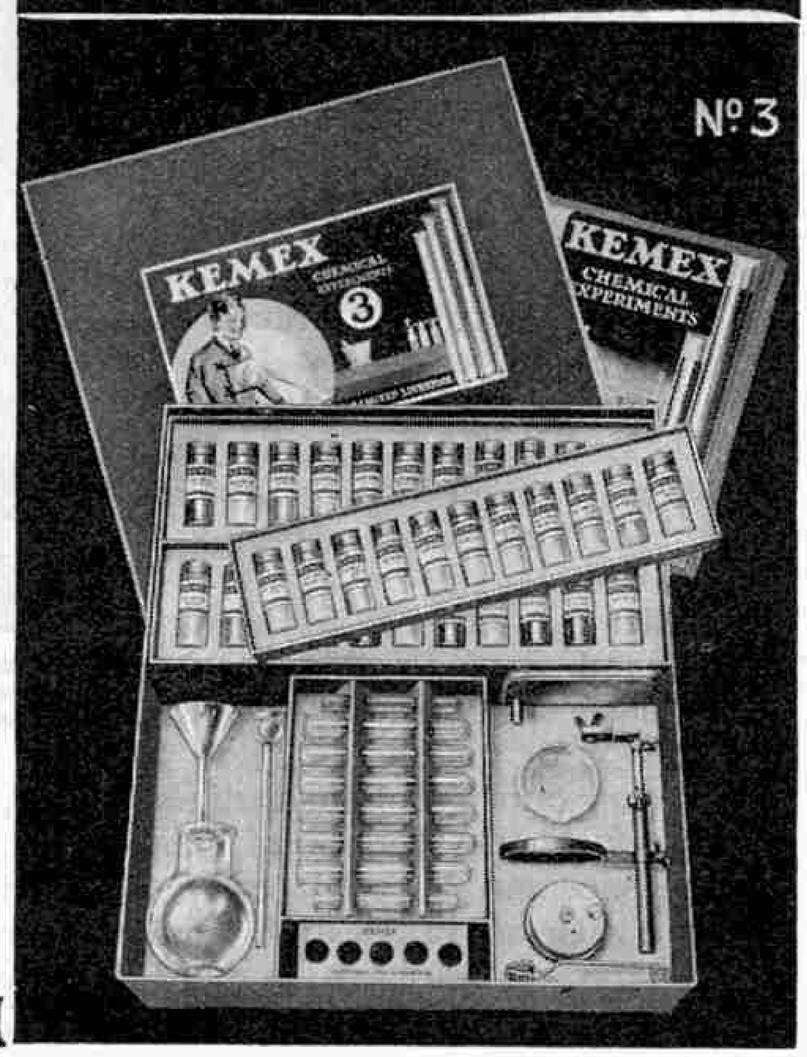

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H.R.C. COMPETITION PAGE

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, Meccano Limited, Binns Road, Liverpool 13. The name, full address and membership number of each competitor should appear in clear writing on every sheet of paper used.

AN IMPOSSIBLE TOUR

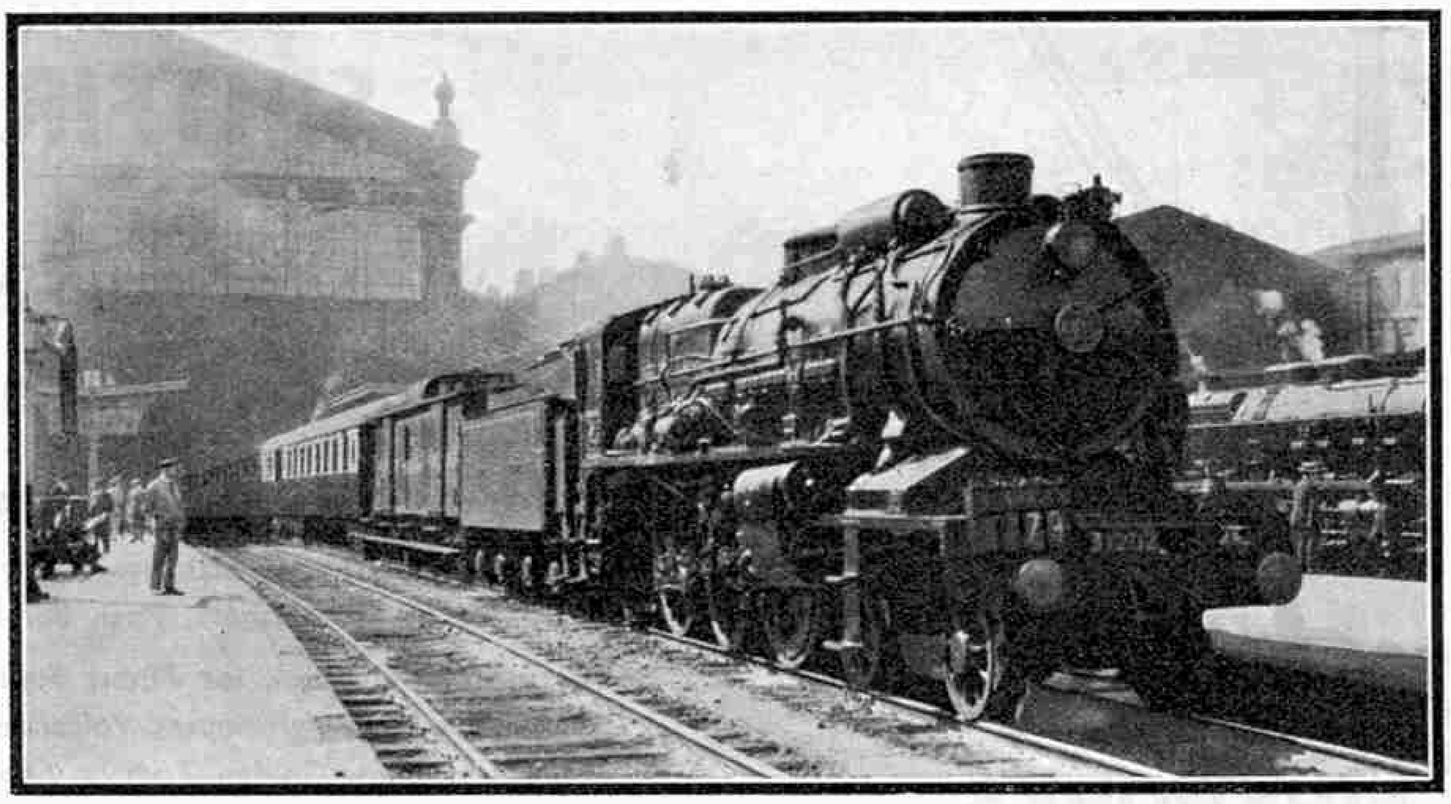
On several occasions we have presented as the subject of H.R.C. competitions accounts of railway journeys in which the details have purposely been mixed up, competitors being required to pick out as many of the faults as possible. This month we are returning to this popular form of contest, but in order to add to the interest, and to provide a more thorough test of the knowledge of H.R.C. members, we are making a journey beyond the British Isles. It takes the form of a Continental trip, based on the kind of tour that is so popular to-day, and is so well catered for by the railway companies and the travel organisations. No doubt many of our readers have made tours of this kind during the past summer. Here then is the story.

"Leaving Waterloo one night by the *"Channel Islands Boat Express,"* we made a swift run to Folkestone. The comfort of the train was remarkable, and the Pullman luncheon service of the best. Boarding the vessel moored at Parkstone Quay, we found that it was the well-known *"Twickenham Ferry,"* and we were soon comfortably quartered for the night.

"Next morning the ship berthed at Antwerp, and we caught the famous *"North Star"* Express, composed exclusively of Mitropa articulated stock hauled by one of the rebuilt "Pacifics" of the Paris-Orleans Railway; and across the level Netherlands country we made some good running. The *"Rome Express"* was only a few minutes behind us, so that it was necessary for our train to keep good time in order to avoid delaying that famous flyer. Approaching Paris we were checked by signals, but were able to arrive to time at the Maritime Station. We changed engines here, attaching a giant "Beyer-Garratt" locomotive of the P.L.M. type; and thus well provided we entered Switzerland by means of the Simplon Tunnel and arrived at Lucerne.

"From Switzerland we passed into Italy by the new direct line over the Apennine Bridge, and with stops at Vienna and Belgrade our outward journey to Rome was completed.

"Our return was made partly by sea, the voyage to Marseilles from Naples being by way of the Suez Canal. At Marseilles we entrained for Paris once more, and the long journey passed pleasantly enough, for the Est trains are noted for their comfort and excellent service. The locomotive work on the journey was very fine, our Nord "Super-Mountain" taking the heavy train along in good style. We ran in exactly on time, and proceeded to explore Paris during the next day or two.



The "North Star" Express of the Belgian State Railways at Antwerp. It is composed of "Mitropa" stock and the engine is a rebuilt "Pacific" of the Paris-Orleans type.

"On the day we left for England traffic was very heavy, and several trains bringing passengers from almost all parts of the Continent ran into Calais to catch the same steamer as ourselves. After a good crossing Plymouth was reached in ample time to allow us to catch one of the famous S.R. "Ocean Liner" expresses with Pullman attached. Our engine up to Victoria was a "Pacific," *"King George V,"* and after Exeter it was allowed to show its paces to some good purpose. We were delayed through Bristol and again at Guildford, but after some fast running from Tring onward we managed to arrive on time."

We do not think that readers will find any difficulty in discovering mistakes! Each competitor should make a list of these on one side of a sheet of paper in the order in which they occur, and when he thinks that every error has been accounted for, he should write his name, full address and membership number on the reverse side.

Envelopes containing entries should be marked in the top left-hand corner *"H.R.C. Impossible Tour Contest"* and posted to reach Headquarters at Meccano Ltd., Binns Road, Liverpool 13, on or before 31st October. Overseas closing date, 31st January, 1935.

The competition will be divided as usual into two sections, Home and Overseas. Prizes of Hornby Train goods (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded to the senders of the four best entries in each section.

Railway Description Contest

Railway operations during the summer months are of particular interest. Many special excursions are run, and often bring to a district "foreign" engines and vehicles. During the holiday period members of the H.R.C. will have made trips to the seaside or country, and come across many interesting features in the strange railway surroundings. It is good fun to recall these features and to describe them as accurately as possible in a small number of words; and this month we invite members to send in a description, of not more than 500 words, of *"The Most Interesting Railway Feature I Saw During the Holidays."*

The competition will be divided as usual into two sections, Home and Overseas. To the competitors who submit the four best entries in each section will be awarded prizes of Hornby Train goods (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively.

Envelopes containing entries should be marked *"H.R.C. October Description Contest,"* and posted to reach Meccano Ltd., Binns Road, Liverpool 13, on or before 31st October. The closing date for the Overseas Section is 31st January, 1935.

Articles Suggestion Contest

This month marks the beginning in real earnest of the model railway season, and H.R.C. members will be considering changes of layout or other developments to increase the interest of their railways. We should like to be at hand to give advice on the many little problems that crop up in this connection; but this, unfortunately, is impossible, and the alternative is to do the best we can to assist with really practical articles. We want readers to help us in the choice of topics for these articles, and this month we offer prizes for the best set of *"Six Suggestions for Articles Dealing with Model Railway Problems."* The subjects chosen should be those in which the competitor himself has found difficulty, or the need for further information. In most cases a suggested title for the article will be sufficient, but a few words of explanation may be added where necessary.

Envelopes containing entries should be marked *"H.R.C. Articles Contest,"* and posted to reach Meccano Ltd., Binns Road, Liverpool 13, on or before 31st October. The closing date for the Overseas Section is 31st January, 1935.

Prizes of Hornby Train or Meccano products to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded to the four winners in each Section, Home and Overseas.

COMPETITION RESULTS

HOME

July "Locomotive Problem."—1. R. Barbary (5580), St. Ewe, Mevagissey, 2. L. Parish (18054), Coventry. 3. B. Sheldon (2311), Birmingham. 4. R. J. C. Arnold (36214), Leicester.

July "Photographic Contest."—1. S. Garbutt (30122), Altrincham. 2. C. J. C. Walker (26861), Mollington. 3. R. B. Hayter (21630), Bedford. 4. A. Picknell (38591), Hatch End.

OVERSEAS

April "Hidden Stations Contest."—1. Rene Pascaud (29988), Chaumont, France. 2. G. Hallock (17578), Capetown. 3. A. A. Khand (34857), Bombay. 4. A. Abdulrahim (10438), Karachi.

April "Photographic Contest."—1. A. R. Bacon (38242), India. 2. J. A. Coates (23863), Canada. 3. F. W. Whyte (17289), Australia. 4. M. De Lima (34925), India.

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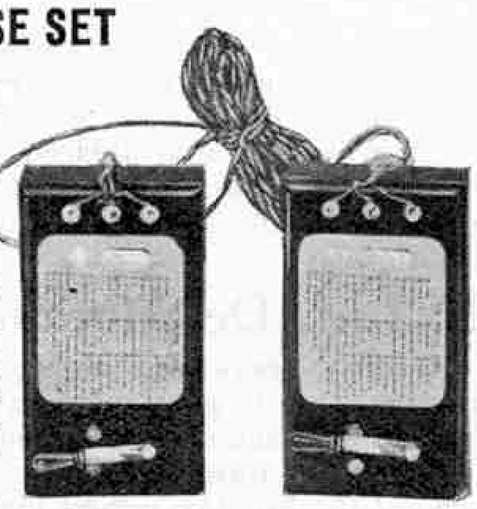

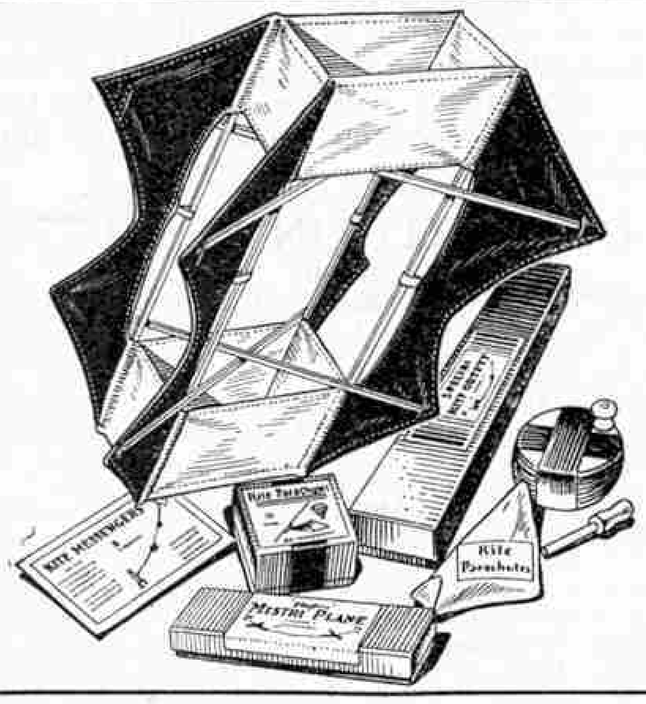

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THE POWER OF THE PRESS

Burglar: "Come on! Let's reckon up and see what we've made on this haul."

Burglar's Mate: "I'm tired, let's wait and look in the morning papers."

* * * *

"Yes, we went all over the Continent, but papa really only enjoyed himself in Venice."

"Ah, yes, the cathedral and the gondolas—"

"Oh, it wasn't that; he could sit in the hotel and fish out of the windows."

* * * *

There was once a Scotsman who invented a mouse trap that would kill the mouse before it had time to eat the cheese.

* * * *

Londoner (visiting New York): "The sky here seems clearer than it is in London."

New York Friend: "Of course, we have skyscrapers here."

* * * *

"Since Brown lost all his money half his friends don't know him any more."

"What about the other half?"

"They haven't found out that he lost it."

* * * *

"I want some grapes for a sick friend."

"Yes, sir. Here's a nice bunch at four-and-sixpence."

"Oh! He's not as sick as that."

* * * *

"And is all your money the result of sheer hard work?"

"Oh, absolutely. My father worked jolly hard for it."

* * * *

"Now, Tommy, why don't you go and play with your friends?"

"I've only got one friend, and I hate him."

* * * *

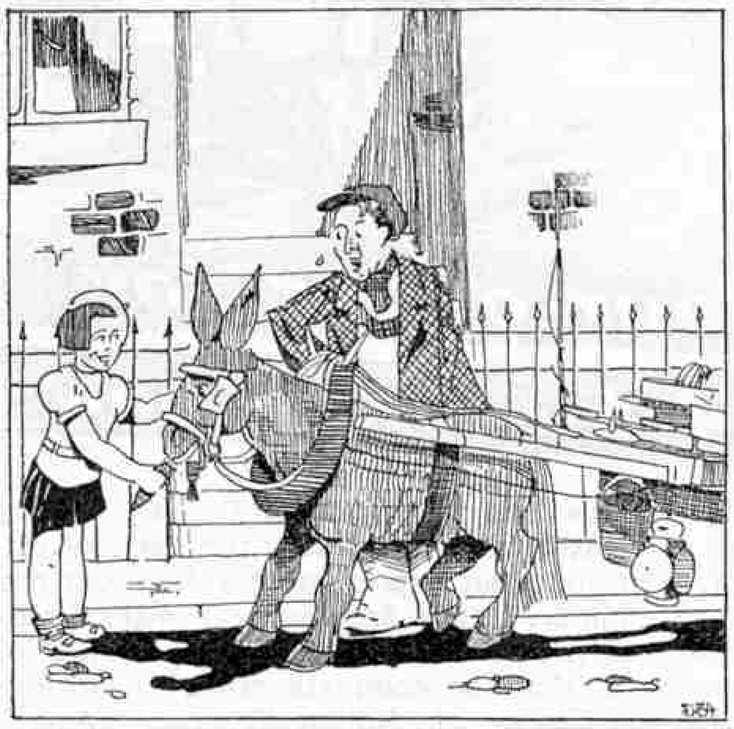
"Jim is growing a moustache on the instalment plan."

"Don't be silly!"

"It's a fact; a little down every week."

* * * *

A SHOCK FOR THE COSTER



The costermonger smiled happily at the thought that his donkey was enjoying a free feed.

"You're a good little girl to be so kind to a dumb friend," he said. "But who gave you those carrots?"

"I took them from the back of your barrow," said the girl.

* * * *

Teacher: "Johnny, what is a cannibal?"

Johnny: "I don't know."

Teacher: "Well, if you ate your father and mother what would you be?"

Johnny: "An orphan."

A FULL STOP

The flying instructor was concluding his lecture on parachute work.

"And if it doesn't open—well, gentlemen, that's what is known as 'jumping to a conclusion'."

* * * *

"How did you miss that partridge?"

"It flew zig-zag, and I shot at zig and it flew zag."

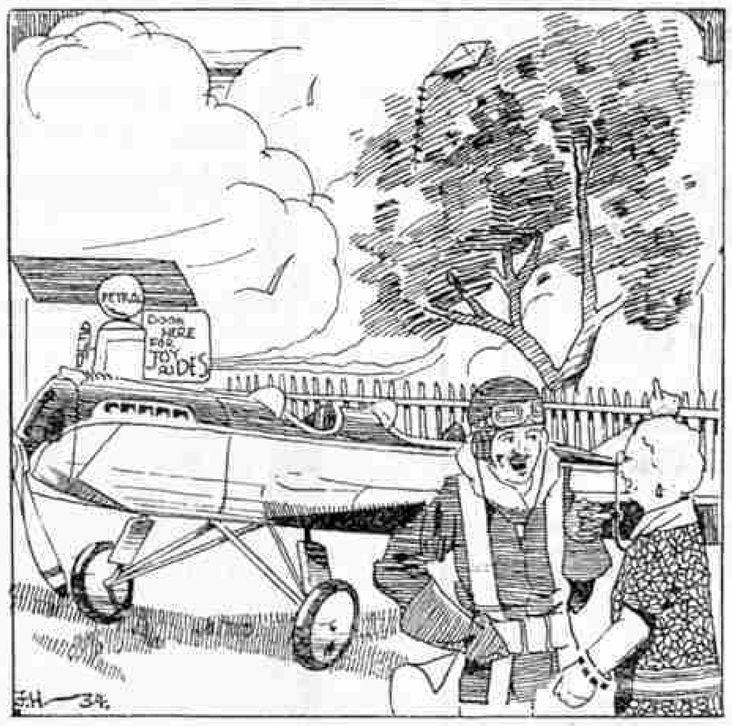
* * * *

"You don't look like a starving man."

"Ah, that's just it, mum. This 'ere 'ealthy look o' mine'll be the death o' me."

* * * *

WHY THE PILOT GRINNED



Fond Mother (to pilot): "Next time you go up would you mind getting my little Billie's kite from the top of that big tree?"

* * * *

A person advertising goods for sale stated: "Money returned if not satisfactory."

When a dissatisfied client applied for the return of his money, however, the reply he received was: "Your money is quite satisfactory, therefore we decline to return it."

* * * *

"What did the editor think of your humorous drawings?"

"When he looked at them he clapped his hands—"

"Splendid!"

"Er—over his eyes!"

* * * *

"What on earth is the use of the times set down in these railway timetables?" asked the angry old gentleman, whose train was overdue.

"Why," explained the genial stationmaster, "if it weren't for those figures we'd have no way of finding out how late the trains are."

* * * *

"What about that ten-shilling note? When you borrowed it you promised you wouldn't keep it long."

"Well, I didn't. It was gone within half an hour."

* * * *

An old Indian was riding along the road on his pony, while his squaw followed on foot heavily burdened with luggage.

"Say, Redskin, why isn't your wife riding?" asked a passing motorist.

"Ugh," answered the Indian, "she got no pony."

* * * *

Visitor (to oldest inhabitant): "Well, sir, I must say you're looking remarkably well."

Methuselah: "Aye, aye, my lad. One hundred and two I be, and every tooth in my head the same as when I was born."

REDUCING THE NAVY

"How is Jim getting on with his reducing exercises?"

"Fine. The battleship he had tattoed on his chest is only a rowing boat now."

* * * *

Grandma was helping Molly to make out a list of little guests for her party.

"How about the Williams twins?" Grandma asked.

"Well, there's no need to ask them both," Molly answered; "they're exactly alike."

* * * *

"Do school-teachers get paid?" asked Johnny.

"Of course they do, son," replied father.

"Well, I don't think it's fair," said the indignant Johnny. "Why should teachers be paid when we boys do all the work?"

* * * *

Artist (to old villager): "I'll give you ten shillings if you will let me paint you."

Villager: "It sounds all right mister, but how will I get the paint off afterwards?"

* * * *

The boastful young man had been bragging about the ancestry of his family.

"I suppose," said a bored friend, "you'll be telling us next that your ancestors were in the Ark with Noah!"

"Certainly not," said the boaster, "my people had a boat of their own."

* * * *

"Sandy, Sandy, there's a cow in the garden."

"Don't stand there wasting time, go and milk it before it gets out."

* * * *

Tommy fancied himself as a detective.

"Now," he said, "I see there are some ashes in the yard. By deduction, that is evidence that we have had a fire."

"Fine!" said his father. "Now go and sift the evidence."

* * * *

MAKING TRACKS

A Chinaman was visiting the famous Yellowstone National Park in America when he discovered to his horror that a bear was following him and was sniffing at his tracks in the snow.

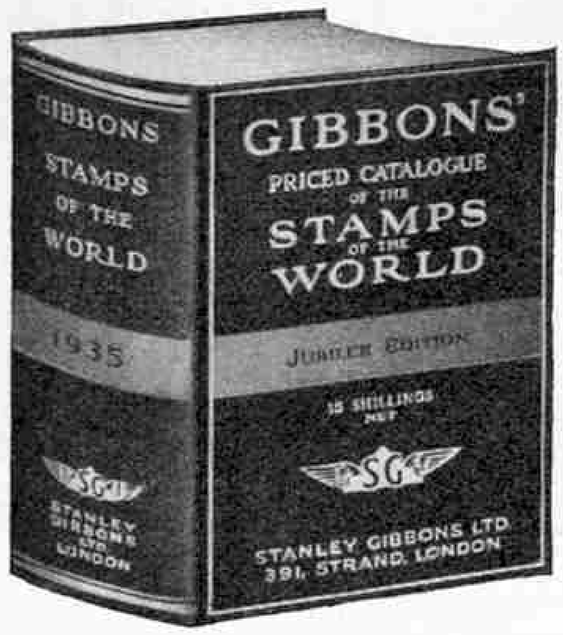
"You likee tracks?" he shouted to the bear as he made off as fast as he could. "Velly good, me makee plenty more."

* * * *

An old lady was visiting a hospital when she approached a bed where a man lay nearly hidden among a mass of bandages.

"Poor man," she said, "have you been wounded?"

"Oh, no, mum," he replied bitterly, "I've just been kicked by a canary."



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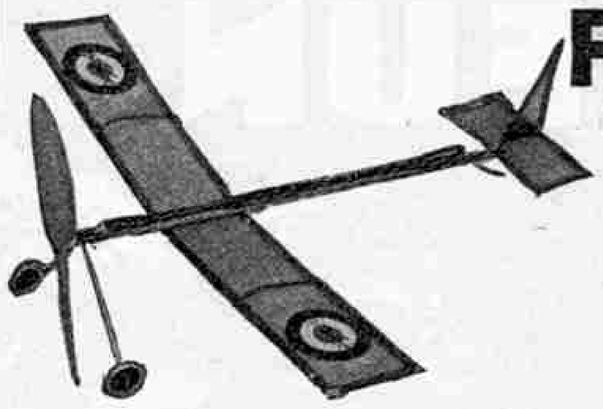

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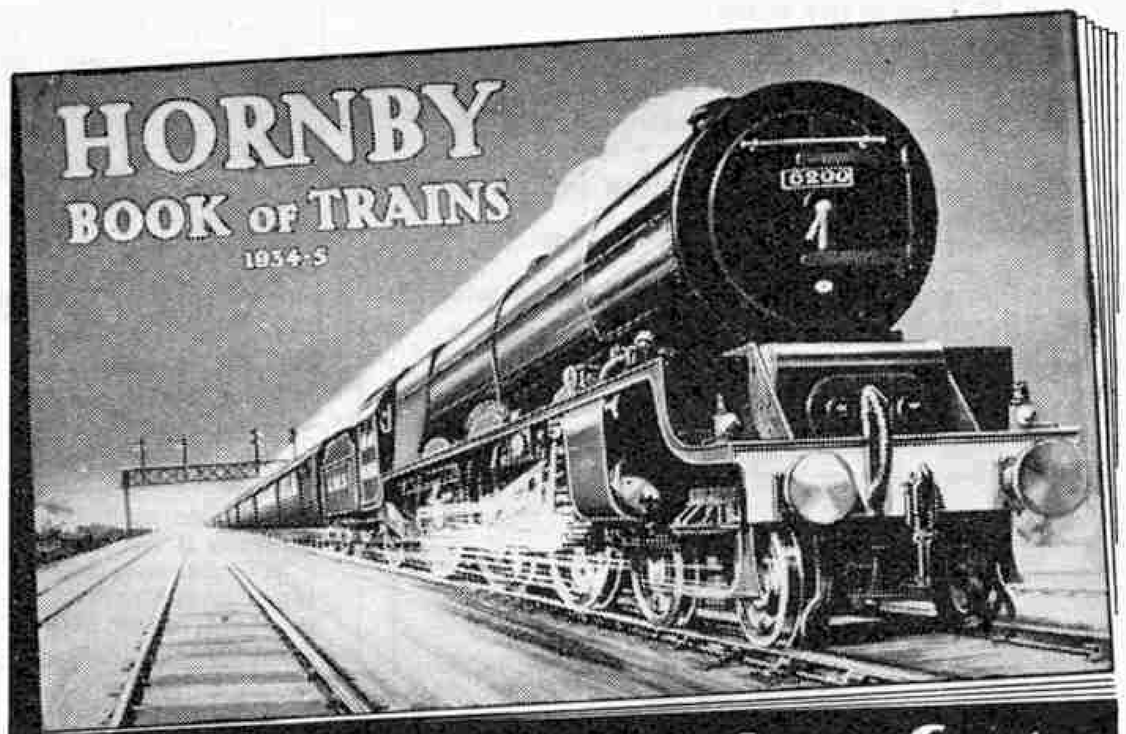

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Stamp Gossip

and Notes on New Issues

Canada's Latest Commemoratives

Canadian pictorial stamps have achieved an exceptionally high standard of design, but the two new commemoratives illustrated this month are equal to anything produced in recent years.

The first, a 10c. value, celebrates the 250th anniversary of the arrival in Canada of the body of immigrants who have come down in history as the United Empire Loyalists. These were the 40,000 who, after the conclusion of the American War of Independence, preferred to retain their British citizenship, and in pursuance of their ideals sacrificed all their lands and personal property and crossed the border into Canada. Subsequently the British Government granted them new lands in Canada and financial assistance.

The stamp design is a reproduction of the United Empire Loyalists statue in Hamilton, Ontario. It shows a family group of immigrants and, in the side panels, effigies of Britannia and a Red Indian.

The second stamp, a 3c. value, is to commemorate the 400th anniversary of Jaques Cartier's discovery of Canada. Cartier, originally a St. Malo fisherman, was engaged in an expedition to discover the North-West passage when he first touched upon the coast of Newfoundland.

New Pictorials for Cyprus

Apparently the Colonial Office does not share the conservatism of the Post Office on the subject of stamp issues. Yet another Colony, Cyprus, is to be provided with a new pictorial series of stamps, on which the Island's many historical attractions for tourists are to be featured.

There are to be 11 stamps in the set, with designs as follows: ¼p., the Palace at Vouni; ½p., the Marble Forum at Salamis; ¾p., the Church at Peristerona; 1p., the Theatre at Soli; 1½p., Kyrenia Castle and Harbour; 2½p., the Tower at Colossi; 4½p., the Cathedral of San Sophia; 6p., the Baraikdar; 9p., the Castle of St. Hilarion; 18p., the Buyuk Khan; 45p., view in the hills.

Memories of a Lost Empire

Germany's undying hope that in days to come she may regain the Colonies lost during the Great War is evidenced by a simple series of stamps that has just been issued to commemorate the 50th anniversary of the establishment of the German Colonial Empire.

The series consists of four stamps each bearing a portrait of one of the pioneers of German Colonial settlement. The 3pf. value shows Franz Luderitz, the Bremen merchant who founded the German S.W. African Colony. Karl Peters, the founder of German East Africa, is shown on the 12pf.

Hermann Von Wissman (25pf.) was an outstanding Coloniser. He was a wise administrator, and became the first Imperial Commissioner of German East Africa. The 6pf. stamp shows Dr. Gustav Nachtizal, who annexed Togoland and the Cameroons for Germany in 1884.

Papua's Jubilee Designs

Two exceedingly interesting designs are to be used for the Papuan Jubilee Commemorative issue to appear next month.

There are to be two designs covering four values, 1d., 2d., 3d. and 5d. The design for the 2d. and 5d. values will show a vivid impression of the scene at the hoisting of the Union Jack during the Annexation ceremony at Port Moresby in 1884. The central feature is the flagstaff with the ensign just unfurled, flanked on two sides by a parade of bluejackets and marines. In the right foreground is a trading station below the verandah of which a group of natives is squatting. In the background the British Fleet lies at anchor, and inset to the left and right are portraits of Boe Vagi, the native chief, and Commander Erskine, the leader of the British expedition.

The 3d. value shows a group of natives and British officers in conference aboard H.M.S. *Nelson*, Erskine's ship.

A Genuine Error

It is rare for an extensively perpetrated "error" to find itself sold out before stamp dealers and collectors have become aware of its existence. An instance is reported from Guatemala, however. Early in May, 47 sheets (2,350 stamps) of the 15 pesos air stamp, surcharged *Q.O.05* on a Perkins-Bacon printing instead of the Waterlow printing, were put on sale. All were sold to commercial houses before the philatelists came upon the scene.

Another New Colonial Issue

Messrs. De La Rue are to be congratulated on the production of the splendid new series of stamps for the little island of Ascension. Each of the 10 stamps in the set is a little pictorial gem and well worthy of inclusion in any stamp album.

We have chosen the 1d. and 1½d. values for illustration here. The former serves also for the 2d., 8d. and 2/6 values, and shows a map of the island in addition to the customary royal portrait. The principal interest of this design lies in its subsidiary features. The turtle superimposed on the map recalls Ascension's importance as a breeding ground for these reptiles. At birth, when it is so tiny as to be only an inch in diameter across the shell, the turtle scrambles away across the beach and takes to the water. It travels many hundreds of miles, but like the salmon, returns to its birthplace to breed. The mark-buoys and radio masts are reminders that to-day Ascension is both a cable and wireless telegraph station.

The 1½d. design shows the pier and loading equipment at Georgetown.

The remaining designs are as follows: ½d., general view of Georgetown from the sea; 3d., Long Beach; 5d., the Three Sisters Mountains; 1/–, Wideawake Fair, a beach on which the Sooty Tern, known as the "Wideawake" bird, is established in large colonies. The din in the neighbourhood of the breeding grounds of these birds is indescribable, and their incessant screeching by night as well as by day is the source of their name "Wideawake." A remarkable feature of the design is the vivid impression of the huge concourses of birds that the artist has managed to convey. Inset is a specimen bird and an egg.

* * * * *

Aeronautical enthusiasts among our readers will be delighted with the design of Peru's air stamps, reproduced here. The design shows a splendid action picture of one of the Fairey Fighters recently purchased by the Peruvian Government. In the background are the snow-capped Andes.

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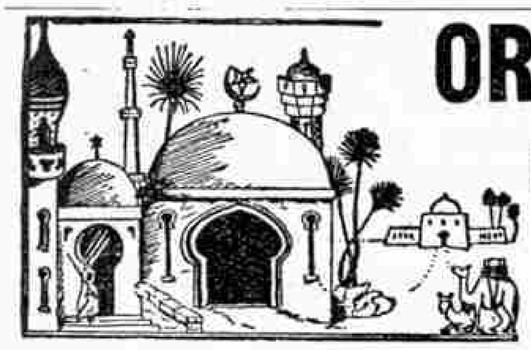

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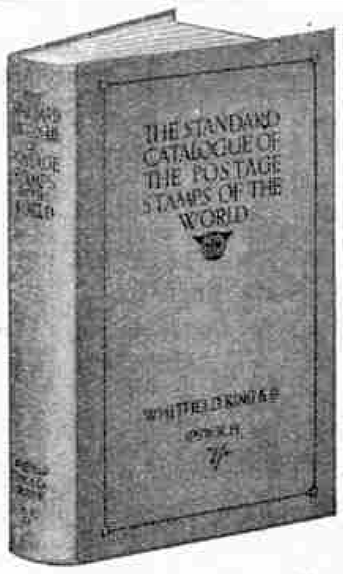

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WHITFIELD KING & CO., Ipswich, Suffolk
Established 1869

Victoria Centennial Series

Philatelically speaking, the most interesting feature of the celebrations to mark the centenary of the State of Victoria now in progress is the issue of a special stamp series, bearing, appropriately enough, the best Australian commemorative design yet produced.

The design, reproduced here, shows an Australian aboriginal of the 1834 period gazing across the River Yarra at the present day city of Melbourne. The suggestion of the passage of a century is indicated by the clever placing of the figures 1834 and 1934. There are three stamps in the series, the values being 2d. (red); 3d. (blue); and 1/– (black). The same design is used throughout.

The Swiss Pictorial Issue

The designs of the new Swiss stamps have come to hand too late for reproduction in this issue, but we hope to include specimens in our next issue. For the moment our readers will be interested to have brief details of the designs, which are decidedly interesting, although disappointing representatives of some of the most glorious views in Europe.

There are seven stamps, as follows: 3pf., The Lauterbrunnen Valley; 5pf., Mount Pilatus and the Lake of Lucerne; 10c., the Dents du Midi and Lake of Geneva; 15c., the Rhône Glacier and the Grimsel Pass; 20c., the Leventine Valley, Ticino, incorporating a view of a section of the St. Gotthard Mountain Railway; 25c., the Via Mala; 30c., the Rhine Falls, near Schallhausen.

Jugo-Slavian Air Stamps

Although the standard of production of Jugo-Slavian stamps is rarely to be compared with that of most other countries, in point of interest the designs of the stamps more than hold their own.

The new air issue is a typical instance. There are five stamps in the set, each depicting some scene of exceptional historic interest. The 50 para stamp shows the old harbour of Dubrovink, famous in Roman times and known in Russian days as Ragusa, home of Franciscan monks. The 1 dinar value, illustrated here, shows the beautifully situated town of Bled, while the 2d. value gives a view of the Pliva Falls at the ancient city of Jacje. Another relic of the Romans, the bridge at Mostar, is depicted on the 10d. stamp. The remaining stamp, the 3d., shows the Oplenac at Sofia.

A New Stamp Magazine

Our keen stamp collector readers will welcome the new magazine known as *"The Stamp Magazine,"* that has just made its appearance, with the contributing support of such prominent philatelists as Mr. Fred J. Melville and Brig.-Gen. Ridgway. The October issue, full details of which are included in our advertisement columns this month, includes an article by Mr. F. J. Melville on the Universal Appeal of Stamps and another by Brig.-Gen. Ridgway on the England-Australia Air Mails. A feature of the new magazine is the care that has been devoted to securing excellent illustrations.

The magazine is to appear monthly, price 3d., and copies can be obtained from any newsagent or stamp dealer. A specimen copy, price 3d., can be had from the Publishers of The Stamp Magazine, 36, Camomile Street, London, E.C.3.

Curacao Tercentenary

In our June "Stamp Gossip" notes we referred to the series of commemorative stamps issued by Curacao to celebrate the 300th anniversary of its acquisition by Holland. This month we illustrate the two stamps issued by Holland itself to mark the occasion.

The 6c. value shows a splendid view of the harbour at Willemstadt, with petroleum storage tanks in the foreground as a specially interesting feature. The 12½c. value gives us another picture of Johannes Van Walbeeck's flagship. A view of this ship, it will be remembered, figured in the Curacao issue.

A Gaelic Sports Issue

The jubilee of the Gaelic Athletic Association, as was mentioned in our August issue, has been commemorated by the issue of a special stamp.

The stamp, as our illustration shows, bears a very spirited design representing a hurler in action. Hurling is a Gaelic ball game of considerable antiquity. The implements closely resemble those used in hockey, which game is, in fact, a development of hurling, except that the hurling stick, known as the ceman, has a broad flat end. The ball and goal net and system of scoring are very much as in hockey.

The inscriptions on the stamp, *"Eire,"* Ireland, and *"Cumann Luith—Chleas Gaedheal,"* Gaelic Athletic Association, are in Gaelic characters, and are accompanied by the dates of the foundation and jubilee, "1884—1934." The poster-like style is very reminiscent of the Royal Dublin Society issue of 1931.

The occasion of the celebration is appropriate, for the Gaelic Athletic Society has played a prominent part in fostering the national spirit in sports circles.

* * * *

The Eucharist Congress now in progress at Buenos Aires is being celebrated in the Argentine by the issue of two stamps, values 10c. and 15c. One million copies of each stamp were placed on sale on 1st October.

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

The 1935 Catalogues

The new season's catalogues, to hand just as this issue goes to press, are of more than usual interest. The Gibbons' Catalogue celebrates its Jubilee with this issue, while the Whitfield King production is remarkable for its several outstanding improvements on previous issues.

These huge, though amazingly compact, catalogues do more than anything else to demonstrate the remarkable grip that the stamp collecting hobby has upon its devotees, and are a striking illustration of the growth of the hobby. When Stanley Gibbons published his first stamp catalogue in 1865, it consisted of a 16-page pamphlet listing less than 2,000 stamps. The Jubilee edition is a volume of 2,132 pages, which lists and prices over 105,000 separate items and requires 14,321 full size illustrations to do justice to them.

The enormous increase in the values of some of the early stamps is another striking revelation of the strength of the hobby. The Gibbons' Catalogue shows that the first stamp of all, our British "Penny Black," now sells at 144 times the halfpenny it cost the collector in 1865.

The Gibbons' Catalogue is an essential to the advanced collector, for it records with a wealth of detail all the important and most of the minor varieties that are the food of the specialist's studies. Brief descriptions of the subject are given for all pictorial stamp designs. As usual, the catalogue is available in one complete volume, known as the Whole World Volume, price 15/–, or in two parts, Part I (British Empire), price 6/6 and Part II (Foreign Countries), price 10/6.

When reviewing past editions of the Whitfield King Catalogue we have referred to it as the ideal catalogue for the newcomer to the stamp collecting hobby, and, indeed, for all young collectors. That commendation applies with no less force to the 1935 edition. Details of all important varieties, including their watermarks, are included, but minor varieties are excluded, an arrangement that gives the catalogue a simple directness that cannot fail to be helpful to the new collector.

We learn from the preface that the catalogue lists a total of 58,607 stamps, from which Europe claims 18,402, Africa 13,075, Asia 10,795, America 10,013, the West Indies 3,380 and Oceania 2,941. Of these 1,733 are new issues, Europe claiming 542, Asia 357, Africa 392, America 333, West Indies 47, Oceania 62.

The catalogue is published by Messrs. Whitfield King & Company, at 7/–, and both it and Gibbons' Catalogue can be obtained from any stamp dealer or bookseller.

CANADA—FREE!

15 different Canada, including the beautiful **5c. Postal Congress,** shewing view of Parliament Buildings across the river. This stamp is **rising in value** and you are advised to send at once. **All Free** to genuine applicants for our approval sheets sending 2d. postage.
You will be glad you sent.
SHIRLEY STAMP CO.,
19, SANDRINGHAM AVENUE, LONDON, S.W.20.

GOLD COAST PACKET FREE!

This WONDERFUL packet of all different **high class** stamps contains a fine set of **4** SCARCE GOLD COAST; **3 Charkari Pictorials;** fine set of **7 INDIAN;** set of **4 N. Zealand; 2 Nigeria; Jamaica** large Pictorial; Set of **5 Japanese; U.S.A.** Bi-centenary; **2** FRENCH peace issues;a **Hungary Official** (Cat. 4d.); NATAL (Q.V.); **Old South Australia;** MALTA; **Cape of Good Hope; Victoria,** etc. And NO damaged stamps. ALL FREE! Just send 1½d. postage requesting our **famous** approvals. THE PUCKA STAMP CO., 27, **Normandy Ave., Barnet.**

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To all applicants for our "R.T." Approvals we will send FREE a **Set of Poland High Values** and a **packet of 50 Foreign and Colonial Varieties** (Heads, Maps, Pictorials, etc., from a dozen different countries). Write at once enclosing 2d. for postage and request Approvals. Genuine applicants only.
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(ROOM M), 29, VENNER ROAD, LONDON, S.E.26.

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F 3 SPAIN CATACOMBS. 2, 3 and 5 centimos. F
R Request approvals and send R
E **2d.** postage. E
HELY. HUTCHINSON
E **(Dept. M), Eddington House, Kendal.** E

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100 DIFFERENT BRITISH COLONIALS 1/- Post Free
including Gold Coast pictorials, ½d., 1d., 1½d., 2d.; N. Rhodesia, 1d., 2d.; Nigeria, ½d., 1d., 1½d., 2d., 3d.; Mauritius, 2, 4, 5c.; Iraq, ½, 1, 3 annas; N. Zealand, ½d., 1d., 1½d., 2d., 3d., 4d., 6d., 1/-. Newfoundland, Palestine, Jamaica, Fiji, Bahamas, etc., etc. Finest packet YOU have ever had. MONEY BACK if not satisfied. Ask for "Worth While" Approval Sheets.
JOS. H. GAZE, DIDSBURY, MANCHESTER.

A "GOLDEN GATE" for 1½d.

You must have this packet. There is the "Golden Gate" stamp, also Malta, Australia (Commem.),Canada, Estonia, Siam, South Africa, Ireland (Congress), Chili. **It's free** to you. Just ask for Approval Sheets and enclose 1½d. stamp for postage. Mention Gift 610. **New Approval Sheets.** Grand variety. Good Discount. I exchange stamps with Colonial Collectors.
F. G. ROWE,
69, EDGEHILL ROAD, BOURNEMOUTH.

CHEAP APPROVALS
Write to-day for a selection of beautiful Stamps. Pictorials, Portraits, etc., priced from 4 a penny. Free Set Persia all applicants.
A. V. TAPP, 108, Chesterfield Road, BRISTOL.

The Island of Ascension

A new set of Pictorial Stamps from this British possession sent free of charge to bona-fide applicants for selections of duplicates on approval. Extra Mystery **PACKET** of 450 (approx.) unpicked stamps post free 8d. 6 French Oceanic Settlements pictorials, new issue, 1c. to 15c. Post free 4½d. 16 Eng. Revenue stamps 1/- to 15/-. Post free 3d.
HENRY TURNER,
110, BARNET ROAD, PRESTON, BRIGHTON, SUSSEX.

THE FIRST STAMP EVER ISSUED

was the British 1840 Penny Black. Against a P.O. **1/9** we will send you a genuine postally-used copy of this interesting stamp (cat. 6/-); for a further 5/- you may have a copy of its companion stamp, the 1840 2d. Blue (cat. 20/-). Another "classic" which every Collector should have is the **Cape of Good Hope** 4d. blue **Triangular** (cat. 15/-), and a nice copy will be supplied at **5/-.** Superb approvals of any country against satisfactory English references or a deposit. **Full Lists Free.**
NORRIS & CO. (Dept. M), Norwood, London, S.E.19.

I WANT 500

regular customers. Collectors who are so satisfied with the value offered in my selections that they will come to me for all their philatelic requirements. AND I have a scheme which will pay them to become **regular** customers.
Send now for my **4-a-penny selections** and full particulars of the new scheme.
L. D. MAYNARD,
78, RICHMOND ST., SOUTHEND-ON-SEA.

THE BRIGHTON PACKET
A Free Set of 6 Czecho. fine Independence Issue, to all purchasers of my "Brighton" Packet of 100 stamps. Includes Cochin, Persia, China (Martyrs Issue), Cameroons, Bolivia, St. Thomas, Azores, Inhambane, France (Air Mail), Tanganyika, Andorra, Sudan, Reunion, Malta (Provisional), Madagascar, Ecuador (Centenary Issue), Selangor, Iceland, Inini, Belgium (Queen Elizabeth), Danish West Indies and 79 other fine stamps. Price only 1/-, 6 Air Mail Stamps free to those asking for approvals. Whitfield King's 1934 Cat. whole world, 3/- post free.—**H. S. HILL, 10, The Lanes, Brighton.**

Boys! Look! Famous **"XLCR" Stamp Outfit** is unbeatable value. Contains: Pair Tweezers, Watermark Detector, Pocket Wallet (Strip pockets), Perforation Gauge, Approval Book (120 spaces), 125 stamp hinges, 5 transparent envelopes. Price lists and a free gift set Pictorial Stamps (cat. 3d.). **All for 6½d.** Ask your shop to write to **THOMAS CLIFFE, COLWYN BAY.**

TREASURE HUNTERS!
Stamps you want on approval at prices guaranteed to astonish. Thousands of attractive stamps at ⅛th cat. Finest "space-filler" sheets and books of good class. Mention interests. Genuine bargains, no gifts!
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"MECCANO MAGAZINE" BINDERS
There is no better way of keeping your Magazines clean and tidy than by binding them in one of the special binders we supply.
These binders have strong stiff backs, covered with black imitation leather, tastefully tooled, and are lettered in gold. The large binder holds 12 Magazines—price 3/6 post free. The small binder holds 6 Magazines—price 2/6 post free. Meccano Ltd., Binns Road, Liverpool 13.

NYASSA TRIANGLES! EGYPT AIR MAILS ! ! PICTORIALS ! ! ! 80 STAMPS 6d.

Including set of unused **Nyassa Triangles.** Set of **Egypt 1933 Air Mails** showing Aeroplane flying over Pyramids. Eight interesting **African British Colonials** catalogued at 5/1. Seven **Canada** including Ottawa Conference issue. Large **Belgium Piccard Balloon Commemorative** stamp. Other stamps include used **Roumania 1931 Air Mails** showing Monoplane, unused Air Mails, surcharged issues and pictorials. **Price 6d.** (Postage 1½d. extra). Money and postage will be returned if not satisfactory. We have numerous other offers at low prices. Hundreds of unsolicited testimonials have been received.
W. BENNETT
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The MYSTIC PACKET

1,000 UNKNOWN, UNUSUAL, UNSORTED, 1/3
Stamps on paper, etc., just as received from Convents, Shippers, Missions, Bankers, etc. Guaranteed unpicked. Chance of a **FIND** in every lot. Send to-day for your treasure hunt to-morrow. **3** for **3/6**. **6** for **6/6**. Abroad, **1/6** pkt. **FREE!** 103 diff. inc. Alouites, Syria, Leban, etc., to Approval applicants. Many other gifts. Send postage only. Overseas **3d.**
ASTLEY & CO. (M.24), LOWHILL, WOLVERHAMPTON.

FOOTBALL World Cup Italian Pictorial Commemoratives. Set of Postage and Air Issues **VERY SCARCE.** Only 10d. to genuine **"POPULAR"** Approval Applicants. **THE WESTERN IMPERIAL STAMP CO., Trowbridge, Wilts.**

Stamps. Selling collection. 100, 2/-. 250, 4/6. Excellent value.—M.A.Walker, 1,Park Cres.,Wolverhampton

Value for money—send 6d. P.O. and stamped envelope for 30 fine stamps.—N. Albert, 53, Lewisham High Road, London, S.E.14.

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IDEAL PACKET. 100 diff., includes Pictorials, Commemoratives and Air 1/-. 25 India 6d. 25 Great Britain 6d.—Williams, 71, Albany Rd., Rock Ferry, Cheshire.

STAMPS. Newfoundland and others for disposal.—Price, "Springfield," 22, Tyrfran Avenue, Llanelly.

FREE! 200 Different, to genuine Appro. Applicants. Shakeshaft, 'Homeleigh,' South Rd., Preston, Brighton.

HERE IT IS! NUMBER ONE IS NOW OUT

The STAMP Magazine

The Contents include:

F. J. MELVILLE on The Universal Appeal of Stamps—Brig.-Gen. R. RIDGWAY, C.B., on England-Australia Air Mails—The Congress Stamps of Egypt—Catalogue Reviews—Enlarged Illustrations—New Issue Supplement—And many other features.
Order it from your Newsagent, or send threepence in stamps for a post-free copy to:

THE STAMP MAGAZINE, 36, Camomile Street, London, E.C.3.

Competition Corner

"POINT WORDS": A NOVEL WORD PUZZLE

Rather more than a year ago we introduced a new form of competition to our readers, under the name of "Point Words." Many readers have written to ask for a second competition of the type, for they found it a distinctly teasing novelty, more puzzling than the average word competition.

For the benefit of new readers we must explain that in a Point Words Competition the problem is to take a phrase or sentence containing exactly 25 letters and re-arrange the letters to form a square of five letters by five letters, so that as many complete words as possible are formed in the vertical and horizontal lines of the square. For each word of five letters in one line 10 points are awarded; for a word of four letters, five points; for a word of three letters, two points; and for a word of two letters, one point. A line containing two words of three and two letters respectively thus scores three points. The maximum possible score is 100, but a score of 60 points from an average phrase may be considered quite satisfactory.

	10	3	3	10	5
5	B	U	S	T	J
10	A	G	A	I	N
10	T	H	Y	M	E
3	E	H	H	I	T
5	D	E	A	D	T

Total: 64

It will be understood that the letters may appear in the square only as many times as they occur in the original sentence, and that short words forming part of a longer word in the same line do not count in reckoning up the score. Only English words in current use may be used; proper nouns and coined words are ineligible.

Competitors are at liberty to select any suitable sentence or phrase in this issue of the *"M.M."*, but in submitting their entries they must indicate the line and page from which the words are taken.

To make the working clear we have taken the phrase "that may be adjusted in height" from the 26th and 27th lines in the second column on page 781, and in the centre of this page we have given a specimen "Point Words" working from this phrase. It will be seen that the score is 64, and we have deliberately chosen this phrase to give what we consider to be an average result. Careful examination of the magazine probably will reveal other phrases that will give larger scoring solutions, and readers will find it desirable to make a careful search to ensure that the phrase selected shall give a satisfactory number of letters that are commonly used. A fair sprinkling of letters such as T, R, S and E is desirable.

Prizes consisting of Meccano products to the value of 21/-, 15/-, 10/6 and 5/- respectively, will be awarded to the four best entries. In the event of a tie, preference will be given to the entries displaying the neatest or most novel presentation.

Entries should be addressed to "Point Words, Meccano Magazine, Binns Road, Liverpool 13," and must reach this office not later than 31st October. There will be a duplicate set of prizes reserved for Overseas entrants, those living outside Great Britain, Northern Ireland, the Irish Free State and the Channel Islands. Entries for the Overseas Section must arrive not later than 31st January, 1935.

Holiday Story Competition

To most of us the summer holiday has faded to a dim recollection, brightened by happy memories. The stories attaching to those happy memories will be told again and again during the coming winter, and because we are sure that many of our readers have stories that are worth telling, we are offering prizes this month for *"The Best Story of a 1934 Holiday Incident."*

Prizes of Meccano Products, to be chosen from the current catalogues, to the value of 21/-, 15/-, 10/6 and 5/- respectively, are offered to the senders of the four best stories in order of merit.

Entries should be addressed to "Holiday Stories Competition, Meccano Magazine, Binns Road, Liverpool 13," and must reach this office not later than 31st October.

To meet the special convenience of Overseas readers, whose holiday times do not in many cases coincide with our own, the stories entered for the Overseas section may relate to any holiday of recent years. A separate set of prizes to the same amounts will be awarded in the Overseas section, entries for which must arrive not later than 31st January, 1935.

October Drawing Contest

Last winter's drawing competitions proved so very popular that we have decided to run a drawing and painting contest every month throughout the winter. No special subjects will be set, the monthly prizes being offered simply for the best drawings or paintings submitted during the month. The entries may be of any size to suit the competitor's preference.

The entries each month will be divided into the usual two sections, A for readers aged 16 and over, B for those under 16, and prizes of Meccano products to the value of 21/- and 10/6 will be awarded for the best entries in each section.

A separate set of prizes, to be awarded in similar conditions, will be reserved in special Overseas sections for competitors living outside Great Britain, Northern Ireland, the Irish Free State and the Channel Islands.

Entries to the October competition must be addressed "October Drawing Contest, Meccano Magazine, Binns Road, Liverpool 13," and must arrive not later than 31st October. Overseas closing date, 31st January, 1935.

COMPETITION RESULTS

HOME

August Crossword Puzzle.—1. G. Riley (Matlock, Bath); 2. D. M. Davies (Warminster); 3. H. Rutter (Blackhill); 4. S. R. Williams (Beckenham). Consolation Prizes: G. Burgess (London, N.12); A. Dixey (Gillingham); G. J. Main (Northampton); L. R. Pool (Ilford).

August Photo Contest.—Due to the greater opportunities provided by summer holidays at the seaside no doubt, the entries to this competition showed a considerable increase over those of previous months, and many splendid photographs were submitted. Naturally, seaside incidents predominated among the subjects, and particularly we were struck by the number of readers who had endeavoured to record an impression of the attractive effect of pier lighting at dusk. With such subjects it is always difficult to judge the right time to commence the exposure, and several readers made the fatal error of making too early an exposure, with the result that the actual seascape was too clearly defined. The prizes were awarded as follows:—First Prizes: Section A, R. Gardiner (Edinburgh); Section B, C. Greener (Maghull); Second Prizes: Section A, F. T. Bunnin (London, S.E.26); Section B, Jt. Prize: K. H. M. Curtis (St. Albans); J. W. Wynne (Droitwich).

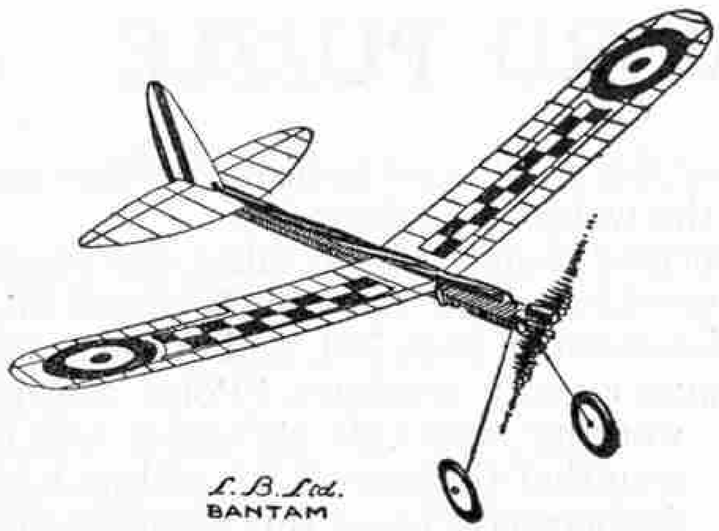
OVERSEAS

May Advertisement Jig-Saw.—1. K. J. Orams (Blenheim, N.Z.); 2. F. Van Bulck (Forest-Brussels); 3. K. C. Ho (Hong Kong); 4. J. Pascaud (Yonne, France).

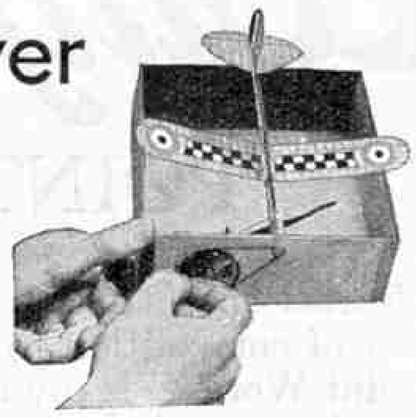
May Photo Contest.—First Prizes: Section A, J. Credie (Capetown); Section B, J. Jasper (Brisbane). Second Prizes: Section A, Miss M. Bedlington (Auckland, N.Z.); Section B, P. K. Wiener (Claremont, S. Africa).

There's more fun with a Model Aeroplane

The "BANTAM" a splendid new outdoor flyer



Here's a fine new model! Flies anywhere out of doors and performs remarkably well. No trouble to wind—a few turns with the special High Speed winder supplied with each model and away she goes. Will rise off ground after a short run. Wings printed in colours with the markings of a famous squadron. Sold completely assembled and equipped. Look for the distinctive "BANTAM" Box.



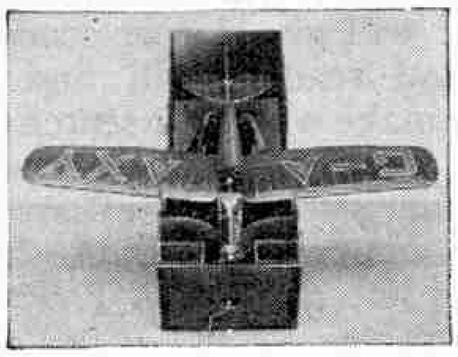
The BANTAM is complete with high speed winder box, spare motor and lubricant.

Price **2/6**

Includes high speed winder-box, spare motor, lubricant and illustrated flying hints.

WING SPAN 9 ins.
FLIES 200 ft.
DURATION 30 SECS.

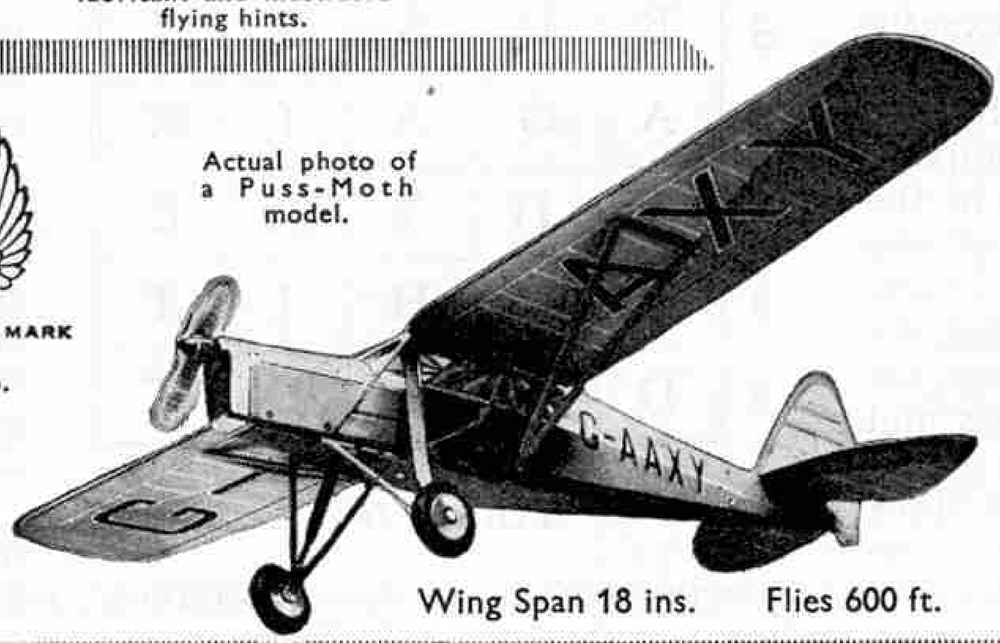
PUSS-MOTH MONOPLANE



The PUSS-MOTH is sold complete with high speed winder box, spare motor, inserter rod, gear box oil, elastic lubricant and illustrated flying manual.

FROG TRADE MARK REGD.

Actual photo of a Puss-Moth model.



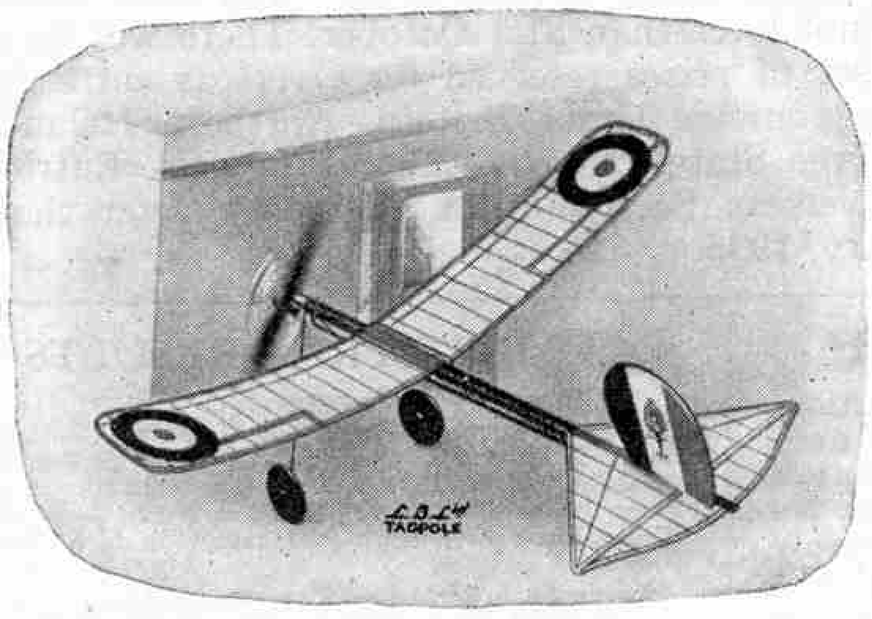
Wing Span 18 ins. Flies 600 ft.

A magnificent scale model of the famous record-breaking light aeroplane. All metal fuselage with bulkhead reinforcement, hollow wings of special design and construction. Dual motor coupled to gear box, glazed cabin and roof lights. "FROG" patent quick detachable fittings and high-speed mechanical winder. The model aeroplane "par excellence."

17/6

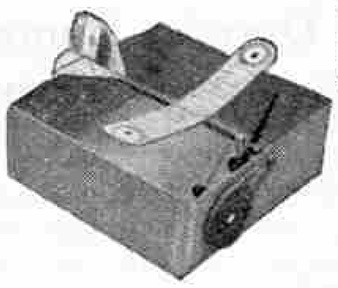
Including full equipment as specified.

"Tadpole" **INDOOR** Aeroplane



Price **2/6**

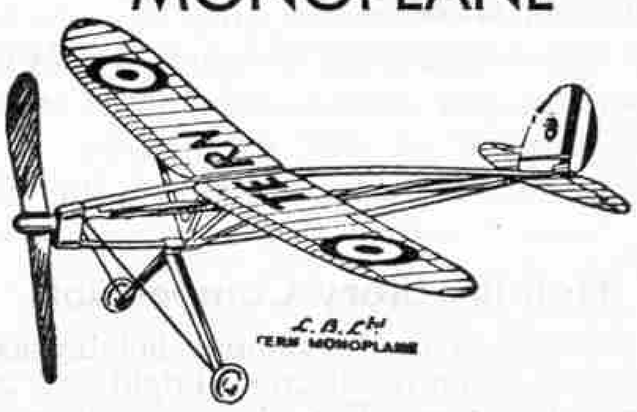
Complete with Patent High-Speed Winder Box.



This is **the** model for **indoor flying.** It will rise off the floor or table or even off its own box, and fly round any room—large or small. Marvellous flights—no skill required—**quickly wound with its patented high-speed winder box as shown.**

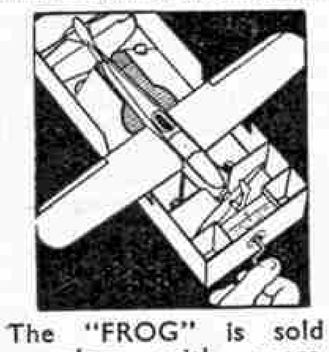
WING SPAN 8 ins.
DURATION 30 secs.

"TERN" MONOPLANE



A splendid model for outdoor flying. Very durable construction. Wing Span 15 ins. Flies 200 ft.

1/6



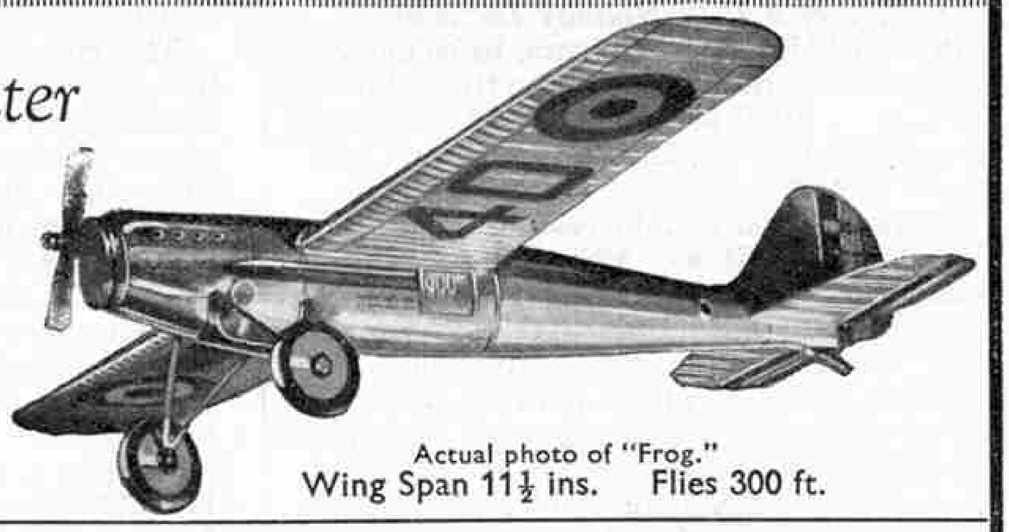
The "FROG" is sold complete with spare motors, lubricant and gear box oil, patent high speed winder box and illustrated flying manual.

"FROG" *Interceptor Fighter*

The original and now famous model. A scale model of high-speed Monoplane. Tubular construction, patented quick detachable fittings. High efficiency air-screw. A popular machine for realistic stunting. Seven models, each of handsome appearance and with the correct colours of the following nationalities: British R.A.F., France, Belgium, Holland, Italy, U.S.A. and Argentine.

7/6

Including full equipment as specified.



Actual photo of "Frog."
Wing Span 11½ ins. Flies 300 ft.

Sole Concessionaires: Designed and Made by International Model Aircraft Ltd., London, S.W.19.

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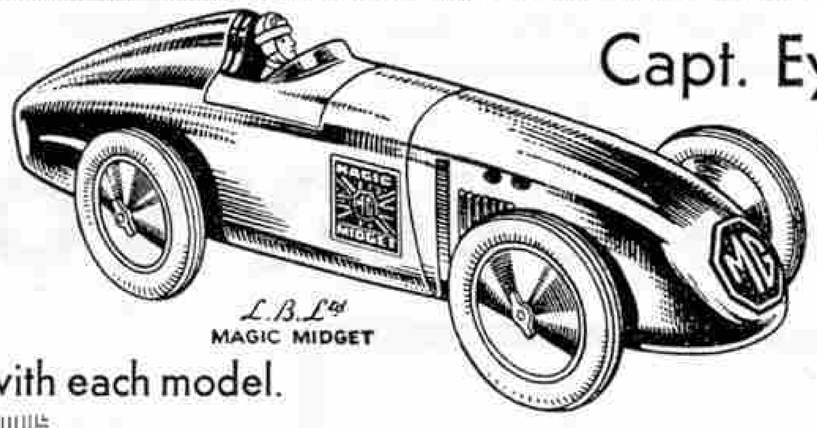

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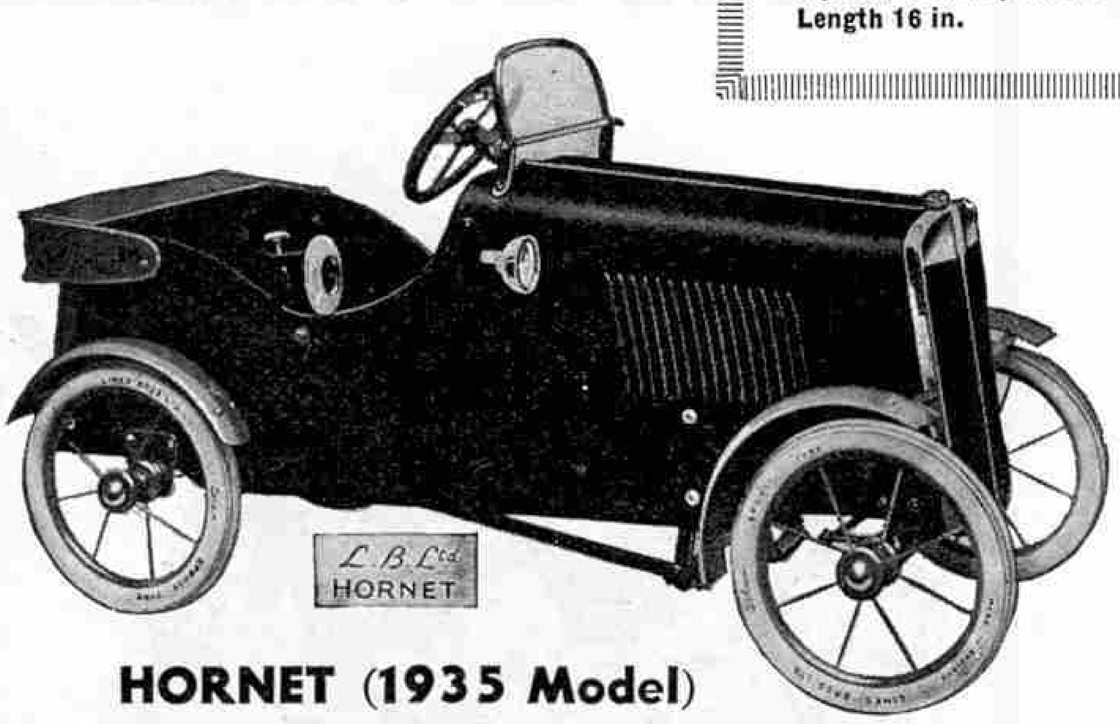

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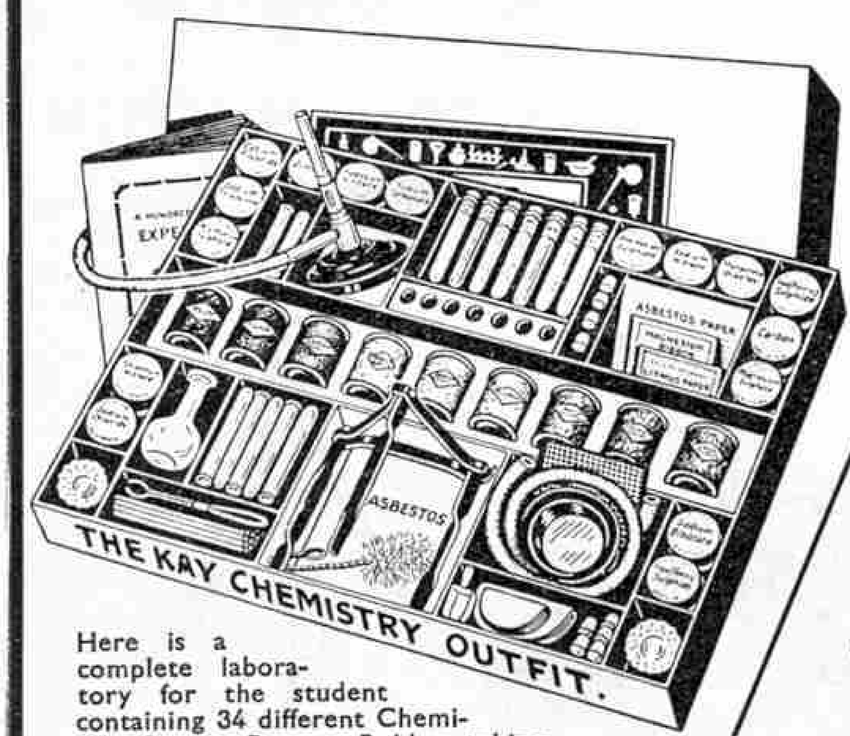

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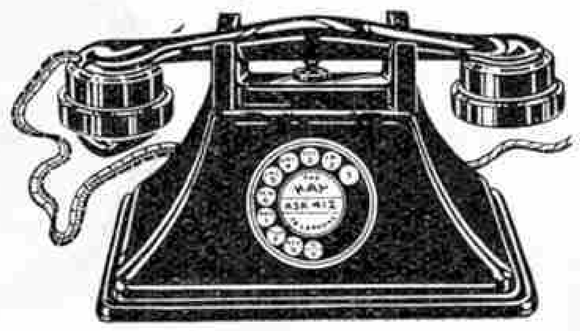

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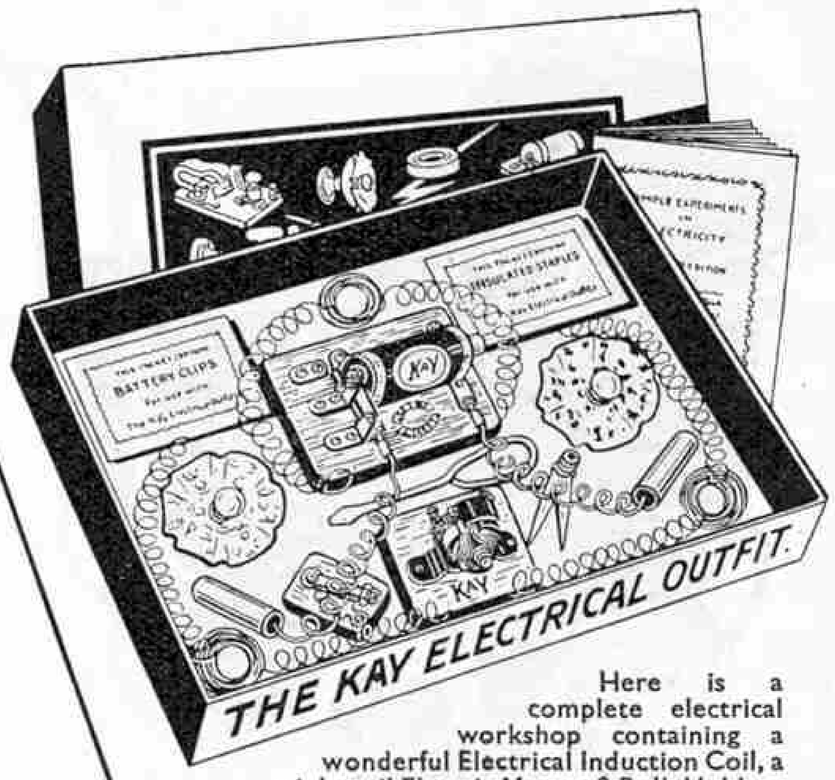

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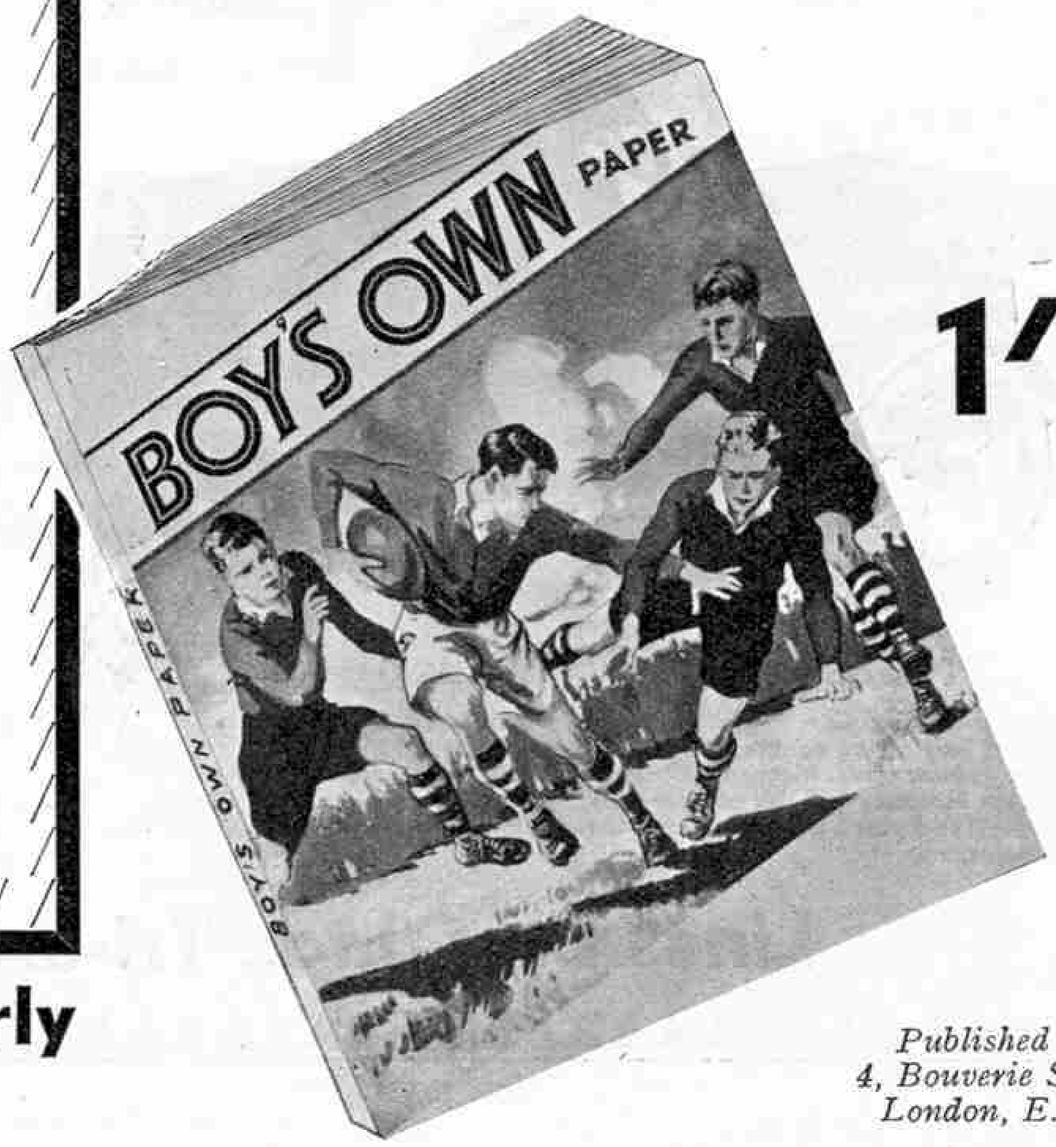

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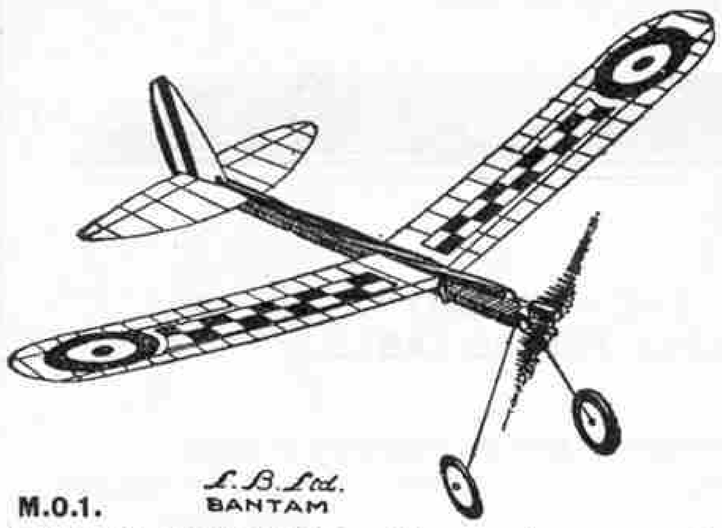

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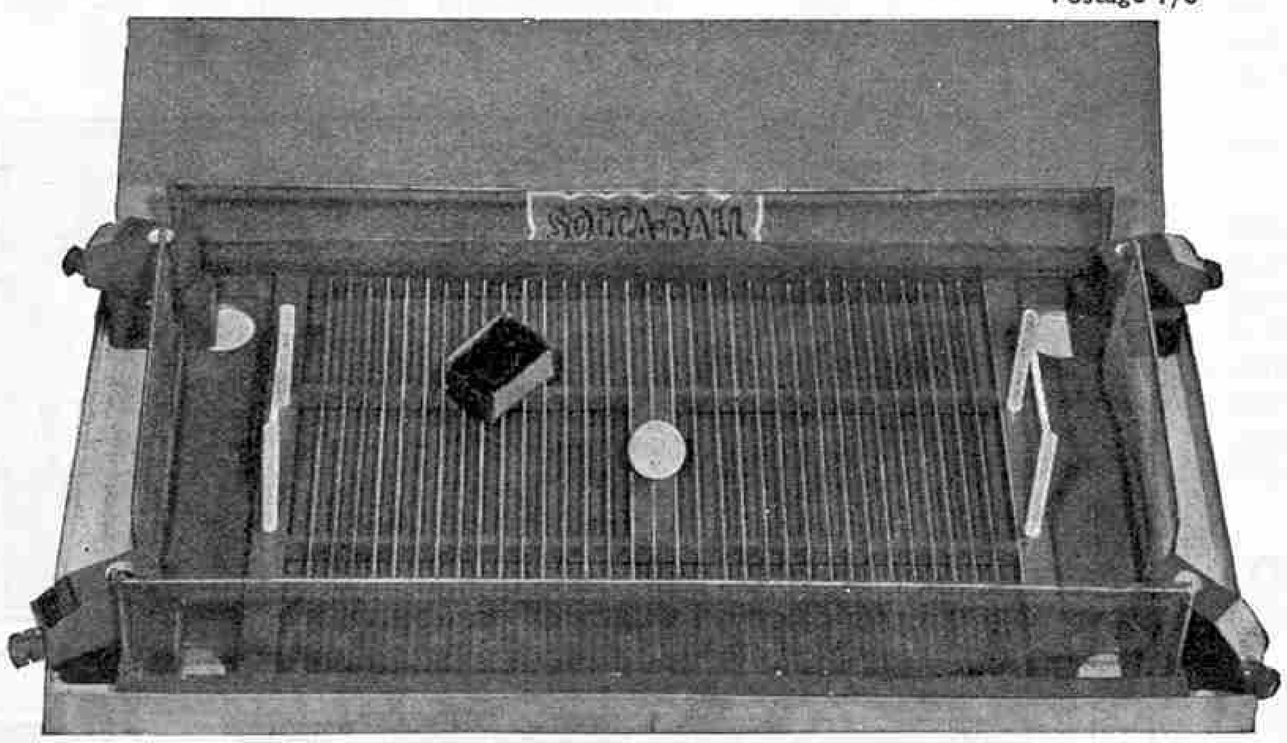

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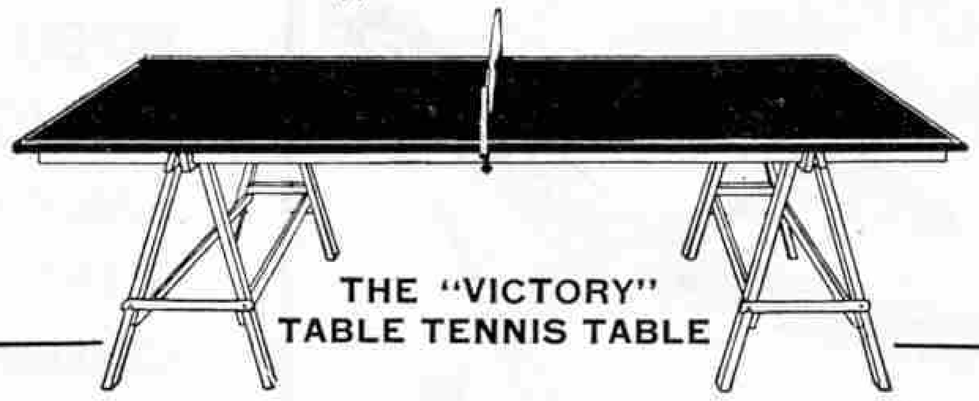

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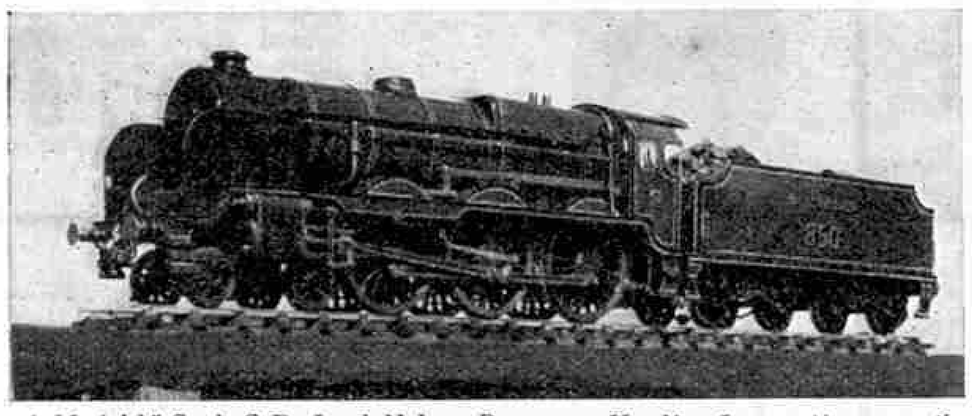

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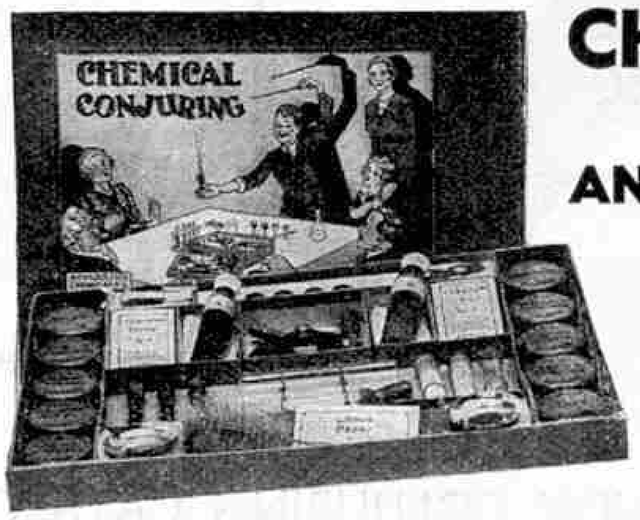

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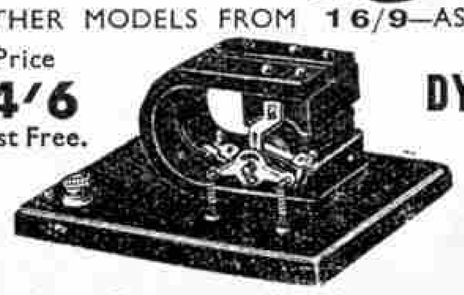

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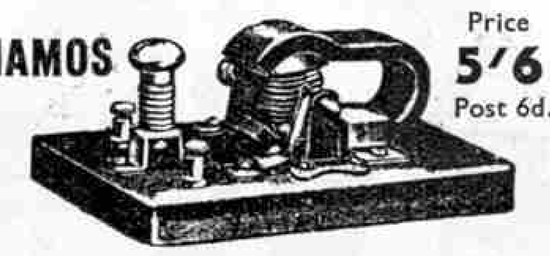

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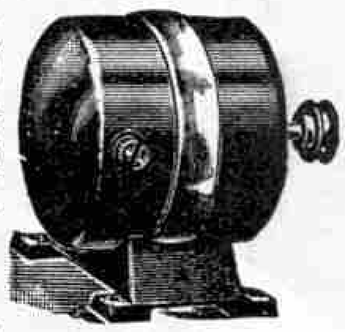

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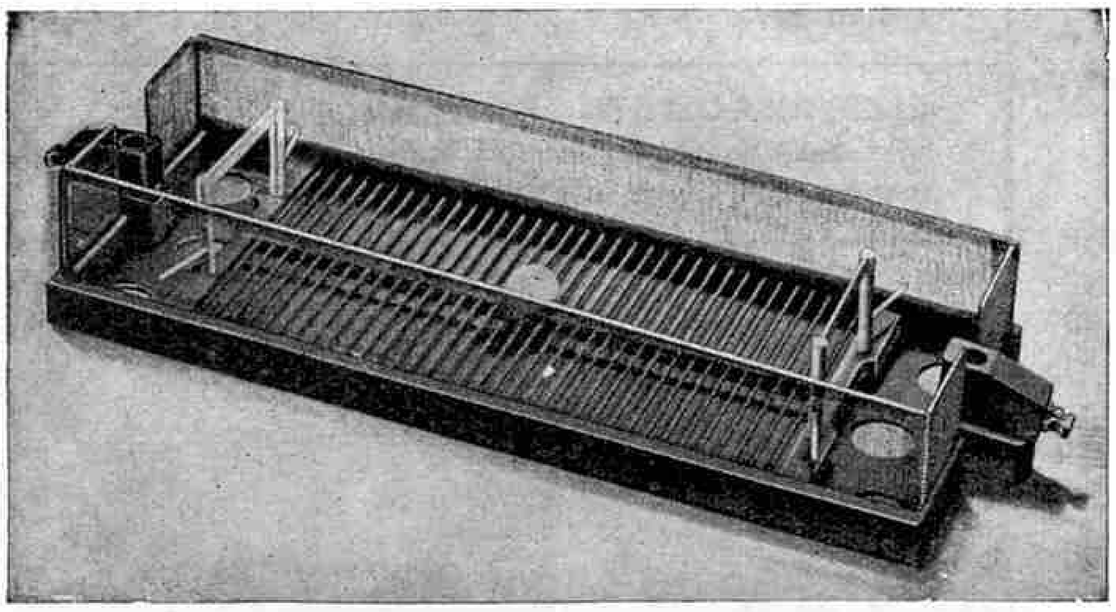

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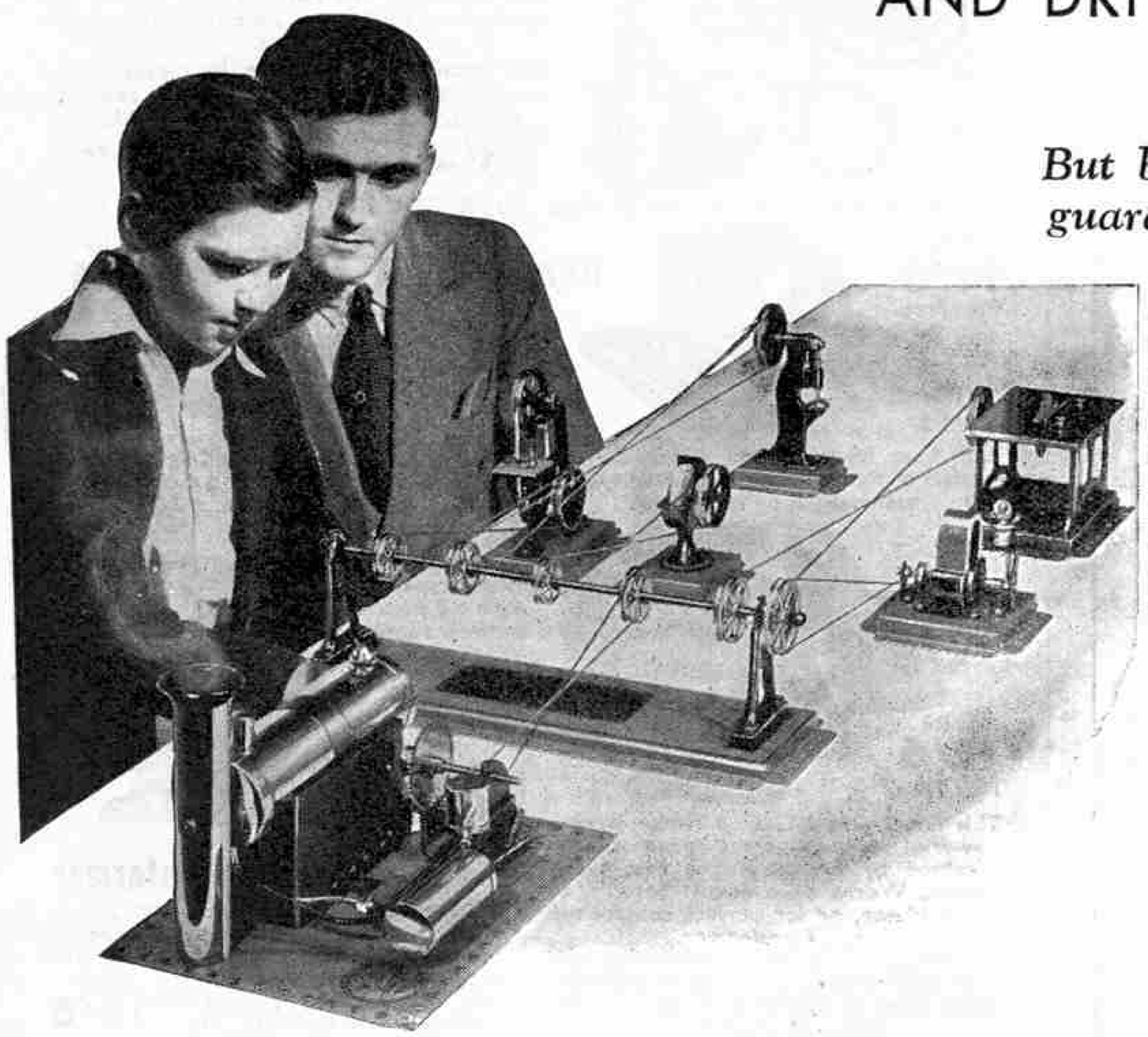

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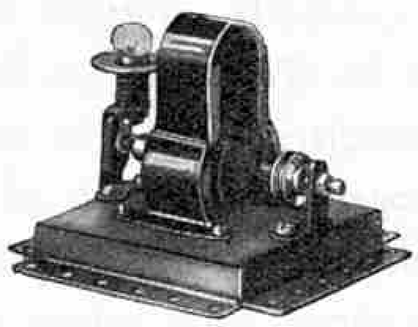

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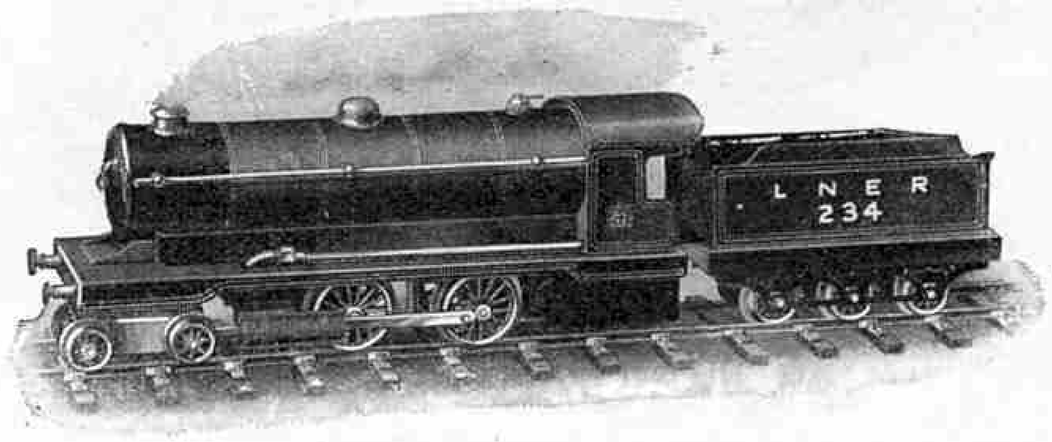

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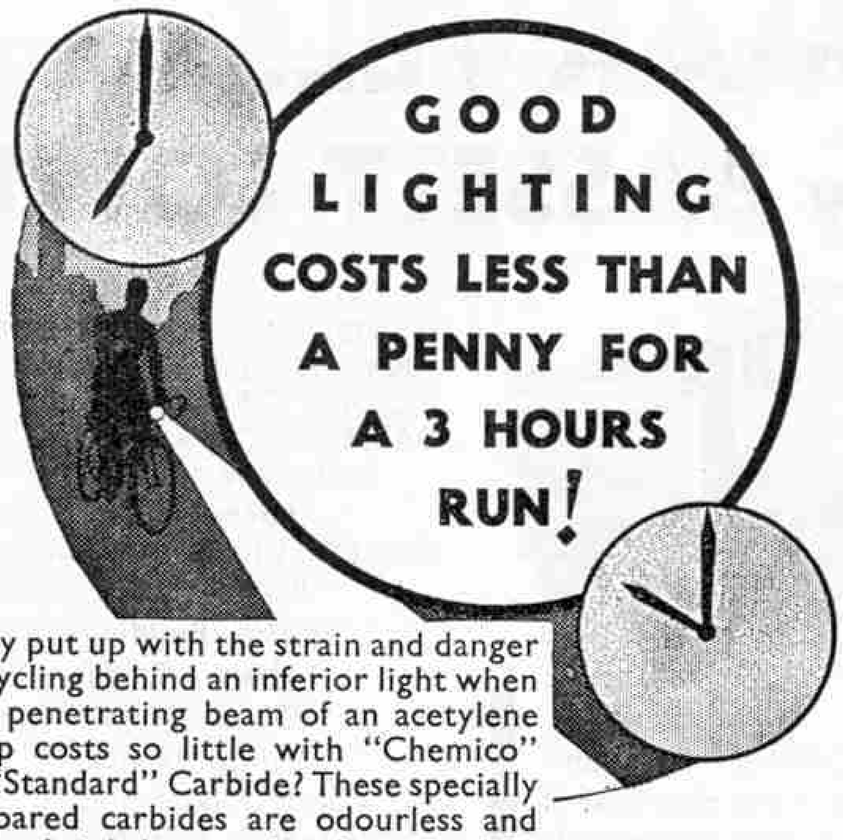

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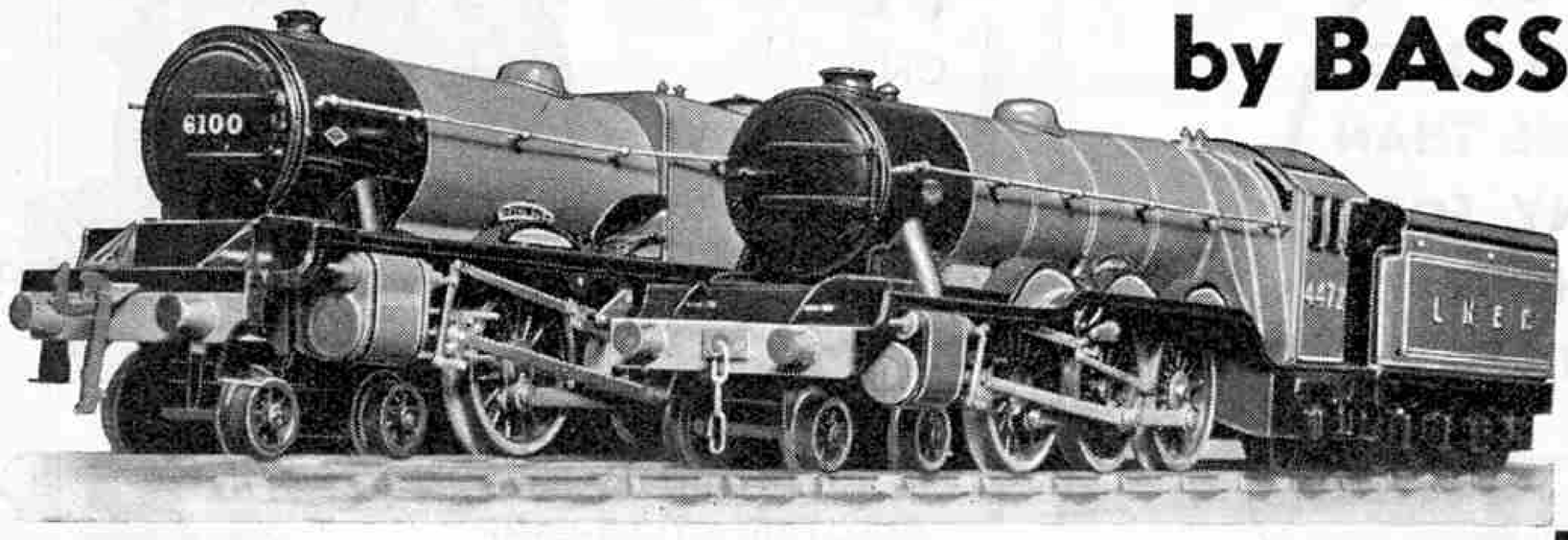

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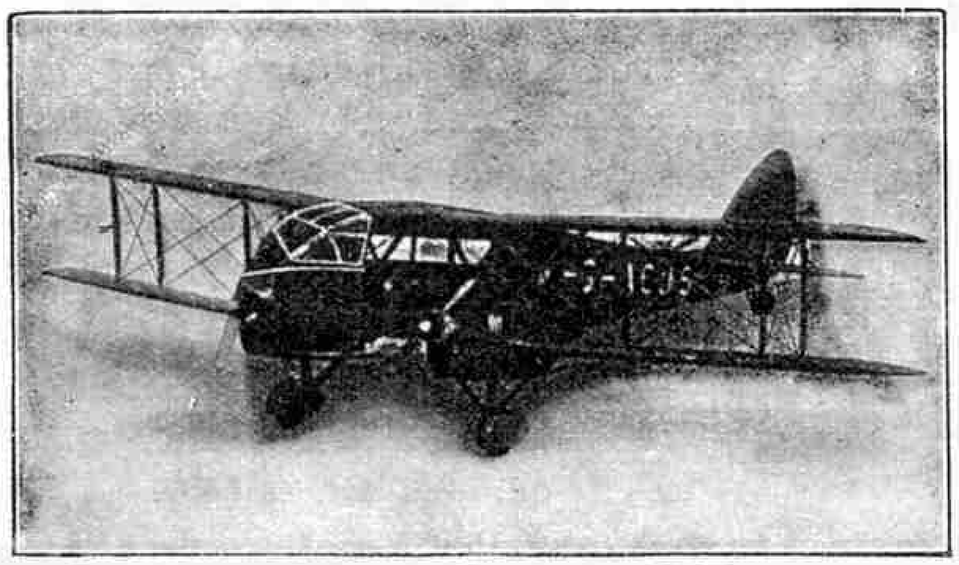

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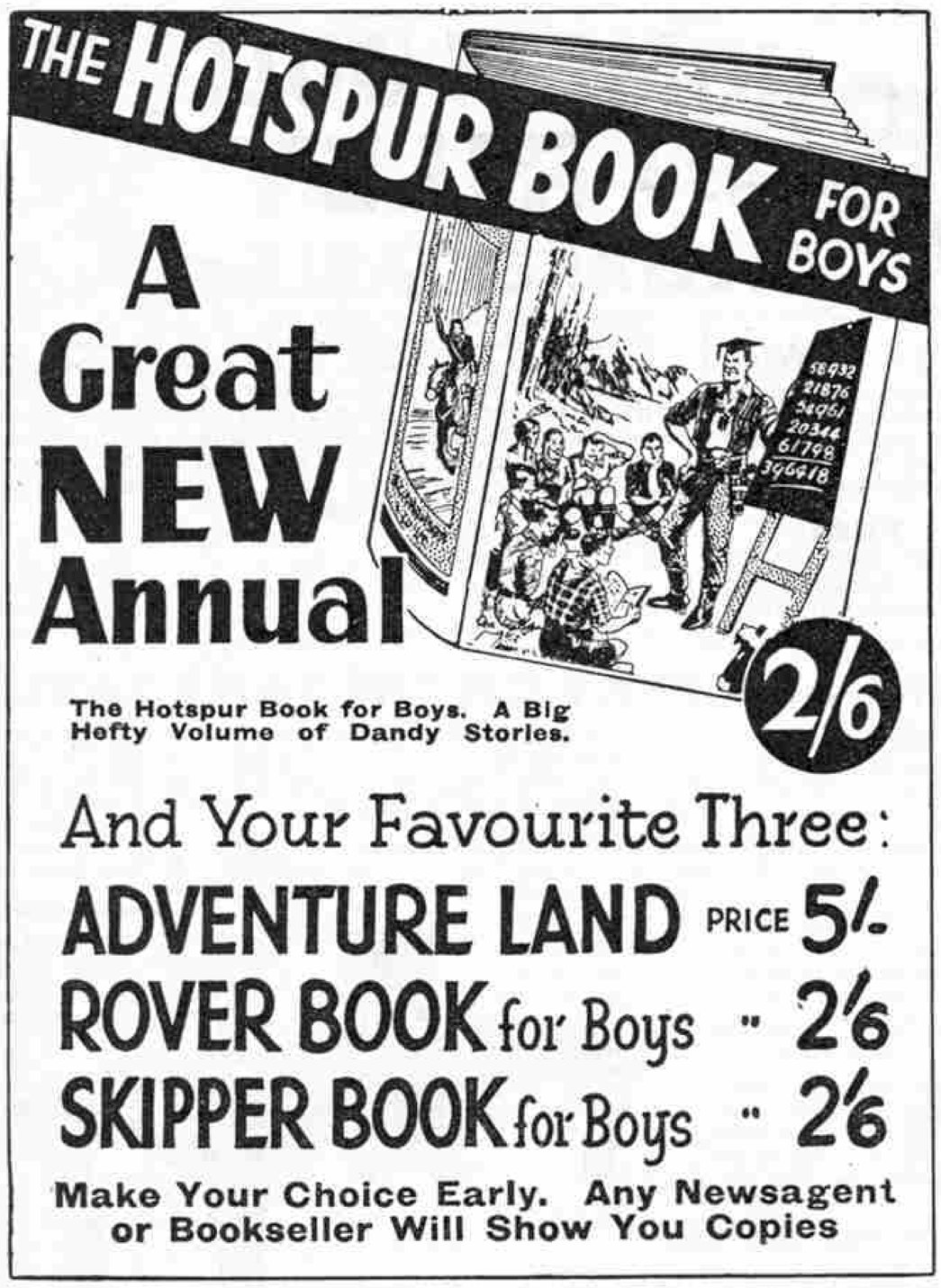

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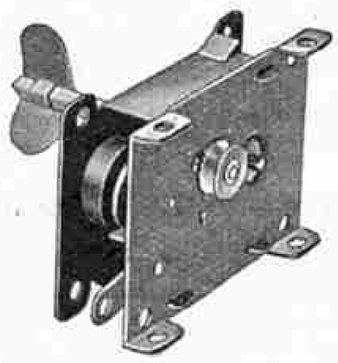

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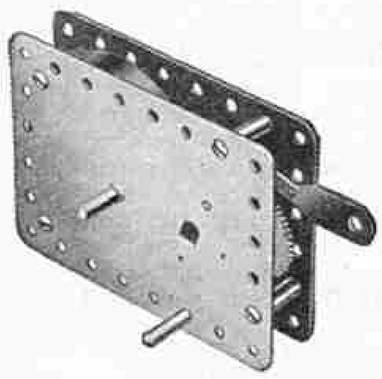

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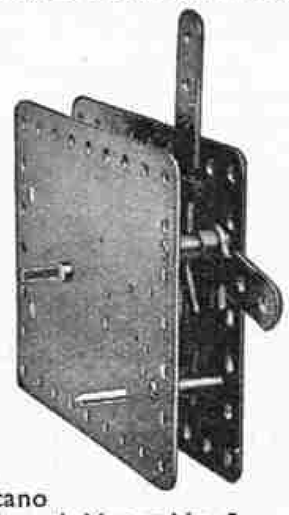

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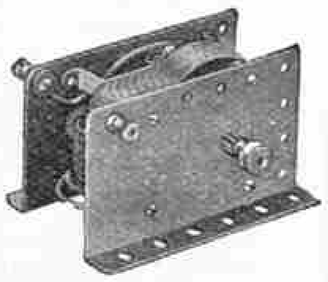

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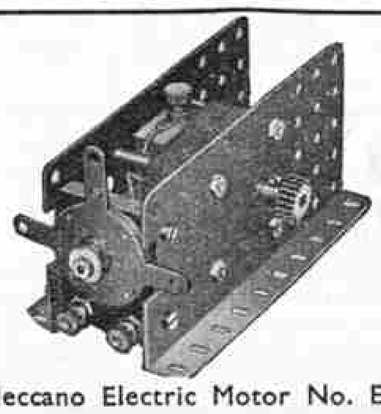

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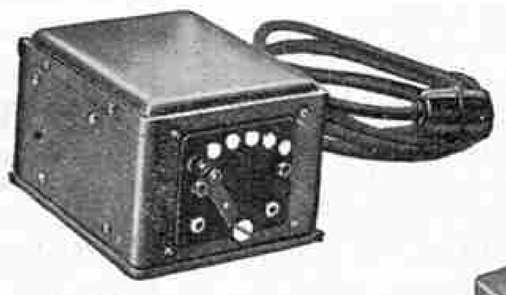

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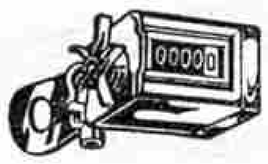

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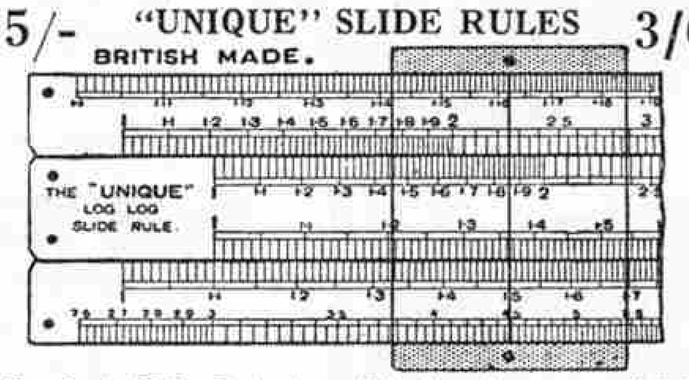

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The Second Dutch War—(*Cont. from page 777*)

before she blew up he later died of his wounds. The English ship "*Charity*," of 46 guns, after being attacked by three Dutch ships in succession and badly damaged, was attacked and captured by a fourth, the "*Stad en Landen*" of 46 guns, and was taken to Holland as a prize.

By evening the Dutch were in full flight, but their fleet was depleted by about 26 ships, 14 of which had been captured and the others sunk or burned by the English. About 4,000 Dutchmen had been killed or wounded, and 2,500 taken prisoners. The flight was splendidly covered at the rear by Vice Admiral Tromp, who had assumed chief command after the death of Opdam. The English losses were slight in comparison with those of the enemy, and totalled one ship, 250 men killed and 350 wounded, and 100 or so taken prisoners.

While the Dutch were hastening homeward pursued by the English, a council of war was held on the "*Royal Charles*" to decide what action should be taken when the enemy were overtaken. Before the English fleet had set out the Duchess had strictly ordered all James' servants to do all they could to prevent him engaging "too far with the enemy." This request seems to have been borne in mind by some of those who attended the council of war, as later that night, after James had retired, Penn was ordered in the name of the Duke to slacken sail. He realised that this meant the escape of the enemy, but he did not doubt the genuineness of the order. Thus it came about that by the time James awoke next morning the Dutch were too far away to be overtaken. There was so much indignation and criticism in England when it became known that the Dutch had been allowed to get away that James resigned his command. He was succeeded as Lord High Admiral by the Earl of Albemarle, who as Admiral Monk had taken an important part in the First Dutch War.

Shortly after the return of the fleet news reached England that De Ruyter was on his way back to Holland from America by way of the North of Scotland. A squadron commanded by the Earl of Sandwich sailed from Southwold Bay on 5th July to intercept him, but unfortunately it missed him.

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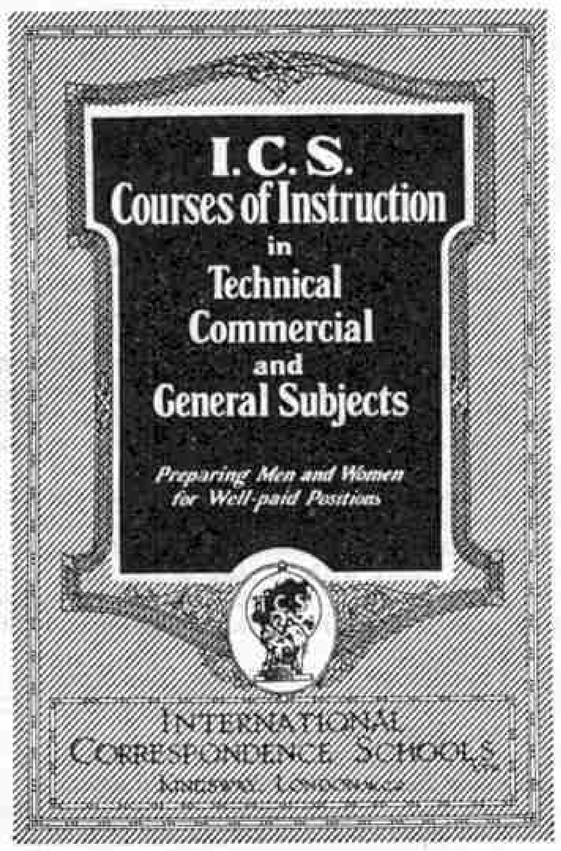

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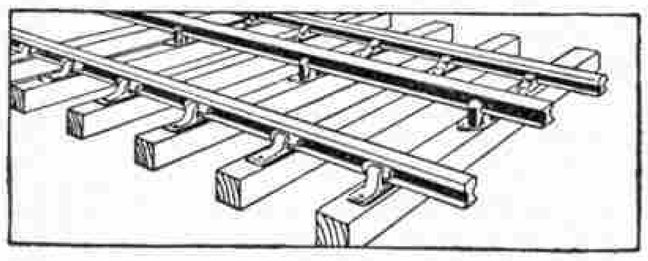

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Wanted. Complete Set of Arthur Mee's Children's Encyclopædia. State condition and lowest cash price. —Jackson, Hameringham, Horncastle.

Pioneers of Chemistry—(*Continued from page 797*)

When Boyle returned from his Continental tour, civil war had broken out between the King and Parliament. Ireland was in a state of anarchy, and he was compelled to settle on his father's estate in England. There he devoted himself to scientific work, and later he continued this at Oxford, where he became a member of the "Invisible College." This was not a secret society, but a band of enquiring young men who met weekly for discussions on science in each other's rooms, either in Oxford or London. The Invisible College grew into the Royal Society for Improving Natural Knowledge, which was incorporated by Charles II in 1662. To-day the Royal Society is Britain's greatest scientific association, and to be elected a member is one of the greatest honours to which a British scientist can attain. Boyle became President of the Royal Society in 1680 and continued to occupy that office until he died in 1691.

Boyle carried out many interesting chemical experiments, but his greatest work was to clear away many vague and misleading ideas. He disagreed with the beliefs that everything was built up of air, fire, earth and water in various proportions, as the alchemists thought, or of sulphur, quicksilver and salt, as Paracelsus had asserted; and challenged those who clung to these notions to show him any one of the so-called elements that had been extracted from gold. His own belief was that gold itself was an element, for it could not be broken up into simpler forms by heating or by any other means. This belief quickly gained ground, and to-day we know of 91 elements, or substances that cannot be changed by chemical means into simpler forms.

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Up the Amazon—(*Continued from page 775*)

One excursion from Manáos is of special interest—that to Taruma Falls, in the heart of the neighbouring forest. At high-river season, that is during the English spring and summer months, we go in a stern-wheel steamer as far up the Taruma creek as possible, and then embark in boats to be paddled through the flooded forest to the falls. At times the tree trunks are so close together that it is only possible for the boats to pass between them in certain places. It is almost uncanny to look down into the water and see that we are actually passing over the tops of trees of no mean size that the rising river has submerged. Great blue "Morpho" butterflies float idly about and make vivid splashes of colour in the dim light. The stream teems with fish, notably the ferocious piranha, which does not exceed 18 in. in length but swims in vast shoals. These fishes are instantly attracted by any blood in the water, and it ill betides man or beast, bleeding perhaps from some slight wound, to encounter them, as they strip the flesh from the bones in an incredibly short time. At the period of low river, when there is not sufficient water for boats, the trip is made in motors along a track cut through the forest to the top of the falls.

At length the time of our stay at Manáos draws to a close, and about the sixth day the "*Hilary*" once more weighs anchor and the homeward journey commences. Calls are again made at Pará, Madeira, Lisbon and Leixões, and seven weeks after leaving the Mersey we gaze once more on Liverpool's imposing waterfront and proceed alongside the landing stage. The voyage is over; we have travelled half-way across the world. We have steamed 1,000 miles up the mightiest of rivers into the heart of Brazil, and have returned full of enthusiasm to greet our friends and kinsfolk.

We are indebted to the courtesy of The Booth Steamship Co. Ltd., Liverpool, for the information contained in this article.

Chemistry—(*Continued from page 795*)

slightly when it sets. The result of this expansion is that the material fills every crevice of the mould.

The lower illustration on page 794 shows Plaster of Paris, made in the manner just described, being used for producing a cast of a medallion. The first step is to clean the medallion thoroughly, and then to rub it with a clean rag on which a drop or two of machine oil has been placed. Then the paste made by mixing the Plaster of Paris with a few drops of water is simply spread over the medallion. Setting takes place within a few minutes, and a cast reproducing in reverse the features of one side of the medallion is thus obtained. The cast is easily removed from the medallion by tapping it gently round the edge.

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EDITORIAL AND ADVERTISING OFFICE :—
LIVERPOOL 13, 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.

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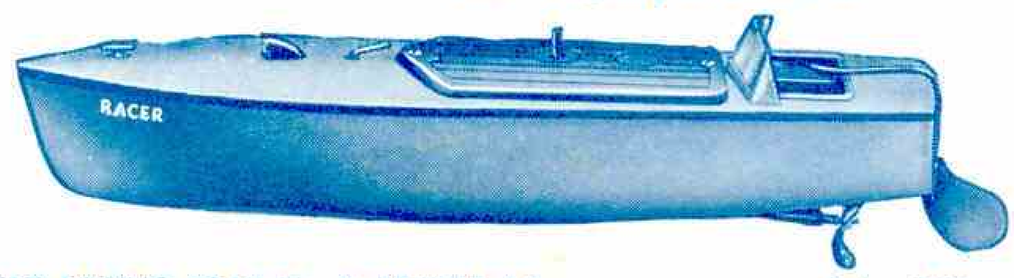

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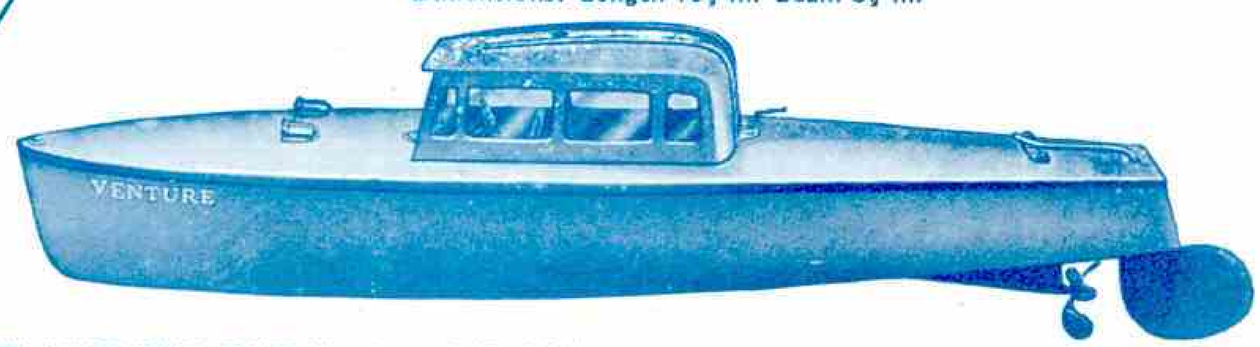

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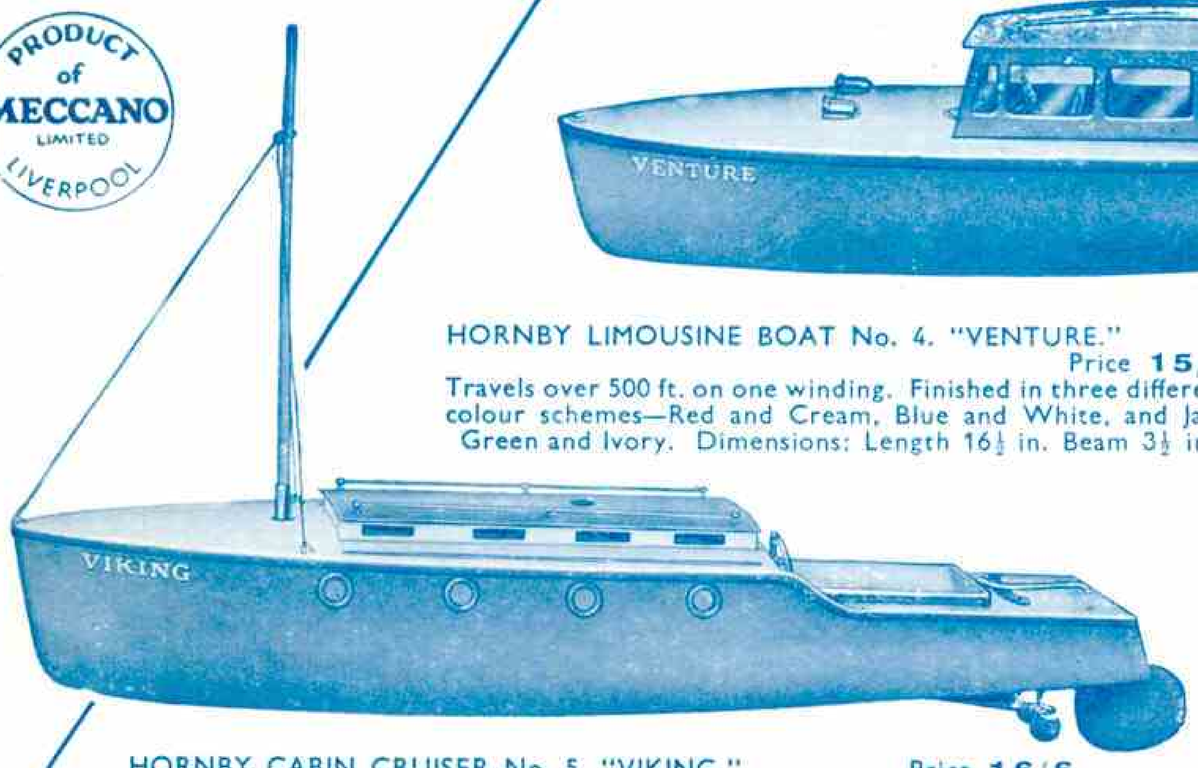

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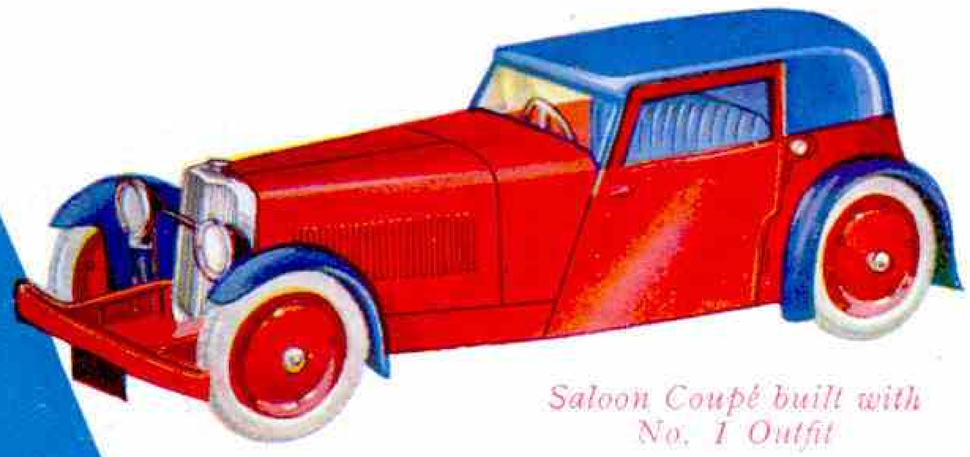

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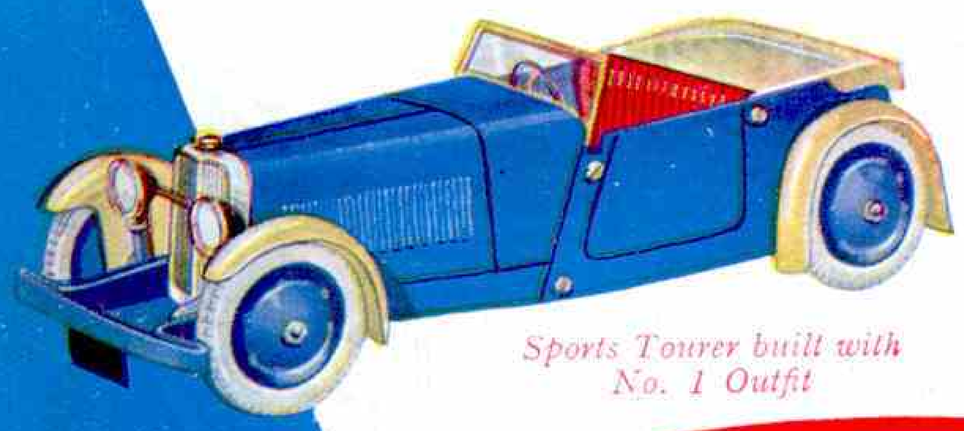

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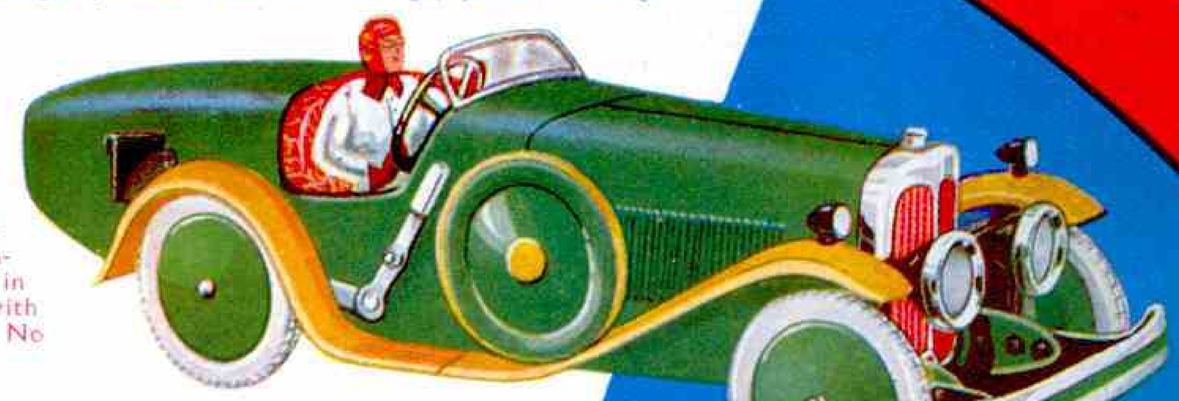

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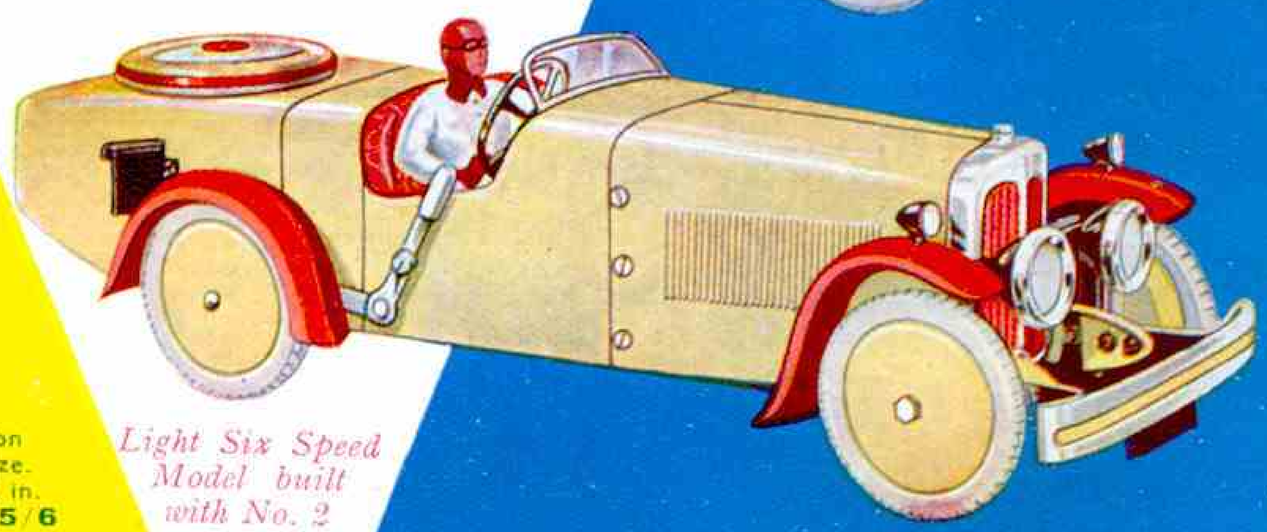

Light Six Speed Model built with No. 2 Outfit

Motor Car Garage

The Meccano Motor Car Garage provides accommodation for any Meccano model motor car or other car of suitable size. Inside dimensions : Height 5 in. Length 13 in. Width 7¾ in. Price **5/6**

Manufactured by

Meccano Ltd., Binns Rd., Liverpool 13

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