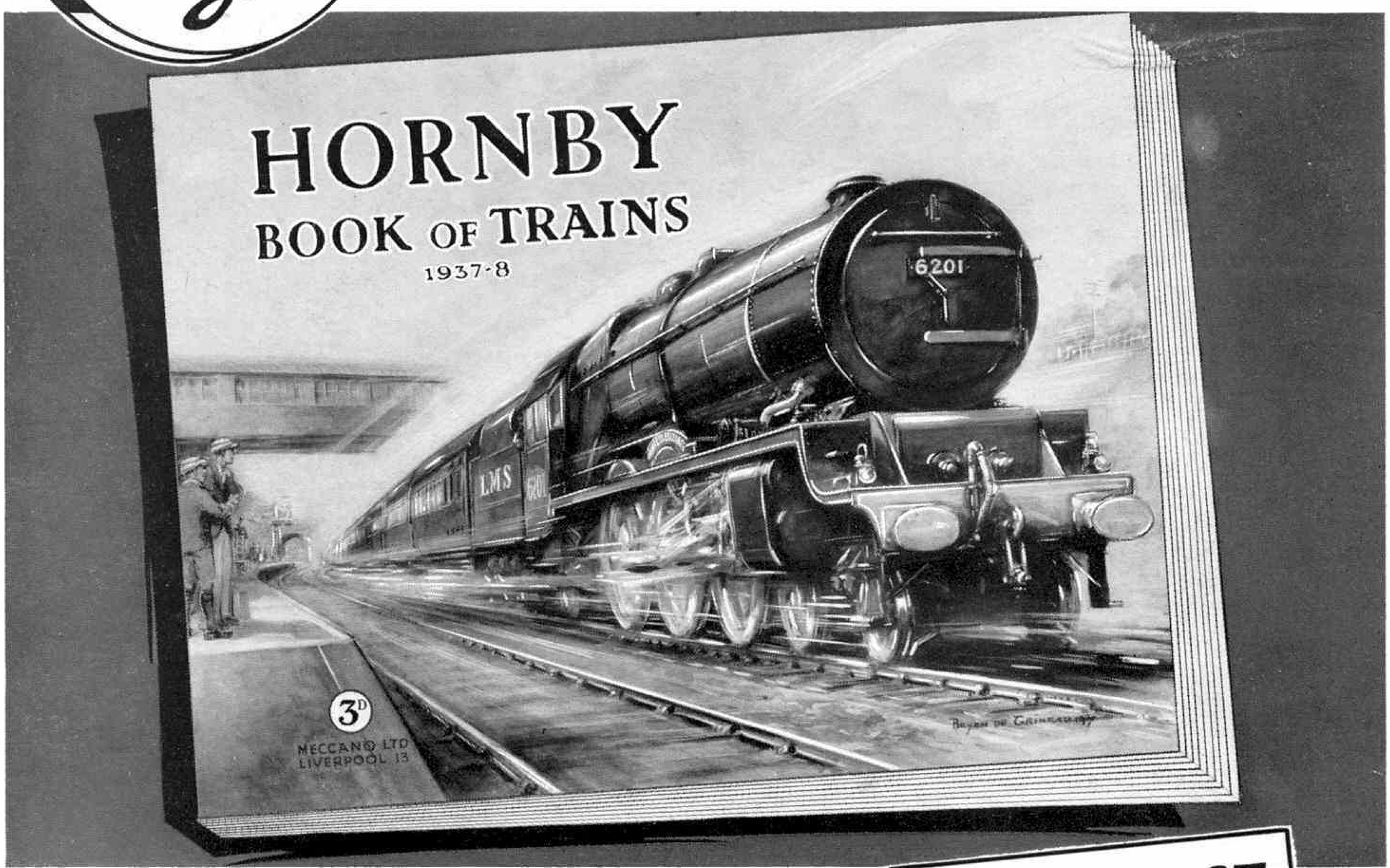
VOL. XXIII. No. 3 MARCH 1938

MECCANO MAGAZINE

A DOWN MIDLAND EXPRESS

The 1937-8 HORNBY BOOK of TRAINS



Of absorbing interest to Railway enthusiasts

The 1937-8 issue of the Hornby Book of Trains is the finest that has ever been produced. It contains splendid articles, fully illustrated by photographs, dealing with British express trains and locomotives, the mysteries of an engine shed, the fascination of operating a miniature railway, and other interesting topics.

In addition the book forms a complete catalogue of Hornby Trains for electric and clockwork railways. The Hornby Locomotives, Rolling Stock and Accessories are beautifully illustrated in full colour.

How to obtain the Book

The Hornby Book of Trains may be obtained from any Meccano dealer, price 3d., or direct from Meccano Ltd. (Dept. A.M.), Binns Road, Liverpool 13, price 4½d. post free. In the latter case a remittance in stamps should be sent and the name and address of the sender should be clearly written.

Readers living in Australia, New Zealand or South Africa who require copies should send their postal orders for 8d. (which includes postage) to the addresses given below. The Meccano Branch at Toronto will deal with Canadian orders and the price is 12 cents pos.paid.

Readers living in countries other than those mentioned should order from Meccano Ltd., Binns Road, Liverpool 13, sending 6d. in stamps with their order.

Overseas Agencies:

AUSTRALIA: E. G. Page & Co., 52, Clarence St., Sydney (P.O. Box 1832k).
NEW ZEALAND: Models Limited, Fayle's Buildings, Anzac Avenue, Auckland C.1 (P.O. Box 129).
SOUTH AFRICA: Arthur E. Harris, 142, Market Street, Johannesburg (P.O. Box 1199).
CANADA: Meccano Ltd., 187-189, Church Street, Toronto.

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Hamley's News

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No. 30 March, 1938

A Motor Car Which Obeys

REAL TRAFFIC LIGHTS

Mysterious Flashes at Night!

A COMPLETE PARTY IN ONE BOX

Here's an amusing way to spend the evening! A puzzle party is an assured success. Good-natured rivalry in solving these fascinating puzzles will provide hilarious evenings.

Price **2/3**
Post 4d.

EVERYTHING for the CYCLIST

A wonderful cyclist's outfit. Cyclometer, combination padlock, security chain, etc., together in one box.

Price **4/6**
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★A torch with red, green and white light for night signalling. Signal with your friends in your own secret code! *(Foreign.)*

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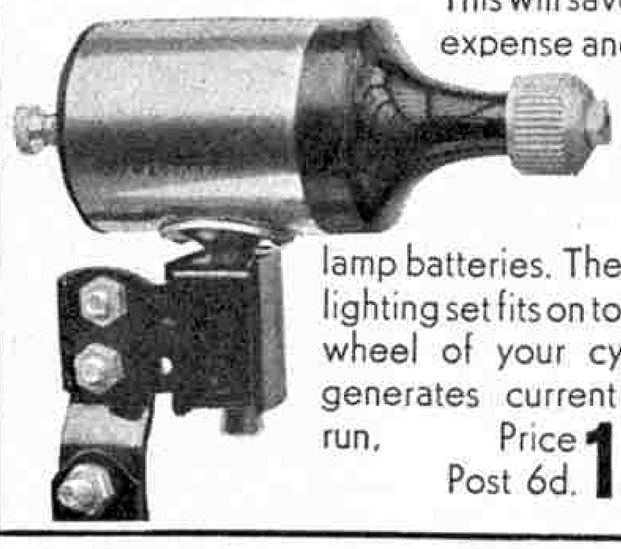
STOP—CAUTION—GO!

Control your own model cars with a real model three-light signal equipped with battery and switch. Height 7¾".

Price **3/11**
Post 4d.

CHEAPER LIGHTING



This will save you the expense and trouble of buying and renewing your lamp batteries. The dynamo lighting set fits on to the front wheel of your cycle and generates current as you run.

Price **19/6**
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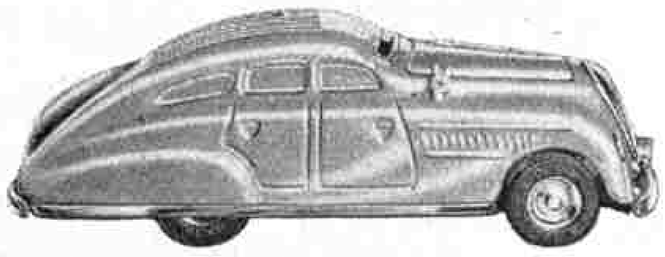
WHEN I SAY 'GO!'



The mystery car of the year. This will amaze grown-ups as well as children. By just giving the command "Off" the car will start and when you wish it to stop, you just say "Stop." And it will accomplish many other intriguing manceuvres. *(Foreign.)*

Price **3/6**
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WHAT IS PHILATELY?

A large and varied range of all Stamps, Stamp Albums and Accessories always in stock—Visit the Stationery Department on the Lower Ground Floor.

It's the world's most honoured hobby. The stamp outfit de Luxe contains magnifying glass, damper, hinges, tweezers, etc., with 200 assorted stamps.

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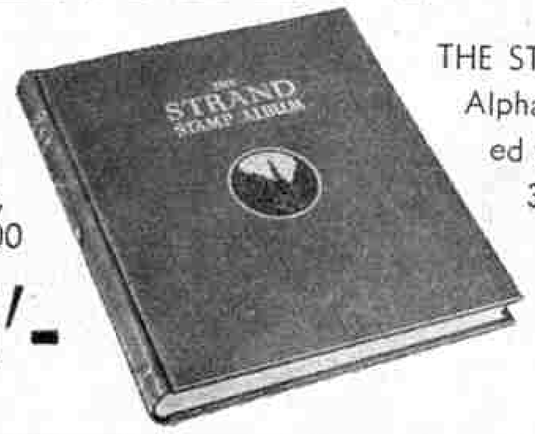

THE STRAND ALBUM. Alphabetically arranged cloth-bound album, 352 pages.

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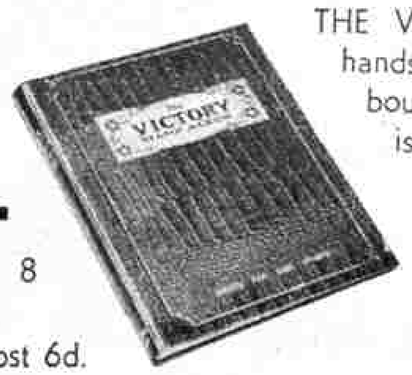

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Smaller size, price **2/6.**
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A fascinating building hobby

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Dinky Builder Outfits are great favourites with boys and girls. Simplicity is the keynote of this building system, by means of which even the youngest children can construct an unlimited variety of models.

No. O DINKY BUILDER OUTFIT

The first Outfit in the Series, from which 40 models as shown in the Instructions Folder, and many others, can be built. Price **2/6**

No. 1 DINKY BUILDER OUTFIT

Contains a larger and more varied selection of parts with which 56 models can be built, as shown in the Instructions Manual. Price **4/11**

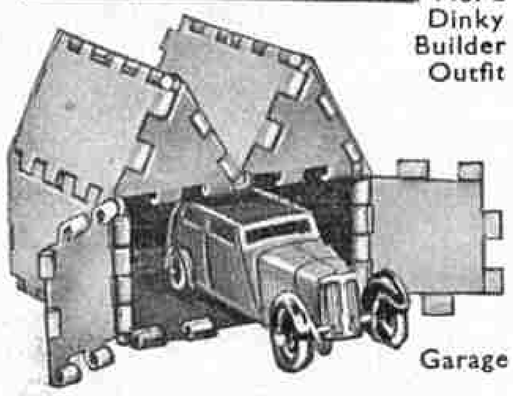
No. 2 DINKY BUILDER OUTFIT

With the parts in this Outfit all the No. O and No. 1 models can be built, together with groups of model furniture, as illustrated in the Instructions Manual. Price **7/9**

DINKY BUILDER "A"

The Dinky Builder "A" packet contains a useful assortment of Dinky Builder Parts with which Outfits No. O, No. 1, No. 2 and No. 3 may be supplemented. Price **1/-**

No. 2 Dinky Builder Outfit



Garage

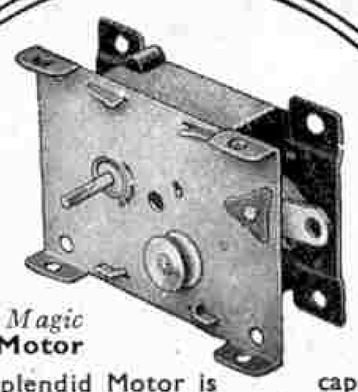
No. 3 DINKY BUILDER OUTFIT

This is the largest and best Outfit in the Series. The models that can be built with it are almost endless in number, and the Manual of Instructions illustrates **92 splendid examples. Price 10/9**

DINKY BUILDER

Manufactured by Meccano Limited, Binns Road, Liverpool 13

MECCANO MOTORS FOR DRIVING MODELS



The *Magic* Motor

This splendid Motor is capable of driving models made with Meccano Outfits Nos. O, 1, 2, 3 and 4. It costs only 2/-.

If you want to obtain the fullest enjoyment from the Meccano hobby you must operate your models by means of one of the Meccano Clockwork or Electric Motors listed below.

CLOCKWORK MOTORS

The *Magic* Motor (non-reversing)	Price **2/-**
No. 1 Clockwork Motor (non-reversing) ...	" **4/6**
No. 1a Clockwork Motor (reversing) ...	" **6/6**
No. 2 Clockwork Motor (reversing) ...	" **9/-**

ELECTRIC MOTORS

No. E1 Electric Motor (6-volt). Non-reversing ...	Price **7/6**
No. E6 Electric Motor (6-volt). Reversing ...	" **12/9**
No. E120 Electric Motor (20-volt). Non-reversing	" **7/6**
No. E20B Electric Motor (20-volt). Reversing ...	" **13/6**

TRANSFORMERS

The Transformers made by Meccano Limited provide a convenient and safe means of driving 6-volt or 20-volt Electric Motors and Train Sets from the mains supply where this is alternating current.

When ordering a Transformer the voltage and frequency of the supply must be stated. These particulars are given on the supply meter.

No. T6A Transformer (Output 40 VA at 9/3½ volts) for 6-volt Electric Motors. Fitted with speed regulator and separate circuit for supplying current for eighteen 3½-volt lamps ... ... Price **22/6**

No. T6 Transformer (Output 25 VA at 9 volts) for 6-volt Electric Motors. Fitted with speed regulator. Price **17/6**

No. T6M Transformer (Output 25 VA at 9 volts) for 6-volt Electric Motors. This is similar to No. T6, but is not fitted with a speed regulator ... ... Price **12/6**

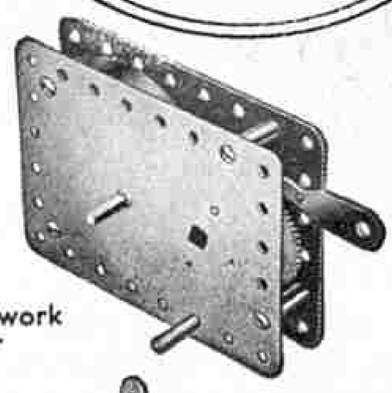
No. T26M Transformer (Output 50 VA at 9 volts) for 6-volt Electric Motors. Not fitted with speed regulator. Will operate two Meccano 6-volt Motors simultaneously. Price **13/6**

No. T20A Transformer (Output 35 VA at 20/3½ volts) for 20-volt Electric Motors. Fitted with speed regulator and output sockets for lighting fourteen 3½-volt lamps. Price **22/6**

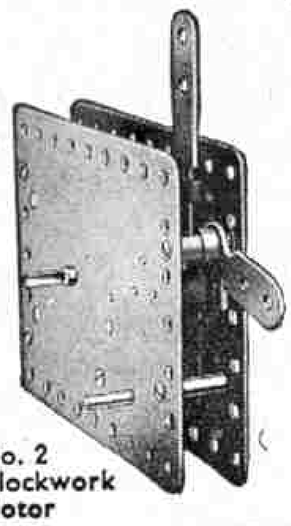
No. T20 Transformer (Output 20 VA at 20 volts) for 20-volt Electric Motors. Fitted with speed regulator. Price **17/6**

No. T20M Transformer (Output 20 VA at 20 volts) for 20-volt Electric Motors. This is similar to No. T20 but is not fitted with speed regulator ... ... Price **12/6**

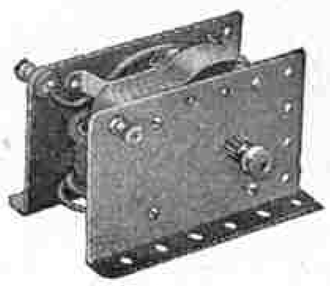
No. T22M Transformer (Output 50 VA at 20 volts) for 20-volt Electric Motors. Not fitted with speed regulator. Will operate two Meccano 20-volt Motors simultaneously ... ... Price **13/6**



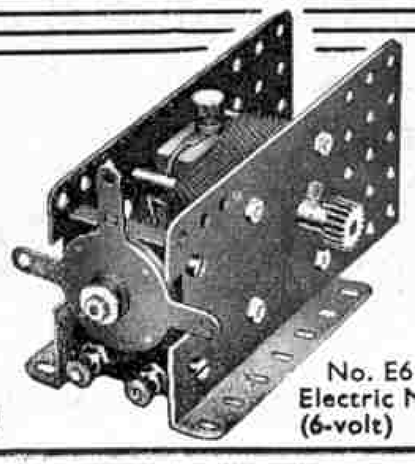
No. 1 Clockwork Motor



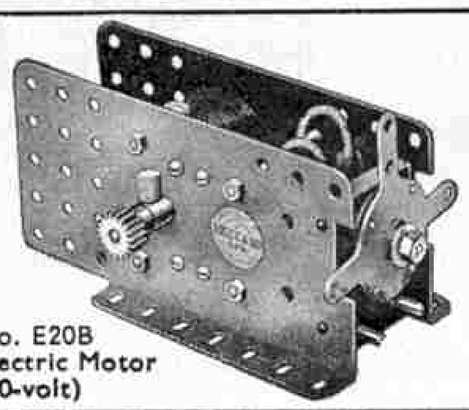
No. 2 Clockwork Motor



No. E1 Electric Motor (6-volt)



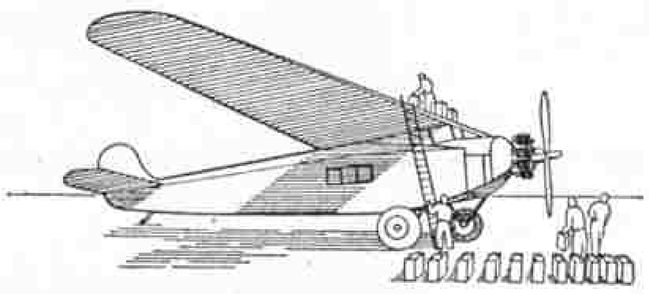
No. E6 Electric Motor (6-volt)



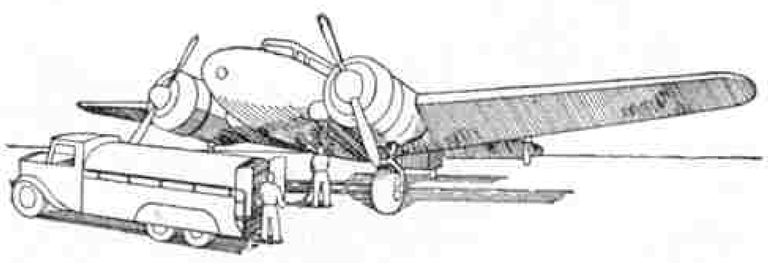
No. E20B Electric Motor (20-volt)

No. T20 Transformer

—Save time on the ground



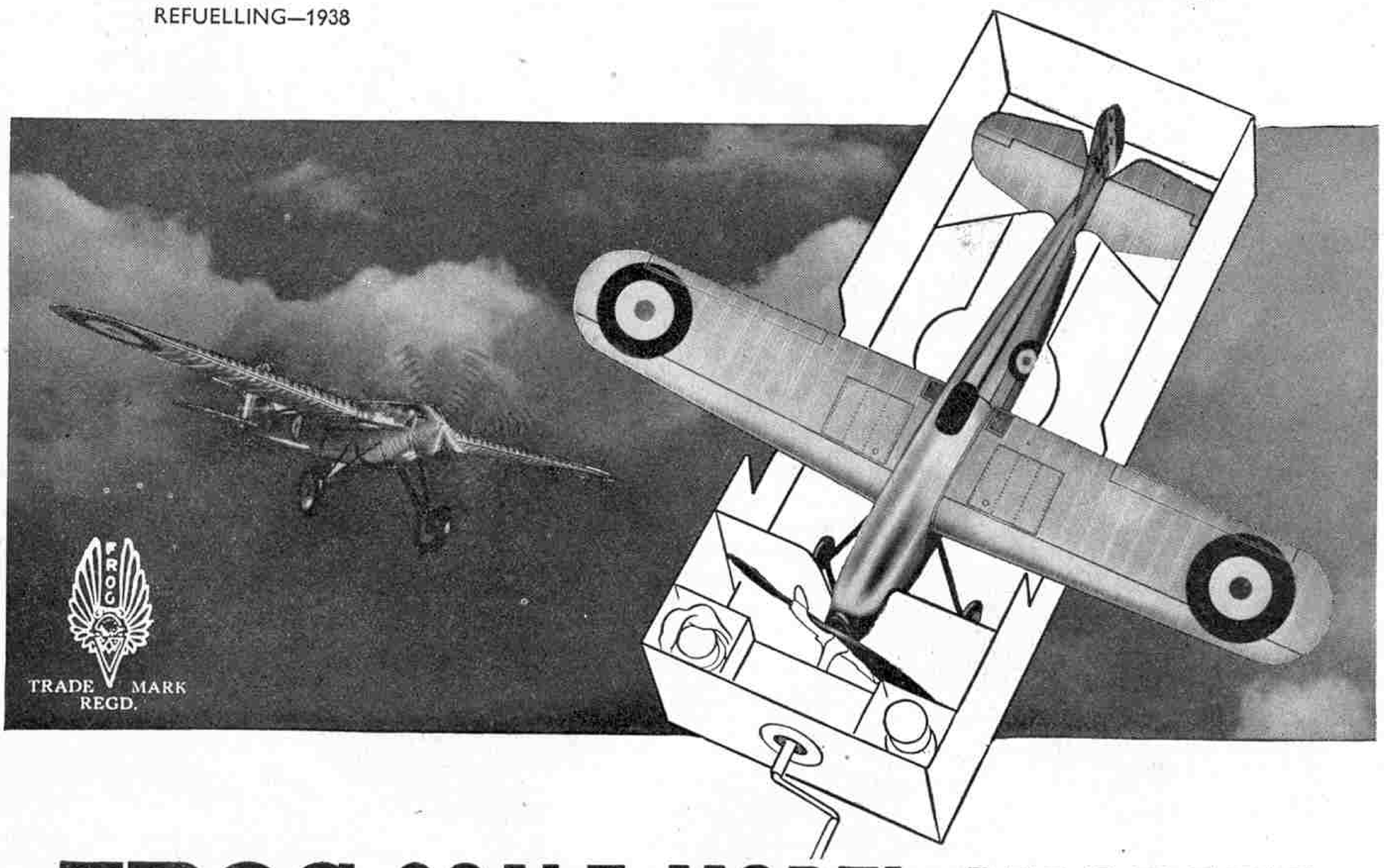
REFUELLING—1924



REFUELLING—1938

In the early days of aviation much time was lost on the ground. The modern tendency is to improve ground servicing and minimise delays at the aerodrome. Your model aircraft, too, should spend its time in the air and not on the ground. Every FROG MK IV scale model interceptor fighter is supplied complete with a patent high-speed winder box which cuts out tedious winding and enables the machine to do six flights in the time of one.

FROG MK IV COMPLETE IN PATENT WINDER BOX **5/-**



★ FROG SCALE-MODEL AIRCRAFT ★

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Please send me your "Frog" coloured leaflet with particulars of the "Frog" Flying Club and how to obtain handsome enamelled FROG Pilot Badges.

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Please write in block letters. 5/38

PERFECT SCALE MODELS

DINKY TOYS

OVER 250 VARIETIES

Collecting Dinky Toys is one of the most fascinating of all hobbies. These realistic miniatures are unique in their rich colouring and perfection of design and finish, and their range is so wide as to appeal to all tastes.

This season, in addition to reducing the prices of many of the existing models and sets, we have introduced several new items, including wonderful scale models of military Tanks and Aeroplanes, latest types of Motor Cars, complete with driver and passenger, and many others.

Every boy or girl who has not already done so should start this delightful collecting hobby to-day. All the models can be purchased either separately or in complete sets.

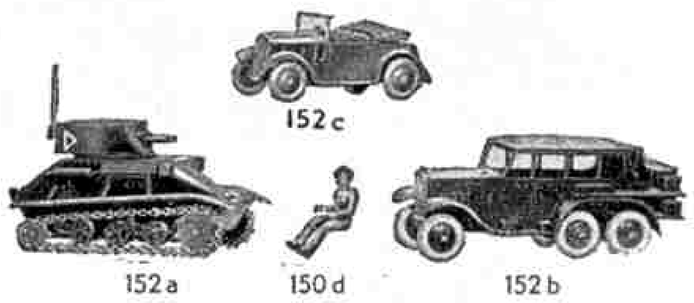
ROYAL TANK CORPS PERSONNEL

Dinky Toys No. 150

No. 150a Officer ... ... each **3d.**
No. 150b Private in sitting position (2) ... „ **3d.**
No. 150c Private in standing position (2) ... „ **3d.**
No. 150e N.C.O. ... ... „ **3d.**
Price of complete set **1/6**

Dinky Toys Nos. 150b, 150c, 150d and 150e can each be purchased in boxes containing one dozen at the special price of **2/9** per box.

ROYAL TANK CORPS LIGHT TANK SET



Dinky Toys No. 152

No. 152a Light Tank (4½ tons, 25 h.p.) ... ... each **1/2**
No. 152b Reconnaissance Car ... „ **1/-**
No. 152c Austin Seven Car ... „ **4d.**
No. 150d Driver ... ... „ **3d.**
Price of complete set **2/9**

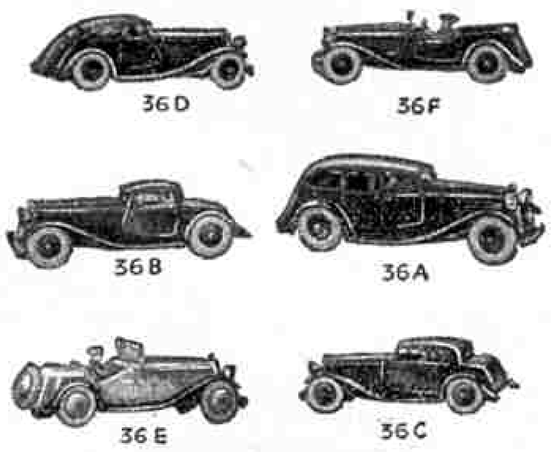
AUSTIN SEVEN CAR

Dinky Toys No. 35d

This model is the same as No. 152c, illustrated above, except that it is finished in a range of different colours. Price **4d.** each.

MOTOR CARS

WITH DRIVERS, PASSENGERS, Etc.



Dinky Toys No. 36

Fitted with detachable rubber tyres. Silver-plated radiators.

No. 36a Armstrong Siddeley (Limousine) with driver and footman ... each **11d.**
No. 36b Bentley (Two-seater Sports Coupe) with driver and passenger ... „ **11d.**
No. 36c Humber (Vogue Saloon) with driver and footman ... ... „ **11d.**
No. 36d Rover (Streamline Saloon) with driver and passenger ... ... „ **11d.**
No. 36e British Salmson (Two-seater Sports) with driver ... ... „ **11d.**
No. 36f British Salmson (Four-seater Sports) with driver ... ... „ **11d.**
Price of complete set **5/6**

ROYAL TANK CORPS MEDIUM TANK SET

Dinky Toys No. 151

No. 151a Medium Tank (12 tons, 90 h.p.) ... ... each **1/6**
No. 151b Three-ton Transport Wagon ... ... „ **1/1**
No. 151c Cooker Trailer with jack stand ... ... each **7d.**
No. 151d Water Tank Trailer ... „ **6d.**
No. 150d Driver ... ... „ **3d.**
Price of complete set **3/11**

EMPIRE FLYING BOATS

Dinky Toys No. 60r

Scale models of the latest Imperial Airways Flying Boats. Twelve models available named: *"Caledonia," "Canopus," "Corsair," "Challenger," "Centurion," "Cambria," "Calpurnia," "Ceres," "Clio," "Calypso," "Corinna"* and *"Cheviot."* Price **1/-** each

POLICE MOTOR CYCLIST

Dinky Toys No. 37b

Price **6d.** each

CIVILIAN MOTOR CYCLIST

Dinky Toys No. 37a

Assorted colours. Price **6d.** each

Royal Corps of Signals Despatch Rider. Dinky Toys No. 37c
Similar to Dinky Toys No. 37b. Finished in correct colours. Rubber tyres. Price **6d.** each

SIX WHEELED WAGON

Dinky Toys No. 25s

An interesting model of a modern three-ton wagon. In assorted colours.
Price **1/-** each.

ATLANTIC FLYING BOAT

Dinky Toys No. 60x

Similar in type to the Empire Flying Boat. Assorted colours.
Price **1/-** each

R.A.F. AEROPLANES

60n

DOUGLAS D.C.3 AIR LINER

Dinky Toys No. 60t

A scale model of a Douglas D.C.3 air liner, a type in regular service on American and European routes
Price **9d.** each

ARMSTRONG WHITWORTH "WHITLEY" BOMBER

Dinky Toys No. 60v

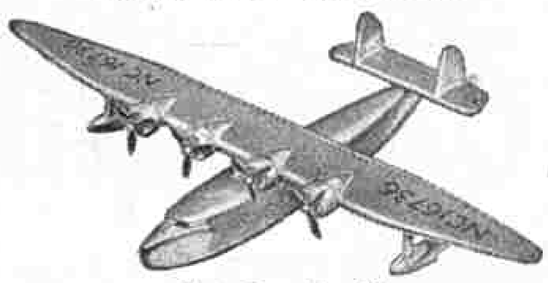
Scale model of the "Whitley" long-range heavy bomber adopted by the R.A.F.
Price **9d.** each

TAXI WITH DRIVER

Dinky Toys No. 36g

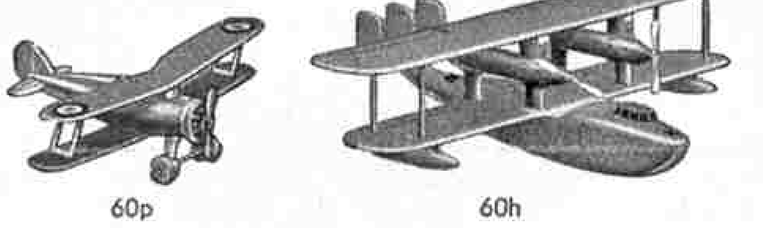
Fitted with detachable rubber tyres.
Price **11d.** each.

FLYING BOAT "CLIPPER III"



Dinky Toys No. 60w

Scale model of the Pan American Airways flying boat that took part in the transatlantic experimental flights in 1937.
Price **1/-** each



Dinky Toys No. 61

No. 60h "Singapore" Flying Boat ... ... each **1/-**
No. 60n Fairey "Battle" Bomber (2) ... ... „ **4½d.**
No. 60p Gloster "Gladiator" Biplane (2) ... „ **6d.**
Price of complete set **2/9**

MEDIUM BOMBER

Dinky Toys No. 60s

Similar to Fairey "Battle" Bomber (No. 60n), but with new Air Ministry Shadow Shading. Price **6d.** each

MECCANO LIMITED — BINNS ROAD — LIVERPOOL 13

A FASCINATING COLLECTING HOBBY

DINKY TOYS

FINISHED IN RICH COLOURS

ROBOT TRAFFIC SIGNAL

Dinky Toys No. 47a (Four face) Price **3d.** each
No. 47b (Three face) Price **3d.** each
No. 47c (Two face) Right-angle or back-to-back. Price **3d.** each

BEACON

Dinky Toys No. 47d
Realistic model of the Belisha Safety Beacon.
Price **1d.** each

D.H. "COMET" AEROPLANE

Dinky Toys No. 60g
Scale model of the aeroplane used by Flying Officer A. E. Clouston and Mrs. Kirby-Green in their record flight to Capetown and back. Price **6d.** each

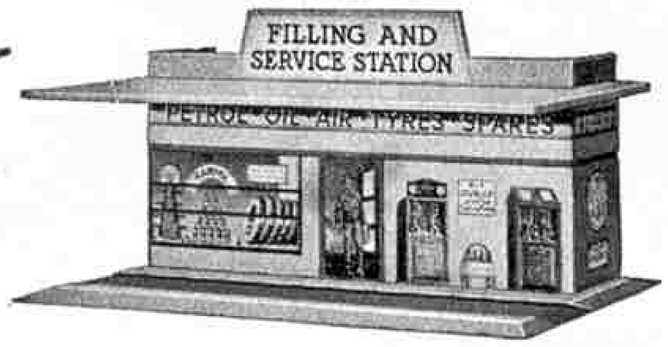
STREAMLINE SALOON

Dinky Toys No. 22h
Assorted colours. Fitted with detachable rubber tyres.
Price **4d.** each

REFUELLING TENDER

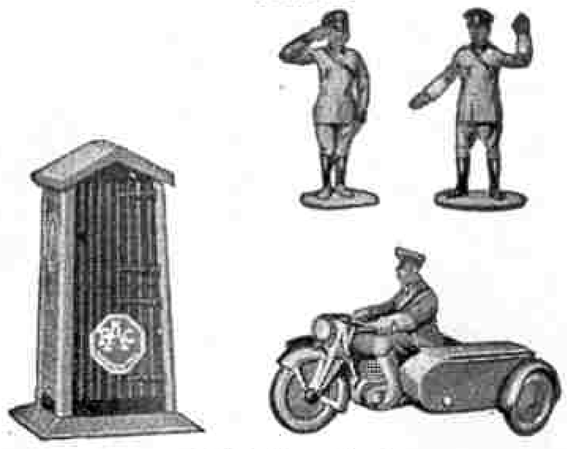
Dinky Toys No. 60y
Realistic model of Thompson Bros. Tender used for refuelling aeroplanes at aerodromes.
Price **8d.** each

PETROL STATION



Dinky Toys No. 48
Accurate reproduction of a filling station.
Price **1/3** each

R.A.C. BOX, MOTOR CYCLE PATROL AND GUIDES

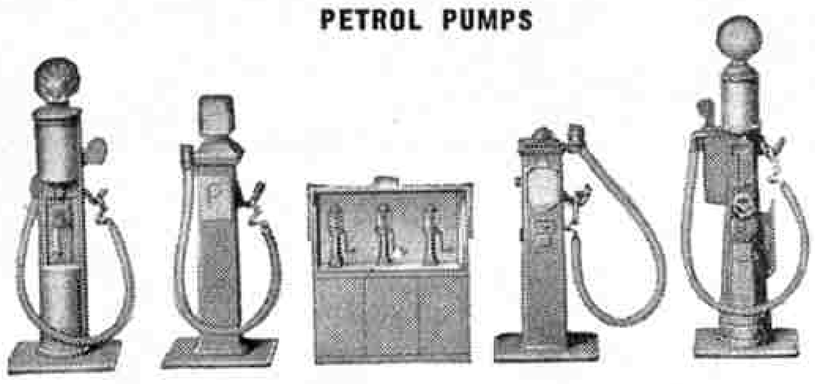


Dinky Toys No. 43
This set is representative of the familiar personnel and road box of the R.A.C. Each item is finished in correct colours.

No. 43a R.A.C. Box	each	**6d.**
No. 43b R.A.C. Motor Cycle Patrol	"	**9d.**
No. 43c R.A.C. Guide directing traffic	"	**3d.**
No. 43d R.A.C. Guide at the salute	"	**3d.**

Price of complete set **1/9**

PETROL PUMPS

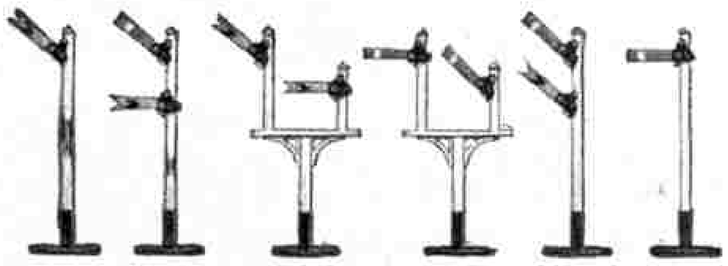


Dinky Toys No. 49
Scale models fitted with rubber hose pipes. Finished in correct colours.

No. 49a Bowser Pump	each	**3d.**
No. 49b Wayne Pump	"	**3d.**
No. 49c Theo Pump	"	**3d.**
No. 49d Shell Pump	"	**3d.**
No. 49e Oil Bin (Pratts)	"	**3d.**

Price of complete set **1/3**

RAILWAY SIGNALS



15a 15b 15c 15c 15b 15a

Dinky Toys No. 15

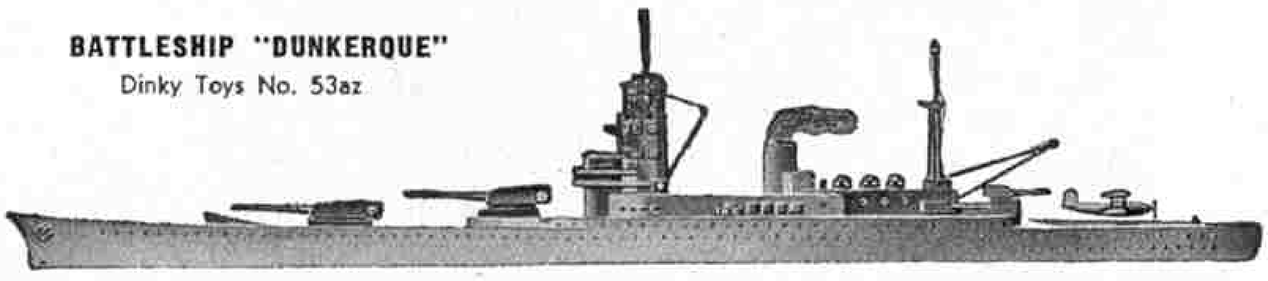
No. 15a Single Arm Signals ("Home" and "Distant")	each	**2d.**
No. 15b Double Arm Signals (two in set)	"	**3d.**
No. 15c Junction Signals ("Home" and "Distant")	"	**4d.**

Price of complete set **1/6**

A SELECTION OF DINKY TOYS MADE IN THE MECCANO FACTORY IN PARIS

BATTLESHIP "DUNKERQUE"

Dinky Toys No. 53az



Scale model of the French 26,500 ton Battleship "*Dunkerque,*" which has an overall length of 702 ft. 9 in., and a main armament of eight 13 in. guns. Price **9d.** each
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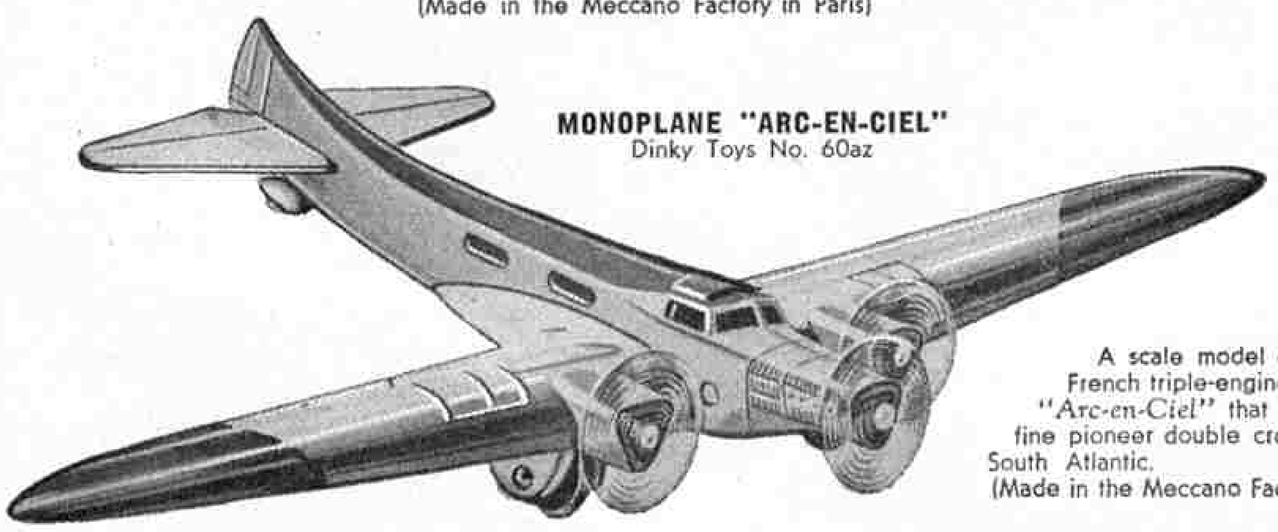

A scale model of the famous French triple-engined monoplane "*Arc-en-Ciel*" that made several fine pioneer double crossings of the South Atlantic. Price **9d.**
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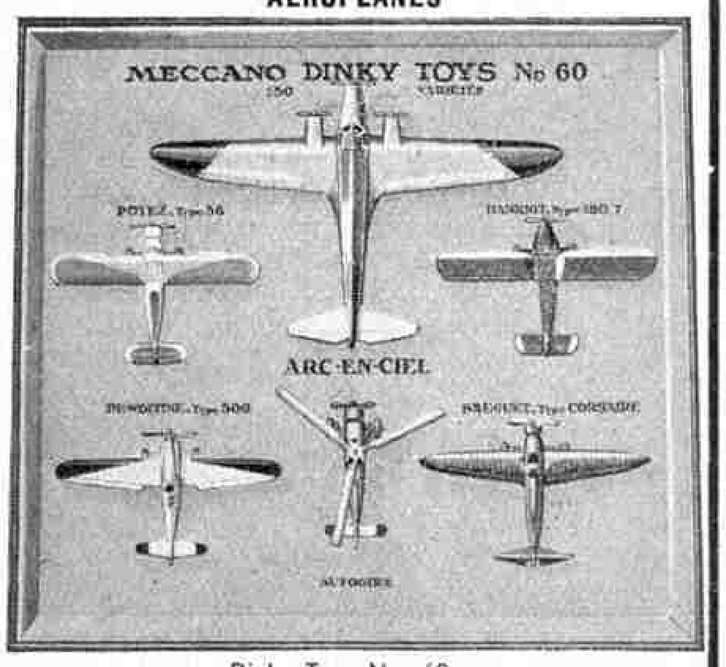
AEROPLANES



Dinky Toys No. 60z
The set consists of six models of famous French aeroplanes as follows: "*Arc-en-Ciel,*" Potez 58, Hanriot H180T, Breguet-Corsaire low wing monoplane, Dewoitine 500 and Cierva Autogiro. Price **3/.**
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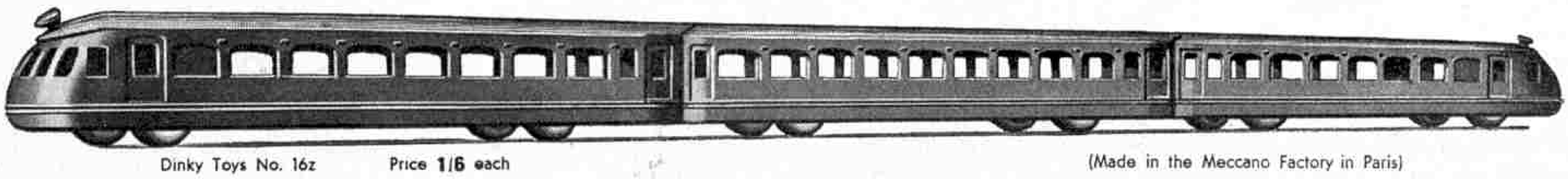

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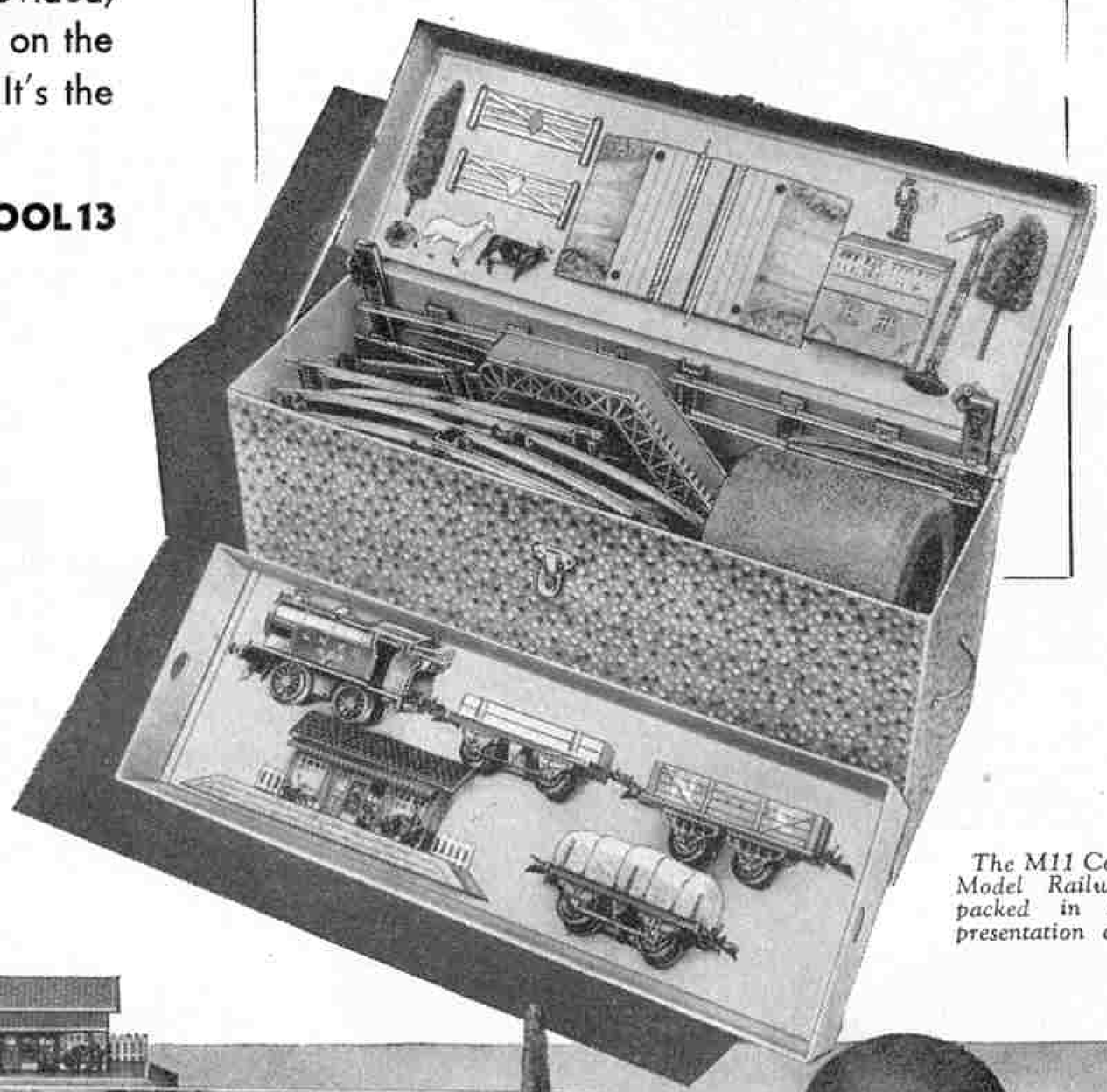
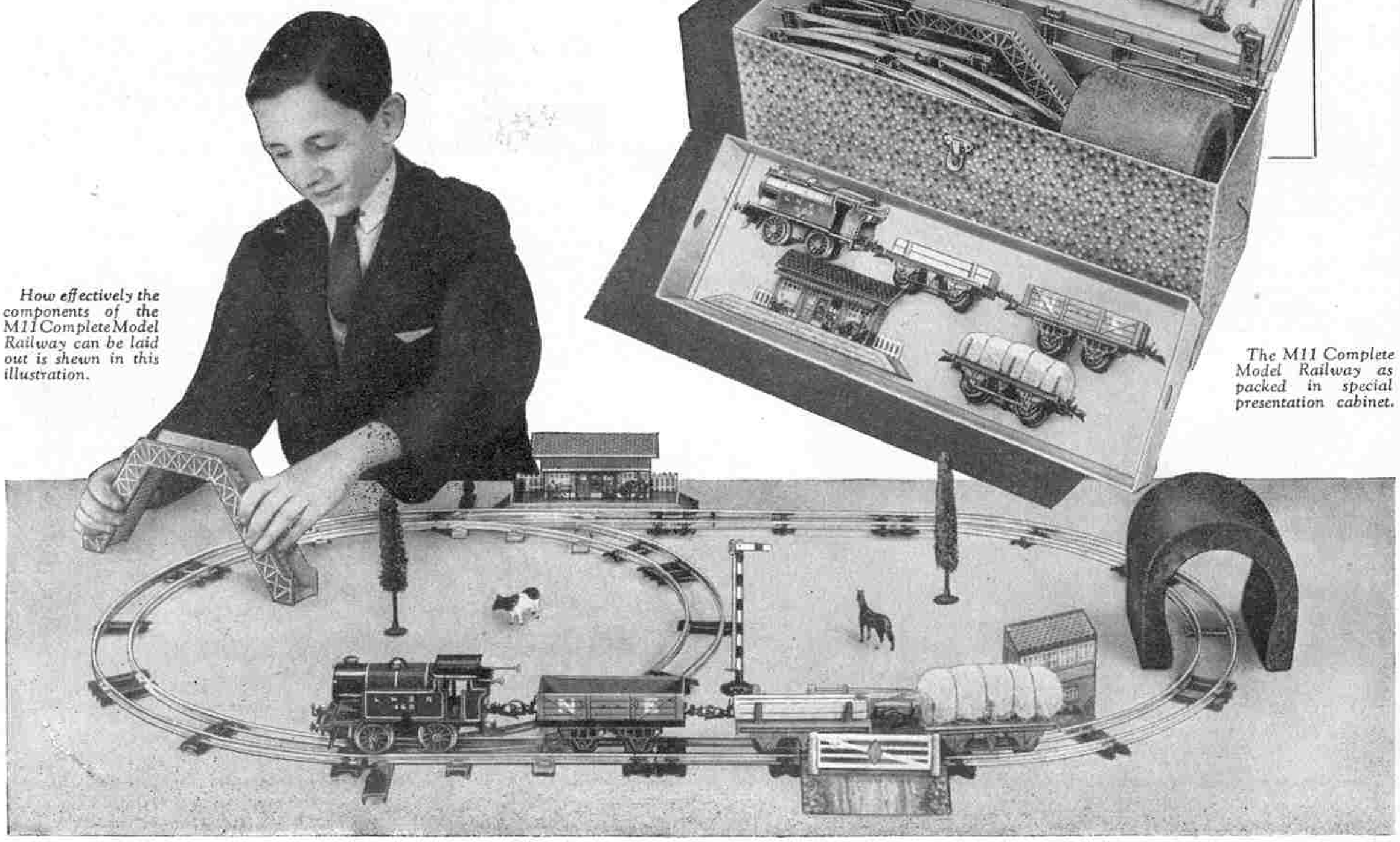


The M11 Complete Model Railway as packed in special presentation cabinet.



How effectively the components of the M11 Complete Model Railway can be laid out is shewn in this illustration.

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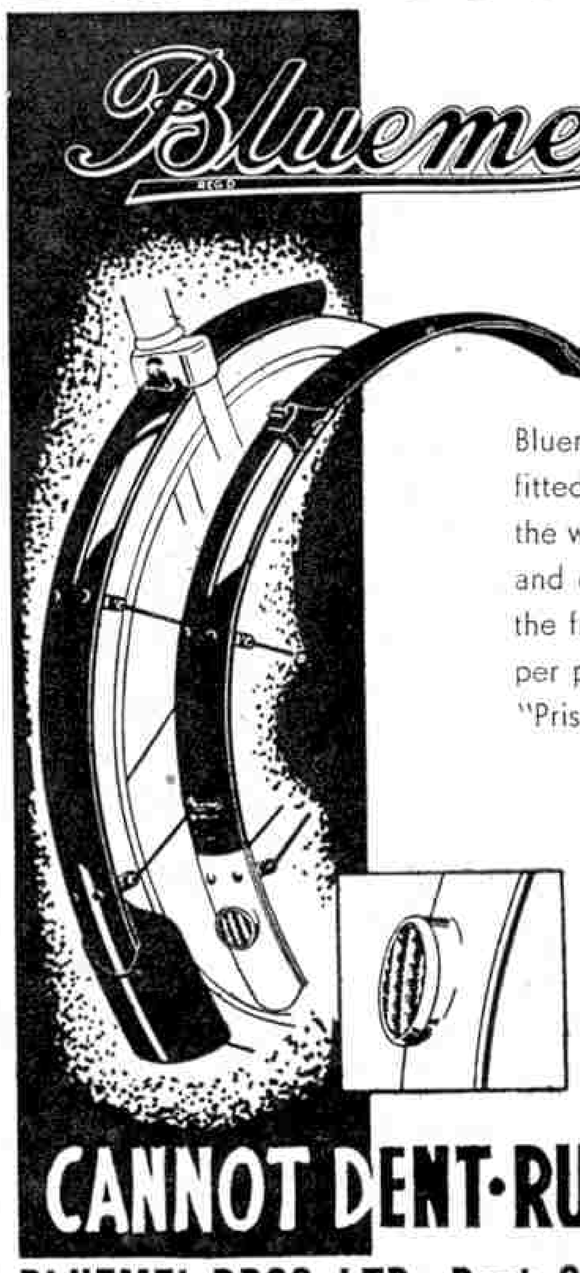

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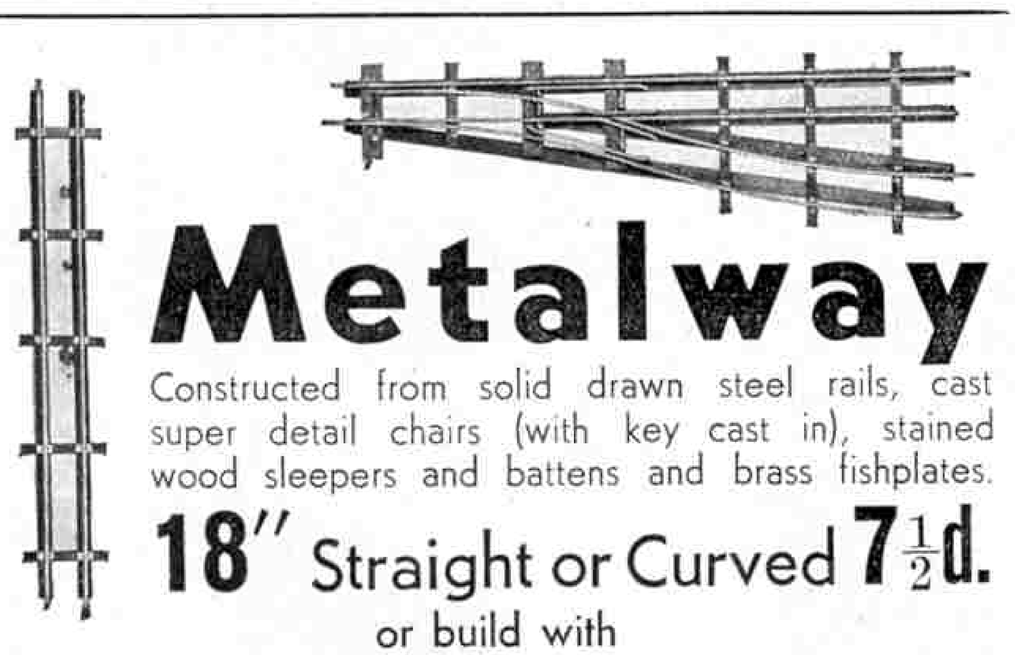

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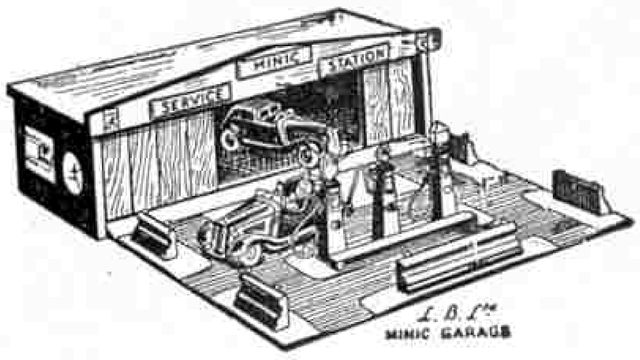

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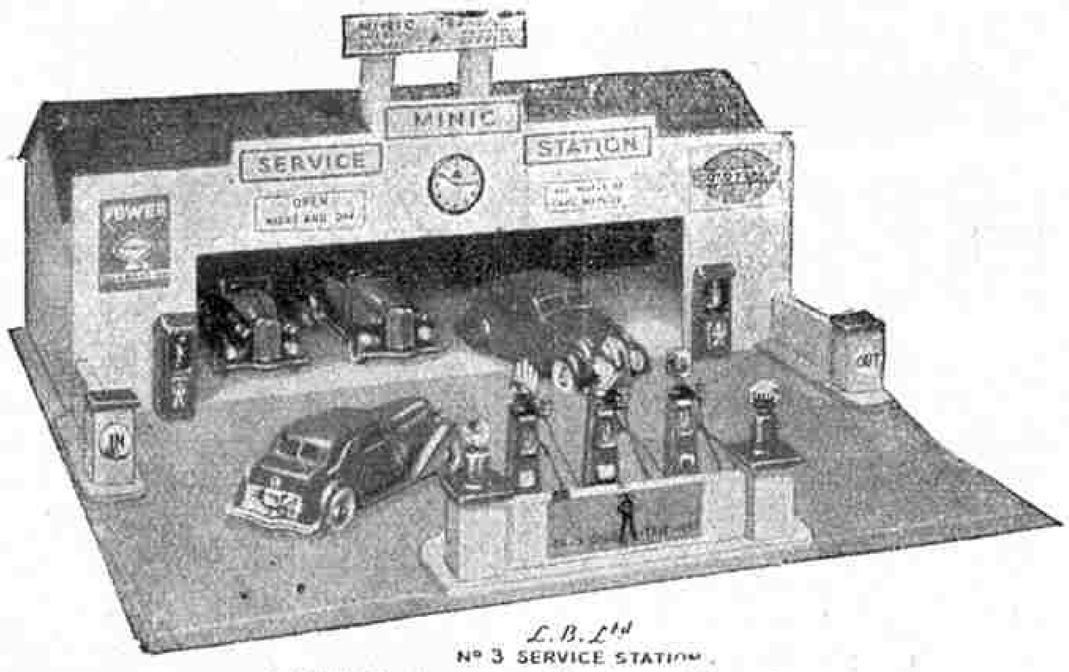

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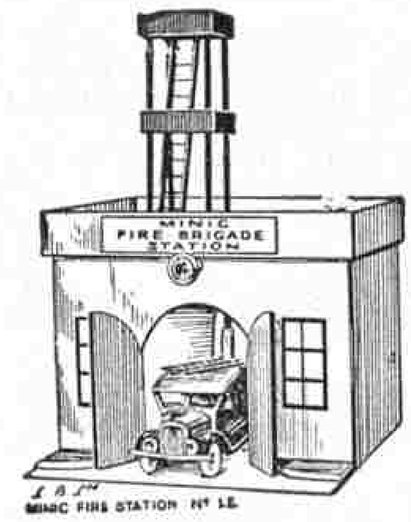

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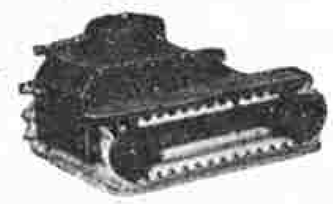

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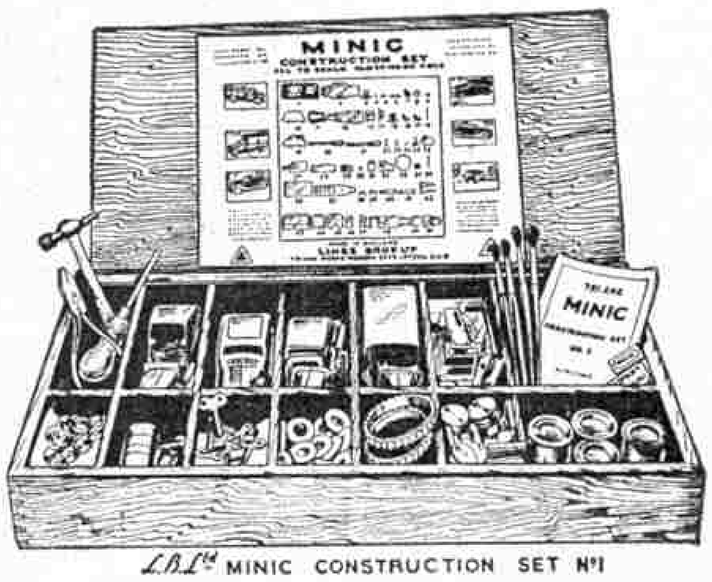

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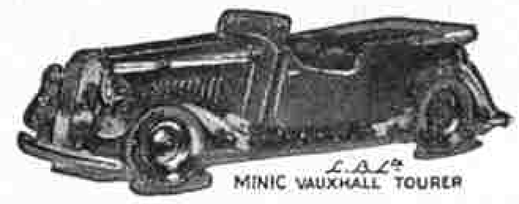

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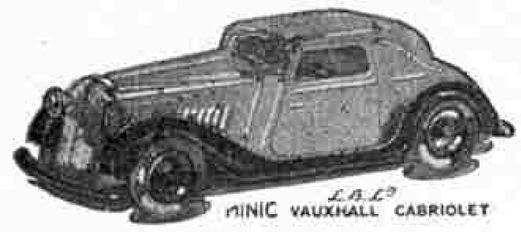

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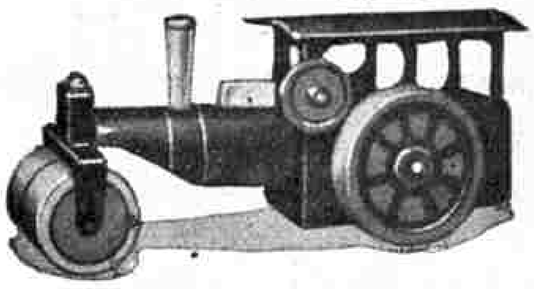

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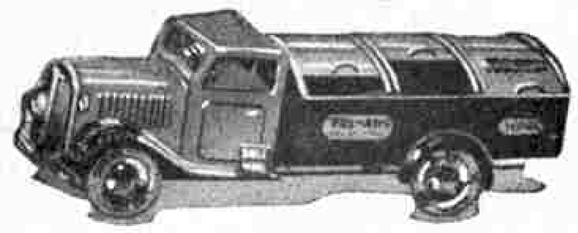

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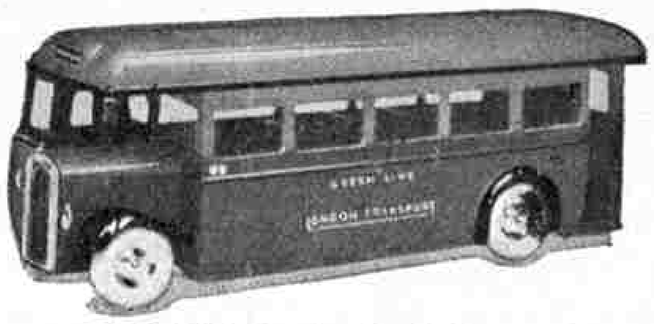

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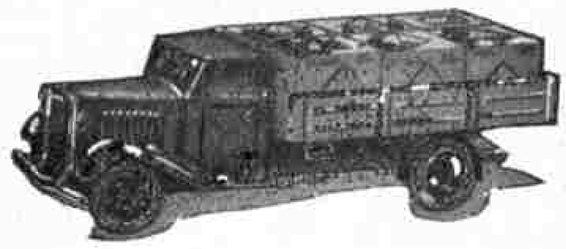

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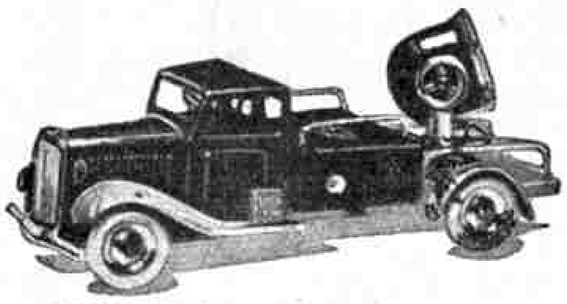

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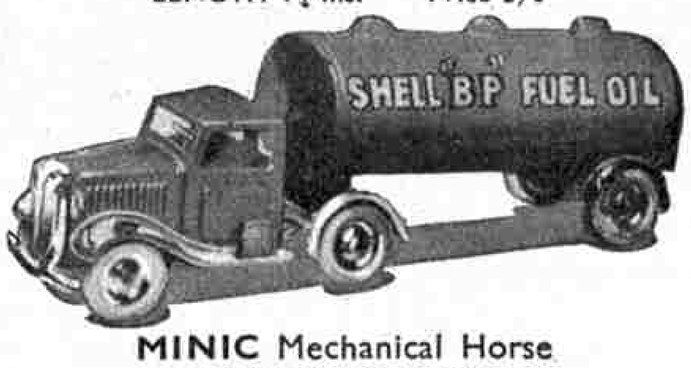

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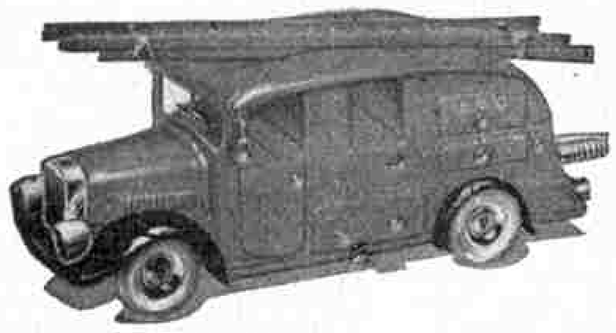

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MECCANO MAGAZINE

Editorial Office:
Binns Road, Liverpool 13
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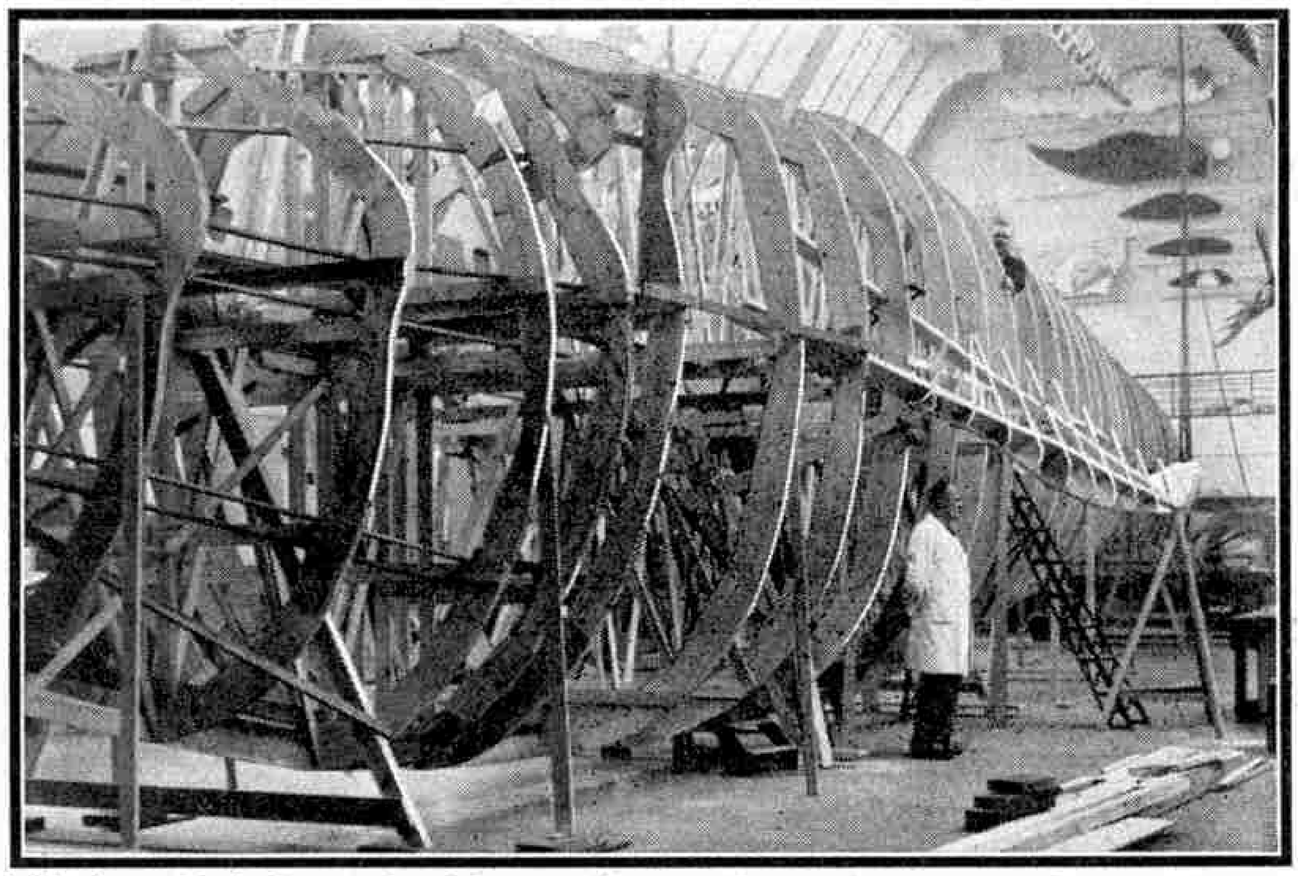
Vol. XXIII. No. 3
March 1938

With the Editor

A Great Swedish Engineer

I draw the special attention of readers to the first instalment of an article (page 146) dealing with the career of the Swedish engineer John Ericsson. Ericsson is not as well known as he deserves to be, in view of his inventive genius and all-round work as an engineer. He designed and built the first steam fire engine, and his locomotive *"Novelty,"* constructed in seven weeks, probably would have won the famous Rainhill trials if he had had time to build it in more sturdy fashion. As it was he gave George Stephenson, who won the prize with his *"Rocket,"* a great fright by the speed and ease with which his locomotive ran. Ericsson also won a great reputation as a marine engineer. He was the first to apply the screw propeller on a large scale, and he built the first ironclad to have a turret for its guns.



A life-size model of a blue whale under construction at the Natural History Museum, South Kensington. The model will be 90 ft. long, and will weigh 5 tons. Wire netting covered with hessian cloth steeped in plaster will form the skin. Photograph by A. H. B. Anson, London.

The Inventor of the Screw Propeller

Mention of the screw propeller reminds me that on the 6th of this month it will be 100 years since the death of Col. John Stevens, the American engineer who was the first to use the screw propeller for steamboats. Stevens was born in New York in 1749. He was the greatest rival of Robert Fulton, the famous American steamship pioneer, and in 1804 he built a boat 68 ft. long that in many respects foreshadowed later developments more closely than Fulton's own vessels. In this boat he installed a sectional boiler of the tubular type, together with a direct-acting high-pressure engine that drove a screw propeller with four blades. Other steamboat pioneers used paddle wheels, and Stevens was so far in advance of his time that it was not until Ericsson appeared on the scene some 40 years later that paddle wheels began to be displaced by screws. Stevens even anticipated the twin screw system now so largely employed, for his second boat was provided with two propellers.

Stevens was handicapped by the fact that a monopoly had been granted to Fulton for steamship services in New York waters. One result of this was that he decided to send a further steamboat that he built in 1807 from New York to Philadelphia. To this vessel he gave the name *"Phœnix."* On the trip to Philadelphia it was in charge of Robert L. Stevens, the inventor's son, who thus earned the distinction of being the first man to trust himself to the open sea in a vessel relying only upon steam power, for other pioneer steamboats had plied on rivers and inland waters.

Railway Developments

Several railway developments of interest are in hand at the present time or are to be proceeded with shortly. Most notable perhaps is the announcement of the G.W.R. that in view of the increasing cost of steam working a scheme for the electrification of part of the system is to be prepared. It is thought that the substitution of electric traction may enable considerable economies to be effected.

A further extension of the S.R. electrification will be completed early in the coming summer when the Mid-Sussex line of the former L.B. & S.C.R. that runs to the south coast via Horsham and the Arun Gap is to be electrified. Considerable disappointment has been caused by the recent decision of the S.R. not to proceed with the electrification of the Hastings line via Sevenoaks.

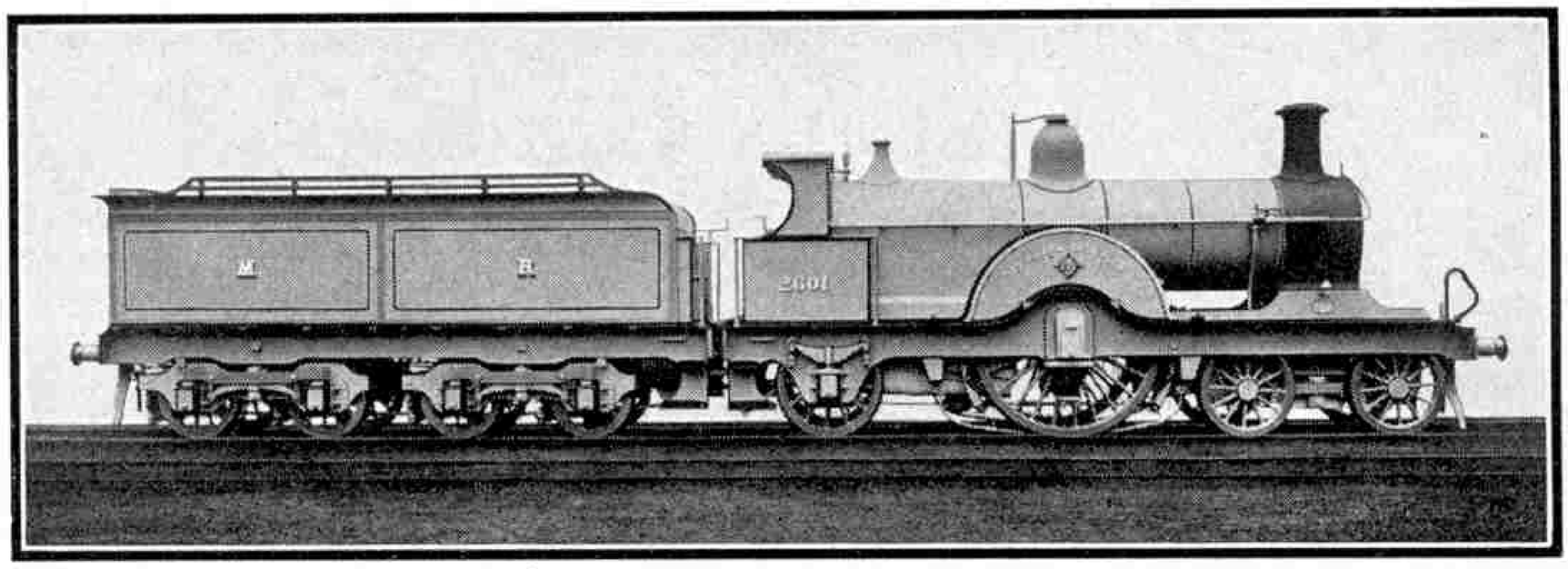
The severe reduction of speed that has been necessary on the part of expresses at Trent Valley Junction on the L.M.S. will be avoided when work of reconstructing the Junction now in hand has been completed. The raising of the speed limit from 30 m.p.h. to 55 m.p.h. is anticipated, and this will not only save time but it will also have the effect of reducing locomotive coal consumption.

The L.N.E.R. have recently placed contracts for the construction of 975 wagons. Of these 800 are to be for timber, steel girders or other loads of exceptional length.

Midland Section Locomotives of the L.M.S.

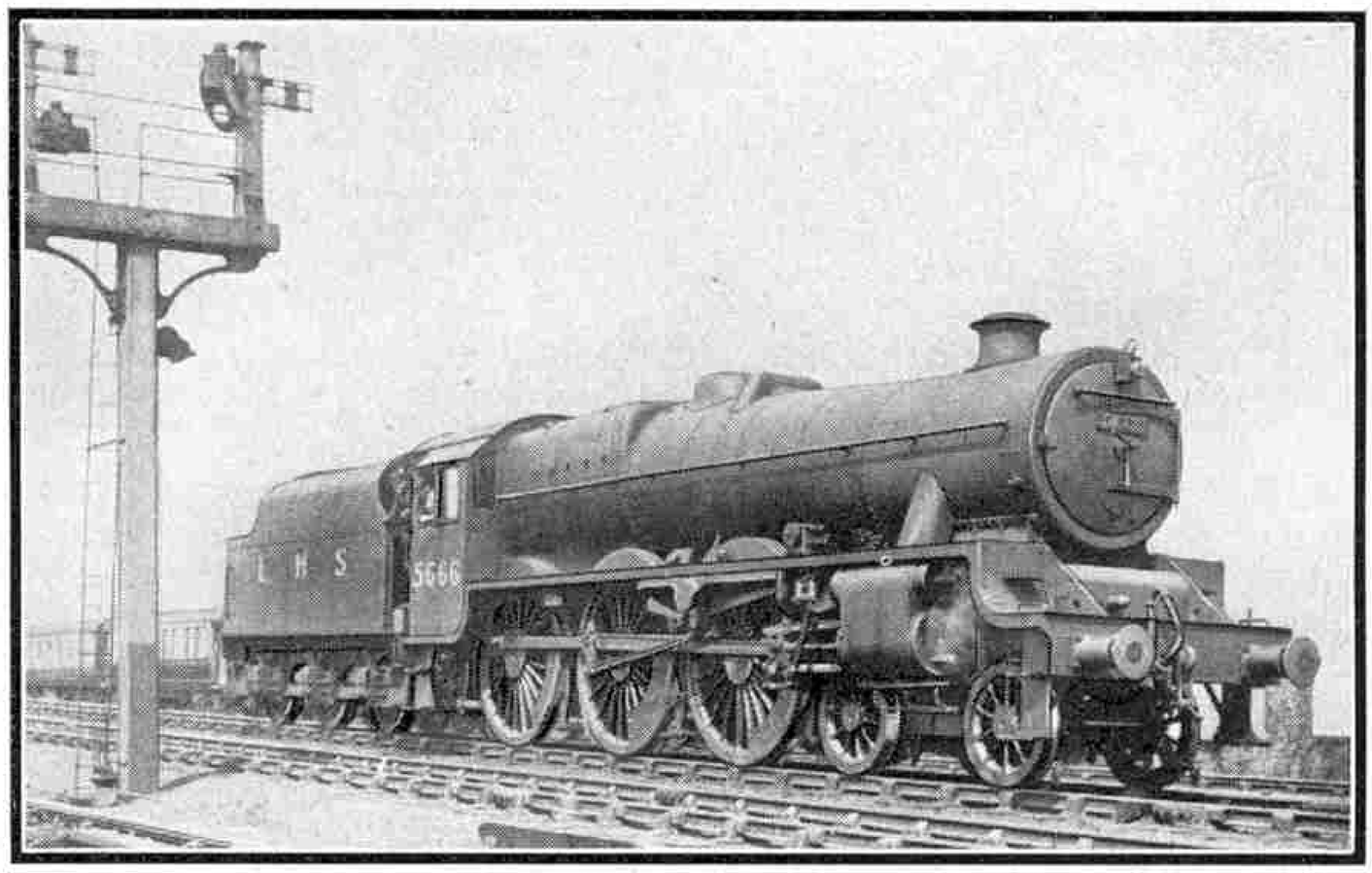
From Single-Drivers to 4-6-0s

LOCOMOTIVE standardisation on the L.M.S. has caused the disappearance of many old locomotive favourites and the relegation of others to secondary and less important duties. Less sweeping changes are apparent on the Midland Division than on other sections, for many of the earlier standard types of locomotives brought out by Sir Henry Fowler were developments of previously existing Midland types. In addition, where new designs were created, external features made familiar in the days of the former Midland Railway were still applied.



"Princess of Wales," the last development of the 4-2-2 type on the former Midland Railway. These engines were long famous for their speedy running and remained in main line service for many years. Photograph by courtesy of the L.M.S.

For many years four-coupled engines were the most powerful seen at St. Pancras, but now the Stanier 4–6–0s hold sway. The introduction of these has paved the way for the speed-up of the Midland Division express services described on page 698 of the "*M.M.*" for last December. The consequent ousting of the remaining Midland engines from express passenger work is an opportune moment to recall some of the many fine locomotives that have worn the well-known uniform of Derby red that distinguished the former Midland Railway.



L.M.S. "Jubilee" class 4-6-0 locomotive No. 5666, now named "Cornwallis." Engines of this class are widely employed on Midland Division trains. Photograph by Rev. E. Treacy, Liverpool.

It would be hard to find a greater contrast to the muscular taper-boilered 4-6-0s of to-day than the slim and graceful single-drivers that were retained for so long in main line service on the Midland. One of these engines, then fresh from the Derby shops and representative of the latest type built there, was exhibited at Paris in 1900 and won for its owners the Grand Prix. This was the "*Princess of Wales*," which is shown in the upper illustration on this page. The type was originally developed in 1887 from the design of S. W. Johnson, then Locomotive Superintendent at Derby, but it survived even into the L.M.S. period and did not disappear entirely from the road until 1928! Fortunately one of these speedy engines is still preserved at Derby, and is a rare specimen of the typically British 4–2–2 design that at one time was to be found on seven important main lines in this country.

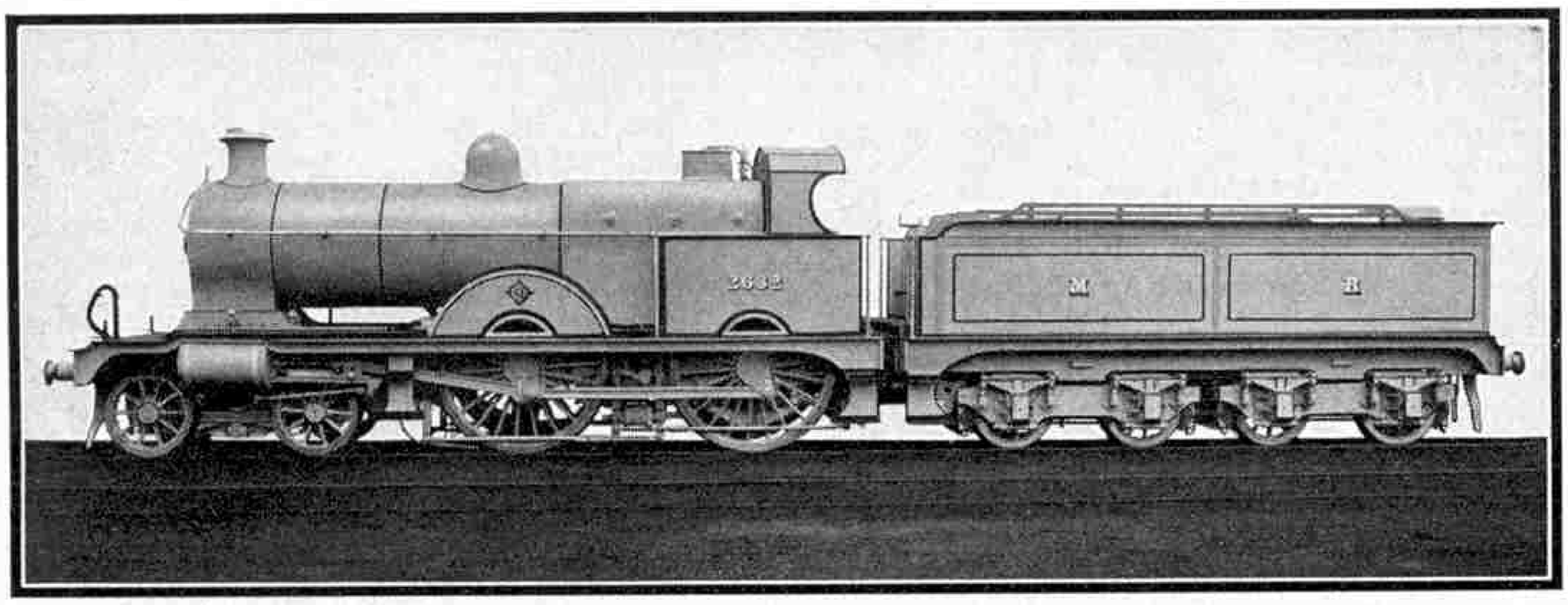
Contemporary with these "singles" were various 4–4–0s. In later Midland days many of these became the subjects of a sort of "new engines for old" rebuilding policy, whereby they were reconstructed and reboilered to bring them up to the requirements of the time. The most extensive form of reconstruction provided the locomotives of the familiar Class 2, a 4–4–0 design that ultimately formed the basis for the L.M.S. standard Class 2P developed for secondary duties.

Other 4–4–0s, the original lines of which can still be traced to some extent on the few of them that remain, were the "Belpaires." The name was applied to these engines because they were the first on the Midland to have Belpaire fire-boxes, but the term gradually lost its significance as this type of fire-box became a standard feature of Derby design. The original "Belpaires" also were Johnson productions and dated from 1901. The survivors can be recognised by their straight footplates and square cab panels covering the rear coupled wheels. They ultimately became known as Class 3 4–4–0s, and played a large part in the haulage of the heavier expresses on Midland routes.

The next development was the introduction in 1902 of the well-known compounds, the most powerful express type the Midland ever possessed. The chief purpose of the introduction of these engines was to deal with the important trains on the difficult Settle and Carlisle line. Only five engines, then Nos. 2631–35, were built to the original design, and in their early state they were considered among

the most handsome engines that ever ran on the Midland. They were provided with large bogie tenders, for water troughs had not been installed at the time on the Midland system, and had the Belpaire pattern of fire-box then, as we have seen, a recent innovation in Derby practice.

From the first these compounds were successful, and what they were capable of was shown in September 1902 when No. 2631 made a remarkable run from Hellifield to Carlisle on the 1.30 p.m. express from St. Pancras to Glasgow after starting 17½ min. late. The load was 210 tons, but the 76¾ miles were covered in 79 min., and 13 min. were regained in spite of the severe climb to Ais Gill Summit.



The earliest form of the Midland Compound is shown in this photograph of M.R. No. 2632. This was one of the first five Johnson engines, from which the subsequent Deeley Compounds and later the Standard Compounds of the L.M.S. were developed.

Mr. R. M. Deeley, who assumed command at Derby in 1903, modified the details of the original design somewhat in the compound engines—Nos. 1000-1029—that he built in 1905-6, and the original five of 1902-3 were subsequently altered to suit. The alterations resulted in the application to the engines of the name "Deeley Compounds." In appearance these differed considerably from the Johnson engines. The shapes of the footplates and cab were altered. A narrower chimney, characteristic of Deeley engines generally, replaced the original one, and the large brass casing fitted over the safety-valves on the first engines was done away with, thus exposing the plain open columns and spring of the Ramsbottom safety valves to view. New six-wheeled flat-sided tenders with large numerals also were introduced in place of the "water carts," as the Johnson bogie tenders previously used were known.

L.M.S. Standard Compound No. 1100 on a heavy down express. This photograph was taken some years ago when experiments were being made with oil firing. This accounts for the round tank on the tender.

The Midland Compounds remained the chief express engines of the line throughout the rest of its independent existence. The last of them were constructed in 1908-1909, and no new passenger engines were built for the Midland after that, in view of the reconstruction process instituted for the older engines, to which we have already referred. The application of superheaters to the compounds first occurred in 1913, and the extended pattern of smoke-box, then already a feature of the latest simple engines, was added.

The superheated Midland Compounds achieved remarkable results for their size and formed the basis of the Standard Compound design adopted in the early days of the L.M.S. Except for the first 20, these were provided with chimneys and domes of reduced height, while Ross "pop" safety valves also made their appearance in the later engines. The reduction in height of the boiler fittings gives the engines a powerful and rather massive appearance that was lacking in the earlier engines.

Following some comparative trials over the difficult Settle and Carlisle line in the early days of grouping, several ex-L.N.W.R. "Claughtons" were drafted to the Midland Division for use on the heavier trains. These were different in design and external appearance from anything that had previously been seen on Midland metals, quite apart from the fact that they were 4–6–0s. They had four cylinders, all driving on the leading coupled axle, and outside Walschaerts valve gear. Externally they incorporated the features made familiar by many years of Crewe practice, but some at least of these working on the Midland were provided with tenders taken from engines of Great Central design that had been built for War service and subsequently acquired by the L.M.S.

With the development at a later date of the "Baby Scots," or "Patriot" class as they are now known, some of these also came into use on Midland metals. With them details of Derby design reappeared, although with some modifications. The engines themselves of course were not of traditional Midland type, for they were simple 4-6-0s with three cylinders, not three-cylinder compounds.

The 4–6–0 type of locomotive did not appear on the Midland Division in large numbers until the introduction of the characteristic Stanier 4–6–0s of the "5X Jubilee" and "5P5F" Mixed Traffic classes. The "Jubilees" and the two-cylinder Mixed Traffic engines have tapered boilers and altered cabs, and many other details in which they differ considerably in appearance from previous engines.

The First Atlantic Crossing Under Steam

The Triumph of the "*Sirius*"

ON 28th March 1838, the steamship "*Sirius*" left London on the first crossing of the Atlantic ever made by a vessel relying entirely on steam engines. This month therefore marks the centenary of one of the most important turning points in the story of the sea. Steam previously had been regarded merely as an auxiliary to sail, and few people believed that long voyages could be made under steam power alone. The triumph of the "*Sirius*" showed these ideas to be wrong. Her voyage was the beginning of the great Atlantic Ferry, the most romantic of all steamship services, which has been maintained by a succession of magnificent liners, culminating in the "*Queen Mary*" and the "*Normandie.*"

For more than 20 years before the "*Sirius*" started out on her memorable voyage traffic across the Atlantic had been increasing, largely because of the number of emigrants sailing to the United States. The service was kept up chiefly by means of sailing packets, which were well handled and often were driven hard to make good passages. Conditions in them were very bad, however, especially for steerage passengers, who were herded together and often half-starved, as they had to provide their own food, and in many cases exhausted their resources on the long westward runs against head winds. One vessel of the Black Ball Line made a record eastward passage of 15 days 18 hrs., but 40 days was not an unusual time for the westward run, and voyages of this duration naturally involved great hardship aboard the crowded emigrant ships.

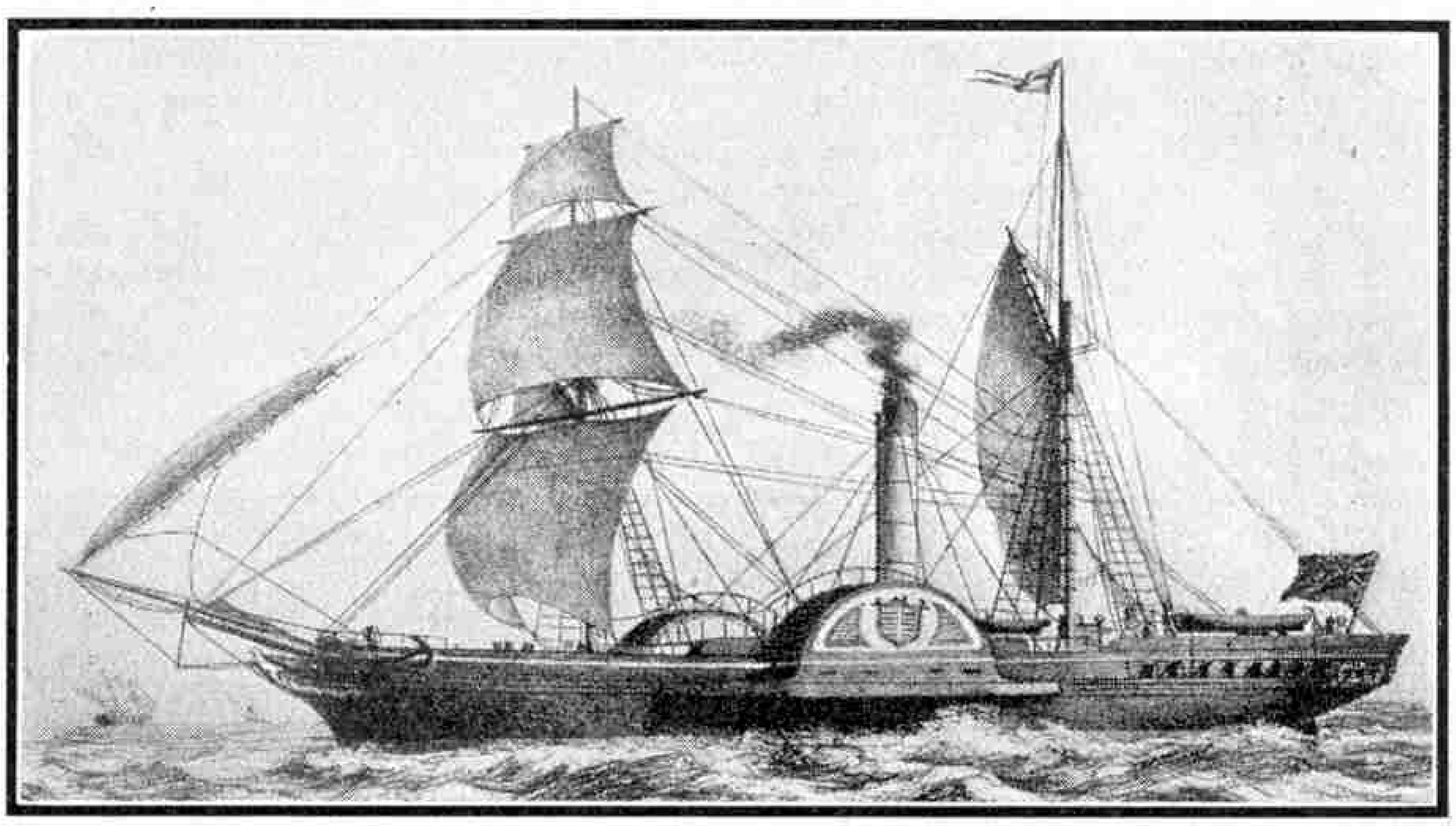
The first signs of the coming change were given in 1819, when the "*Savannah*" crossed the Atlantic. This famous vessel was really a sailing ship fitted with engines, and on her first voyage from Savannah in the United States to Liverpool she steamed for only 80 hrs., although the trip occupied nearly 30 days. It was not until eight years later that another crossing was made by a steamship. This was the "*Curacoa,*" built at Dover in 1825. From Holland she reached Surinam, or Dutch Guiana, in South America, in 28 days, but only on 12 of these were her engines put to use.

The next step, foreshadowing more definitely the coming of steam, was the voyage of the "*Royal William,*" a Canadian steamer sent across the Atlantic in the hope of finding a purchaser. The "*Royal William*" was built in 1831 at Quebec, and fitted with engines sent out from England. She left Quebec in August 1833 and reached Gravesend in the following month. The crossing was made partly under sail, and partly under steam, but more use was made of the engines than in the case of the "*Savannah.*"

These voyages and the success of coasting steamers prepared the way for the triumph of steam. This was not achieved without great difficulty, however. Apart from the prejudice against the new power that then prevailed in many quarters, there was a lack of belief in the capacity of steam-driven vessels to undertake long voyages. Engines were still comparatively inefficient and wasteful of fuel, and it was asserted that they could never carry sufficient coal for a transatlantic service, unless this were made in stages, calling at the Azores. Dr. Lardner, a famous scientist of that time, declared at a meeting in Liverpool late in 1835 that a project announced in newspapers to make a voyage directly from New York to Liverpool by steam was chimerical, adding that "they might as well talk of making a voyage from New York to the Moon."

Less than three years were required to disprove this assertion, and by the beginning of 1838 there were several schemes in progress for carrying out the voyage that Dr. Lardner had declared impossible. In 1836 a company was formed by Dr. Julius Smith for the purpose of building a steamship to cross the Atlantic. This was known as the British and American Steam Navigation Company, and an order for the "*British Queen,*" the vessel with which it was intended to begin the service, was placed with Curling and Young, of Blackwall, London. Misfortune followed the "*British Queen*" from her commencement. Her engines were to be built in Glasgow, but the firm that was to make them became bankrupt, and a new one had to be found. The task was undertaken by the Napiers, of Glasgow, but there were so many delays that she was not ready for launching until May 1838.

In the meantime a rival firm appeared on the scene at Bristol. This was the Great Western Steamship Company, formed for the purpose of building and equipping a vessel to be named the "*Great Western,*" with the determination to get ahead of the "*British Queen*" and to seize the honour of starting the first Atlantic steamship service. This project is said to have originated in joke at a meeting of the directors of the Great Western Railway Company in 1836. One of those present spoke of the enormous length of the proposed railway from London to Bristol. Brunel, the famous engineer of the company, thereupon exclaimed: "Why not make it longer and have a steamboat go from Bristol to New York and call it the "*Great Western?*" Some of the directors saw that this was meant seriously and decided to put it into effect. Their plans were pushed forward so rapidly that it appeared certain their vessel would be ready before the "*British Queen,*" and would make the first Atlantic steam crossing.



The paddle steamship "Sirius," the first vessel to cross the Atlantic under steam. She achieved this honour in an exciting race with the "Great Western," as described in the accompanying article. Our illustration is reproduced from a lithograph in the Science Museum, South Kensington, London.

The owners of this vessel, anxious to save the honour of their firm, responded to the challenge by chartering the "*Sirius,*" a steamship belonging to the St. George's Steam Packet Company and designed for the cross-channel run to Dublin. Thus the stage was set for the great steamship race across the Atlantic Ocean, one of the most famous in history.

The "*Sirius*" had been built at Leith in 1837. Although she was a comparatively small boat of only 703 tons register, she had cost her owners £27,000, which was considered a large amount in those days. Her engines were of the side lever type working at a pressure of 15 lb. per sq. in. Her single funnel was placed just behind the paddle wheels, which were 24 ft. in diameter and situated amidship, and she carried auxiliary sails.

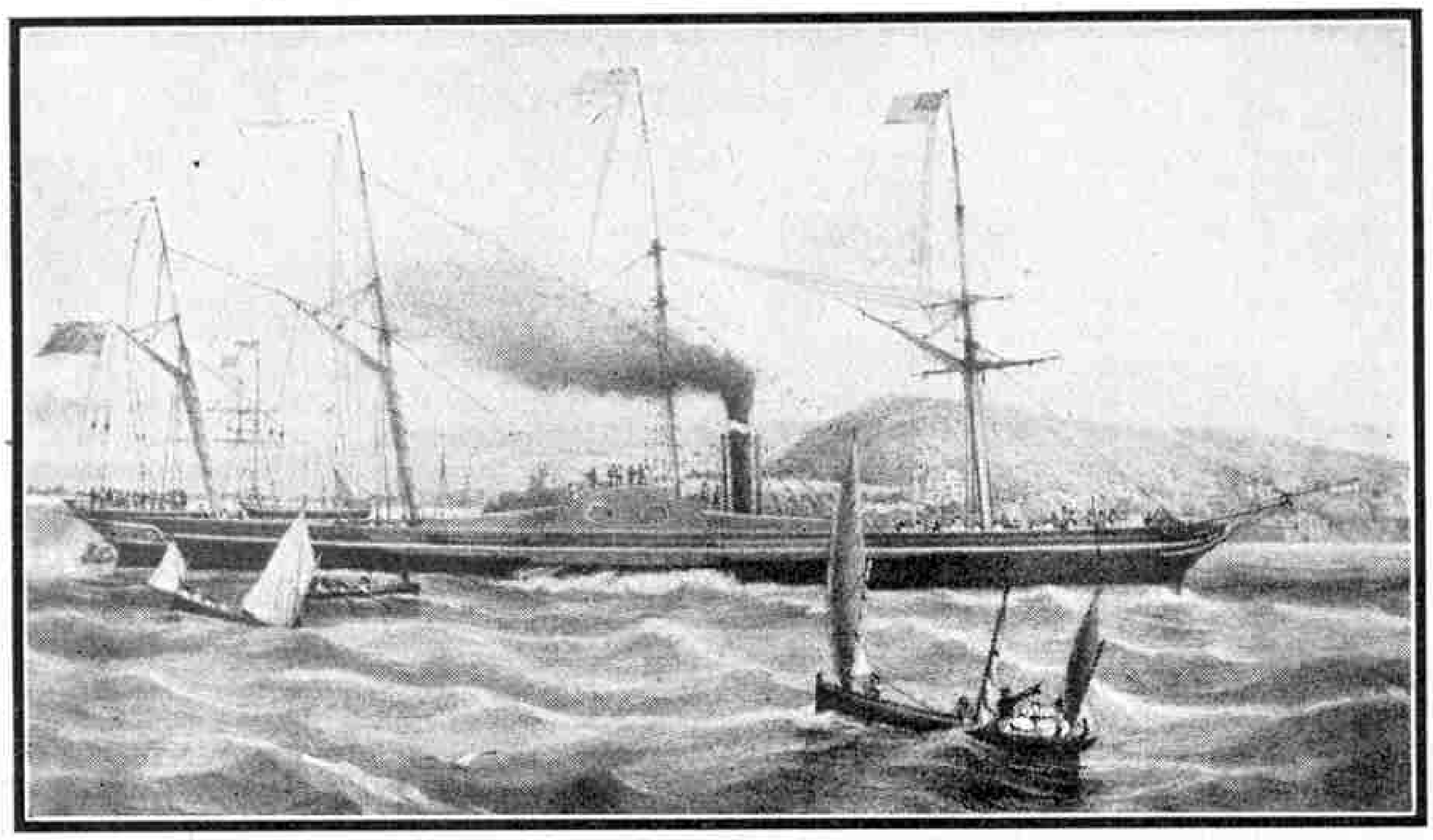
The vessel left Blackwall, London, on 28th March, 1838, under the command of Lt. Roberts, R.N. As she steamed down river she passed her rival the "*Great Western,*" which was making a trial trip with a party of distinguished passengers on board. There was an informal race between the two ships, and the "*Sirius*" was well ahead after a few miles, covering the distance between Greenwich and Gravesend against the tide in 1 hr. 56 min. Behind her the American sailing ship "*Quebec*" started for America. Wagers were freely made that this vessel would arrive at New York first, but those who backed her had the mortification of losing their money.

When the "*Sirius*" reached Cork she waited for the arrival of the steam packet "*Ocean*" from Liverpool with mails and passengers. At last, on 4th April, everything was ready. The day was fine and clear, the city was bedecked with flags, and every boat in the harbour was crowded with enthusiastic spectators as the "*Sirius*" steamed slowly out of harbour shortly after 10 o'clock, with the guns of the

batteries that guarded the harbour booming out a parting salute.

For the first few days at sea rough weather and strong headwinds kept the speed of the "*Sirius*" down to 4½ knots. The vessel was heavily weighted with stores and coal, and the crew became demoralised and unruly as the voyage proceeded and the headwinds persisted. Their alarm was justifiable, for the "*Sirius*" was so heavily loaded that probably she would have foundered if she had encountered really stormy weather. Lt. Roberts was determined to be the first to reach New York in a steamship, however, and he quelled all discontent by stern disciplinary measures. His boldness was rewarded when he arrived off the American coast on the evening of 22nd April after a passage lasting 19 days.

Next morning the "*Sirius*" steamed proudly up New York harbour, and cast anchor off the Battery at 10 o'clock in the morning of 23rd April. She had not only used up all her coal, but had even had to burn some of her spars. It was her engines and not her sails that had taken her across the ocean, however, and her appearance was greeted with the greatest enthusiasm.



The "Great Western," the famous steamship built in 1838 by Brunel for the transatlantic service. She reached New York a few hours after the "Sirius," which had three days start. Photograph by courtesy of the Directors of the Science Museum, South Kensington, London.

The "*Sirius*" had only been in New York harbour a few hours when the excitement was intensified by the news of the approach of another and much larger steamship. This was the "*Great Western*," which had left London on 31st March. She had only reached Southend when fire broke out in her engine room. The heat and smoke drove the engine room staff on deck, but they had not stopped the engines, and the vessel was beached. Her decks were then cut open and water poured down to extinguish the flames. Fortunately, the damage was not as serious as feared; the vessel was re-floated on the tide and was able to proceed to Bristol under her own steam. There was some delay while repairs were effected, however, and the "*Great Western*" did not leave Bristol for New York until 7th April, so that she was three days behind her smaller rival. The "*Great Western*" was much faster than the "*Sirius*," and rapidly overhauled her. The leeway was too much to make up, however, and thus the honour of completing the first Atlantic steam-crossing went to the "*Sirius*."

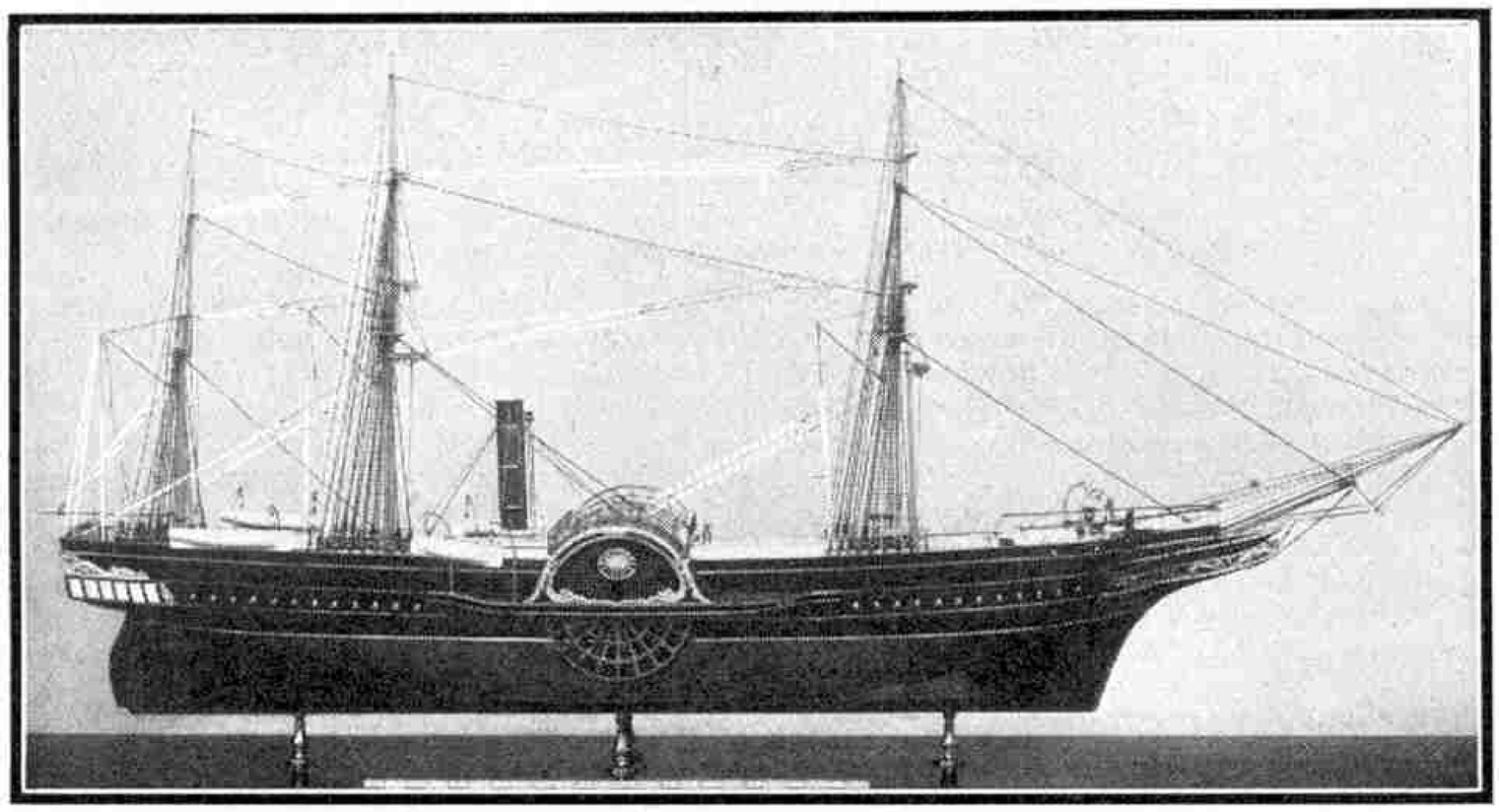
The "*Great Western*" made the voyage in 16 days, a time about equal to that of the fastest sailing vessels; and she was actually sighted twice during the voyage, on the 15th and 22nd April, by the sailing ship "*Westminster*." She maintained an average of 8.2 knots and experienced no difficulty with her fuel supplies, for she still had nearly 200 tons of coal left in her bunkers when she reached America. The crossing indeed was uneventful, with favourable weather throughout except on one afternoon when the ship ran into a heavy snow storm. The passengers appreciated the diversion this event offered, and enjoyed a good snowball fight on the deck.

The "*Great Western*" was a far finer vessel than the "*Sirius*." She was built at Bristol under the supervision of Brunel himself, and had an overall length of 236 ft., with a tonnage of 1,321. Her engines were made by Maudslays, London, and were rated at 750 h.p. They worked at a pressure of 15 lb. per sq. in. and drove paddles 28.5 ft. in diameter that made about 15 revolutions a minute. She was rigged as a four-masted schooner.

A novelty in her construction was the use of iron to fasten her ribs, which were made of oak, and were thus specially strengthened to meet the buffeting she might expect on the Atlantic and to bear the great weight of her engines and fuel.

It is interesting to follow the further history of these famous ships. After her wonderful reception at New York, the "*Sirius*" sailed for England on 1st May and arrived off Falmouth on the 19th. She had not been intended for the regular Atlantic service and only made one more round trip. Afterwards she was employed on coastal and cross-channel routes, and in 1847 was wrecked in Ballycottin Bay, on the southern coast of Ireland.

The "*Great Western*" continued in service between New York and Bristol for eight years. She completed her first round voyage by leaving New York on 7th May, carrying 68 passengers, and arriving at Bristol 14 days later. Her average speed on the eastward trip was nine knots. On her second voyage she took out 65 cabin passengers, completing the westward trip in 14½ days. She returned with 92 passengers, and her success is best indicated by the rush for accommodation on subsequent voyages, showing that she had convinced transatlantic passengers that steamships were safe and reliable. She outlasted her immediate rivals, including the "*British Queen*," which made her first voyage to New York in July 1839. She was not surpassed in transatlantic service until the appearance on the scene of the earlier Cunarders. She was sold to the Royal Mail Steam Packet Company in 1847 and was broken up nine years later.



The Cunard steamship "Britannia," the first vessel to carry the mails between Great Britain and America. From a model in the Science Museum, South Kensington, London.

In these days of giant steel liners such as the "*Queen Mary*" and the "*Normandie*," which are floating cities in themselves, it is difficult to realise what a great achievement it was to establish a regular service across the stormy Atlantic Ocean with the comparatively frail wooden steamships of 100 years ago. To us these vessels would seem incredibly small. For instance, the "*Great Western*," with her length of only 236 ft., was far smaller, and offered less spacious and luxurious accommodation, than many modern vessels operating to-day in cross-channel services. This is shown by comparing her with the motor-ship "*Leinster*," described in last month's "*M.M.*," which has been built for service in the Irish Sea. That vessel is 131 ft. longer than was the "*Great Western*," and would have towered over the even tinier "*Sirius*," which was only 170 ft. in length.

Even the Cunarders that eventually surpassed the "*Great Western*" were tiny vessels when measured by modern standards. The first of them was the "*Britannia*," a model of which is shown in the lower illustration on this page. This vessel was only 207 ft. long, and her hull could easily have been passed through one of the funnels of the "*Queen Mary*."

On the Footplate of the "*Loch Long*"

A Remarkable West Highland Locomotive

By a Railway Engineer

EVER since grouping took place, in 1923, it has been the policy of the L.N.E.R. to build special locomotives for all the varying classes of duty on the system. Thus, in addition to the various types of main line Pacific, there are "Sandringhams" for East Anglia, "Mikados" for the Aberdeen route, and "Green Arrows" for mixed traffic. Until the spring of last year the West Highland line, from Glasgow to Maillaig, lay outside the pale; here, Sir Nigel Gresley's 2-cylinder Moguls of Class K2, though excellent engines in themselves, are allowed to take only one bogie coach more than the four-coupled "Glens," of which I wrote in January. But in March 1937 an entirely new type of engine specially designed for the West Highland line was turned out of Darlington works; this was No. 3441 "*Loch Long.*"

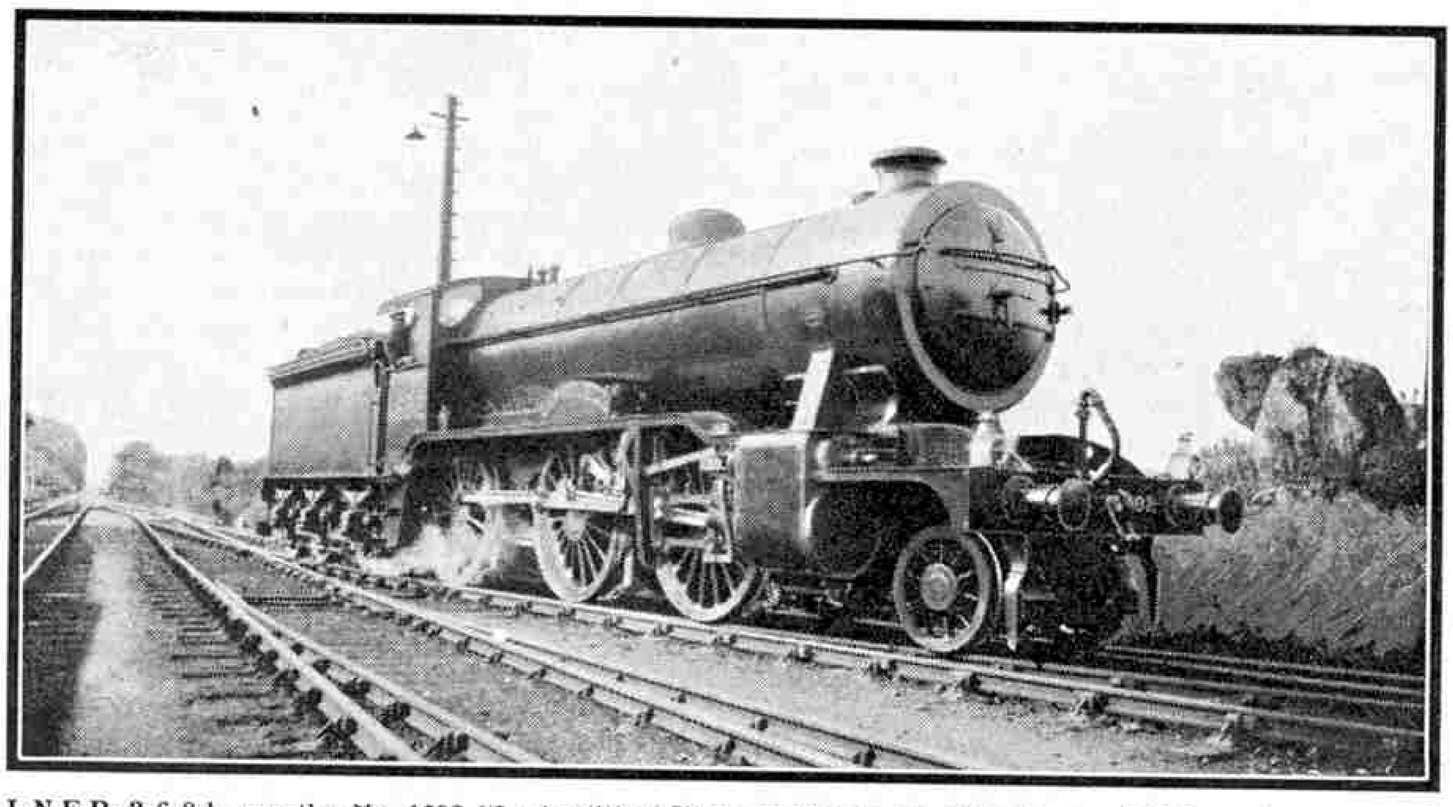
This fine engine is also a 2–6–0. Except for the cab, it looks very similar to the "K2" locomotives, which also are named after lochs, and there is little outward suggestion of No. 3441's tremendous power. The boiler and the cab arrangements are similar to that of the "Sandringhams"; but the working pressure is 200 lb. per sq. in., and this, combined with three cylinders 18½ in. dia. by 26 in. stroke, and the unusually small coupled wheel diameter of 5 ft. 2 in., give "*Loch Long*" a tractive effort of 36,598 lb. The engine is allowed a tare load of 300 tons.

I enjoyed a splendid trip with Driver J. Thompson and Fireman G. Paterson, of Fort William, on a day when the 5.45 a.m. from Glasgow was made up to 286 tons tare—almost full load—and 305 tons with passengers and luggage. "*Loch Long*" made short work of the gentle ups and downs along the north bank of the Clyde, and then, just as dawn was coming, we got away from Dumbarton for the real business. For the first 7 miles the line is dead level, alongside the Firth; Thompson quickly linked up to 22 per cent. cut-off, and we got away in a style more like that of the "*Coronation*" than a West Highland train. Cardoss, 3 miles out, was passed at 56 m.p.h. and despite the hindrance, on the level, of 5 ft. 2 in. wheels, speed was within an ace of 60 m.p.h. when we shut off steam for Craigendoran junction. But once over the junction we entered the 40 m.p.h. speed limit, which extends right to Fort William, and from here onward it was either stiff collar work or coasting.

At the very junction points climbing starts with a vengeance. The line strikes off straight up the hillside on a gradient of 1 in 58, and as soon as we had secured the tablet Thompson opened right out to full regulator and no less than 40 per cent. cut-off. "*Loch Long*" responded well: we steadily gathered speed, and until nearing Helensburgh upper station 22 m.p.h. was maintained. This initial bank is quite short; the 2.2 miles from Craigendoran to the stop at Helensburgh took 5¾ minutes, and then we got away on a high undulating piece of road overlooking the Gare Loch. In the half light before full day this placid arm of the Firth of Clyde looked very beautiful, with an occasional shaft of sunshine breaking through the moisture-laden clouds. Thompson got the train along as fast as the curves permit; with a speed limit of 40 m.p.h. this did not make any severe demands upon No. 3441, but the way in which the engine was handled was a joy to watch. Sometimes we would be running with full regulator, and rousing the echoes; then coasting, and steam put on again at just the right moment to make full use of impetus gained downhill. So we covered the 6.9 miles from Helensburgh to Garelochhead in 12¼ minutes, passing slowly through the station to exchange tablets.

Once over the points at the north end of the station "*Loch Long*" was given full regulator and 32 per cent. cut-off. On a grade of 1 in 55 we forged our way up among the mountains, going 25 m.p.h. until nearing Whistlefield platform. Here, among the grandest scenery imaginable, the incline steepens to 1 in 49, and the railway comes out on a high ledge overlooking the narrow fiord after which the engine is named. Speed fell off slightly, but Thompson increased the cut-off to 40 per cent. and "*Loch Long*" mounted this very steep and winding pitch without falling below 21 m.p.h. On the easier grade to Glen Douglas summit she accelerated to 38 m.p.h.

Now, after passing the lonely crossing loop at the summit, we began a spell of coasting down the side of the high mountains that sweep down to Loch Long. The regulator was not quite closed; the steam chest pressure gauge, which had shown 180 to 185 lb. per sq. in. all the way up from Garelochhead, now registered 10 lb. per sq. in. Just a breath of steam was passing through the cylinders, and with 45 per cent. cut-off the cushioning action was perfect. Thompson scarcely had to touch the brake, and we glided smoothly down to Arrochar on a 1 in 57 grade never exceeding the 40 m.p.h. speed limit. When nearly down to the level of the loch the line suddenly swings away and cuts across the narrow isthmus that separates Loch Long from Loch Lomond. A moment later we were running into Arrochar, the 17½ miles from Helensburgh having taken 33¼ minutes.



L.N.E.R. 2-6-0 locomotive No. 4692 "Loch Eil" of Class K2. This is one of the former G.N.R. engines now used on the West Highland line, and accordingly provided with a name of local interest.

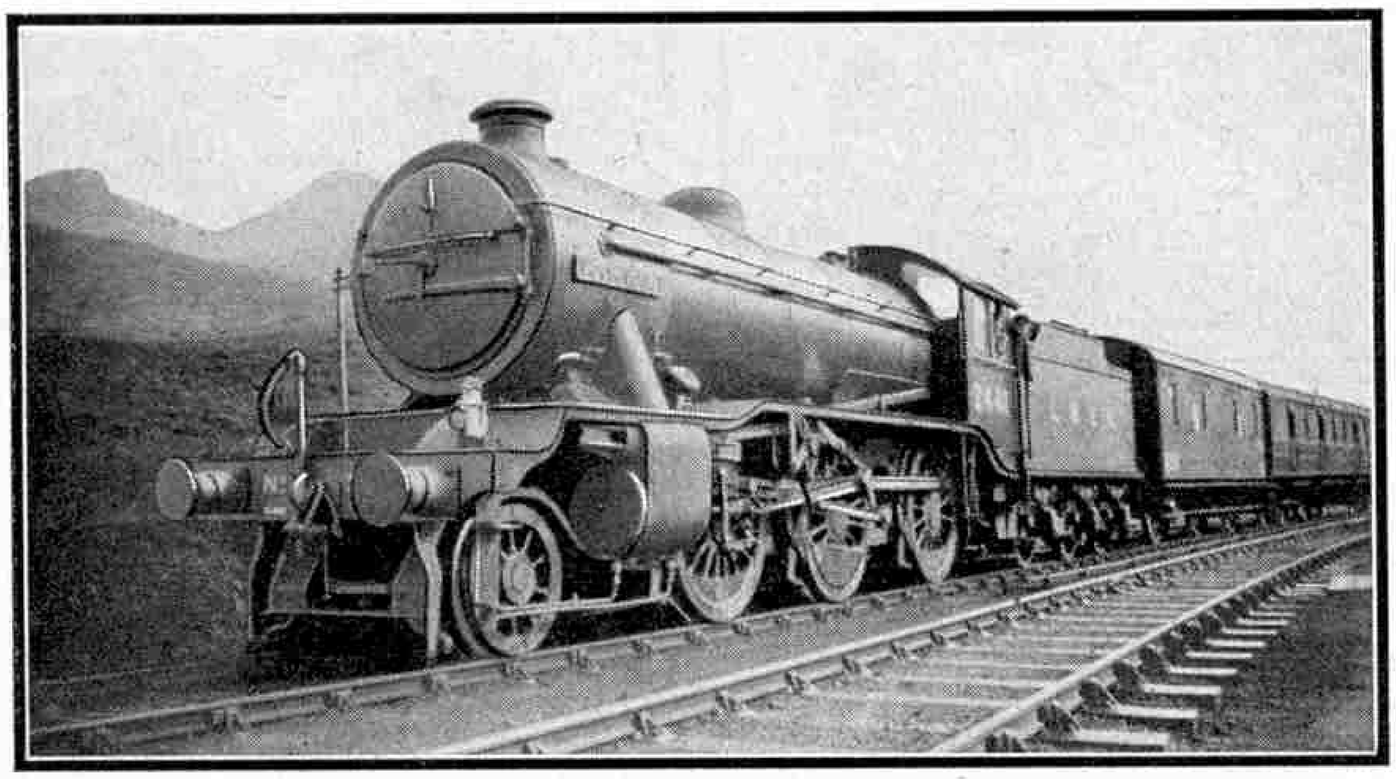
For the next eight miles the track twists and turns among the woods above Loch Lomond. It is a most fascinating run: there are charming glimpses across the water; vast peaks are suddenly revealed through gaps in the hills, and as suddenly lost to view. From the locomotive point of view it is an easy stretch of sharp ups and downs, where no gradient lasts long enough to demand any hard work. But 40 m.p.h. was not exceeded, and so the 8 miles from Arrochar to Ardlui took 13¾ minutes start to stop.

All this time I was wondering how we should fare for water with this big train. The older engines with their loads of 200 to 220 tons are allowed only one stop to take water, at Crainlarich; now "*Loch Long*" was getting along rather faster than is usual on this route, and with nearly 50 per cent. more load one might naturally expect a greater consumption of water. In any event it is no mean achievement to work over the 59 miles from Glasgow to Crianlarich without any replenishment of the tanks, and on several previous runs with heavy trains I have known drivers of the K2 Moguls, apprehensive of their supply running out, to spend an extra minute or so taking water at Ardlui. Not so "*Loch Long.*"

The ascent of Glen Falloch is the hardest bit of the whole run. For nearly eight miles the gradient is 1 in 60 to 1 in 66, and on my trip conditions were made worse by drizzling rain and a wet rail. Yet once again "*Loch Long*" was completely master of the situation. Thompson used full forward gear in getting away from Ardlui, that is 65 per cent. cut-off; this was quickly reduced to 40, and then after about half a mile the valves were linked up to 32 per cent. We steadily gathered speed; in 1½ miles we were up to 26 m.p.h., and on the brief easier length beyond the Dubh Eas viaduct No. 3441 attained 33½ miles per hour. Then the grade steepened again, and we thundered on at a splendid 26 m.p.h. Still the boiler pressure

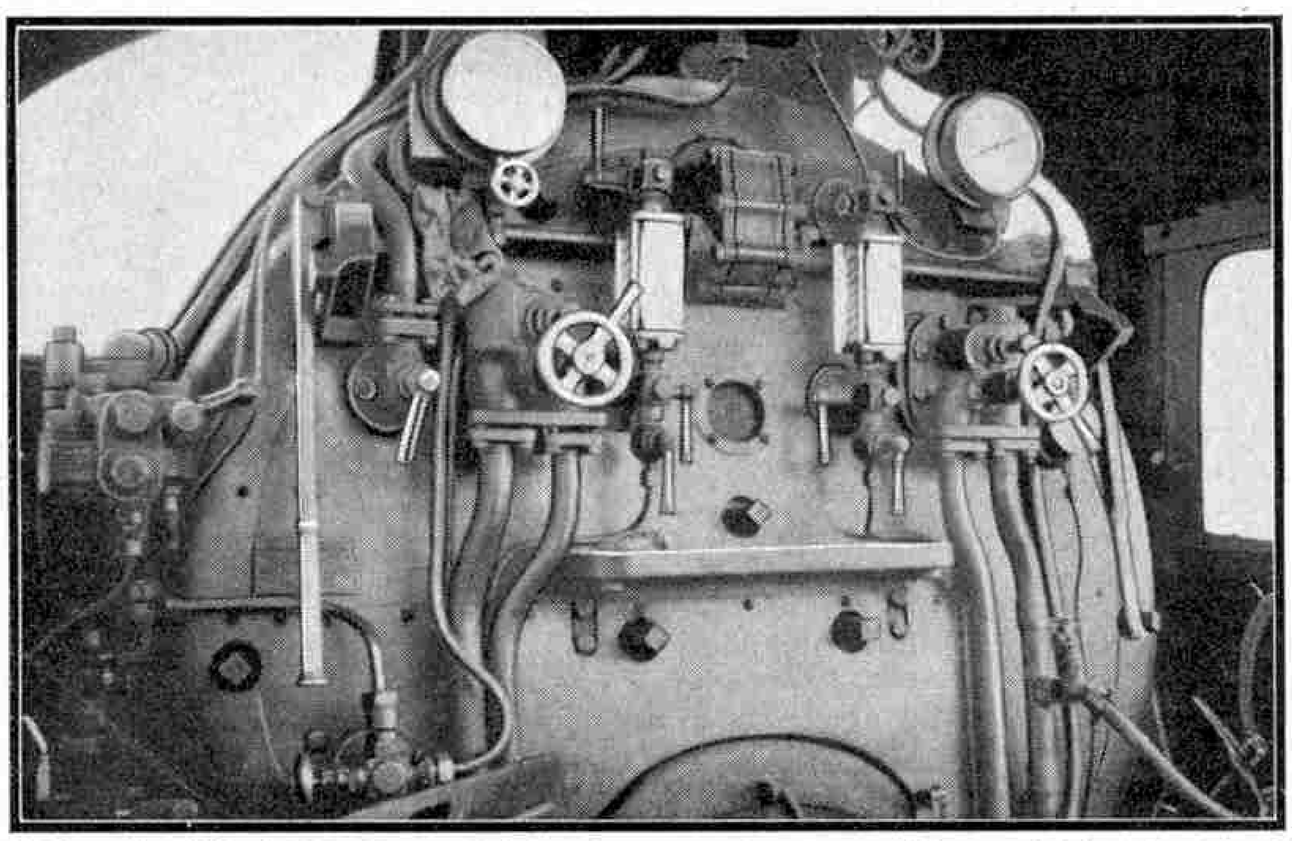
remained full up, with 195 lb. per sq. in. showing on the gauge, while the steam chest pressure was 185 lb. per sq. in.

With such a load as 305 tons, 32 per cent. was a remarkably early cut-off in these conditions. It was thrilling enough at the time, in the fascinating atmosphere of the footplate, but when some weeks later I came to work out the results the performance of *"Loch Long"* proved to be far more astonishing than it appeared at the time. On these tremendous ascents the K2 Moguls with loads of 210-220 tons are usually worked at about 50 to 55 per cent. cut-off, with practically full regulator. At 32 per cent. cut-off the three cylinders of *"Loch Long"* are using almost exactly the same amount of steam, and hauling 305 tons as against 220. It is small wonder that the tender did not need extra replenishment, for this amazing engine hauls its 50 per cent. greater load on the same amount of steam! Studying the appearance of *"Loch Long"* against one of the K2 engines, this increase in tractive power seems utterly incredible, but it is of course due to a much more economical use of steam. Now we were approaching the head of Glen Falloch. Great mountains peeped over the ridge ahead. *"Loch Long"* topped the summit in full cry, and a moment or so later we were coasting into Crianlarich. The 8.7 miles from Ardlui had taken 19¾ minutes, just inside schedule time.



"Loch Long," the powerful 2-6-0 locomotive of Class K4 built last year specially for West Highland duties. The journey described in this article shows very well the work of which the engine is capable.

There is little respite either for the engine or the fireman in the next 25 miles. Through a chain of wild austere glens the railway zig-zags its way up to Rannoch Moor. There is however an excellent down hill start from Crianlarich, for the line coming over from Glen Falloch strikes the length of Strathfillan exactly at right angles; beyond the station the track is carried straight across to the opposite side of the strath, and then begins climbing up the hillside. In just half a mile from the restart we were up to 40 m.p.h.; then, as we got on to the 1 in 60, speed was wonderfully sustained, and it was several miles before we fell below 30 m.p.h. But now the weather, which had been only slightly wet up to now, seemed to be taking a definite turn for the worse. A great cloud of rain came drifting across from the opposite mountains, veiling the head of the glen below and obscuring completely the magnificent Ben Lui range. The engine slipped once on the wet rail, Thompson lengthened the cut-off to 35 and then to 40 per cent.; but the rain and the curves were taking their toll, and as we rounded what the driver called "the worst corner we have" speed was down to 24 m.p.h.



In the cab of "Loch Long," on which footplate arrangements are of the usual L.N.E.R. standard. The characteristic twin regulator handles are prominent in the illustration.

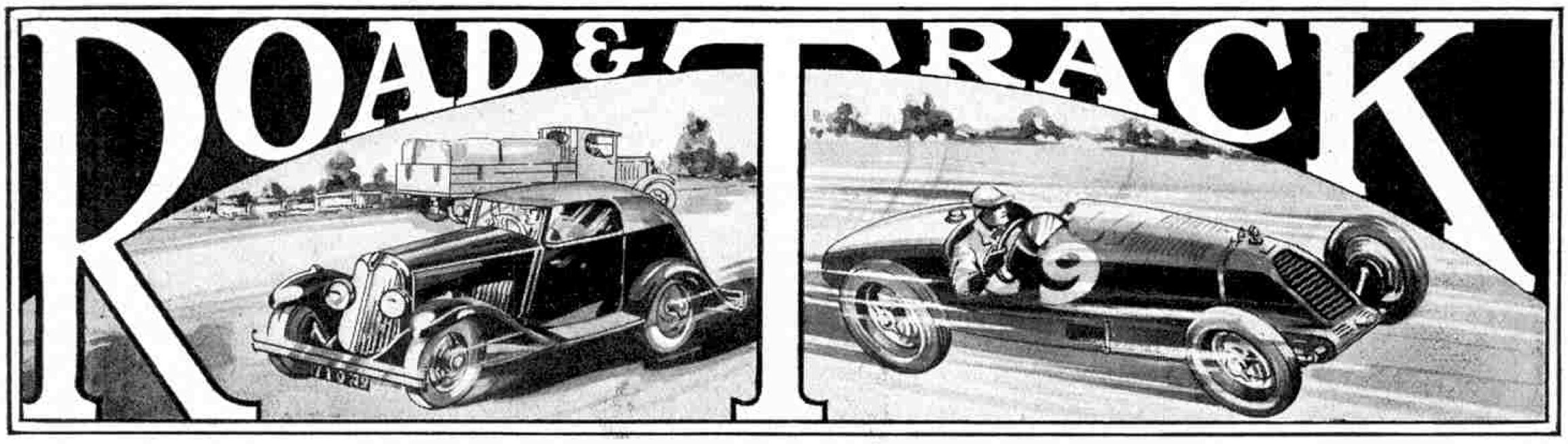
Nevertheless we covered the 5 miles from Crianlarich up to Tyndrum in 11¼ minutes, and in spite of the weather the restart was grand. There is no chance of a run at this bank, and *"Loch Long"* roared out of Tyndrum with the valves cutting off at 50 per cent. Very soon she was linked up to 35 per cent., and we sailed over the County March summit, 1,024 ft. above sea level, at 28½ miles per hour. Coasting now, in blinding rain, we came to the Horseshoe Bend where Ben Dorain's shapely cone was lost in a mantle of cloud. Thompson went very cautiously round those thrilling curves, and even after we came on to straighter stretches the engine had to be held in so as not to exceed the 40 m.p.h. limit. So, Bridge of Orchy 7½ miles beyond Tyndrum was reached in 14½ minutes, and after the usual brief stop, rarely more than 50 or 60 seconds at these intermediate stations, we started off on the last stretch of really hard climbing.

The work of the engine here was perhaps finer than anywhere else in the journey. After a short but sharp rise out of Bridge of Orchy station there comes a welcome length of comparatively easy grading, where the railway overlooks Loch Tulla and the pine forests of the Black Mount. The ascent averages 1 in 200, and *"Loch Long"* was linked right up to 25 per cent. cut-off; but here the acceleration was so rapid that we slightly exceeded the speed limit, and touched 44½ m.p.h. Then comes the tug-of-war up to Rannoch, on grades of 1 in 60 and 1 in 70 for most of the way; Thompson increased cut-off by the modest amount of 2 per cent., and No. 3441 fairly stormed up to the Moor, never falling below 28½ m.p.h. On no more than 27 per cent. cut-off this was an extraordinary piece of work with a load of 305 tons. At Gortan crossing loop, 8.7 miles from Bridge of Orchy, the heaviest collar work ends. We passed this point in 16½ minutes, and some brisk running across seven miles of the Moor brought us to Rannoch station 10¾ minutes later.

There is a tremendous pull from Rannoch up to the snow-shed, 1½ miles at 1 in 54, and for the most part curving one way or the other so sharply as to necessitate check rails. The engine was not unduly pressed here, for although the weather was clearing the rails were still wet and many a powerful engine has "stuck" ignominiously through slipping on this tricky ascent. Thompson used 35 per cent. cut-off, and speed rose to 18 m.p.h. as we passed out of the snow-shed. Over some of the wildest and loneliest stretches we now made good speed, and a final stiff pull at 1 in 79 brought us to Corrour, the summit point of the whole route. The 7.3 miles from Rannoch had taken 15¼ minutes. From Dumbarton to Corrour is just 79 miles, and our running time over this section was 150¾ minutes. This gives the very fine average of 32 m.p.h. over a route of exceptionally heavy grading, and still more remarkable on account of the 40 m.p.h. speed limit.

Little remains to be described now, for during the long descent to Fort William the engine was coasting practically the whole way. At a mere jog-trot we ran down alongside Loch Treig, round the sweeping curve into Tulloch, and through the Spean Gorge to Roy Bridge; so to Spean Bridge, and over rough moorland to the first sight of Loch Linnhe and the mountains of Ardgour. It is indeed a striking commentary on the difficult winding nature of the descent that the 28 miles from Corrour to Fort William, during which the railway drops 1,340 ft., took no less than 56 minutes, inclusive of the three brief stops.

As we ran into Fort William, a K2 Mogul and a "Glen" were waiting to take the train westwards to Mallaig. I have written throughout in the warmest praise of *"Loch Long's"* performance, but in paying such a tribute the supremely competent driving and firing must not be overlooked. Some idea of the exactness of Thompson's work can be gathered from the timekeeping; except on the downhill section from Corrour to Tulloch, where we gained 1¾ minutes, we were never more than 25 seconds different from schedule time on any stage. A most engrossing footplate experience.



Preparations for the Grand Prix Races

This season will see the first Grand Prix races under the new international formula governing racing car construction. Cars with supercharged or unsupercharged engines of widely different sizes will now be able to compete together on more or less equal terms, and some very exciting and interesting races should result.

Two complete scales of weights and engine capacities have been drawn up, one for supercharged and the other for unsupercharged vehicles. For the former the scales range from a minimum capacity of 666 c.c., with a minimum weight of 400 kg., to a maximum of 3,000 c.c., with a corresponding minimum weight of 850 kg. In the unsupercharged class the minimum cylinder capacity allowed is 1,000 c.c. and an engine of this type must have a weight of at least 400 kg. The maximum cylinder capacity and minimum weight for an unsupercharged car are 4,500 c.c. and 850 kg. respectively.

The back axle and tyres used in the race are included in the weight of the vehicle, but the water in the radiator, fuel, tools, spare wheels and oil in the motor are excluded from the net weight.

Any type of fuel may be used and the body can have one or two seats, but it must be at least 85 cm. in exterior width, and this minimum must be maintained for a minimum height of 25 cm. The width is measured on a vertical plane touching the back of the flywheel and perpendicular to the longitudinal axis of the car.

Italian Racing Cars of 1938

Manufacturers of racing cars are now busily engaged in modifying their machines to meet the new regulations. Maseratis, for example, are introducing a new 3-litre eight-cylinder car fitted with twin superchargers. On the test bench this engine has run at 7,000 r.p.m. and is expected to produce a road speed of over 170 m.p.h.! The 1½-litre Maserati that has proved so successful in recent years will be continued in new forms of both six- and four-cylinder types. The new six-cylinder car will conform to Grand Prix formula as regards weight and measurements, and will be better streamlined than last year's model. Both the new 1½-litre and the 3-litre cars will make their first public appearance at Tripoli on 15th May, and if present intentions are carried out, the 1½-litre model will be seen in several races in England during the summer, while the 3-litre cars will compete in the Donnington Grand Prix in October.

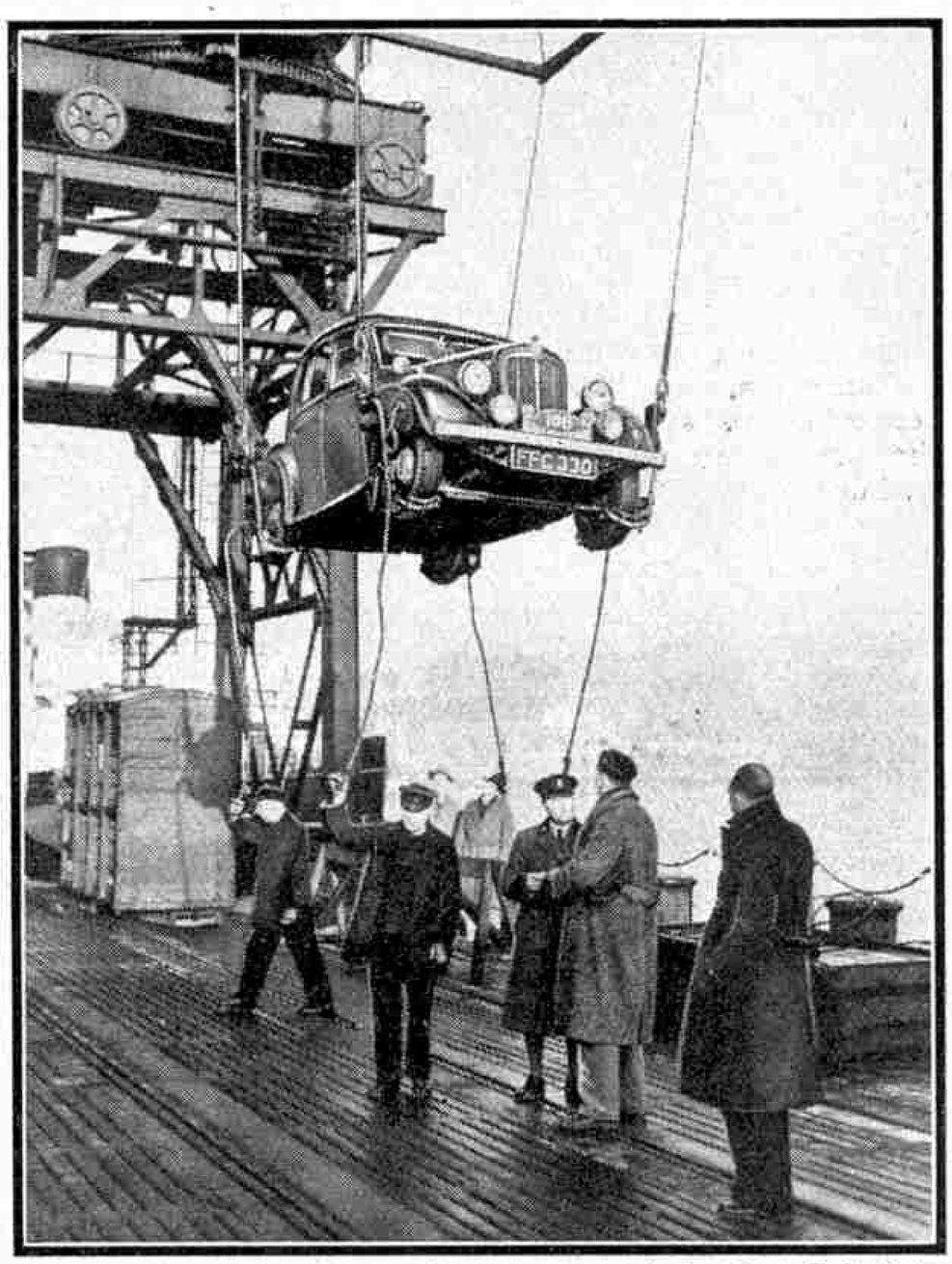
The official Maserati drivers this year will be Varzi, Trossi, Cortese, Rocco and Marazza. Marazza is a young driver for whom Signor Maserati predicts a great future.

The new Alfa-Romeo cars for this year's Grand Prix races are to be of the supercharged 3-litre type, and there will be also several new 1½-litre models fitted with six-cylinder engines. A novel feature of the 3-litre cars is that they can be fitted with any one of three interchangeable engines of six, eight and 12 cylinders. One of the new 1½-litre cars will probably take part in the Tripoli Grand Prix on 15th May, and it will be interesting to compare its performance with those of the new Maserati racers.

E.R.A. Team to Compete

Probably the most interesting feature of this year's Grand Prix racing will be the presence of a team of British cars for the first time for many years. The British representatives will be the famous E.R.A. team that has done so much to uphold Britain's prestige in international motor racing, and which won more races last season than any other team in the world.

Four special E.R.A. Grand Prix cars have been built, and it is hoped that these will take part in six or seven of the nine Grand Prix to be run under the new formula. The engines of these cars will have a capacity of about 2½ litres. Two cars will be raced at a time, and in the meantime the other two will be prepared for the next race. It will be exciting to follow the careers of the new machines and to see how they shape against the crack Continental makes.



Mr. F. H. S. Rasch's Morris "Ten," a competing car in the Monte Carlo Rally, being shipped at Folkestone. It started from John o' Groats and arrived at Monte Carlo without the loss of a single mark. Photograph by courtesy of Morris Motors Ltd., Cowley, Oxford.

The Monte Carlo Rally

This year's Monte Carlo Rally did not prove so difficult as usual, owing to the comparatively mild weather, but there was plenty of snow and ice over many parts of the various scheduled routes, and the Rally was far from being an easy matter. Out of 125 starters only 54 finished without penalty.

The premier award in the Rally is the International Sporting Club Cup. This was won by two Dutchmen, G. Bakker Schut and his co-driver Karel Ton, who drove a Ford V8 from Athens, the route to which most marks are awarded and which is generally regarded as the most difficult. Bakker Schut has competed in several Monte Carlo Rallies, each time with a Ford. In 1936 he was placed fourth and in 1935 seventh.

A Lancia driven by M. G. Descollas and Mme. Descollas, who also started from Athens, won the Riviera Cup for cars in the 1,500 c.c. class, while the Ladies' Cup was taken by Mme. C. Roualt and Mme. J. d'Harlique, who drove a Matford, a specialised Ford manufactured in France.

The leading British competitor was Lord Waleran, who drove a 12 h.p. Italian Lancia. He started from John o' Groats during a vicious hailstorm, and finished an equal ninth with 770.50 points. This may be considered a very fine performance since this is the first time for many years that a competitor starting from John o' Groats has finished so high in the Rally. Lord Waleran also finished second in the Riviera Cup.

In the Comfort Competition, which forms one of the many trials and contests held at the end of the road section of the Rally, a 3½-litre S.S. Jaguar, driven by J. O. H. Willing, was awarded the Grand Prix d'Honneur.

One of the new 10 h.p. Vauxhalls, which started from Stavanger, Norway, covered the road section without the loss of a single mark,

and was placed second among the all British light cars irrespective of price or type. Another British light car that put up an excellent performance was a Morris "Ten," which started from John o' Groats and arrived at Monte Carlo unpenalised. In the Ladies' Cup Mrs. A. C. Lace's Talbot-Darracq was fourth, and Mrs. M. J. Cotton's Lancia was placed sixth.

This year all the competitors converged upon Grenoble, France, where they had to pass through a gruelling test over the Winter Route des Alpes, a very difficult section over wild mountain passes, before making the final spurt to Monte Carlo. In passing through this section each car had to maintain an average speed between 50 k.p.h. and 60 k.p.h., that is 31.05 m.p.h. and 37.26 m.p.h.

At the high altitudes in this region the conditions are sometimes very bad and snow ploughs are frequently in use. At one point the road ascends to a height of 3,858 ft. and is very twisty, while in one part it is bordered by a yawning chasm. Although the road surface is good very skilful driving was necessary to maintain the average speed required, and excitement of competitors was at fever heat as their cars wended their way up and down the sinuous frozen roads.

Many competitors came to grief on this section. A Norwegian driver of a Lancia who had driven splendidly from Umea, Sweden, crashed into a non-competing car, and although he was not hurt his car was badly damaged.

Novel Features of a New Light Car

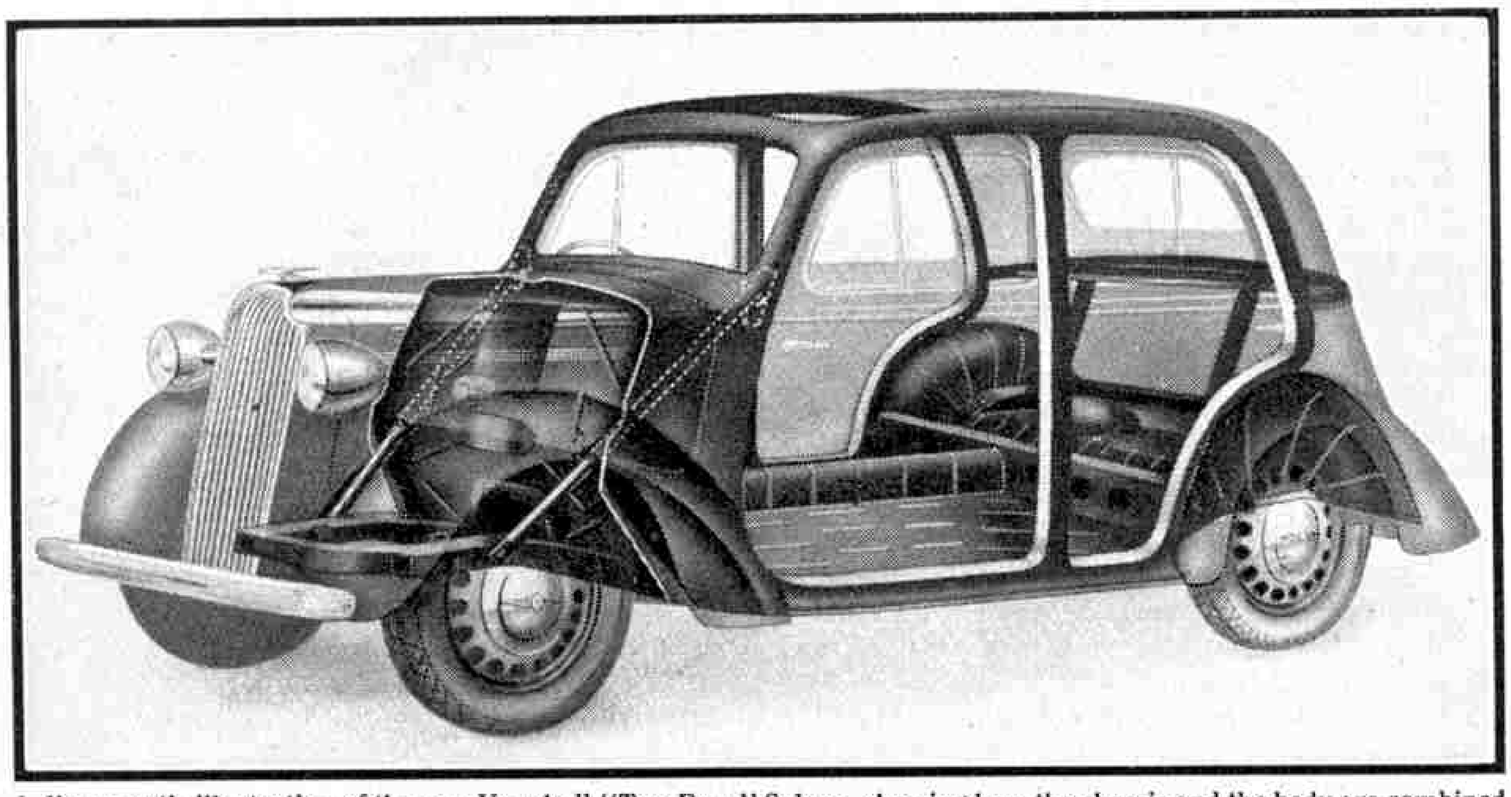
One of the most interesting of the cars recently introduced is the Vauxhall "Ten-Four," a sectional illustration of which appears on this page. The outstanding feature of this car is that its body and chassis are combined into a single unit, the object being to employ the strength and rigidity of the whole structure to resist road shocks. It is claimed that this form of construction also results in a considerable saving of weight compared with the usual separate chassis and bodywork.

Across the front of the unit is a stout "bridge," which stiffens the body just behind the engine, and further strengthening girders are placed along the sides, beneath the floor, and at the rear. The engine is carried in a sub-frame, built on to the front of the body unit.

Each of the road wheels is independently sprung by an ingenious arrangement of torsion-bars and torsion-tubes. The wheel-hubs are mounted on the ends of carrier arms, which are attached to the front axle through torsion bars and tubes. Road shocks are absorbed by the twisting of these bars and tubes. Each bar-and-tube assembly has a powerful coil spring connected to it, in such a manner as to assist in the torsion of the bar and tube under slight shocks, but to offer proportionately less and less resistance as the shocks increase. The effect is to give an almost infinitely variable suspension, which automatically adjusts itself to each shock.

Another interesting and useful feature of the Vauxhall "Ten-Four" is a thermostat control on the exhaust manifold, the purpose of which is to give rapid warming up of the engine. The thermostat is so fitted that when the engine is cold the hot exhaust gases are deflected over the inlet manifold, and are used to pre-heat the mixture going into the cylinders. The operation of the device is controlled by a flap actuated by a bi-metallic spring, which causes the flap to assume "a normal running position" when the engine warms up.

T. R. Robinson.



A diagramatic illustration of the new Vauxhall "Ten-Four" Saloon, showing how the chassis and the body are combined in a single unit. Other novel features of this car are described on this page.

A Driving Mirror that Measures Distance

Driving mirrors are a necessary accessory of any car, but with those of the usual type it is often difficult to estimate just how far off is another car that is following. With some mirrors this may seem a long way off, and with others only just behind. This of course depends on the size of the mirror and its curvature.

When making signals or braking it is often very useful to know how far off the car at the rear is, and a new mirror known as the "Meyrowitz" helps in this in a very ingenious way. In effect it becomes a range "finder." Lines of varying length are marked on it with the longest at the top and those below successively shorter. The lines are marked "20," "50," "100" and "150" and the approximate distance of a car can be judged by comparing its image in the mirror with the lines. With these as guides the appropriate allowance can be made after a little practice, the reading being in feet.

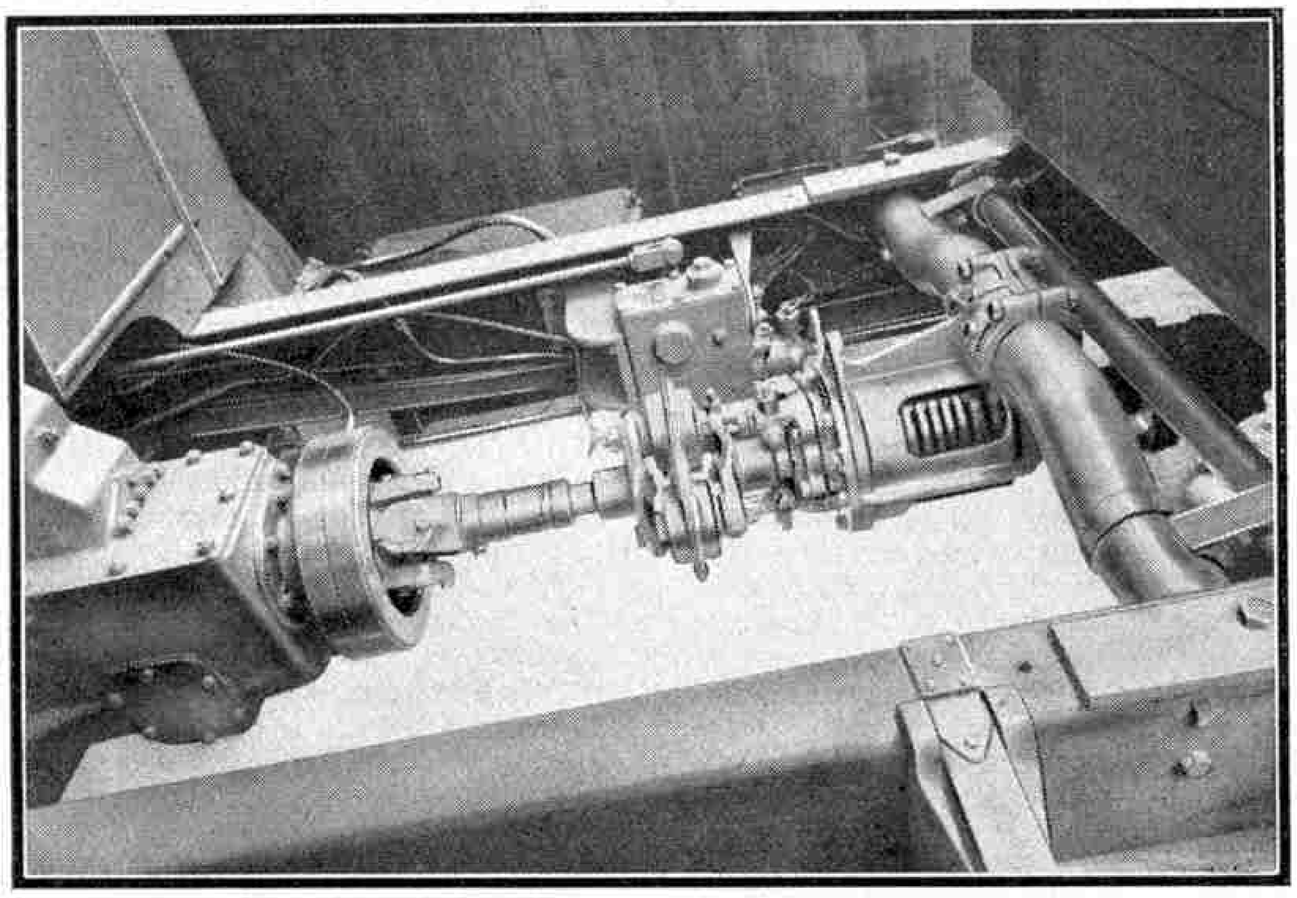
As the lines are clearly visible reading this simple gauge soon becomes automatic. The mirror cannot compensate for the various widths of different cars, but in practice these do not vary enough to interfere with its value.

T. R. Robinson.

An Interesting Brake Booster

The driver of a heavy type of motor vehicle usually is unable to exert sufficient pressure on the foot pedal to operate the powerful brakes fitted. For this reason it is now becoming the practice to include in the braking equipment of such vehicles some mechanical or hydraulic device for supplying the power required. All that the driver then has to do is to control this power by means of a foot pedal.

An interesting brake mechanism of this kind is the Lockheed-Gates mechanical-hydraulic brake booster, made by Automotive Products Co. Ltd., Leamington. This mechanism makes use of the momentum of the vehicle to actuate the brakes. It is primarily designed for use in conjunction with Lockheed hydraulic brakes, but can be adapted to instances in which ordinary mechanical brakes are fitted. The lower illustration on this page shows the system fitted to the propeller shaft of a Leyland "Cub" chassis.



The Lockheed-Gates brake booster fitted to the propeller shaft of a Leyland "Cub" chassis. Photograph by courtesy of Automotive Products Company Ltd., Leamington Spa.

The mechanism consists of a number of friction discs fixed to an extension of the gear-box shaft and interleaved by cast iron plates to form a friction clutch. When the foot pedal in the driver's cab is depressed, oil under pressure is forced into the casing so that the plates are pressed into contact with the friction discs and caused to revolve. Their motion moves a chain that in turn applies the brakes. This is effected hydraulically where Lockheed hydraulic brakes are concerned, but a mechanical device is used with brakes of the ordinary type.

Driving a Traction Engine

Interesting Stories of Bygone Days

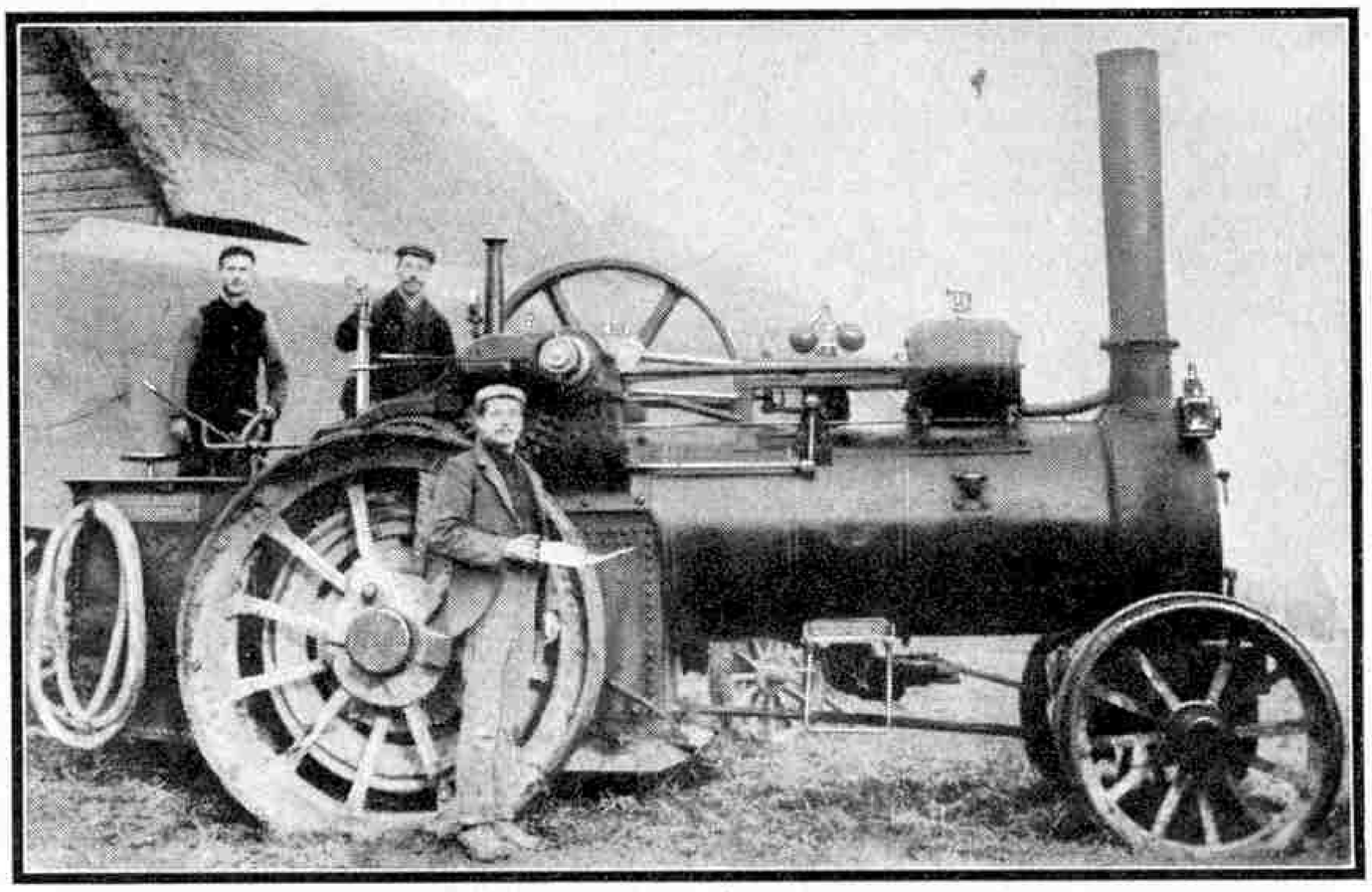
By N. Lester

As model steam traction engines seem to have grown more popular of late, a few words from an old traction engine driver may be of interest to "*M.M.*" readers. The boys of to-day who are fond of machinery are much more fortunate than I was between 40 and 50 years ago. In Thame, Oxfordshire, the small country town where I lived, the few of us who were steam enthusiasts thought a traction engine was a wonderful sight, and whenever one came clanking along it had a small group of interested boys walking by its side to see it working.

I learned to know all the traction engines for some miles around my home town. There were not many, for the district was an agricultural one, and sometimes I would not see one for a week or two. Nevertheless I learned to recognise the particular make of an engine at first sight, as many boys do to-day with motor cars.

There were then about fifteen leading makes of traction engines, I believe. I don't suppose these firms went in for mass production, or we should see more of the old relics now, as the usual life of a traction engine is from 30 to 40 years.

Show-men and contractors for heavy haulage purposes use what are known as "road locomotives." These have a disc flywheel and enclosed working parts, and an extra water tank is fitted under the boiler barrel to enable them to travel a long way without stopping for water. They are, of course, mounted on springs. Agricultural traction engines are of lighter build and have spoked flywheels. Their working parts are not enclosed, and they are not usually mounted on springs. When travelling on the road the water in their tanks lasts only about five or six miles, so if you should see one with the driver wearing a worried look, you may guess he is thinking of water!



An old-time traction engine that travelled the district round the country town in which the author of the accompanying article lived when a boy.

It was with an agricultural traction engine that I had my first experience in driving and steering, somewhere about 37 years ago. Watching one at work from the footplate was altogether different from walking alongside. It seemed strange to see the crankshaft revolving so fast, with the huge driving wheels moving slowly round like the waterwheel of an old mill; but the jolting and jarring I received made me think that four miles per hour was quite fast enough! The clang and rattle of exposed gear wheels, together with the rumbling and grinding of iron-shod wheels on macadam roads, made conversation between my mate and myself impossible unless we shouted into each other's ears. When we stopped at a wayside stream after travelling some four or five miles, and put in the suction hose to replenish our now almost empty water tank, the silence seemed almost uncanny, and we were a little surprised to hear each other speaking in ordinary tones.

Starting away with a single-cylinder traction engine requires some practice to do it quietly and without fuss. Compound engines with double cranks were then thought to be complicated and expensive, however, and I think most of the old-time drivers had a fondness for listening to the sharp "chug" of the exhaust of a single cylinder. When pulling hard up a steep hill, the exhaust was so fierce that some of the engines I have driven threw up from the chimney little red-hot cinders that had a playful habit of finding their way inside my coat collar, or into one of my pockets.

Curious and often amusing incidents were frequent. I remember travelling with a threshing machine on one occasion, when I found it was necessary to uncouple the engine from the machine and turn into a lane to get at water for the tank. After filling up, I backed the engine down to the machine in order to couple up again. My steersman was on the ground, holding the draw bar up with the coupling pin in one hand ready to drop it in. I heard the "clink" as the engine touched the draw bar, and started ahead, thinking the coupling pin had been dropped in and knowing that my steersman had only to take a few steps to get up alongside of me. It then occurred to me that he was a long time taking the wheel. I turned to look for him, to find that the machine was 15 yds. away, with my steersman wearing a puzzled look and still holding the pin and draw bar.

I often wondered why each maker of traction engines tried to make his particular production as different as possible from all others. Some engines had two gear reduction shafts between crankshaft and driving axle. Others had only one, so that the crankshaft revolved in the opposite direction to that of the first type when the reversing lever was in the forward position. Then some had the steering wheel on the left and others on the right, while each maker had his own views in regard to the position of the boiler feed pump and injector and other fittings.

I firmly believe that the regulators or steam throttles of all steam traction engines and tractors should be made to open or close the same way. On one occasion, when I was driving an engine with a pull-out regulator, I was getting a threshing machine into position against a corn rick. My mate was holding a push pole about 9 ft. or 10 ft. long against the front axle of the engine, with the other end butting against the back axle of the machine. Another man was holding the draw bar at the front of the machine, and because he was there the job had to be done very steadily. A few days previously I had worked on an engine with a regulator that was pushed to open and pulled to close. The result was that when my mate with the push pole shouted "Whoa!" I pulled the regulator wide open instead of pushing it. The engine jumped towards the threshing machine, and although I realised my mistake almost instantly and reversed at once, I stopped with only just room for my mate between the smokebox of the engine and the back of the threshing machine. Luckily for the man in front holding up the heavy draw bar, our push pole had splintered and skidded off the threshing machine axle.

Needless to say, my mate was a bit wary of me for some time after this lapse of mine. He did not throw half a brick at my head, however, as one country gentleman threatened to do when he wanted to drive his horse and trap past my engine in a quiet country lane. This was because I did not stop soon enough to please him. I did not mind his threat, as I could see that he had not half a brick with him!

Although the country roads were almost deserted in the days of which I am writing, traction engines were not universal favourites. Their noise and smoke, and a peculiar tendency to frighten horses, caused them to be regarded as a nuisance by many people, and heaps of abuse were piled on them and their luckless drivers. Little did those people dream that our old friend the steam traction engine was the pioneer of mechanical road transport as it is to-day.

Scotland's Empire Exhibition

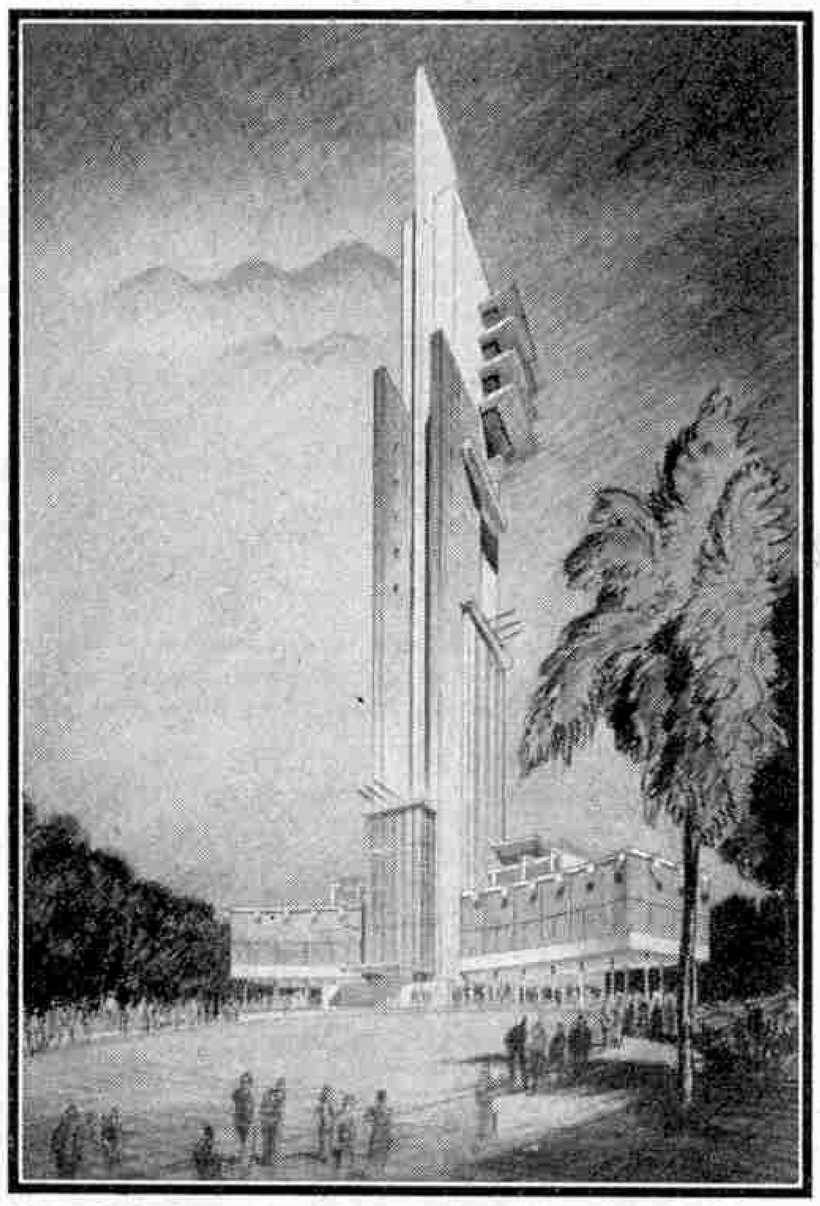
Building a 300-ft. Observation Tower

THIS summer the greatest Exhibition since that at Wembley in 1924-5 will be held in Scotland. It will be known as the Empire Exhibition, Scotland, and will run from 3rd May, when it will be opened officially by His Majesty the King, until the end of October. It will be held in Bellahouston Park, Glasgow, and its main purpose is to give visitors some idea of the Empire as a whole, and of the way in which its peoples live.

The Exhibition will cost altogether over £10,000,000 and more than 15,000,000 people are expected to visit it. It will be "a city within a city," for it will have all the services of a normal city of half a million inhabitants. Electricity, gas, water and drains have all been installed. There are 10 sub-stations to distribute the power for the illuminations, and 13 miles of underground cables and 240 miles of wiring were required to complete this system.

A post office also will be installed, and there will be a special Fire Brigade. Fireproof materials have been used in all the buildings, so that the danger of fire is slight, but the authorities are taking no risks and hydrants have been installed along all the main avenues at intervals of 50 yards. Special roads have been built to carry the heavy machinery to be shown, and miles of lighter roads, pathways and promenades have been prepared to cope with the expected crowds. A special railway station is being built for the convenience of visitors, and parking space for 10,000 cars will be provided.

The buildings to house the exhibits are now in process of completion. Among them there will be a vast pavilion for the home country, and Northern Ireland, Eire and the great Dominions also will be represented. Exhibits will be arranged by Malaya, East and West Africa, certain of the West Indies and many other colonies, and Scotland will have special displays in two pavilions and a Highland Village. Every feature of great Exhibitions of the past will be reproduced and even surpassed. The area covered will be 175 acres, and on it there also will be what is claimed to be the finest amusement park ever seen in Great Britain. Sporting events and athletic displays will be staged in Ibrox Stadium, which is only a few hundred yards away and is capable of holding 120,000 people.



An artist's impression of the 300-ft. Tower at the Empire Exhibition, Glasgow, as it will appear when completed. The three observation galleries at the top will accommodate 600 people.

There are many features of outstanding engineering interest in the immense buildings of the Exhibition. The most modern materials are being used in the construction of these, and the architects responsible for them have had to solve many exceptional problems.

At first glance, the outstanding feature of the Exhibition will be the immense Tower of Empire. This is 300 ft. in height and from its imposing site on Bellahouston Hill, in the centre of the Park, it dominates its surroundings. From the projecting observatories at its top, which can accommodate 600 people, there will be a magnificent view, stretching across the Clyde, with its famous dockyards to the hills north of Glasgow and far into the Highlands. Two powerful lifts have been provided to carry visitors to its summit, and there is no doubt that these will be kept exceptionally busy throughout the run of the Exhibition.

The great Tower, which is illustrated on this page, is built of steel. It is provided with a covering of special metal sheets, painted aluminium colour on the outside, so that it will form a brilliant landmark by day, while at night searchlights mounted on it will sweep round the countryside. It can be described as a metal skyscraper, streamlined and pencil thin. Its building presented many new problems, for no tower of its height and design has previously been built to withstand the strain that it will be called upon to bear. Wind pressure gave rise to one of these problems. The Tower is of irregular cross-sectional shape, which will give rise to wind pockets and create vacuums at corners. In addition to wind pressure, the designer had to take into consideration the dead weight of the structure itself and of the spectators who will ascend it, and the live load imposed by the lifts, while the whip of the giant flag on the extreme top of the Tower also required careful attention.

A firm foundation of course is essential for such a towering structure. This is provided by a solid block of concrete, 48 ft. long, 52 ft. wide and 21 ft. deep, which contains 3,200 tons of concrete. This vast quantity of material was mixed and poured into position in 12 days. In it the Tower is embedded to a depth of 3 ft. and there it is firmly anchored by means of an elaborate system of bolts and reinforcing rods.

The Tower is not the only engineering wonder of the Exhibition. Another is the Palace of Engineering, which is the largest temporary structure ever raised. It is a gigantic steel-framed building covering an area greater than that of Trafalgar Square. Its length is 470 ft. and from front to back it measures 330 ft. Before its foundations could be laid it was necessary to excavate some 8,000 tons of earth.

The framework of this building contains more than 1,200 tons of steel, and 60,000 sq. ft. of patent glazing and 80,000 sq. yds. of asbestos sheeting were required to cover it. The erection of the framework was a remarkable constructional achievement, for it was completed in three months by 50 men. Every operation was carried out to schedule, the men working as a team, each knowing what he had to do and what he could expect from the others.

When the Exhibition opens this huge building will contain one of the most comprehensive collections of engineering exhibits ever gathered together under one roof. The displays will illustrate shipbuilding, modern engineering and its auxiliary industries, locomotive engineering, electrical appliances and equipment, cranes and constructional and bridge engineering. There will be many working models of industrial plants, special bridges and cranes, with miniatures of various types of ships. Visitors will see many intricate machines in operation, and will come to realise from the multiplicity of their products the bearing that our great industries have on their daily life.

The Palace of Engineering will be separated by a lake 400 ft. long from the Palace of Industry, in which will be shown all kinds of manufactured products from penny-in-the-slot machines to musical instruments. In addition, over 40 special pavilions are being erected. One of these is being organised by the General Post Office, and in it there will be working models of the well-known Post Office underground railway in London, with miniatures of cable ships and mail aircraft. The British Broadcasting Corporation and the British Railways will be among the exhibitors, and other outstanding attractions will include a Hall of Youth and a Highland Village, complete with mountain burn and loch. To ensure accuracy the buildings in the Village were constructed from plaster moulds of actual houses in the Highlands. In the Exhibition Concert Hall audiences of 2,000 will be able to listen to the world's finest orchestras.

When dusk falls a wonderful system of floodlighting will illuminate the Exhibition grounds. This will involve the greatest experiment in floodlighting in colour that has yet been carried out in Great Britain. Beams changing continuously in tint will weave patterns among the trees, and play on streams running down the hillside to the lake with its many fountains. These fountains are of attractive design and will be illuminated at night by an extensive system of underwater lighting.

HOW THINGS ARE MADE:

Sparking Plugs

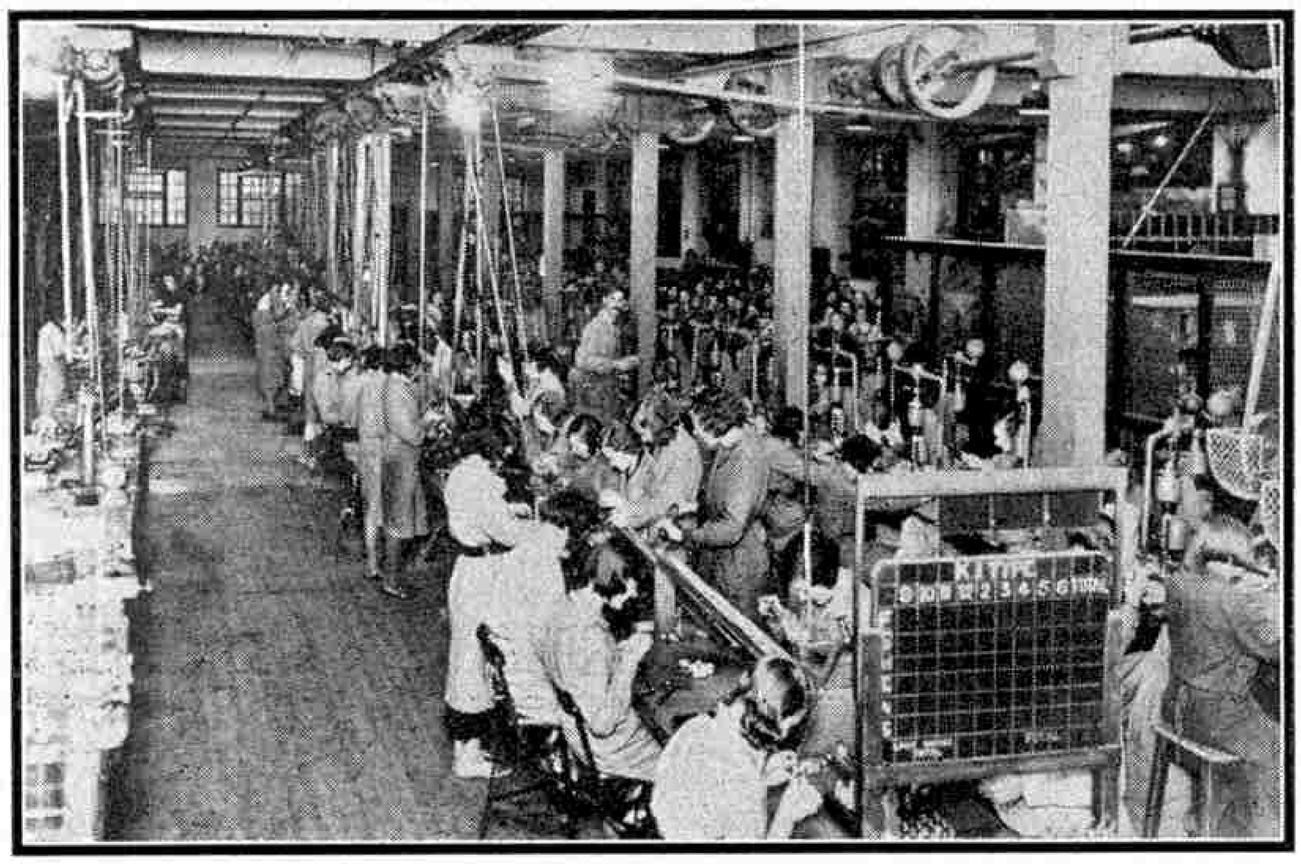
High Precision Work in the K.L.G. Factory

By T. R. Robinson

THE manufacture of the thousands of sparking plugs required for petrol engines is a highly specialised business. Each type of engine and condition of service calls for its own particular design, but it will be a great surprise to many to learn that nearly 970 different kinds of plug are made as standard productions at the K.L.G. factory at Putney Vale, London.

Although sparking plugs appear simple enough in construction, precise workmanship is necessary at every stage of manufacture if performance is to be efficient. In some cases measurements of .00015 in., or 1½ ten-thousandths of an inch, are worked to, and even the rougher turning operations are to tolerance limits of .0003 in.

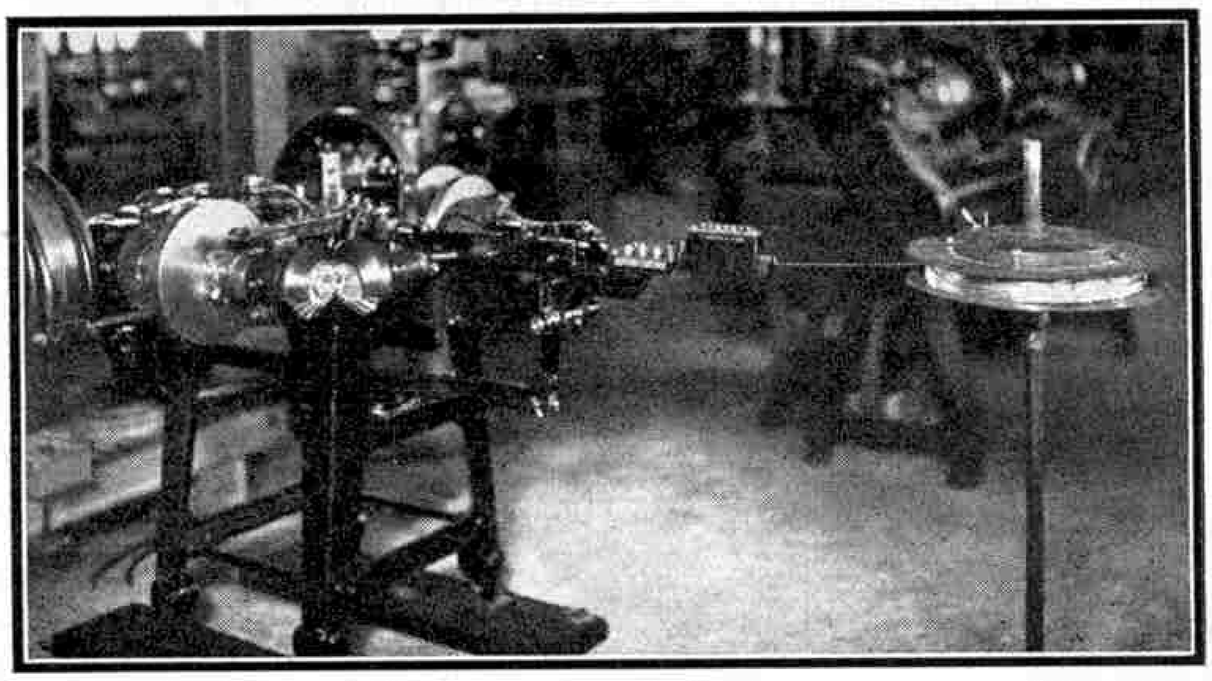
The bodies, or metal shells of the plugs are turned up from lengths of hexagonal rod on large automatic lathes. Four of these rods are mounted in a rotating magazine, somewhat similar to the chambers of a revolver. The magazine is moved round step-by-step, and various tools work on each bar in turn, drilling down through the centre, turning up the outside, knurling a ring around the circular portion, and so on. At one point a neat combination drill takes a final cut through the central hole, and finishes the various lengths and diameters in one operation. This work must be done very accurately, for all subsequent operations are gauged from the finished central hole.



Assembly lines at the factory where K.L.G. plugs are made. For the illustrations to this article we are indebted to the courtesy of K.L.G. Sparking Plugs Ltd., London.

After the last tool has done its work, the body is parted-off from its rod and falls away down a shoot into a basket. Five plug bodies are turned out by each machine every minute, and the tools operate under a stream of oil kept in circulation by a pump.

Automatic lathes of a somewhat similar type are used to turn up the gland-nuts, which attach the central parts of the plugs to the bodies. Six bars are worked upon at one time in these machines, and turning, drilling, reaming, threading and so on are carried out at high speed, 12 gland-nuts being turned out every minute on each lathe. One of these machines is shown at work in the upper illustration on the opposite page.



The machine that makes the well-known clips fitted on top of K.L.G. sparking plugs.

The bodies for the small 14 mm. plugs are produced on a wonderful super-automatic lathe. This has an output of nine bodies a minute, and shows a red light when it has come to the end of its supply of bars. Even its turnings are removed by a conveyor and tipped out into a bin at the end of the machine, and a special interlocking arrangement makes it impossible to set the lathe running unless there is a sufficient oil pressure to ensure lubrication of tools and moving parts. Another clever automatic device on the revolving magazine of this lathe ensures that wear is reduced to a minimum, and that in any case it cannot cause inaccuracies in the finished work.

As the bodies and gland-nuts come from the automatics, they are gauged and inspected, and each part must pass its test before it is allowed to go forward for further handling. Next follows the stamping of the letters "K.L.G." and the type-number of the plug on the flats of the hexagon, by small presses equipped with jigs that hold the plugs in position.

After this the earth point ring is prepared for. On many K.L.G. plugs this earth point is a pressed-out metal disc, pierced to form three tongues that point to the centre, that is towards the place that in the finished plug will be occupied by the central electrode. It is fixed in a groove or socket in the body, and the cutting of this socket and the mounting of the disc are among the next processes.

To have its socket cut, the body is placed on a rotary jig that has a number of projections radiating from its centre like the spokes of a wheel. Each projection fits into the central hole of a plug body, and so positions it accurately. Then the jig is turned to bring the body vertically under a rotary cutter, which descends and shapes the socket ready for the disc. The use of this jig saves much time. While one socket is being cut the next to be dealt with is placed on the "spoke" that follows next in order, and the body in which the socket has previously been cut is removed.

Between the cutting of the socket and the insertion of the disc, the thread for the gland-nut is cut in the largest part of the internal hole in the body. A method very similar to that just described is used, bodies being placed alternately in one or other of two holes in the ends of a swinging jig that moves them round to come under a rotating tap, which descends and cuts the thread. Although the hole is of fairly large diameter, 10 plugs can be threaded in this way in a minute.

After another inspection and more gauging, the insertion of the earthing disc follows. The disc is placed in its socket and two hard steel rollers on a rotary head then press the edges of the socket over to hold it firmly. The whole process is carried out with great speed. The girl operator places a plug body on a jig, drops the earth disc into its socket, and rolls the edge over in a few seconds. She fits 26 discs in a minute, each being neatly and securely fixed in position.

Two further processes are still necessary. These are the threading of the lower end of the body to enable the plug to be screwed into the engine, and the shaping of the earth points in readiness for the final setting, which is made when the central electrode is in place.

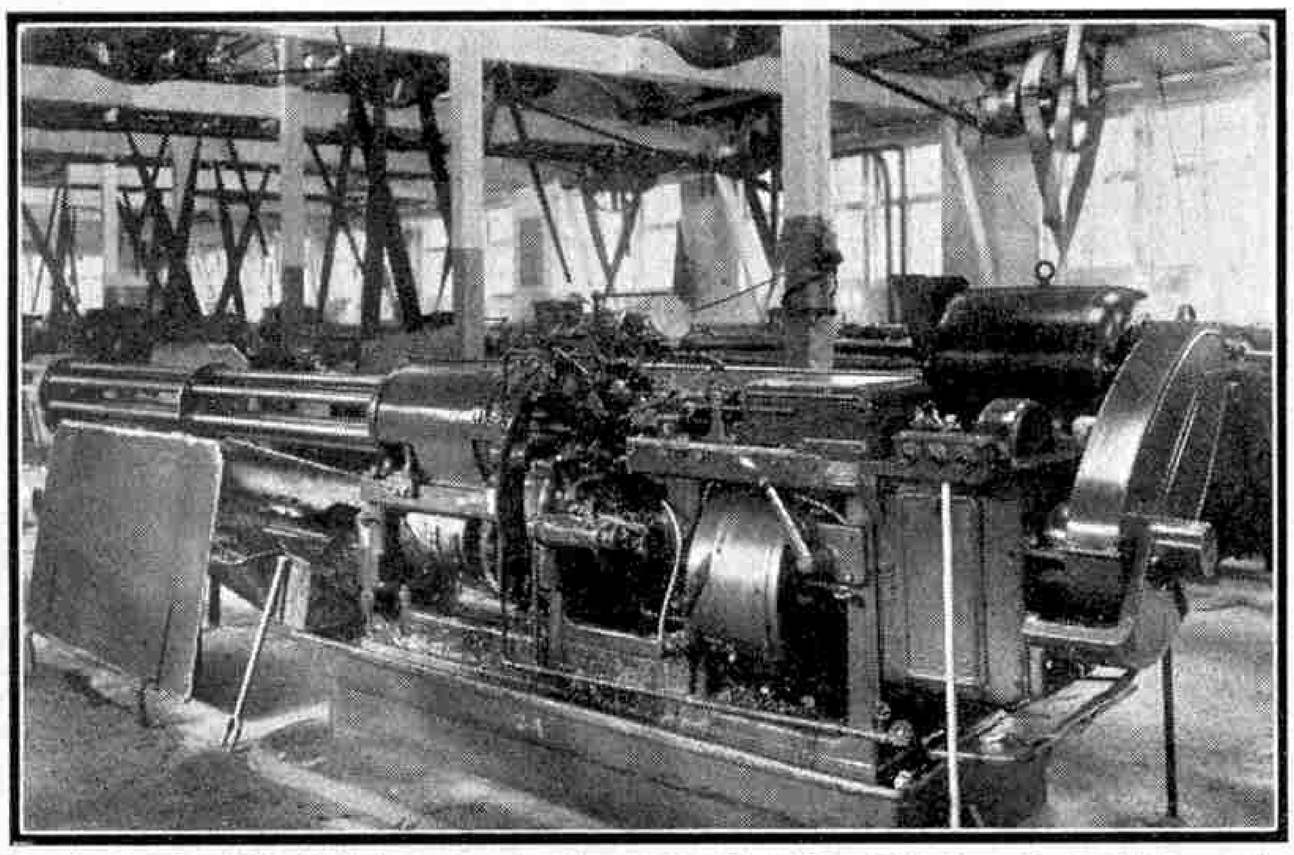
The screw thread is cut by a four-jaw die fixed to the bed of the

machine used for this work, the plug body being inserted in a revolving chuck and fed into the die. As soon as threading is completed the plug body trips a stop on the die and the jaws fly apart, giving a quick release of the finished screw thread. The shaping of the earth points is done on small presses. The body is placed on a jig with a conically pointed press tool resting against the earth disc, and the other half of the press tool, which has a recessed cone formed in it, is then brought down.

The finished plug bodies and gland-nuts are then placed in a special bath, which gives them an anti-corrosive surface and results in the familiar grey-matt finish.

The inner portion of a plug consists of a central electrode and its surrounding insulator, together with a steel sleeve, known as the gland or cone, by which it is secured to the body. In construction it is somewhat more complex than that of the body and gland-nut.

The electrode is made from high-tensile steel bar, overlaid with a copper sleeve 1/32 in. in thickness. The rough bar is drilled at one end to form a hole for the insertion of the firing point, and is then cut off to a suitable length in automatic lathes, after which the thread for the terminal nut is cut. The electrode then passes on to a clever annealing and drying machine. Batches of electrodes are placed on the hopper of this machine, and from it they fall on two slowly revolving drums that carry them through gas jets and finally tip them out into trays. The process dries out any moisture that may be present in the firing-point hole, and also anneals the electrodes in readiness for the next stages.



The gland-nuts of K.L.G. plugs are produced on automatic lathes of this type. Each of these works on six lengths of hexagonal rod, which are shown on the left.

The firing point of the electrode is made from special heat-resisting wire and, like the electrode itself, is produced on an automatic lathe. After it is cut to length, two small projecting burrs are punched up on its sides, and it is then ready for insertion in the hole in the end of the electrode. In the meantime this hole has been re-drilled, or "corrected," to remove any distortion caused by annealing, and the next process is the pressing home of the firing point, which is a tight push-fit. When the point is in place, a spring-loaded punch burrs in the mouth of the hole at the point where the firing point emerges. This, together with the small projecting burrs on the point, ensures that the latter cannot fall out of the electrode, and into the engine cylinder.

The turning-up of the copper electrode sleeve comes next, and then follows the wrapping of the electrode in mica. The raw mica is obtained in slabs, irregular in form, and the first process is to cut these into rectangular pieces of suitable size. This is done by girls equipped with small guillotine cutters, the accuracy of the cut being governed by small jigs or stops.

Assembling and testing plugs. In the centre these are seen undergoing high voltage trials, and on the left they are being examined to make sure that the electrodes are central.

Next the shaped slabs are split on strange looking flat plates fitted with a splitter, which resembles a spear head. The girl slides the slab across the plate and presses it against the spear point, and the mica is rapidly and evenly split down to the required thickness of 1½ thousandths of an inch, after which the sheets are gauged and inspected for defects.

The split-down sheets are passed to machines that wrap them round the central electrode under pressure, a gauge of the dial type indicating when the correct diameter has been reached. The wrapped electrode passes to a machine in which the top end is ground off, ready for the fitting of the gland or cone, and this is next pressed into place on a jig that ensures its being in the correct position during the pressing operation.

Further grinding, this time at the firing end, removes more superfluous mica, and then a powerful press shrinks the gland on to the mica wrapped round the electrode. This is a most important process, for any leak between the gland and the electrode would make the plug useless. In order to make quite certain that both the fit of the gland and the insulation are sound, pressure and high voltage tests are applied before the electrode unit is passed as satisfactory. The joint between gland and mica is tested to a pressure of 100 lb. per sq. in. and a voltage of 20,000 is applied across the mica.

The centre unit now begins to look like part of a plug, and it is made more recognisable by the following stages of facing the cone at the firing end, cutting the top mica to length and building up the external sleeve with mica washers, which are finally secured by a brass clinch-nut.

The mica washers used for the external sleeve are produced from sheets that are thicker than those used for wrapping the other part of the electrode. Small power presses are employed to cut them, and it is interesting to note the way in which the girl-operators get the greatest possible number of washers from the irregularly shaped pieces of mica. The outer surfaces of the washers are ground off level and polished, and the unit is then thoroughly dried in an oven.

In some types of plugs, the conical end of the mica that covers the electrode inside the body is cut in steps, and the turning of these on a lathe provided with a simple slide rest is a highly skilled task. Setting the slides entirely by hand, the girl who does this work cuts step after step with wonderful precision, and a comparison between different cones shows how accurately her hands work.

When the outer surface of the gland has been turned to correct size to fit the gland-nut and has been fitted with a copper sealing washer, the unit is almost ready for assembly in the body. Before this is done, however, it is again tested and gauged, and the central firing point is cut to the correct length and its end rounded off. Then comes the fitting, and the tightening of the gland-nut, after which a final pressure test again checks the plug for leakage.

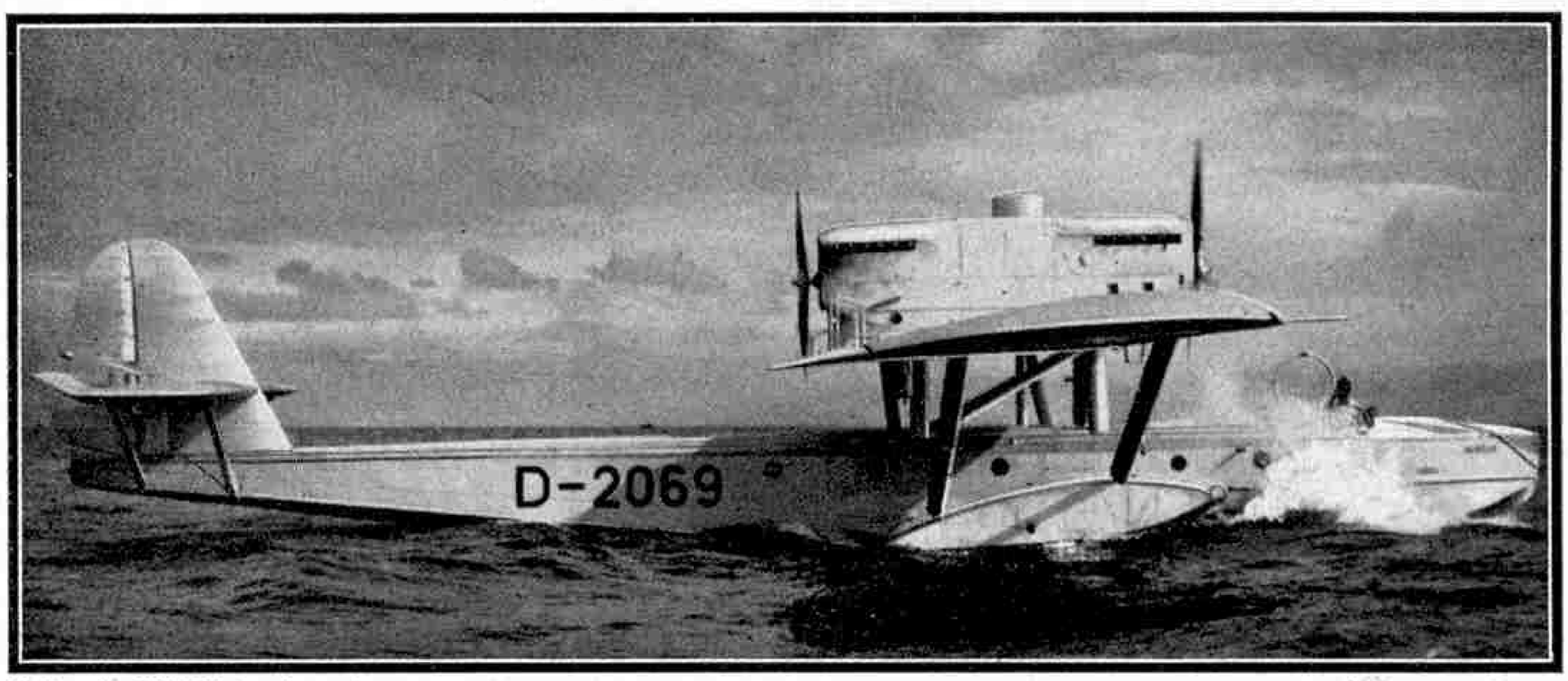
If all is as it should be, the points are set to gauge, and the plug is fitted with its spring terminal-clip. The machine that produces these spring-wire clips is operated by clever cam-action. A spindle carrying a set of cams is mounted on each of the four sides of the square baseplate of the machine, and the four sets work together in a very ingenious manner.

The type of plugs dealt with in this article are of the usual form for a car or motor-cycle. The plugs used for aero-engines and other special work are often far more complex, some using platinum firing points that are fitted to slots in the earth ring. Platinum points are also used for certain types of K.L.G. plugs and they enjoy a very wide popularity in the Air Force. The K.L.G. firm also employ an alternative insulator to mica. This is known as "Corundite." It is intended to supersede the ordinary sparking plug porcelains, and is claimed to be greatly superior to them, both as regards mechanical strength and heat conductivity.

The Dornier "Wal"

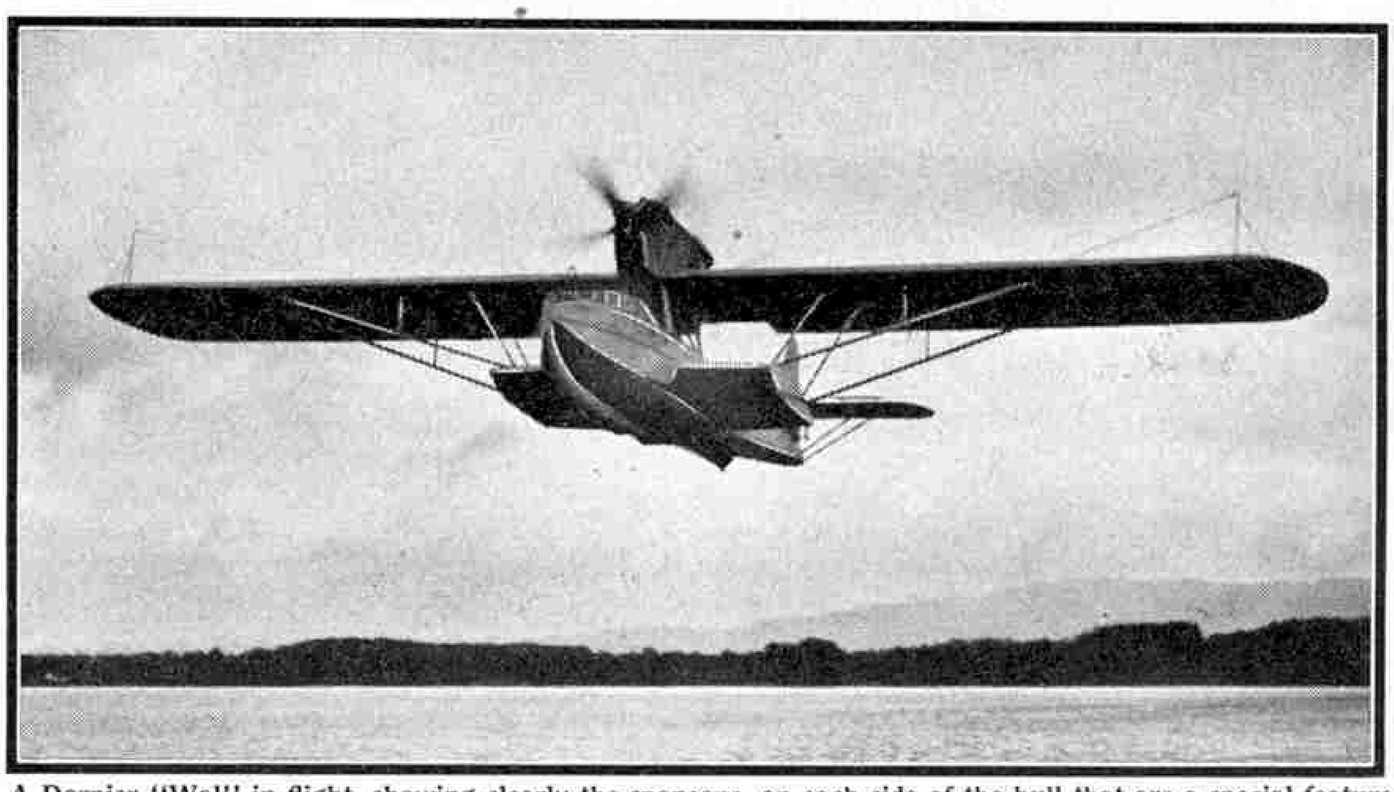
Development of a Famous German Flying Boat

ONE of the most famous and widely used flying boats in the world is the Dornier "Wal." This and other highly efficient flying boats are built by the Dornier Company, the chief works of which are at Friedrichshafen, on the shore of Lake Constance, where the aircraft undergo their test flights, and where Count Zeppelin carried out his famous pioneer work with airships. Dr. Dornier, the founder of the firm, actually began his first experimental work in the early days of the Great War when, with the support and encouragement of Count Zeppelin, he began to develop metal aircraft for mass production.



A Dornier "Wal" taxying. Many great flights have been made in this famous flying boat, which also has given splendid service on the South Atlantic air mail service of Deutsche Luft Hansa since 1934. The illustrations to this article are reproduced by courtesy of Dornier Metallbauten G.m.b.H., Germany.

The first products of Dr. Dornier's industry were flying boats, and the models that he designed were of very great interest. The first, known as the Do Rs I, was ready for flight by the spring of 1915. It had three Maybach 145-h.p. engines and a duralumin float near the outer end of each wing to steady it when on water. The fourth is of special interest as it was the first Dornier flying boat to have the now familiar sponsons, or stub wings at the sides of the hull. The first flying boat with two engines appeared in 1918. This was the Gs I, intended for military purposes, but eventually converted for use in commercial flying. It had its two engines in tandem, that is one behind the other, and was the immediate forerunner of the Dornier "Wal," for experience gained with it laid the foundations of the developments that led to the production of this famous flying boat in 1922. From time to time modifications have been made to the "Wal" in order to improve it and bring it up to date, and the high efficiency of the model is shown by the fact that it is still one of the current "Dornier" types.



A Dornier "Wal" in flight, showing clearly the sponsons, on each side of the hull that are a special feature of Dornier flying boats. They give stability to the aircraft when it is on the water.

The Dornier "Wal" has proved itself by efficient service in many countries in addition to Germany, and it has become famous for the many outstanding flights in which it has been used. In 1925 Amundsen and Lincoln Ellsworth attempted to reach the North Pole by air in Dornier "Wals." They had two of these, each fitted with two 720-h.p. Rolls-Royce "Eagle IX" engines, but after leaving Spitzbergen strong winds forced them off their direct course and reduced their speed, making it necessary to descend on to the ice. One of the machines had been damaged on starting and had to be abandoned. Great difficulty was then encountered in clearing ice and snow away to make a runway for the other, and only after nearly four weeks of hard work was it possible to get the flying boat into the air again. There were many narrow escapes from collision with the tops of icebergs, but the machine brought its double load of explorers within sight of Spitzbergen before jammed controls made a descent on to the sea necessary, and a safe landing was made with little difficulty.

Dornier "Wals" were again used in the Arctic three years later, when the Italian airship *"Italia"* was stranded there during an effort to fly over the Pole. The two flying boats sent northward for this purpose flew from Pisa in Italy to King's Bay, Spitzbergen, and back, a total distance of 10,564 miles. In the meantime several flights across great stretches of the Atlantic Ocean had been made, and Major Franco, a famous Spanish pilot, had crossed from Spain to South America in a Dornier "Wal" fitted with two 450-h.p. Napier "Lions." Later flights included two from Germany to South America by way of Iceland and Greenland, both made by Captain Von Gronau, and in 1932 this airman surpassed his previous efforts by a magnificent flight round the world, the first ever made in a flying boat.

When Deutsche Luft Hansa, the famous German air transport company, began to develop air mail services between Europe and South America, the Dornier "Wal" was chosen for the experimental flights across the South Atlantic Ocean and was employed on this section of the route when the services were begun in 1934. The service has been remarkably regular and free from accident. The westward mail is flown by landplane to Bathurst, in Gambia, on the west coast of Africa, and there is loaded into the flying boat awaiting it on the deck of one of the company's depot ships. When the ship is about 100 miles out to sea the flying boat is catapulted off and flies to Natal, Brazil, from which point the mails are taken on to Rio de Janeiro and eventually to Santiago, Chile, in landplanes.

The distance covered in each of these long non-stop flights across the South Atlantic depends on the position of the depot ship when the flying boat is despatched. It is always from 1,500 to 1,800 miles, however. In the reverse direction the mail-carrying flying boat is conveyed seaward from Natal by a depot ship and then catapulted off to fly non-stop to Bathurst.

The illustrations on this page show the Dornier "Wal" to be a

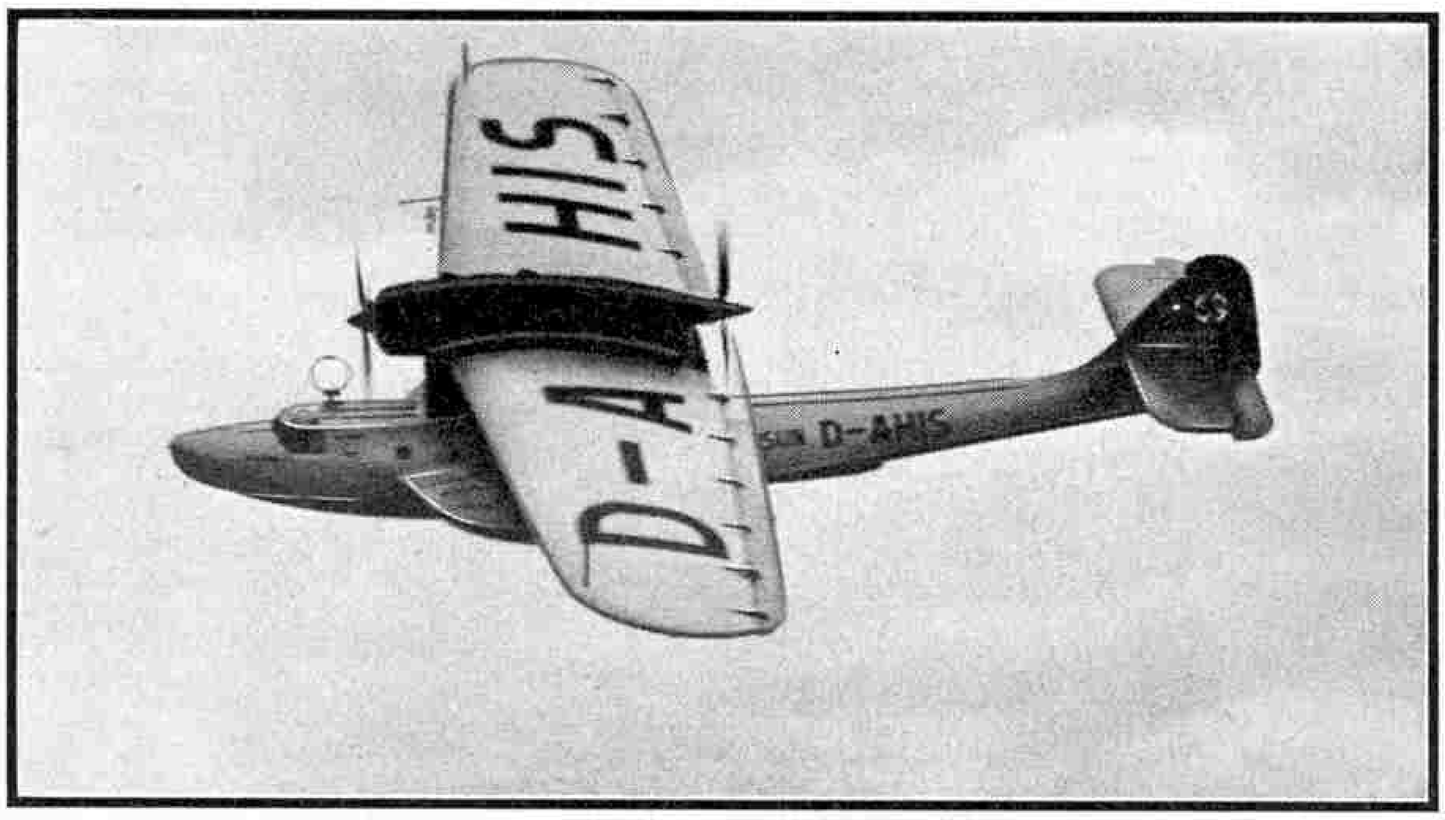
flying boat of the high wing braced monoplane type. It is 89 ft. 3 in. in span, and has rectangular wings, rounded at their outer ends and covered with fabric except in the centre section, which carries the nacelle for the engines and is covered with metal. The hull is divided into seven watertight compartments, any two of which can be filled with water at the same time without causing the flying boat to sink or lose its stability. In the nose is a watertight collision compartment specially strengthened to take the brunt of the blow in the event of a collision. It is used to store the mooring and sea gear, and access to it is gained through a watertight hatch in the deck. Next is the pilots' cabin, which has side-by-side seating and dual control, and immediately behind it on the port side is the navigator's compartment and on the starboard side that for the radio operator. Farther aft is a petrol storage space, and in the stern is the mail compartment.

"Zephyr," one of two Dornier Do. 18E flying boats used by Deutsche Luft Hansa in experimental flights across the North Atlantic in 1936. This improved type has succeeded the "Wal" on the company's South Atlantic service.

Two 600 h.p. B.M.W. VI water-cooled engines are used as standard on the current type. They are mounted one behind the other, the rear one driving a pusher airscrew and that in front a tractor propeller. The engines give the aircraft a top speed of 143 m.p.h. and a cruising speed of 124 m.p.h.

The Dornier "Wal" is still in production, but the firm have developed from it a new flying boat specially designed for flights across great stretches of ocean. This is known as the Do. 18, and was first used in experimental flights across the North Atlantic made in 1936 by Deutsche Luft Hansa. The two boats used were named "*Aeolus*" and "*Zephyr*," and the second of these is shown in the upper illustration on this page.

The plan followed in these experimental flights was similar to that in use in the South Atlantic. On their westward flights the Do. 18s were catapulted from a depot-ship off Lisbon, and flew to New York by way of the Azores and Bermuda. In the meantime the depot ship hastened across the Atlantic in order to start the flying boats off on their return trips, which followed on experimental coastal flights. On one westward trip the call at Bermuda was omitted, the two flying boats going directly from the Azores to New York, a distance of about 2,400 miles, and the long return flight from New York to the Azores also was accomplished non-stop.



A Do. 18E in the air. The engines of this flying boat, like those of the "Wal," are so arranged that the rear one drives a pusher airscrew, and they give the aircraft a top speed of 161.5 m.p.h.

These experimental flights demonstrated the efficiency of the Do. 18s, and this flying boat has now succeeded the "Wal" on the regular D.L.H. South Atlantic air mail service.

The Do. 18 is now available in two forms, known as the Do. 18E and Do. 18F respectively. The first of these is the original type. It is a high wing all-metal monoplane flying boat with a wing span of 77 ft. 9 in. Rising from the hull there is a slender streamlined turret, above which is an equally slim nacelle for the engines. The two halves of the wing are connected by bolts to the engine housing, which serves as the wing centre section, and each is braced by two inclined struts that extend down to the sponsons.

The hull is 63 ft. 1 in. long, and tapers gracefully toward the stern where it merges into the tail unit. It is divided by bulkheads into eight watertight compartments, and is specially strengthened to withstand the shock of catapulting. Above the waterline it is completely rounded, and all parts that might cause unnecessary drag are countersunk. Below water it is similar to that of the "Wal." The sharp keel at the bow changes into a slightly cambered bottom at the first step, aft of which there is a tapering step carrying a water rudder.

The bow compartment is used for storing marine gear. Behind it is the pilots' compartment, which is completely enclosed and gives an excellent view. The pilots can enter it by turning back on their hinges the two top windows. Full dual control is fitted.

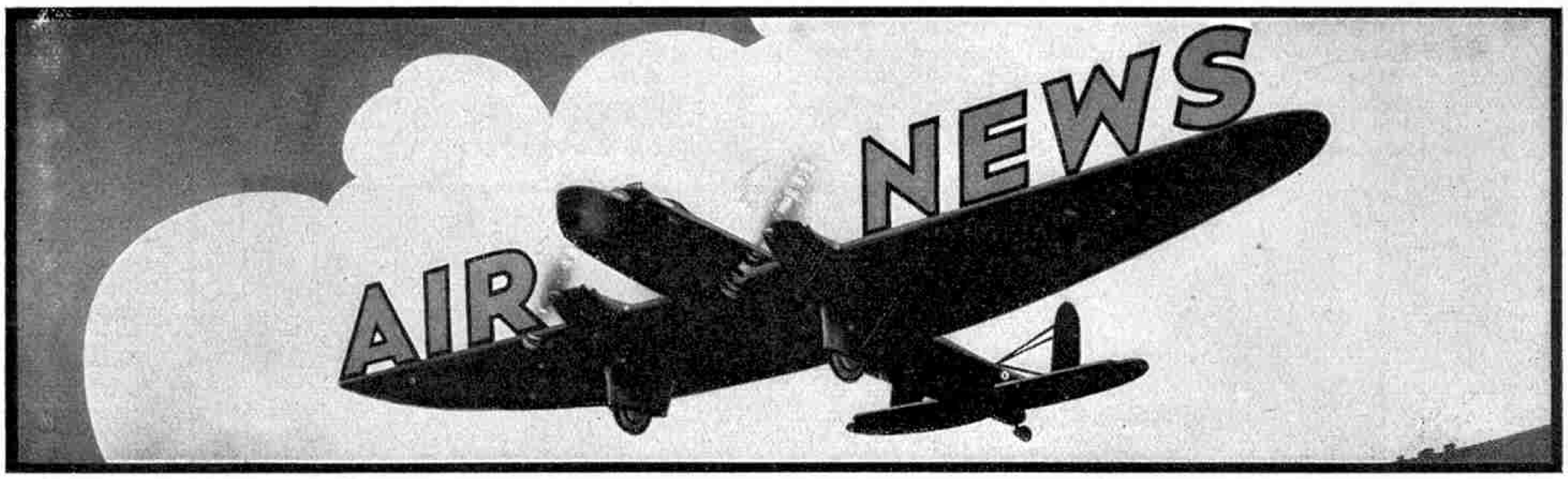
A door in the pilots' compartment leads to the radio and navigation compartment, with the radio direction-finding apparatus on the starboard side and a large map table on the port side. Next is a space occupied by fuel and bilge pumps, accumulators, oil and cooling water tanks, and to the rear of this is the fuel compartment. Then follows the mail and freight compartment, which can be used for the storage of emergency equipment.

The Do. 18 has two Junkers "Jumo" Diesel engines, giving a top speed of 161.5 m.p.h. and a cruising speed of 139.7 m.p.h. The greatest height to which the flying boat can climb is 14,760 ft., and it has a range of 3,220 miles. The two engines are fitted in tandem, in the manner made familiar by the Dornier "Wal." The front engine drives a tractor airscrew, and the rear one a pusher airscrew by means of an extended shaft, an arrangement that allows the nacelle to be well faired. The engine coverings can be easily removed for inspection or repairs, and when those at the sides of the front engine are let down they serve as a platform for the mechanics. There are two tanks for cooling water in the top of the nacelle, and they are replenished as necessary from the water tank in the hull by means of a hand-operated pump in the turret.

An interesting feature of the Do. 18E is that it can be equipped for use as a bomber and a long range reconnaissance aeroplane. For this purpose the bow and stern compartments would each have a gunner's cockpit.

The second and later version of this flying boat, known as the Do. 18F, has a larger wing, the span being 86 ft. 3 in., and is capable of carrying a greater load. With the same engine equipment as the original Do. 18, it gives a slightly lower performance, the top speed being 155 m.p.h. and the cruising speed 136.6 m.p.h. It can fly a greater distance non-stop, however, its larger tanks giving it a radius of 3,600 miles on one filling of petrol. It can climb to a height of 18,370 ft.

The latest type of Dornier flying boat is the Do 24, the first of which recently completed its trial flights. It has been developed for the East Indies station of the Netherlands Navy. The Do 24 is a triple-engined high wing monoplane flying boat, with a tapering hull that curves upward toward the stern and carries a wide twin-rudder tail unit.

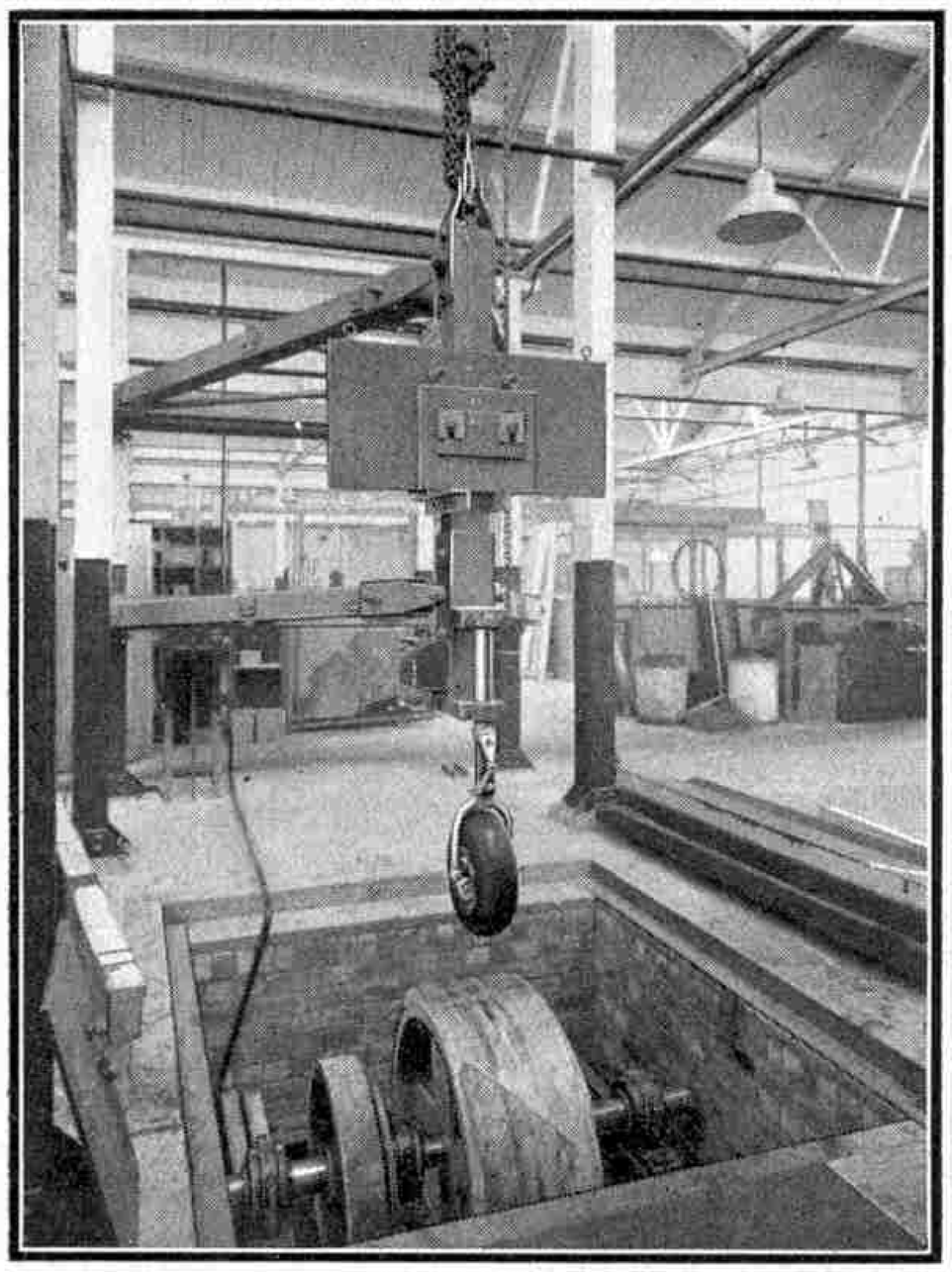


Testing Undercarriage Struts and Tyres

The illustration on this page shows an interesting test rig devised by Automotive Products Co. Ltd. for the purpose of testing the Lockheed "Airdraulic" undercarriage struts they manufacture. The rig is the only apparatus of its kind in this country. It is normally used for testing the behaviour of struts in landing conditions, the struts being dropped on a special platform fitted in the floor of the workshop.

The rig is also employed for testing the taxying qualities of the undercarriage wheel attached to the strut. For this purpose the platform is removed, revealing a large pulley mounted upon a horizontal shaft in a brick chamber below ground level. The wheel under test rests upon this pulley, which can be rotated to reproduce any required ground speed. Wooden cams are mounted on the pulley to represent inequalities in ground surface, and these cams are tapered sideways as well as fore and aft so that they impose both side and drag loads upon the tyre. The beam to which the strut carrying the wheel is attached is free to move up and down, and can be loaded to any desired weight, so that conditions met in actual practice can be reproduced for test purposes.

The rig is also used for endurance tests. Very severe conditions may be simulated for any required length of time, and subsequent examination of the component parts of the strut shows their wearing qualities and reveals any faults in design.



The rig in which Lockheed "Airdraulic" undercarriage struts are tested. The rig was devised by Automotive Products Co. Ltd., the makers of these struts, to whom we are indebted for our illustration.

A Scout Troop Air Patrol

Plymouth Airport, owned by the Whitney Straight Corporation, has a Scout Air Patrol formed from members of the 30th Plymouth Troop. This patrol has proved so successful that similar ones are to be organised at the Exeter, Ramsgate and Ipswich airports of the Corporation. Reliability and all-round proficiency are the chief qualifications of the scouts selected for the patrols, and the Corporation give them a thorough training to qualify them to help pilots and airport managers.

Isle of Man Air Race

A popular annual event in British civil aviation is the Isle of Man Air Race, introduced in 1935. The Manx Government have now decided to grant £500 each year toward the cost of the race. This sum has become available with the abandonment of the Manx Motor Car Races.

The King Visits Cranwell

The recent visit of the King to the R.A.F. Station at Cranwell was of special interest, as His Majesty was stationed there 20 years ago, when a junior officer in the R.A.F. He was then Prince Albert. On his recent visit he flew there from Bircham Newton in the Airspeed "Envoy" of the King's Flight, piloted by Wing Commander E. H. Fielden. After inspecting the Guard of Honour of Flight Cadets and the various aircraft lined up on the aerodrome, the King made a tour of the Station, during which he visited the workshops, flight sheds, and the R.A.F. College, and then lunched with the Cadets.

Sweden Buys Junkers Aircraft

The Swedish Government have acquired two Junkers Ju 34 monoplanes for the use of the Government Survey Department. The aeroplanes are equipped with Zeiss aerial photography compartments, and Swedish specialists are receiving tuition in the use of the apparatus from Zeiss experts.

Famous Aero Engine's Endurance Trials

The four-engined Empire flying boats of Imperial Airways are fitted with Bristol "Pegasus Xc" engines, which develop a total of 3,160 h.p. The prototype engine was built at the end of 1935, and recently completed 1,000 hrs. of test-bench running, the equivalent of 70 transatlantic crossings! After being submitted to an official type test, this engine has undergone four long-period endurance trials totalling 750 hrs., under very severe conditions. In addition 10 to 20 min. periods of maximum take-off conditions were included at intervals of about 10 hrs. No major replacements were necessary during the whole duration of the trials, and a notable feature was the small amount of servicing required by the engine.

Imperial Airways Schools

The steady expansion of Imperial Airways air routes and the increasing demand for highly-trained staff have made it necessary for the company to carry on several different systems of technical instruction. In one of the schools pilots are studying to qualify as First Class Navigators, and will sit for the necessary examinations this spring. In another pilots joining Imperial Airways direct from the R.A.F. or from various branches of commercial air work receive a specialised system of air-line training before taking up actual flying duties in the company's air liners. At Hamble, near Southampton, landplane pilots of long experience go back to school to learn how to handle marine-type aircraft, and there is also an instructional centre for engineers and other technicians.

D.H. "Albatross" Aircraft for Imperial Airways

Imperial Airways have placed an order with the de Havilland Aircraft Co. Ltd., for five D.H. "Albatross" air liners. They will be named *"Falcon," "Fingal," "Fiona," "Fortuna,"* and *"Frobisher"* respectively. The "Albatross" is a low wing, long range monoplane with streamlined fuselage. It has four 500/550 h.p. D.H. "Gipsy Twelve" supercharged engines.

The first of two "Albatross" monoplanes ordered by the Air Ministry has carried out several trial flights. No performance figures have been disclosed, but it is believed that the estimated cruising speed of 200 m.p.h. was considerably exceeded. It is anticipated that one of these machines will be entrusted to Imperial Airways for experimental flights across the North Atlantic this year.

Italian Creates World Seaplane Record

At the close of last year the world's distance record for seaplanes was gained for Italy by Sig. Mario Stoppani, who flew non-stop from Cadiz, in Spain, to Caravellas, a coastal town in Brazil, a distance of 4,349.8 miles. The machine used was a Cant Z.506B bomber seaplane fitted with three 770 h.p. Alfa-Romeo engines, and the flight was made in 26 hr. 15 min. Thus the average speed was 166 m.p.h.

Stoppani had made two previous attempts to obtain the record. On the first he took off from Elmas Airport, Sardinia, on 16th December for Buenos Aires, about 6,750 miles away, but bad weather forced him down off the coast of Algeria. The second effort was made from Cadiz, near Gibraltar, a few days before Christmas, but ended at Casablanca, in Morocco. Stoppani then returned to Cadiz for a third attempt, which proved successful. On these flights he was accompanied by a second pilot, radio operator, and mechanic.

The record was previously held by the big Latécoère six-engined flying boat *"Lieutenant de Vaisseau Paris."* In October 1937 this French aircraft flew non-stop from Kenitra, in French Morocco, to Maceio, in Brazil, covering the 3,612 miles in 36 hrs. M. Guillaumet was in command of the crew of six.

Another outstanding Italian achievement was a formation flight across the South Atlantic on 25th January by three Italian aircraft piloted by Lt. Bruno Mussolini, son of the Duce, Col. Biseo and Capt. Moscatelli respectively. The pilots took off from Rome on 24th January for Dakar, on the coast of French West Africa. They left Dakar next day and accomplished the 2,000-mile ocean flight to Port Natal, in Brazil, in about 8½ hrs. This was 2½ hrs. less than the time taken in November 1937 by the French airmen MM. Codos and Reine when they flew over this route in the course of a flight by stages from Paris to Santiago. Capt. Moscatelli landed at Port Natal owing to engine trouble, but Mussolini and Biseo continued non-stop to Rio de Janeiro.

Britain Gains World Speed Record

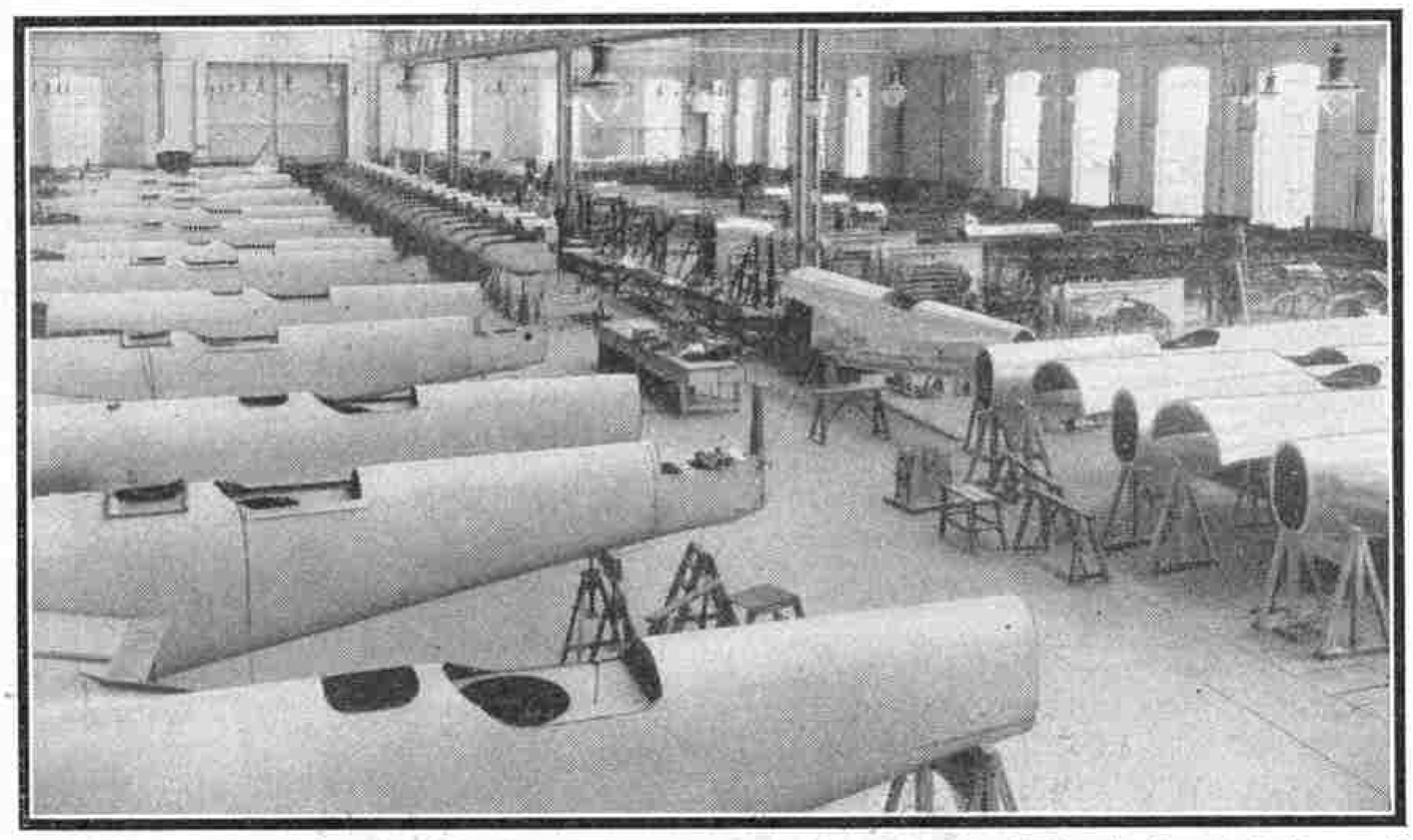
On 10th February last an R.A.F. Hawker "Hurricane" single-seater fighter flew from Turnhouse aerodrome, near Edinburgh, to Northolt, Middlesex, a distance of 327 miles, in 48 min., averaging 408.75 m.p.h. This is the highest speed ever attained by a landplane.

Trial Flights of First "Ensign" Air Liner

The first of the fleet of "Ensign" air liners being built by Sir W. G. Armstrong Whitworth Aircraft Ltd. for Imperial Airways made its first trial flight on 24th January last at Hamble aerodrome, near Southampton. The flight proved entirely successful from a technical standpoint, and the aircraft will now undergo further trials in regard to speed, loads, and endurance. For these tests the liner was flown to the Coventry aerodrome of the builders, and from there it will then pass into the hands of the Air Ministry for official tests at Martlesham Heath, before going into regular service on the Imperial Airways routes.

A total of 14 "Ensign" air liners are being built for the company, and some of them will be used on European routes and others on Empire services. Each will have a crew of five, and those for the European routes will carry 40 passengers in three large luxurious saloons. When carrying a full load of passengers, luggage, mails, freight, crew, and fuel the "Ensign" will weigh just over 20 tons. The air liners that will serve on Empire routes, involving long flights through tropical climates and the transport of larger quantities of mail, will carry 27 passengers by day and will have sleeping berths for 20 at night.

A description of the "Ensign" was published in the March 1937 *"M.M."* It is a high wing all-metal monoplane of 127 ft. span, and is fitted with four Armstrong Siddeley "Tiger IX" medium supercharged engines that give it a top speed of 200 m.p.h. and a cruising speed of 165 m.p.h. The landing gear can be drawn up when the air liner is in flight, and is operated hydraulically. The landing wheels are 6 ft. 6 in. in diameter. The latest form of radio equipment will be installed and an automatic pilot will be fitted.



Assembling Bristol "Blenheim" Bombers. The monocoque all-metal stressed-skin fuselage is built up of light alloy formers and stringers, over which a covering of sheet Alclad is riveted. Photograph by courtesy of The Bristol Aeroplane Co. Ltd.

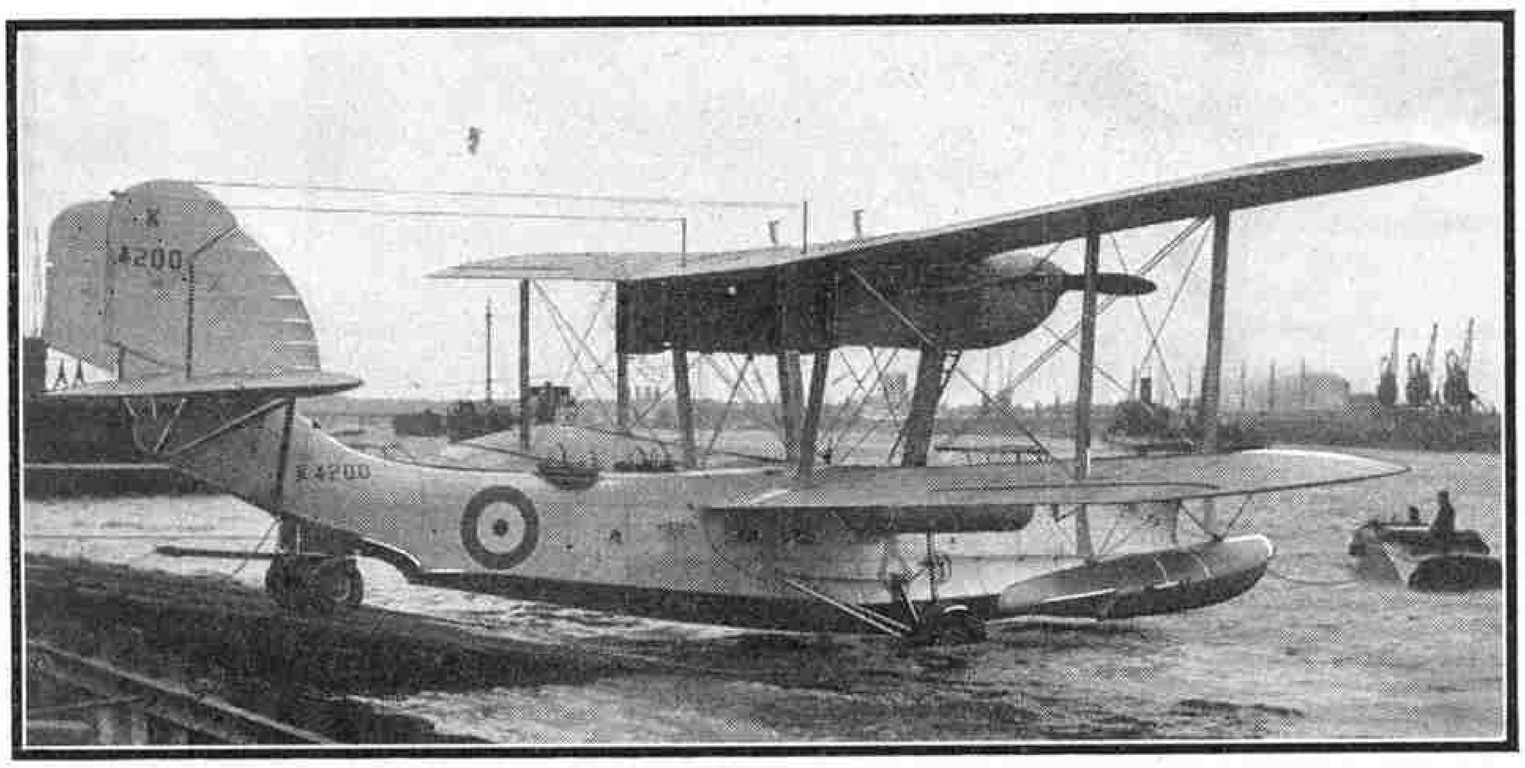
Flying Boat Passenger Fishes in the Nile

While the Imperial Airways flying boat *"Cassiopeia"* was refuelling recently at Malakal, in the Sudan, a lady passenger noticed a large fish swimming in the Nile. Obtaining some bread from the steward, she threw it to the fish. Afterwards, with a little coaxing, she got the fish alongside, and soon it was taking pieces of bread from her hand. The incident is vouched for by other passengers, and also by Captain Caspareuthus, the flying boat Commander.

A little later the same lady passenger, with tackle consisting of a piece of string and a pin, succeeded in less than 10 min. in catching and landing several large fish.

Refuelling *"Cambria"* in the Air

Some interesting experiments have been carried out at Hythe in refuelling an Empire flying boat in the air. An Armstrong Whitworth A.W.23 bomber piloted by Sir Alan Cobham has been used as the tanker. The Empire flying boat employed to receive the petrol was *"Cambria,"* one of the two long-range aircraft that carried out experimental flights across the North Atlantic last year, and usually she was piloted by Capt. Wilcockson. The A.W.23 flew higher than, but near to, *"Cambria,"* and the fuel passed from the tanks of the bomber into those of the flying boat through a flexible hose.



A Supermarine "Scapa" Flying Boat being launched for a test flight. It is an all-metal twin-engined aircraft, and is one of the types used by the R.A.F. for coastal reconnaissance. Photograph by courtesy of "Flight."

Success of Short-Mayo Composite Aircraft

The Short-Mayo Composite aircraft, which consists of a four-engined seaplane mounted upon the back of a four-engined flying boat, made history at Rochester last month when the seaplane was successfully launched in mid-air. The aircraft took off with the two components locked together, and when at a height of about 700 ft. the pilots pulled their release levers and the seaplane and flying boat at once separated, and both made safe landings.

FAMOUS ENGINEERS:

John Ericsson

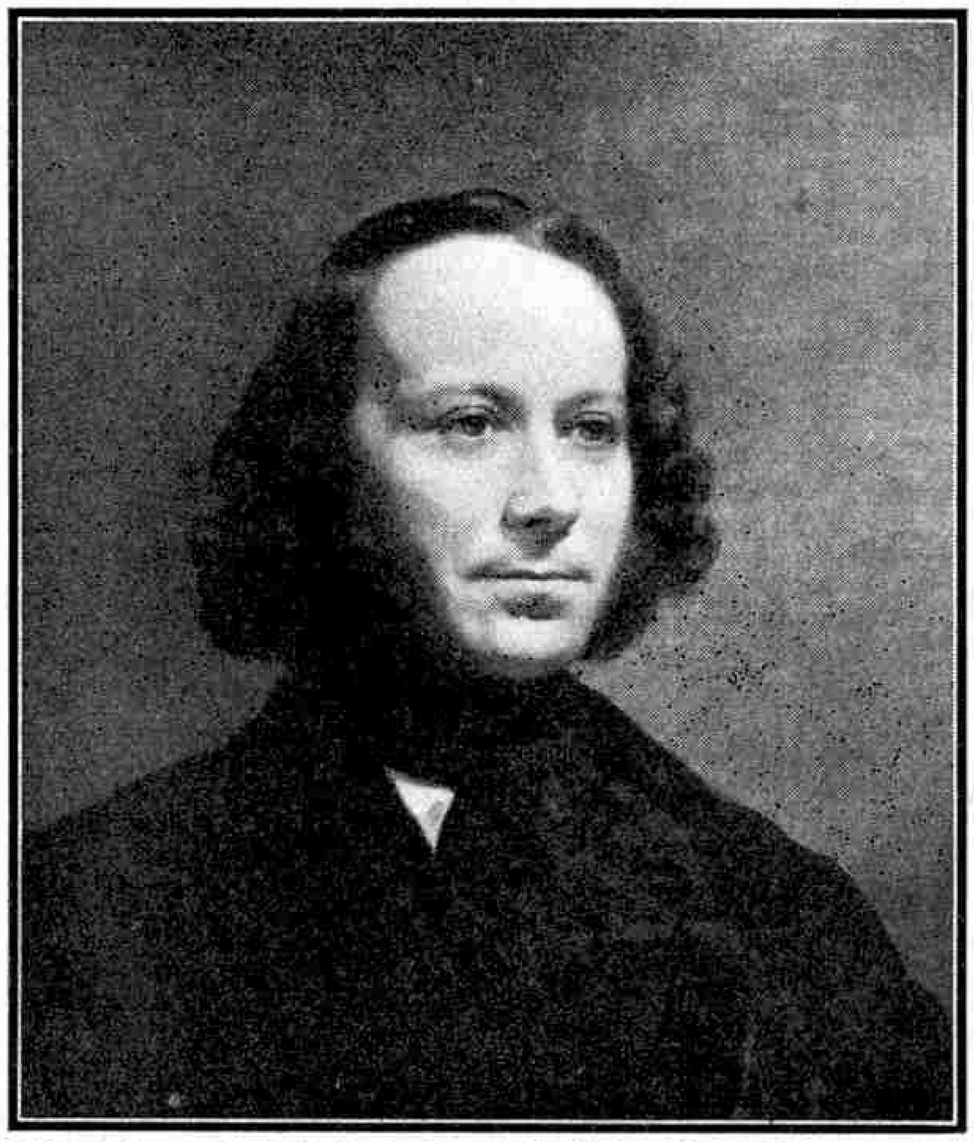
A Swedish Pioneer of the Steam Engine

ONE of the most interesting figures in the story of engineering is John Ericsson, the Swedish inventor, best known as the designer of the locomotive "*Novelty*," which in the Rainhill trials was surpassed only by George Stephenson's "*Rocket*," and of the "*Monitor*," the steel clad battleship that in the American Civil War won the famous battle against the "*Merrimac*," a Confederate ironclad.

Ericsson was born in the province of Vermland, Sweden, on 31st July, 1803. He showed an aptitude for mechanical matters from his earliest years. His father was employed in mining, and gained for the boy permission to visit the mines and examine the machines. There he would spend hours making drawings and constructing models with such crude instruments and materials as he could obtain. When only nine years of age he astonished his parents by making accurate working models of a sawmill, driven by a waterwheel, and a pumping engine, together with a set of drawing instruments, although the only tools he possessed were a jack-knife and a gimlet.

In 1811 the mines in which Ericsson's father was employed failed, and he became a foreman in charge of a gang of men then engaged in blasting rock on the line of the Göta Canal, which was being constructed across the south-western corner of the Scandinavian Peninsula. It is interesting to note that this enterprise was planned and directed by the great British canal builder Thomas Telford. There the boy made accurate scale drawings of the canal cuttings with the instruments he had constructed. These plans came to the notice of Count Platen, who was responsible for building the canal, and from that time he took a special interest in the work and progress of the brilliant youth.

In 1814 Ericsson became a cadet in the Swedish Corps of Mechanical Engineers. He received instruction in various subjects from senior officers of the Corps, and he picked up a knowledge of English by conversing with engineers employed upon the canal. He also obtained a thorough grounding in the drawing office of the Canal Company, and by the time he was 14 such confidence was placed in his ability that he was put in charge of a section of the excavation work, although he could not reach the eye-piece of his levelling instruments without the aid of a stool!



John Ericsson, 1803-1889, the famous Swedish engineer. From a portrait in the Science Museum, South Kensington, London.

In 1820 Ericsson gave up this work to join the Swedish Army as an ensign in a regiment of chasseurs, and soon made a name for himself as a soldier. He was strongly built and very athletic, and could endure the hardships of military service as well as the most experienced of his comrades. He became the champion of his regiment in wrestling, leaping and lifting. Many stories are told of his great physical strength. On one occasion he amazed his fellow officers by lifting without assistance a cannon weighing 600 lb. Such hard training proved very beneficial, and throughout the rest of his life he was noted for his vigour and endurance.

It was not only in physical feats, however, that Ericsson excelled, for he soon became known as an expert military draughtsman. His regiment was engaged to carry out a survey of the district in which it was stationed, and the men employed received payment in accordance with the amount of work they did. Ericsson worked so quickly and accurately that it was found necessary to enter him on the pay list under two names lest the amount he earned should arouse the jealousy of the other men! His ability soon gained for him promotion to the rank of second lieutenant.

Gradually Ericsson's interest began to turn more and more from his military duties to engineering matters. He now became absorbed with the idea of producing what he termed a "hot-air" or "flame" engine, in which the pistons were actuated directly by expanding air heated by the furnace. Thus he hoped to obtain power equal to that of the steam engine with less expenditure of time and fuel. After months of experiment he was successful in constructing a machine to illustrate this principle.

In 1826, while on leave from the army, Ericsson visited England and decided to stay in that country and to devote himself entirely to the development of his inventions. During his first few months there he tried to introduce his hot air engine, which he was confident would revolutionise the mechanical world. A demonstration was arranged, but when subjected to working tests, using coal in the furnace instead of wood, it proved unsuccessful. Ericsson therefore was compelled to turn to other work. He was fortunate to come into contact with John Braithwaite, a well-known British engineer and manufacturer of high pressure boilers, who was so greatly impressed by his ability that he took the young Swede into his firm as a junior partner.

Ericsson was now able to give full play to his creative power. The first of a huge number of inventions that he produced was a pumping engine in which there was a series of cisterns one above the other. The air was exhausted from each in succession, so that the water was raised to the height required by atmospheric pressure. In 1828 he constructed for the Truro Tin Mines in Cornwall an air compressor with a 20 in. cylinder and 5 ft. stroke. This operated a machine for raising water from a shaft at a considerable distance from the compressor unit. On this invention Ericsson based his later claim to priority in the use of compressed air for transmitting power.

Ericsson spent much time during his early years in England in the development of engines for steamships. This was then a promising field for the engineer, for steamships were steadily increasing in number in spite of the low efficiency of their engines. One great need was to quicken up the production of steam in their boilers. These were sluggish and wasteful of fuel, but Ericsson improved them by using bellows or centrifugal blowers worked by the engines to create a powerful artificial draught through the fire-box. He also introduced the use of boiler tubes, and his improved boiler of 1828 contained 20 of these, made of copper. Another of his inventions was a surface condenser that was claimed to be the first of the type that was really successful.

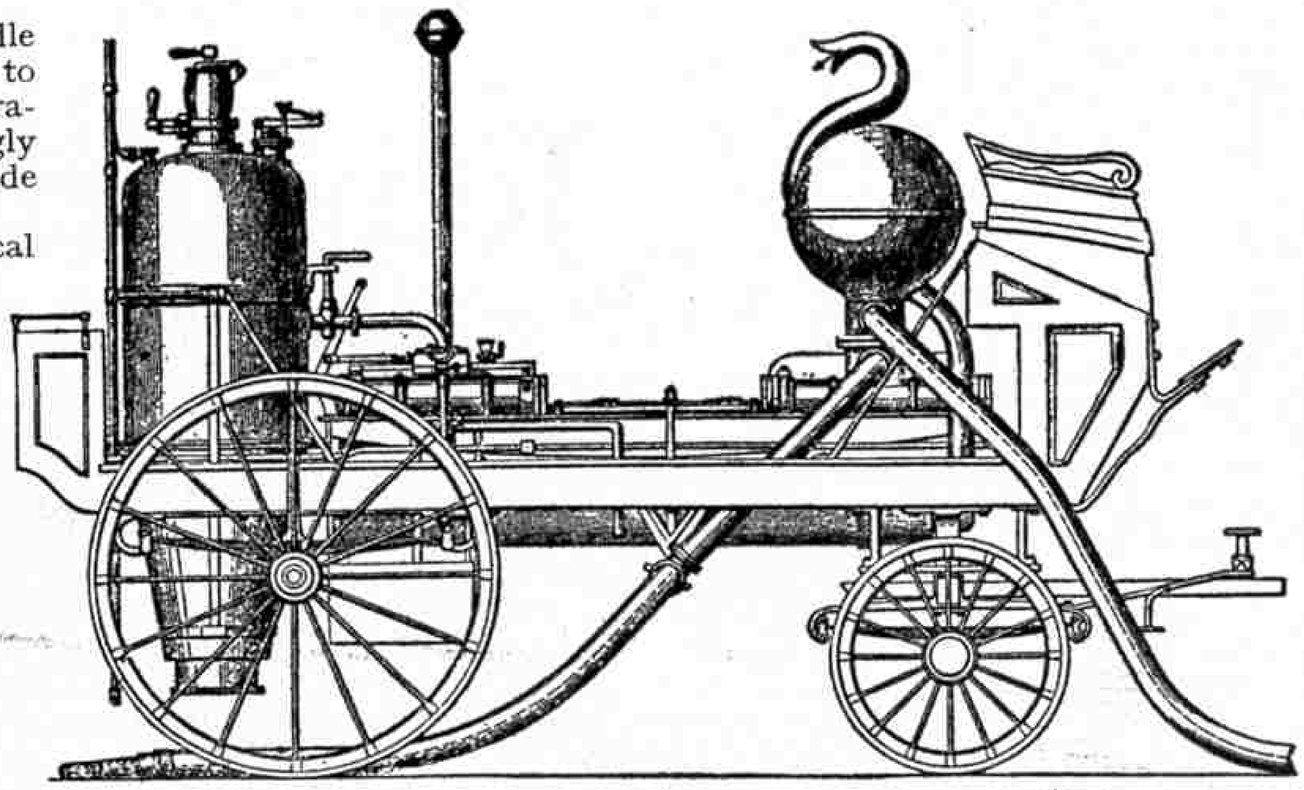
Through these improvements Ericsson became connected with Sir John Ross, the famous Polar explorer who was then about to start on his second Arctic expedition in the "*Victory*." This vessel was an old side-wheel steamship that was being fitted with new machinery. Ross was greatly impressed by Ericsson's boiler and ordered one for his vessel, with a marine engine of 80 h.p. Unfortunately the installation was by no means a success. The engine came adrift before the ship reached Woolwich. It was repaired, but failures continued and then the boiler began to leak, the water from it on one occasion putting out the fire. Trouble arose repeatedly, and it was a great relief to the crew when on reaching the Arctic the machinery was lifted out of the ship and dumped on the ice.

Ericsson asserted that the failure was due to the fact that he had been given no idea of the arduous conditions in which his machinery would work. Ross had concealed his intention of making an Arctic

voyage, and had provided unsuitable gearing and paddle boxes. Braithwaite and Ericsson learned of the purpose to which the "*Victory*" was to be put too late to make the alterations that they realised would be necessary, and strongly resented the charge of negligence that Sir John Ross made against them on his return.

In 1828 Braithwaite and Ericsson built the first practical fire engine from the young Swede's designs. At that time fires were fought by men equipped with hand engines that were little better than squirts, and were so inefficient that fires were always liable to spread rapidly and become great conflagrations. The new engine threw jets of water from 1 in. to 1¼ in. in diameter to great heights, thanks to the power derived from the use of a boiler with the new artificial draught system with which it was equipped.

The 1828 engine was an experimental model, and in the following year Ericsson completed a second, an illustration of which is reproduced on this page. This was mounted on a light frame and suspended on springs to enable it to run easily over rough roads. It quickly showed its powers during a great fire at the Argyle Rooms. The cold was so severe that the hand engines rushed to the scene quickly became frozen up and useless. Ericsson's engine pumped water continuously for five hours, however, throwing a steady stream that reached well up to the dome of the building. The engine was sent voluntarily, and in recognition of their services the men who worked it were given the magnificent sum of one sovereign by the insurance companies.

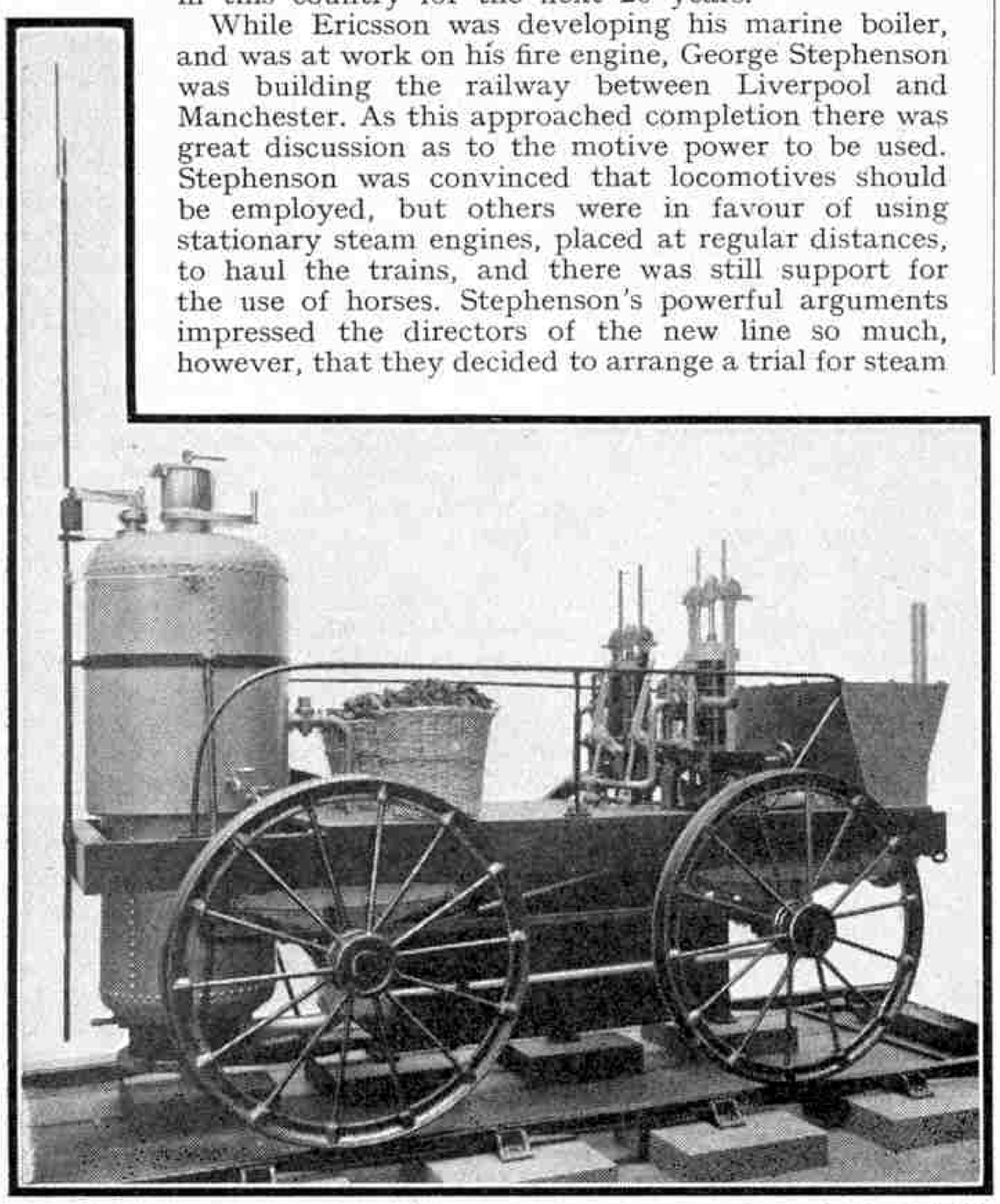


Ericsson's steam fire engine, built in 1829. This was remarkably effective and successful in practice, but opposition by London fire brigade managers led to its withdrawal.

Equally good service was rendered later at a fire at Barclay's Brewery. The owners of this were so greatly impressed by Ericsson's engine that they borrowed it and kept it at work day and night for a month pumping and starting the beer from the vats.

Ericsson's invention was not favourably received by fire brigade authorities. One of them said of it that it was "too powerful for hand use, too heavy for rapid travelling, and required larger supplies of water than could be obtained in London streets." It was also complained that the engine threw too much water, which itself caused damage. Braithwaite's "Steam Squirt," as it was derisively called, therefore remained unappreciated. It was allowed to show its powers without fee or reward at fires, but this voluntary work was soon given up, as the men of the fire brigades did all they could to hinder and annoy those in charge of it. Four more engines were built between 1829 and 1832, but they were so unpopular that no more steam fire engines were built in this country for the next 20 years.

While Ericsson was developing his marine boiler, and was at work on his fire engine, George Stephenson was building the railway between Liverpool and Manchester. As this approached completion there was great discussion as to the motive power to be used. Stephenson was convinced that locomotives should be employed, but others were in favour of using stationary steam engines, placed at regular distances, to haul the trains, and there was still support for the use of horses. Stephenson's powerful arguments impressed the directors of the new line so much, however, that they decided to arrange a trial for steam locomotives, and offered a prize of £500 for one that would satisfactorily perform certain tests. One of their requirements was that the engine should be capable of drawing a weight of 20 tons at the rate of 10 m.p.h. This speed was then regarded as impossible. and a government official of the day offered to breakfast on a stewed engine wheel if it could be achieved!



The "Novelty," the famous locomotive built by Ericsson that took part in the Rainhill trials. By courtesy of the Director of the Science Museum, South Kensington, London.

Five months were allowed for completing the engines for the official trials, which were held at Rainhill, a few miles east of Liverpool. George Stephenson entered the "*Rocket*," the joint production of himself and his son Robert, and the ultimate victor in the trials. Ericsson had never built a locomotive and did not learn of the competition until seven weeks before the contest, when he received a letter from a friend in Liverpool telling him that a "steam race" was expected to take place there. He immediately set to work, however, and in the short time available designed and constructed the "*Novelty*," which is illustrated on this page. This famous locomotive had a general resemblance to the fire engine that he had previously designed. In weight it came well within the limit of seven tons allowed by the conditions, weighing only 3 tons 1 cwt. against the 4 tons 5 cwt. of the "*Rocket*." The wheels were 4 ft. 2 in. in diameter. Forced draught was used in the boiler, a blowing machine worked by the engine itself forcing air into the fire-box, into which coke was fed from a hopper at the top. The two cylinders were vertical, with a diameter of 6 in. and a stroke of 12 in.

The "*Novelty*" was the first locomotive to have a cranked axle. The "*Rocket*," its principal rival at Rainhill, and other locomotives of that time had connecting rods driving directly on the wheels. Another novel feature of Ericsson's engine was that the water tank and fuel supplies were carried on the same frame as the boiler and engine. Thus the "*Novelty*" had no tender and therefore may be regarded as the forerunner of the modern tank engine.

The trial stretch was only two miles in length, and each engine had to make 20 journeys over it at a speed of 10 m.p.h. The "*Rocket*" was ready first and performed the experimental trip satisfactorily. Then the "*Novelty*" came out. This was the favourite with the spectators, and it created a great surprise by shooting along the line without a load at the amazing speed of 30 m.p.h. and thus presenting, in the words of "*The Times*" of 8th October, 1829, "one of the most sublime spectacles of human ingenuity and human daring the world ever beheld."

On the second day the "*Novelty*" showed itself to be equally good in drawing a load, and a few days later started on its final trial. With the specified load behind it the engine completed two trips along the trial stretch at great speed, but on its third run it broke down owing to the bursting of a pipe.

The "*Novelty*" was withdrawn, but had demonstrated its powers in unmistakable fashion. It startled even Robert Stephenson, in spite of that famous engineer's experience, when it shot past the "*Rocket*" at high speed. Its defects were not due to design. In this respect it was at least equal to the "*Rocket*," and probably was superior; and its failure must be ascribed to the haste with which it was built, and the lack of experience of locomotive work of its designer and builder. If the workmanship of the "*Novelty*" had been as strong as the design was original, Ericsson probably would have won the prize.

Ericsson was very disappointed at the result of the trial, and after it he again turned his attention to marine engineering. In this sphere he was to achieve great triumphs in Great Britain and the United States, and how he did so will be explained next month.

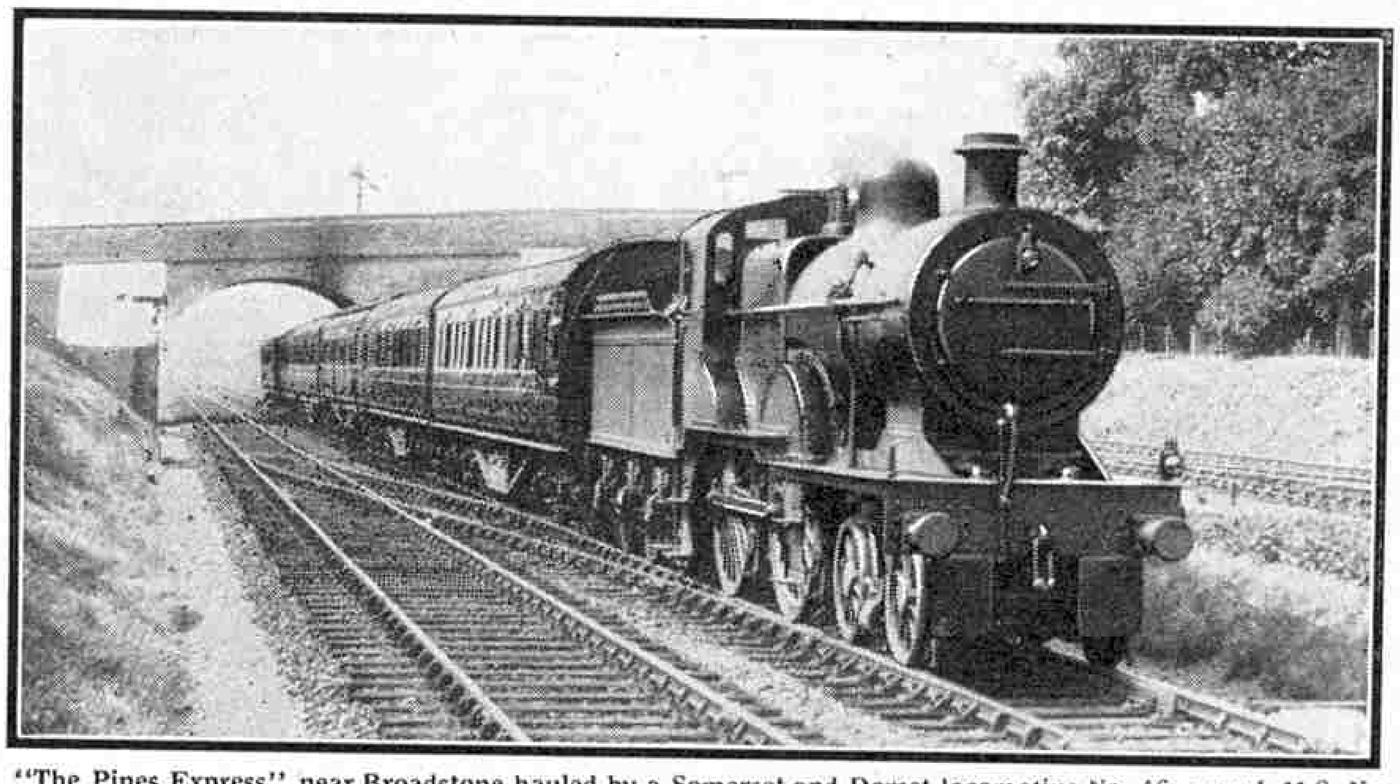
North to West by "*The Pines Express*"

Somerset and Dorset Joint Railway

By D. S. Barrie

A TRAIN which in the course of less than one hundred miles of its journey crosses or runs over every main line railway from London to the West of England, a train which, little more than a hundred miles from the metropolis, travels over a route so mountainous that it reminds the passenger of the Highland or Callander and Oban lines. Such is "*The Pines Express*," which, in providing an all-the-year-round express service between Manchester, Liverpool, the Midlands and the famous South Coast resort of Bournemouth, affords also the principal express service over the Somerset and Dorset Joint line between Bath and Bournemouth.

Until the railway amalgamations of 1923, the Somerset and Dorset Railway was operated independently on behalf of the two owning companies, the Midland and the London and South Western, by a Joint Committee; and during this period the locomotives and coaches—the former showing obvious evidence of Midland influence, many being actually designed and built at Derby—bore a distinctive blue livery. In 1923, however, Parliamentary powers were granted for the dissolution of the Somerset and Dorset Railway and for its vesting in the L.M.S. and Southern Railways jointly; while seven years later the L.M.S. became responsible for the whole of the operating and commercial work of the railway, while the Southern Company undertook the maintenance of the way and works. The locomotives were taken over entirely by the L.M.S. and allotted L.M.S. running numbers (some of the older engines being immediately broken up), while the rolling stock was apportioned between the two companies. Generally speaking, the coaches for the through services are provided by the L.M.S., and those for the local passenger trains by the Southern Railway.



"The Pines Express" near Broadstone hauled by a Somerset and Dorset locomotive No. 46, now L.M.S. No. 635. The unusual headcode for an express train is a feature of practice on the Somerset and Dorset line.

No better idea of the remarkable nature of the Somerset and Dorset line and its attendant operating difficulties could be obtained than by making a trip over the line with "*The Pines Express*," especially if the observer were permitted to ride on the footplate, whence the sinuous curves and mountainous gradients are more markedly appreciated.

Bath L.M.S. station, where "*The Pines Express*" has to reverse in each direction owing to the junction with the Somerset and Dorset line facing west, has only two platforms, and this adds considerably to the operating difficulties at busy periods such as an August weekend. At such times not only is "*The Pines*" itself running in five or six sections, each double-headed for the climb over the Mendips, but numerous relief trains are run to and from the Midlands. In the winter, however, the normal train of six coaches, weighing from 190 to 200 tons tare, is just within the permitted capacity of the Standard Class 2P 4–4–0s—an L.M.S. design of Midland origin—which are booked to work the train. The Class 2s have 6 ft. 9 in. coupled wheels, two inside cylinders 19 in. by 26 in. and a tractive effort of 17,729 lb.

At present these engines, together with the Standard 0–6–0s of Class 4F, work all the express and much of the local passenger traffic, although with the forthcoming completion of a programme of bridge-strengthening between Mangotsfield and Bath, it is expected that the Mixed Traffic 4–6–0s of Class 5P5F, now almost ubiquitous on the L.M.S. system, will before long be available for the Somerset and Dorset section. They will be able to take considerably greater train loads without assistance than the 200 tons allowed to the Class 2s over the steepest section.

Leaving Bath for Bournemouth, "*The Pines Express*" at once crosses the Avon by a substantial bridge at the platform ends, passes the engine sheds on the right, and half-a-mile out at Bath Junction speed is reduced as the train leaves L.M.S. metals for the Somerset and Dorset proper, the direction of travel being changed from west to south. For the initial 4½ miles to Midford the track is single (between Bath and Broadstone Junction 23½ out of 63¾ miles are so operated), and the observant traveller will note the apparatus fitted on the side of the engine cab for exchanging the single-line tokens with suitable ground apparatus, thus obviating the severe reduction of speed that would be necessary if the tokens were exchanged manually between engineman and signalman. The type of apparatus used on the Somerset and Dorset is the "Whitaker," so named after its inventor, Mr. A. Whitaker, a former Locomotive Superintendent of the Somerset and Dorset, and whose son, Mr. A. H. Whitaker, is the present L.M.S. District Locomotive Superintendent at Bristol.

The traveller is not left long in doubt as to the mountainous character of the Somerset and Dorset route, for the line at once begins to rise at 1 in 50 and continues almost without a break at this inclination for two miles through Devonshire Tunnel, 400 yds. long, to the northern portal of the Coombe Down Tunnel, 1,829 yds. long, named after the hill through which it bores. Before the first tunnel, the line crosses over the G.W.R. main line to Bristol, not far west of the G.W.R. Bath station. Near Yate, between Gloucester and Bath, the train has previously passed under the G.W.R. Badminton route to Bristol and South Wales. As the train pants up to Coombe Down Tunnel, the speed with a full load will fall below 20 m.p.h., but once inside the tunnel, where the rail level is as much as 299 ft. below the surface, the gradient changes, and by the time we emerge we are doing a full 60 before passing through Midford, the initial 4½ miles to this place taking some 10 minutes.

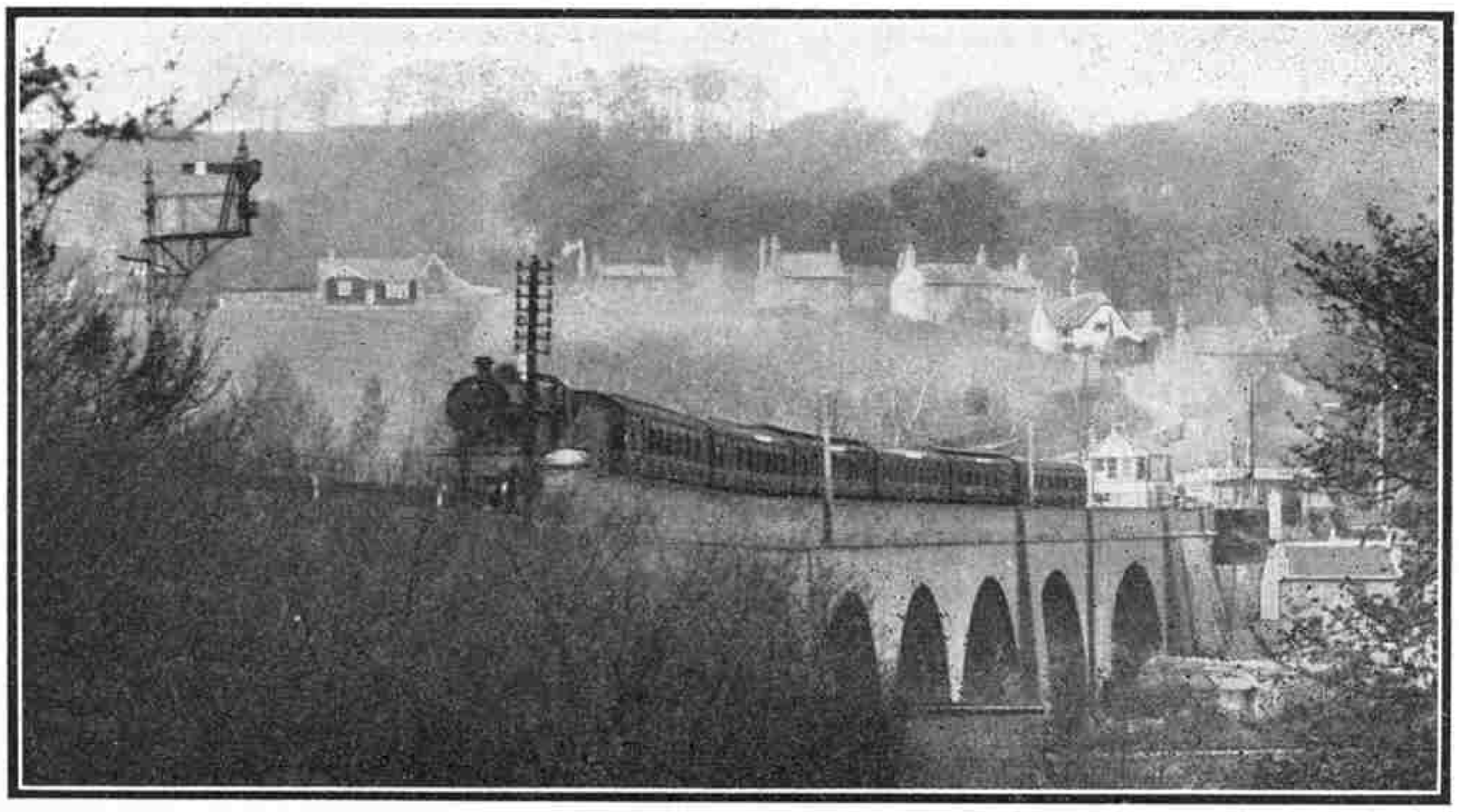
At Midford, where double-line is resumed, the token is delivered swifter than the eye can follow, and we roar across a viaduct over the valley through which runs the single-line G.W.R. goods branch from Limpley Stoke to Camerton. At Midford the line is within a few hundred yards of the western border of Wiltshire. The next 6½ miles over sharply undulating gradients to Radstock follow the course of a well-wooded valley; for part of this stretch the railway adheres closely to the track of a very old horse-tramway built to connect the canal at Midford with the Radstock collieries. Near the lovely village of Wellow, its houses built of that mellow and enduring Somerset stone, we descry on the left a bit of the old tramway cutting and what looks like an old weighbridge-house, now derelict. Notice here, too, a Somerset and Dorset signal-post made out of a discarded length of rail—economical if not ornamental!

Strangely black and incongruous among these timbered hills, coal-pits with their sidings filled with wagons appear on the left, a little narrow-gauge engine puffing merrily along with a long string of trams; and the sound of brakes indicates that we are slackening speed for Radstock, Somerset's colliery town. Here the L.M.S. have an engine-shed at which we may see one, or perhaps both, of the two small 0–4–0 Sentinel locomotives that are used for shunting colliery traffic; their boilers and cabs are cut low down, for they have to pass under a very low arch. Here too we may see a heavy freight train waiting to follow us over the Mendips, a giant 2–8–0 engine at its head, and a small Class 3F 0–6–0 tank ready to bank in rear up to Masbury Summit. The Somerset and Dorset Railway had 11 of these big 2–8–0s, with two cylinders 21 in. by 28 in., coupled wheels 4 ft. 7½ in. in diameter, and with a tractive force of nearly 36,000 lb. They were specially designed for the heavy gradients, and have

been retained in this work by the L.M.S., which have numbered them 13800–13810.

It is a pity the train has to slow down so much through Radstock's curved station, for there is no chance to regain speed before we tackle the almost terrifying ascent of the Mendips proper. This ascent is 7½ miles long, and except for a few short breaks of slightly easier going it is 1 in 50 or thereabouts all the way to the summit level, 811 ft. above sea, at Mile Post 17¾ before Masbury.

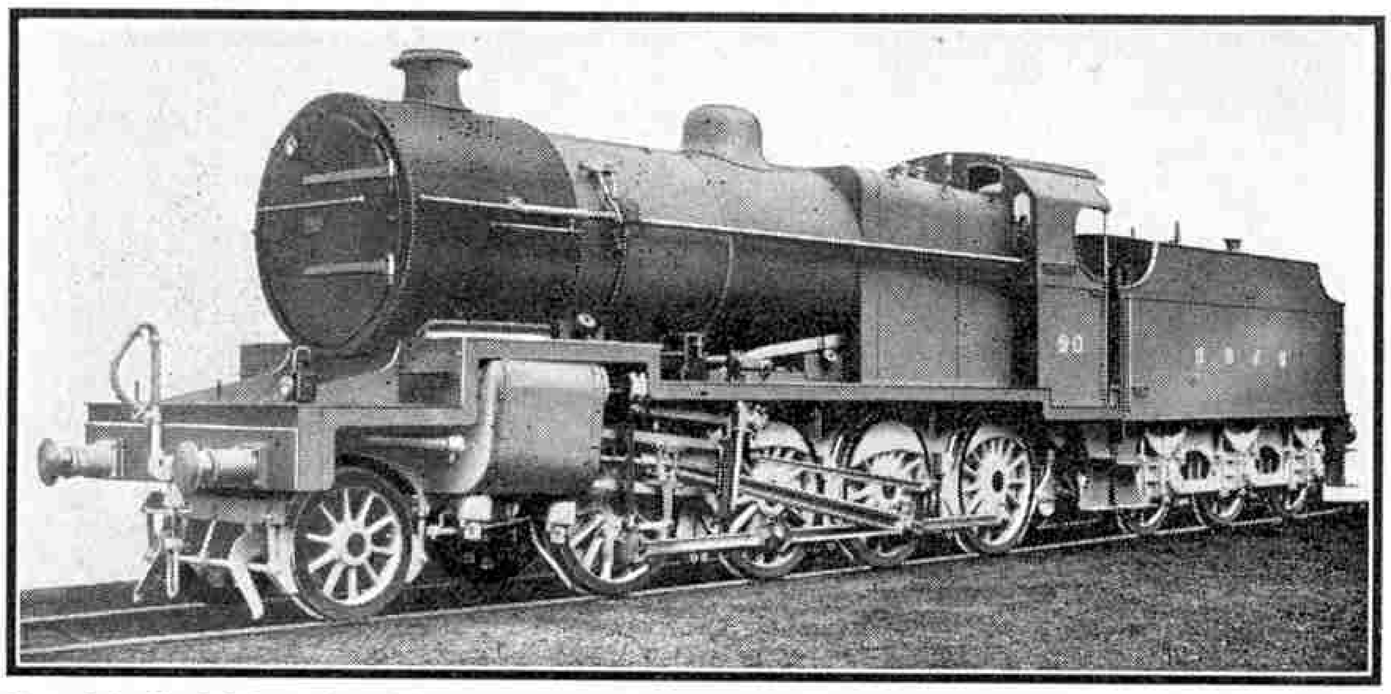
We start this terrific climb at about 30 m.p.h., and the driver is lucky as well as efficient if the speed has not fallen below 20 when we breast the top. Leaving Radstock we cross another G.W.R. branch, from Bristol to Frome, and go straight up into the bleakness of the Mendips. Near Midsomer Norton we leave the last of the coal-pits, and with hammering exhaust go on past Chilcompton to Moorewood Siding, where extensive quarries remind us of the fine quality of the stone won from these barren hills. Through Binegar (a quaintly named station which as a schoolboy I always thought was "Vinegar"!), and we are on the formidable last lap, over a mile rising at 1 in 63–73, ere we cross the crest of the Mendips just above Masbury. Incidentally Binegar is only a few miles from Wells by road, but by rail it is over 25 miles!



"The Pines Express" crossing Midford Viaduct, soon after its departure from Bath. This photograph gives some indication of the picturesque nature of the district. The photographs on this page are by courtesy of the L.M.S.

Apart from the severity of the climb from the point of view of gradients, this stretch of line is terribly difficult to work because of its exposed nature, the line for miles being wide open to the gales that in winter come sweeping off the Bristol Channel not so many miles away. Hard though the ascent is from Radstock to Masbury, however, it is even more difficult in the northbound or "Up" direction the ascent of 7¾ miles from Evercreech Junction to Masbury including 5½ miles at 1 in 50. In the "Down" direction we have taken about 39 minutes for the 18¾ miles from Bath to Masbury, the last 8 miles from Radstock to Masbury having taken nearly 20 minutes, although more than once I have known several minutes to be saved on the climb.

Down the southern slope of the Mendips the train cannot be allowed to career at full speed owing to the curves, and about 60 m.p.h. is our maximum, with repeated careful brake applications. More big quarries at Winsor Hill, where the "Up" and "Down" lines pass through separate short tunnels, and at Downside, precede a fast passage to Shepton Mallet, a scattered but not unpicturesque stone town lying well below the railway; it is served also by a branch of the G.W.R. from Yatton to Witham.



One of the big 2-8-0 engines designed at Derby for coal traffic on the Somerset and Dorset system. No. 90 in this photograph was built in 1925 and is now L.M.S. No. 13810.

A final drop of three miles at 1 in 50 brings us to Evercreech, a Somerset village famous for the architecture of its church. This little farming centre is served by two stations, New, which *"The Pines Express"* passes without stopping, and Evercreech Junction. As we slow to stop at the latter station we notice a branch line coming in on the right, with fairly extensive traffic yards in which several more big 2–8–0s can be seen at work. This line is the Somerset and Dorset's principal branch, and extends for 24 miles through Glastonbury and Highbridge to the Somerset coast resort of Burnham-on-Sea, with two short branches, 5½ and 7¼ miles in length respectively, from Glastonbury to the famous cathedral city of Wells, and from Edington Junction to Bridgwater. This lengthy offshoot is single-track and subject to a maximum speed restriction of 40 m.p.h. throughout; it is level nearly all the way except for a steep bank of four miles between West Pennard and Pylle.

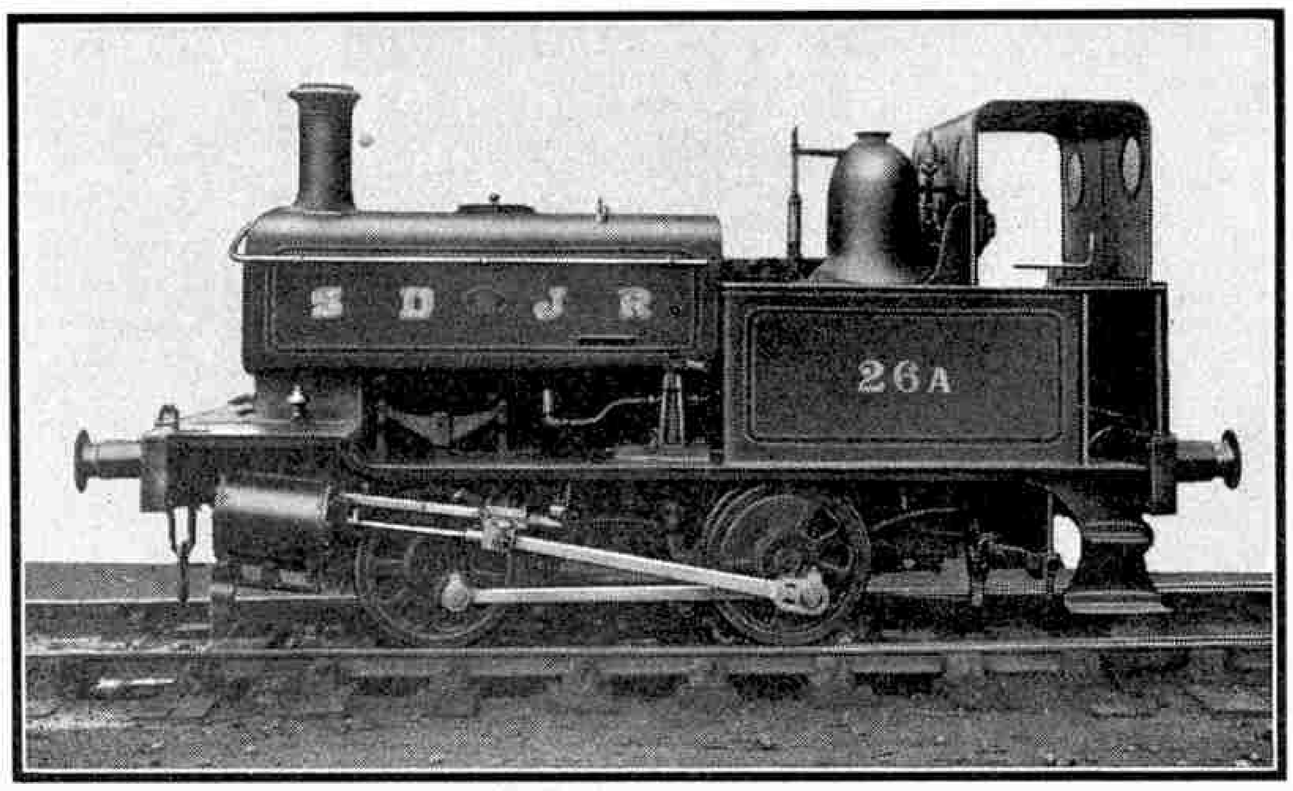
In its independent days the Somerset and Dorset maintained at Highbridge extensive workshops, now closed, for the repair of its engines and rolling-stock, and one or two small tank engines were actually built there. Highbridge has an engine-shed, accommodating mostly 0–6–0 tender and 0–4–4 passenger tank engines, but a novel feature of the layout there is the crossing of the old Bristol and Exeter main line, now the Bristol-Taunton section of the G.W.R., on the level and almost at right angles. This crossing is close to the platform end.

On its journey south, *"The Pines Express"* has taken about 50 minutes to cover the 26½ miles from Bath to Evercreech Junction, not bad going in relation to the heavy gradients, many service slacks and limited engine power. The next stage of 10¾ miles to Templecombe, over sharply undulating grades, takes about 15 minutes; the country is rolling and wooded, very pleasant to the eye, with one fairly important country town, Wincanton, where a considerable milk traffic is dealt with. Near Cole, the station for Bruton School, the Somerset and Dorset crosses over the Reading-Westbury-Taunton line of the G.W.R., and if we are lucky we shall see a "King" or a "Castle" in full cry for the Cornish Riviera. About 70 years ago formation for a connecting spur was laid in between the Somerset and Dorset and Great Western railways, and its derelict embankment may be seen on the right of the line. The earthworks were made, but no junction was effected.

Templecombe, where *"The Pines Express"* makes a brief halt, is the junction with the Southern (ex L. and S.W.) main line from Waterloo and Salisbury to Exeter, and the layout of the lines here is very curious. To reach the north face of the "Up" island platform, the only platform used by Somerset and Dorset trains, the latter leave the main line at Templecombe No. 2 Junction and run up a short spur, the main Somerset and Dorset line passing underneath the Southern at right-angles. While station duties are being performed, a second engine backs on to the rear of *"The Pines Express"* and when the "right away" is given this engine hauls the train back on to the main line at No. 2 Junction, the train engine being still attached at the other end. The pilot engine is then detached from the rear of the train, which proceeds on its journey. This complex manœuvre has to be performed with all through trains except the "Up" *"Pines Express,"* which does not stop, and one other train, which sets down passengers at a "halt" known as Templecombe Lower Platform. During the winter the 11.40 a.m. express from Bournemouth stops at Templecombe No. 2 Junction and detaches a coach which is taken to the Upper station by another engine.

At Templecombe the Somerset and Dorset has, besides fairly

extensive sidings for freight traffic, an engine-shed, populated mainly by 0–6–0 freight engines of Somerset and Dorset type but Midland design. Southward the line is now single-track and as the passing-loops are laid out with the straight run for "Up" trains, "Down" trains have to slacken speed severely at each station. Thus the 16 miles from Templecombe to Blandford, through typical and pleasing Dorset scenery of green, rolling hills, takes fully 24 minutes. Soon after leaving Templecombe, at the County Bridge between Henstridge and Stalbridge stations, the train passes from Somerset into Dorset. From Blandford the line is double for 8 miles to Corfe Mullen Junction where a single line turns away towards Wimborne, the original terminus of the old Dorset Central Railway. The single line branch to Wimborne, where formerly the Joint line had an engine shed, was closed a few years ago, and now runs as a siding to a claypit a short distance from Corfe Mullen Junction.



A Somerset and Dorset veteran once used for shunting in the colliery yards at Radstock. This and a sister engine were built at Highbridge works. Photograph by courtesy of the L.M.S.

Until 1886 all through trains to and from Bournemouth had to go into Wimborne and reverse there (in the case of through trains calling at Templecombe, their third reversal since arriving at Bath, in little more than 60 miles!), but in 1886 a cut-off line, very steeply graded, was built over the three miles from Corfe Mullen Junction to Broadstone, where the Somerset and Dorset tracks terminate and *"The Pines Express"* passes on to the Salisbury-Bournemouth line of the former L.S.W.R. Here we see the pinewoods for which this part of the world is famous, and from which our train takes its picturesque name. But although the Somerset and Dorset line has been left behind, not so the steep gradients, for after running through Broadstone very carefully there is a two-mile drop at 1 in 75 down to Holes Bay Junction, where the train passes on to the Weymouth-Bournemouth line of the Southern. On this final descent we shall perhaps touch 65 miles an hour, a similar speed having probably been reached between Blandford and Corfe Mullen; two service slacks included, the 14¼ miles from Blandford to Poole take less than 23 minutes.

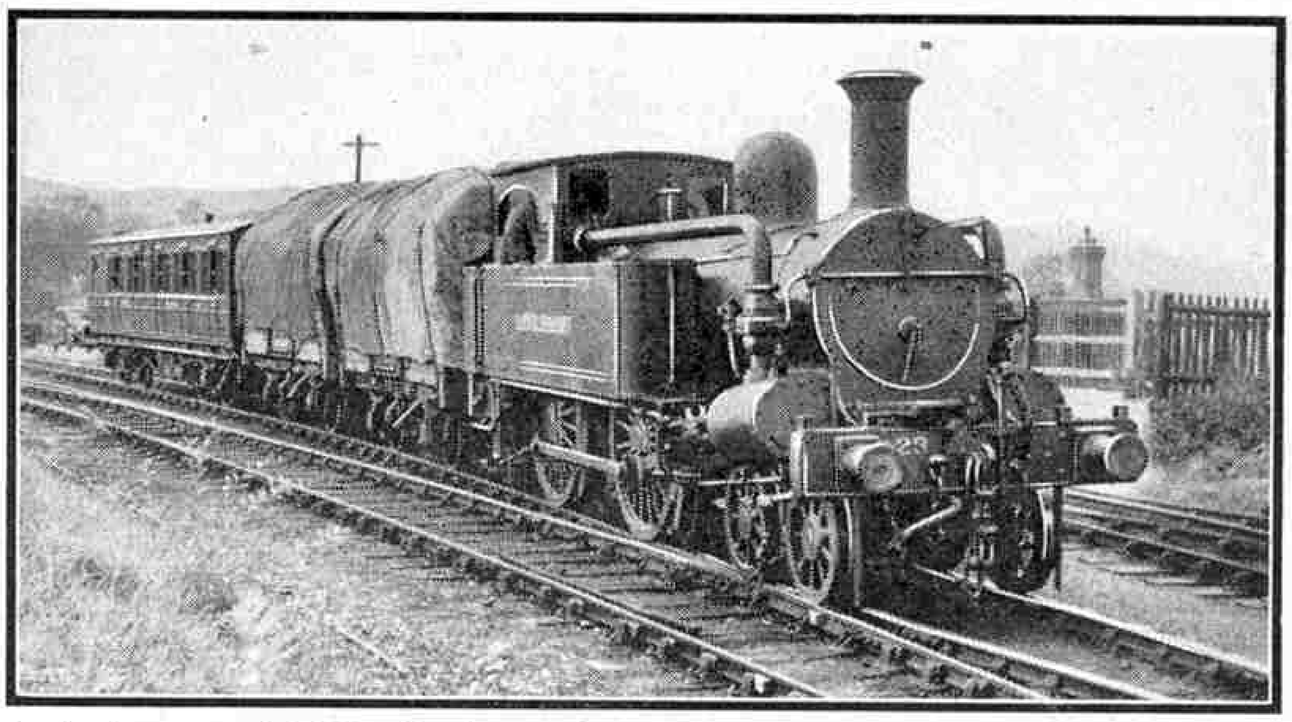
After stopping at Poole, the train runs for some little distance on a breakwater dividing the wide sweep of Poole Harbour from a marine lake, while the climbing is not finished yet, for a two-mile ascent through suburban Parkstone to Branksome yields some 1 in 50 and 1 in 60. Beyond Branksome, just before the train runs into Bournemouth West station, will be seen on the left the engine-shed which accommodates the few engines required to be stabled at this end of the line.

It is a fitting conclusion to a 2¼-hour journey through some of the loveliest scenery in the West of England, and over some of the severest main line gradients in the country, to reflect that we have just passed the most southerly engine-shed on the far-flung L.M.S. system—just about 800 miles away from the most northerly shed, at Thurso in far Caithness!

An Old London Tank Engine

THE London Passenger Transport Board recently transferred 18 of their steam locomotives to the service of the L.N.E.R. They retained some of their older engines, however, among them No. 23, a veteran of 70 years and the only survivor of the old Metropolitan "A" class working on London Transport metals. The accompanying illustration, taken in September 1935, shows No. 23 on the 3.7 p.m. "Mixed" from Brill to Quainton Road. The Brill branch has since been closed, and the engine is now confined to the working of occasional ballast trains from Lillie Bridge Depot.

This type of engine was first introduced in 1863 by Beyer, Peacock and Co. Ltd., to the designs of Mr. John Fowler, who subsequently became Sir John Fowler. Altogether 65 were constructed, and between them they worked the greater part of the suburban passenger services of the old Metropolitan Railway. It seems strange that these engines, with their large driving wheels, should have been designed to work London suburban services, where frequent stops were necessary. Yet it is interesting to note that the old Metropolitan District line also had engines of this same characteristic design, but with minor alterations. Other railways too obtained engines of this kind to work services in the London area, partly over Metropolitan metals. Thus both the L.N.W.R. and the Midland had a few of them, the L.N.W.R. ones working from Broad Street to Mansion House and the Midland ones between Hendon and Moorgate. The L.S.W.R. had some similar engines, and the old North London Railway also relied upon 4–4–0 tanks, but of its own design, for its suburban services.


London Transport 4-4-0 No. 23, about to leave Brill on a "mixed" train. The large condensing pipes referred to in this article are prominent fittings. Photograph by S. H. Pearce Higgins, Bath.

From the illustration it will be seen that No. 23 still retains the old condensing pipes. From the first these engines had exhaust pipes passing upward from the cylinders. These widened out into chambers housing flap valves, so that the exhaust steam might be diverted by means of large-diameter pipes, seen in the illustration, into the side tanks, where it was condensed by the cold feed-water. This condensing was necessitated by one of the statutary conditions imposed on the Metropolitan Railway, which stated that the locomotives should emit no vapour or smoke in the tunnels, so that the atmosphere could be kept as clear as possible. If desired the exhaust steam could be turned up the chimney in the usual way by manipulation of the flap valves, as would be done when working in the open.

The fitting of a cab was not the order of the day when the earliest of these engines were built, and the crew were then protected only by a plain weather board. It is evident that the Victorian drivers were a hardy race!

Although No. 23 is the last survivor working in London there is another of these engines in existence, strangely enough in the service of another electric line, the Mersey Railway, by which it was acquired in 1925. Before coming North it had been rebuilt several times by the Metropolitan Railway, the last occasion being 1921. The boiler is not of the original design, and a new chimney has been fitted. It is still unmistakably one of the "old timers," however, with its small boiler, narrow cab and generally antique air.

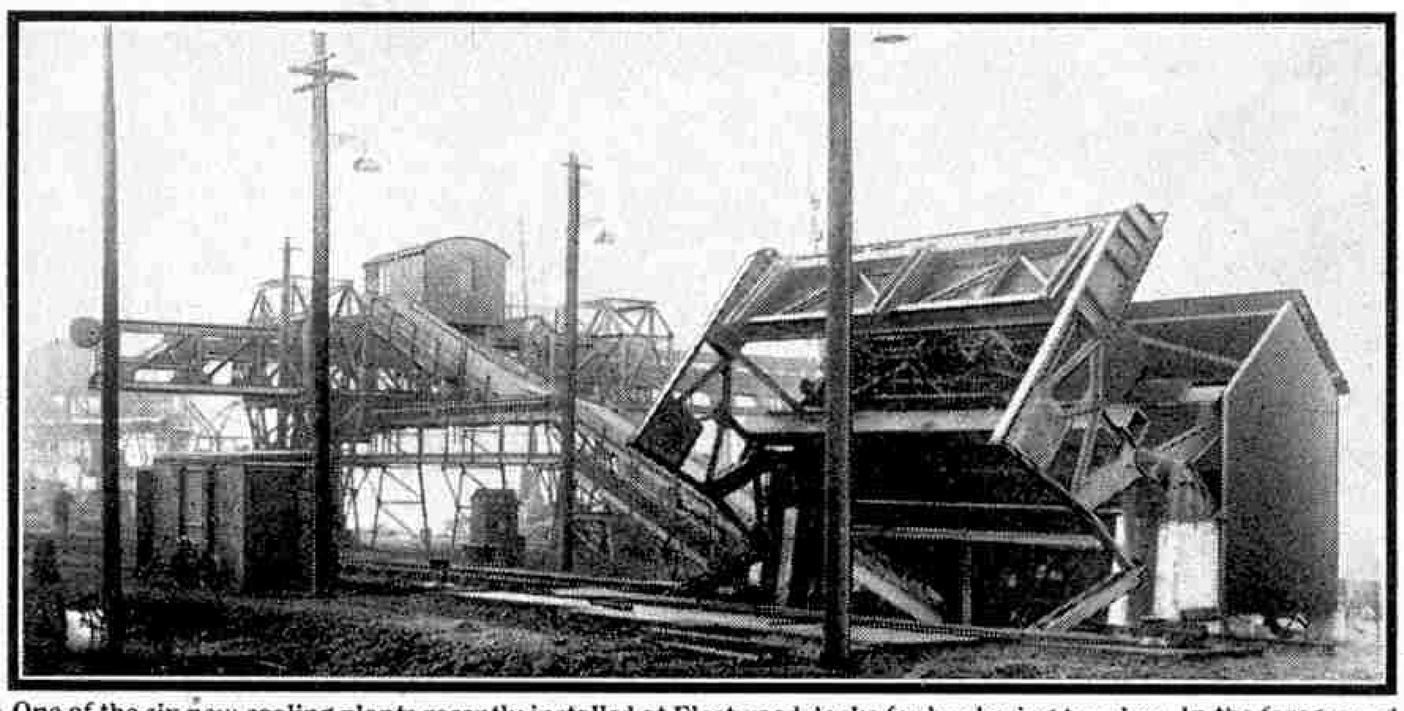
This survivor is now known as Mersey Railway No. 2, and its work is now confined chiefly to ballast trains. It is also used when track repairs are in progress, and so works in the Mersey Railway tunnels, although the old condensing apparatus has been removed from the engine. This engine was illustrated in the *"M.M."* in August 1934.

Coaling the Fleetwood Trawlers

A Fine New Bunkering Plant

FLEETWOOD, on Morecambe Bay, is the leading fishing port on the west coast of England and the third in order of importance in the United Kingdom. The docks are owned by the L.M.S., and nearly 150 steam fishing vessels operate from them, discharging their catches for despatch to inland centres and re-filling their bunkers with coal and taking in other supplies in preparation for further trips.

In the course of a year the Fleetwood trawlers require more than 380,000 tons of bunker coal. Until recently the plant by which they were supplied consisted of three electric traverse cranes, each fitted with buckets having a capacity of 25 cwt. The buckets had to be filled by hand from railway wagons, however, and this process proved too slow for modern requirements. The L.M.S. Railway Company therefore decided to erect an entirely new coaling plant, and to carry out other important improvements in the dock area with the object of bringing the equipment of the port into line with modern requirements.



One of the six new coaling plants recently installed at Fleetwood docks for bunkering trawlers. In the foreground is the wagon tippler, and beyond it is the travelling gantry that extends outwards from the quay. For our illustration we are indebted to Mitchell Engineering Ltd., London.

Part of the new coaling installation is shown in the illustrations on this page. The complete plant consists of six independent electrically-operated belt-conveyor units, each of which is capable of coaling trawlers at the rate of 200 tons an hour. Three of the units are situated on the Fish Dock Quay and the remaining three at the Wyre Dock, an older basin about 10 acres in extent through which the Fish Dock is approached.

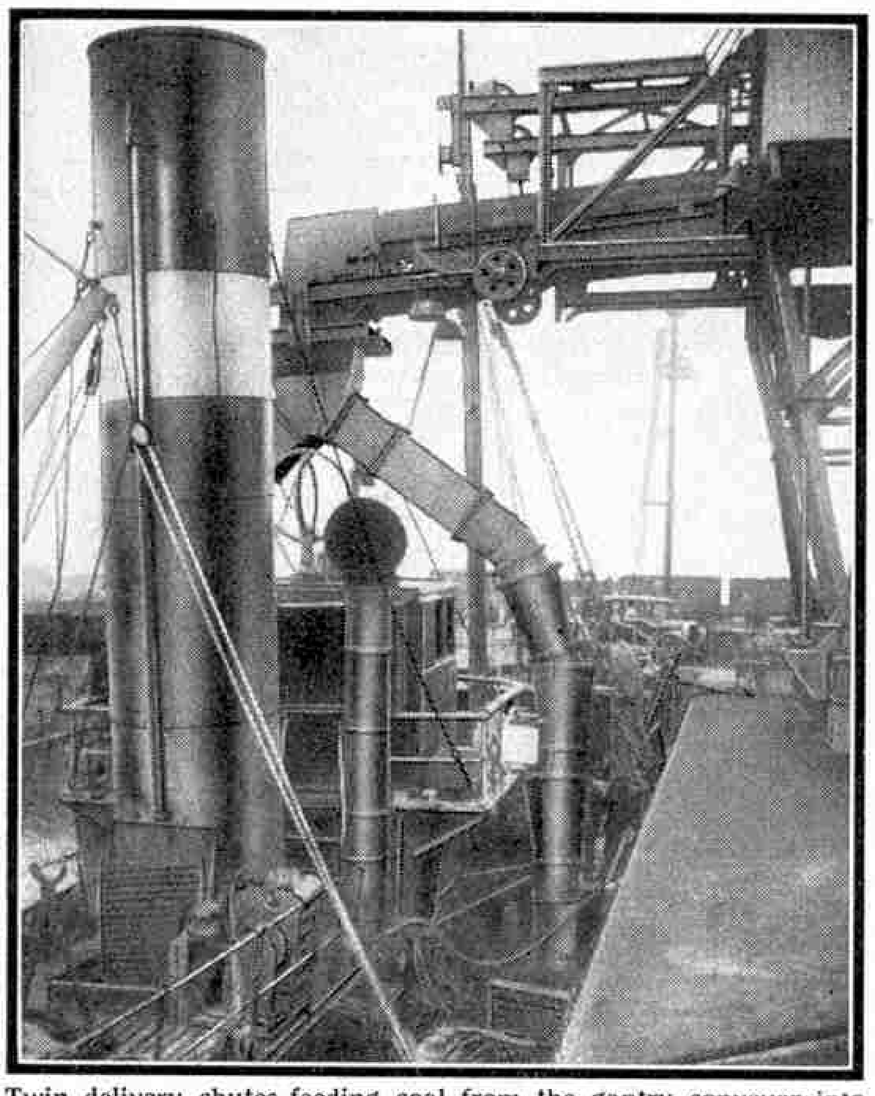
The six plants, which are identical in design, were built by Mitchell Engineering Ltd., London. Each comprises a tippler that turns the wagons over sideways so the coal they carry is poured on to an inclined belt that runs parallel to the quayside. This belt carries the coal upward to the level of a travelling gantry that extends outward from the quayside. On reaching this height the coal is transferred to a second belt that works inside the gantry, and on this it is conveyed to a hopper at the outer end of the gantry, from which it is delivered through twin chutes directly into the trawler's bunkers.

The whole operation is a marvel of speed and ease. The wagons with their loads of coal approach the tippler on tracks graded at about 1 in 60, up which they are hauled in small batches by a 5-ton capstan of the vertical type. The wagons in each batch are not coupled, the hook of the hauling gear being attached to the one in the rear so that those in front are pushed up the incline by it. The capstan stops when the leading wagon makes contact with an automatic cut-out switch placed at the head of the truck. An auxiliary 1-ton capstan then draws the wagons one at a time on to the tippler platform. The same capstan moves the emptied wagon off the tippler, and it is then directed by automatically operated spring-controlled points to the empties siding, down which it runs by gravity.

The hauling rope for the batches of wagons is permanently attached to the bollard of its capstan, and when its end is detached from the wagons it is returned for attachment to a second batch by a tailrope actuated by a weight-operated tensioning device. The capstan mechanism is controlled from a cabin beside the tippler.

The tippler can handle wagons with capacities from 8 to 20 tons, and its machinery is driven by a 35-h.p. electric motor. The coal is tipped into a hopper of W-form from which it falls through two feeder valves to the conveyor belt, and while in the hopper it is sprayed by a jet of water at high pressure. This lays any dust resulting from tipping, and also damps the coal sufficiently to prevent the accumulation of dust at the transfer points on the conveyors.

The conveyor from the tippler hopper is driven by a 15-h.p. motor and travels at a speed of 300 ft. per minute. The first portion is inclined upward. The second is horizontal and is fitted with a tripper for discharging the coal on to the second belt, which is carried on a transporter gantry that stretches out from the quayside over the trawlers to be coaled. The gantry is mounted on four articulated bogies, driven by a 7½ h.p. motor, so that it can be moved along a 40 ft. length of track laid parallel with the quayside in order to deliver coal at any required point. The tripper that diverts the coal on to the gantry belt also can be moved to bring it into suitable positions. For this purpose its lower end is supported on flanged wheels that run on a track laid on the steelwork structure supporting the horizontal portion of the conveyor.



Twin delivery chutes feeding coal from the gantry conveyor into a trawler's bunkers.

The gantry conveyor is carried by a telescopic boom so that it can be extended outwards to reach the hatches of all classes of trawlers. The greatest distance from the quay at which the coaling chutes can be placed is 50 ft., and the outer end of the conveyor can be luffed over a vertical range of 14 ft. to suit varying levels of water in the dock.

The gantry delivers the coal into a small hopper, which forms the head of two delivery chutes, arranged like an inverted U, that feed the port and starboard bunkers of a trawler at the same time or separately, as desired. The delivery hopper contains a distributing valve, which is controlled from the deck of the trawler, and is so designed that the stream of coal can be readily changed from one chute to the other as required for trimming purposes. The lower ends of the two chutes are formed of a number of cone-shaped sections, connected by short chains, in order to give flexibility. These sections are shown in the lower illustration on this page, and the lengths of the chutes can be adjusted as required by adding or removing one or more sections.

Three men only are required to control the operation of the plant.

Wirral Electrified Services

The L.M.S. announce that electric trains will commence running on the Wirral Railway section on 14th of this month. Through electric trains in conjunction with the Mersey Railway will then be run between Liverpool (Central Low Level) and both West Kirby and New Brighton. The journey times will be 29 min. from West Kirby to Liverpool, and 20 min. from New Brighton.

A "dress rehearsal" will be staged on the Sunday before the electric services commence. Electric trains will then be run in order to afford an opportunity for the staff and the travelling public to become acquainted with the altered methods of operation.

In preparation for the new service 19 three-car train sets of the most modern construction, each seating 141 third-class and 40 first-class passengers have been built. During the peak hours the trains will be composed of six cars.

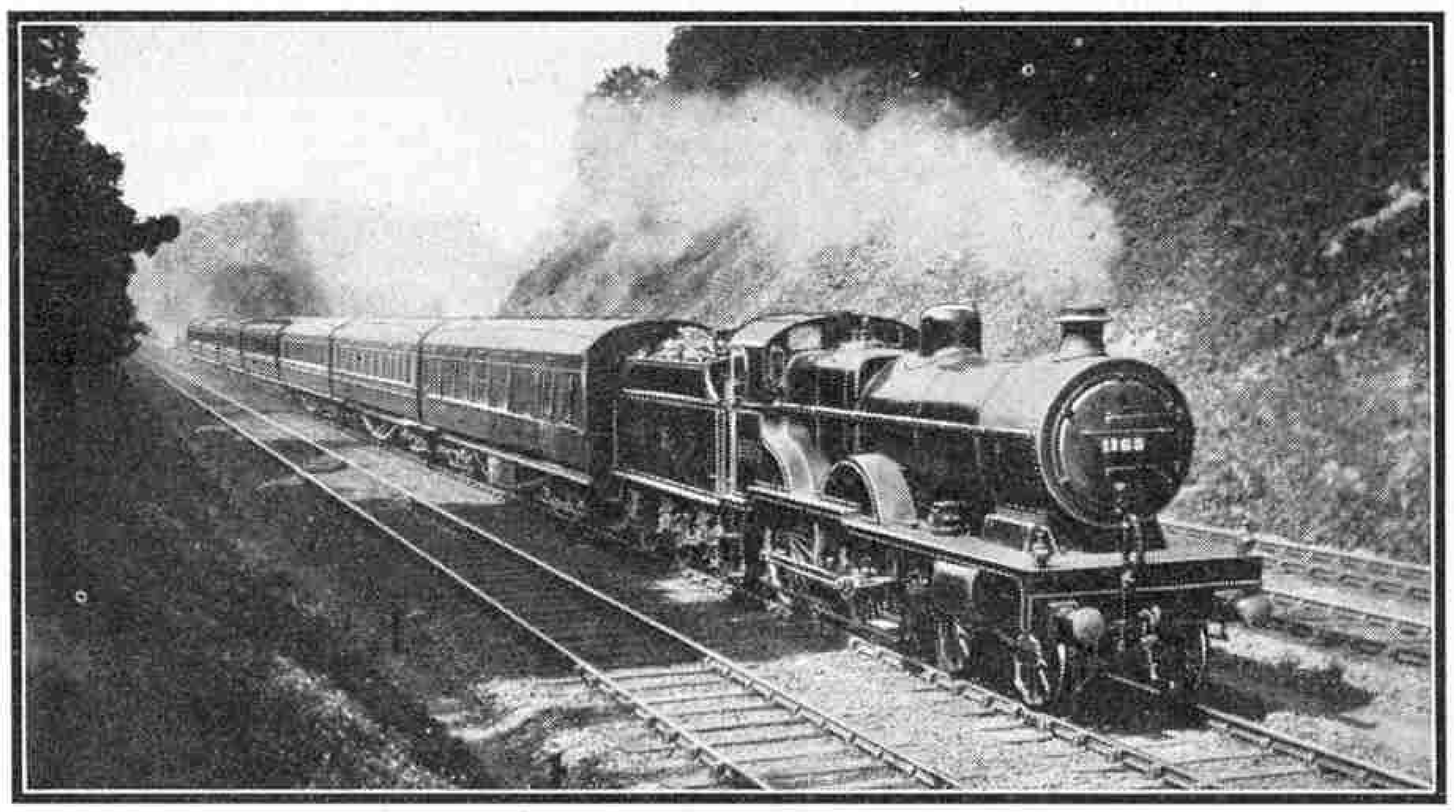
The Fastest Trains in the World

From an article in *"The Railway Gazette"* we note that the German State Railways now have the distinction of operating the fastest trains in the world both with Diesel and steam power. The Diesel train is the *"Fliegende Kölner,"* which covers the 157.8 miles from Berlin to Hanover at an average speed of 82.3 m.p.h. The steam train is a non-stop express from Berlin to Hamburg. It completes the journey of 178.1 miles at an average speed of 74.2 m.p.h.

In the United States the fastest train also is Diesel operated. This is the *"City of Denver,"* of the Union Pacific Railroad, which makes a run at 81.4 m.p.h. over the 62.4 miles between Grand Island and Columbus. The run of the *"Super-Chief"* of the Santa Fé system is now made at 78.3 m.p.h. instead of the previous 83.7 m.p.h. The fastest American steam train is the *"Hiawatha,"* of the Chicago, Milwaukee and St. Paul Railroad, which covers the 43.1 miles from New Lisbon to Portage at 73.9 m.p.h. start-to-stop. This train is shown in the lower illustration on the opposite page.

The United States Diesel and steam runs stand third and second respectively to the corresponding German performances. The fastest trains in Great Britain, the *"Coronation"* of the L.N.E.R. and the *"Cheltenham Flyer"* of the G.W.R., stand seventh and eighth respectively in the speed table of steam-operated trains. In the aggregate mileages run by steam at over 70 m.p.h. the L.N.E.R. is an easy first, however, with a figure of 653 miles against the 410 miles of the Pennsylvania Railroad in the United States and the 356 of the German State Railways.

In France the fastest run is performed by Diesel traction on the 99.1 mile run from Laroche to Dijon on the P.L.M. Railway, which is covered at a speed of 73.3 m.p.h. The fastest steam run is made by the *"Sud Express"* on the P.O.-Midi system in travelling from Poitiers to Angouleme at exactly 70 m.p.h.



An up L.M.S. Birmingham express near Watford in charge of Standard Compound No. 1165. Engines of this class are ideal for fast trains of moderate weight and the L.M.S. Standard Compounds were the regular engines on the Birmingham services for some years. Photograph by M. W. Earley, Reading.

A Fine "Atlantic" Run on the S.R.

Early in the coming summer season yet another important S.R. holiday route will be changed over to electric traction. This is the Mid-Sussex line, which runs via Horsham and the Arun Gap to the south coast at Bognor and Littlehampton. The service on it is now being worked by the handsome 4-4-2 engines built for the former London, Brighton and South Coast Railway, and on a recent run with the heavy 6.15 p.m. express from Victoria No. 2426 of this class, *"St. Albans Head,"* put up an excellent show. This train takes the Brighton main line as far as Three Bridges, and then cuts across country through Crawley to join the Mid-Sussex line at Horsham. The run was timed by Mr. O. S. Nock.

The gross load behind the tender was 375 tons, and this the engine lifted in great style up the 1 in 64 grade from the terminus up to Grosvenor Road bridge over the Thames. Clapham Junction, 2.7 miles, was cleared in 5¾ min., and up the 1 in 94 to Balham Junction speed did not fall below 40 m.p.h. With a maximum of 56 m.p.h. at Streatham Common, the 9.4 miles out to Selhurst had been covered in the fine time of 14¼ min., when there came a bad signal check at Windmill Bridge Junction, near Croydon. Up the long succeeding 1 in 264 gradient speed was recovered in fine style to 46½ m.p.h. at Coulsdon, while on the last two miles up to Quarry Tunnel, where the incline stiffens to 1 in 165, the minimum rate was 44½ m.p.h.

On account of the signal check the train was now 2½ min. behind time. The engine was not extended on the fine racing stretch that follows, yet speed rose to a sustained 67 m.p.h. nearing Horley, and Three Bridges, 29.5 miles out, was cleared only 1¼ min. late in 39¼ min. at a severely reduced speed of 25 m.p.h. The remaining 8.4 miles on to Horsham, mostly on favourable gradients, took a shade under 11 min. and the train arrived on time.

There are some very sharp ups and downs on the Mid-Sussex line, and some really fine locomotive work followed. Two permanent way slacks lay ahead, and so the driver got as much time in hand as he could before reaching them. Pulborough, 12½ miles from the start, was passed in 14½ min., speed varying between 47½ m.p.h. up the stiff mile at 1 in 100 to Itchingfield Junction, and 67 m.p.h. at Billinghurst. The 20.6 miles to Arundel were completed in 25¾ min., three-quarters of a minute inside schedule time, in spite of the two bad slacks. There the Littlehampton portion was detached, leaving 275 tons to be taken forward over the level grades to Bognor. The 8.6 miles thence were run exactly to time in 18 min., inclusive of a stop of two minutes at Barnham Junction.

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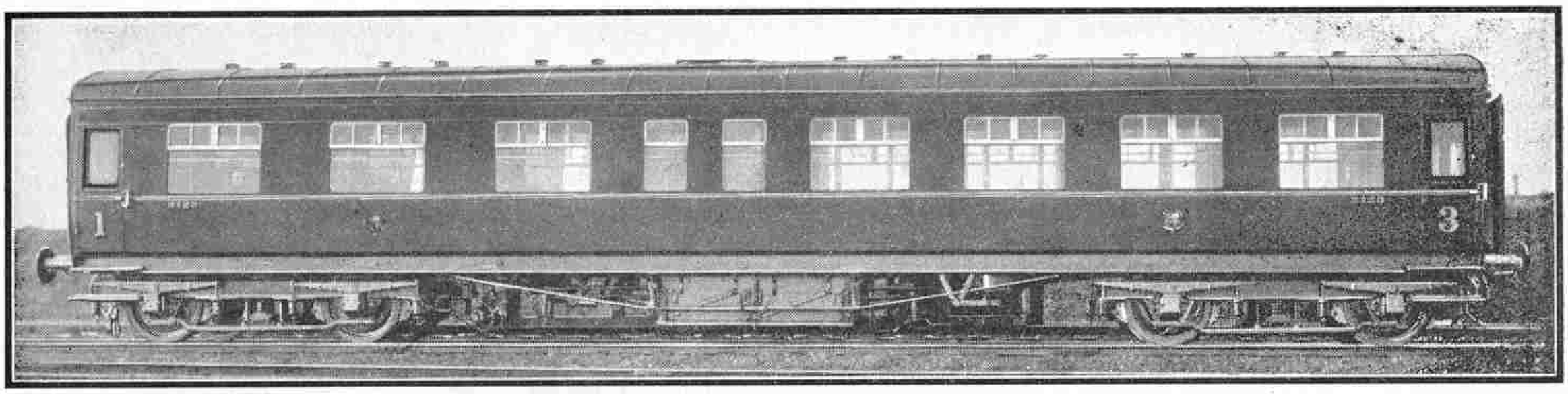
"The Northern Belle" will make three cruises of the Scottish Highlands on June 3rd, 17th and 24th. Passengers will live entirely on the train during the cruises.



One of the new first-third corridor coaches of the Great Southern Railways (Ireland) that were described on page 78 of the "M.M." last month. These vehicles are of the side-corridor type and have flush-finished steel-panelled exteriors. Photograph by courtesy of the Great Southern Railways.

Steam and Electric Pioneers at York

In January last two notable additions were made to the already remarkable collection of railway stock assembled at the Railway Museum at York, when the pioneer British "Atlantic" or 4–4–2 express steam locomotive and the first electric tube coach were placed there.

The locomotive is the former G.N.R. No. 990 *"Henry Oakley,"* and its withdrawal from service as L.N.E.R. No. 3990 was referred to in these pages in January last. It has been repainted in the style of its pre-grouping owners, and now again carries its old number and has the initials "G.N.R." on the tender. The "Atlantic" type was introduced in 1898, when the old 'single driver' passenger engines were just going out of use on the heaviest duties. No. 990 was the first of its type to be built in England.

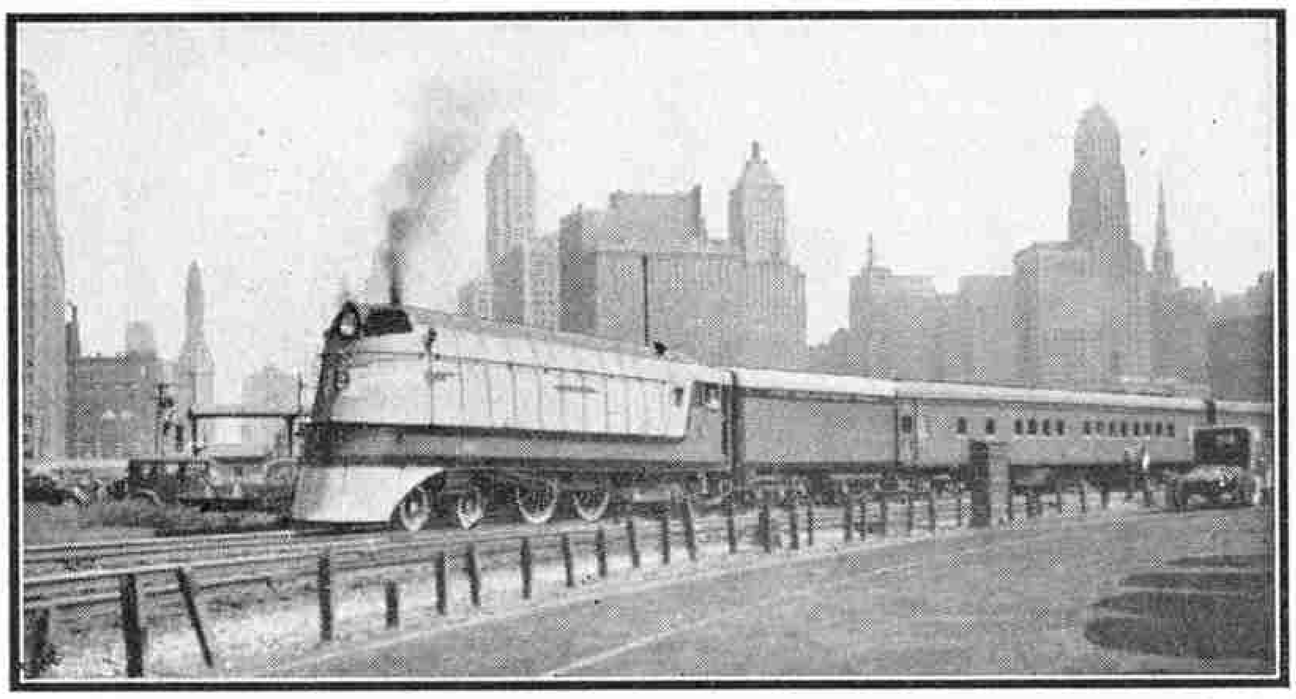
No. 990 and its sister engines were employed in hauling *"The Flying Scotsman"* of those days which, until 1900, made a special stop of 20 minutes at York in order that passengers might obtain refreshments. How far locomotive design has advanced since then may be judged from the fact that while in 1900 *"Henry Oakley"* weighed only 58 tons, and had to deal with an 8-coach *"Flying Scotsman"* of 265 tons, the latest L.N.E.R. streamlined Pacific engines that haul *"The Flying Scotsman," "Coronation"* and other famous trains of to-day weigh 103 tons, and regularly handle trains of 15 coaches or more of over 500 tons in weight.

The tube coach that has found a resting place in York Museum was originally put into service in 1891. It was one of the first type of trailer car used on the City and South London Railway, which opened between King William Street and Stockwell on 18th December, 1890. It is of the gate-entrance type and has only small windows just below the roof to enable passengers to read the station names. There is seating accommodation for 32 passengers arranged longitudinally.

The length of the car is 32 ft. and its height is only 8 ft. 4 in., as against the present-day car height of 9 ft. 5½ in. This is explained by the fact that tube tunnels were, in those days, only 10 ft. 6 in. in diameter. The present-day standard of 11 ft. 8½ in. was adopted in 1922. The tube coach was presented to the York Railway Museum by the London Passenger Transport Board.

A Santa Fé Steam Record

From *"Baldwin Locomotives"* we extract the following details of a run made in December last by a 4–6–4 locomotive of the Atchison, Topeka and Santa Fé Railroad. This engine completed what is believed to be the longest continuous run ever made by a steam locomotive in regular passenger train service by hauling an express mail train over the 2,227.3 miles from Los Angeles to Chicago. The actual running time was 49 hr. 5 min., giving an average speed of about 45.4 m.p.h. for the whole run. No attempt was made at a speed record and the maximum attained was 90 m.p.h.



The "Hiawatha" streamlined express of the Chicago, Milwaukee and St. Paul Railroad, the fastest steam train in the United States, leaving Chicago. Photograph by D. Wilson, Watford.

The locomotive concerned was No. 3461, one of six similar engines recently constructed for the railroad by the Baldwin Locomotive Works. The train included a dynamometer car and was made up differently over certain sections of the run, the load ranging from 10 to 12 standard cars with a total weight varying from 756 to 939 tons. The engine remained coupled to the train throughout the whole run except when detaching or attaching cars at the different stops. Assistant locomotives were employed at three different points on the run, water was taken at 18 stations and the supply of oil fuel was replenished at five points. On arrival at Chicago the locomotive was ready to turn and make the return journey after receiving the usual attention to lubrication and standard adjustments.

The journey described normally requires the use of four different locomotives. The engines of the class to which No. 3461 belongs have driving wheels 7 ft. in diameter, and cylinders 23½ in. in diameter with a piston stroke of 29½ in. The boiler pressure is 300 lb. per sq. in. All the axles of the engine and its 12-wheeled tender are fitted with roller bearings.

Locomotive News

On the Southern Railway the first of 10 new 0–6–0 freight engines known as the "Q" class has been completed at Eastleigh to the designs of Mr. R. E. L. Maunsell, until recently Chief Mechanical Engineer of the S.R. The boiler has a fire-box of the Belpaire type and its working pressure is 200 lb. per sq. in. The tractive effort is 26,157 lb., while the cylinder dimensions are 19 in. by 26 in. The 3,500-gallon tender is of the standard flat-sided type, as used on the 2–6–0 locomotives of class "N," and it carries five tons of coal. The total weight of the engine and tender in working order is 90 tons. We hope to illustrate one of these engines in an early issue.

Three Diesel-electric locomotives of the 0–6–0 wheel arrangement have been introduced on the S.R. They have been designed primarily for shunting duties and at the time of writing are being used in Norwood Yard. The mechanical parts were constructed at Ashford Works, but the engines and electrical parts were supplied by contractors.

On the L.N.E.R. Class A4 streamlined 4–6–2s Nos. 4462 and 4463, named *"Great Snipe"* and *"Sparrow Hawk"* respectively, have been delivered from Doncaster. Nos. 4788–91 of the "Green Arrow" Class V2 have been completed at Darlington and put into service.

New L.M.S. engines put into traffic include Class 3 2–6–2 passenger tank engines Nos. 191–8, built at Crewe, and Nos. 166–74, built at Derby. New engines delivered from contractors and placed in service are Class 5 4–6–0s Nos. 5441-51.

Further L.M.S. locomotives of the "Patriot" series of Class 5XP 4–6–0s have been given names. No. 5511 is to be *"Isle of Man,"* No. 5520 *"Llandudno,"* No. 5521 *"Rhyl,"* and No. 5525 *"Colwyn Bay."* No. 5548 has already been named *"Lytham St. Annes."* The names now given to Nos. 5520 and 5525 were formerly carried by L.N.W.R. engines of the 4–4–0 "George the Fifth" class.

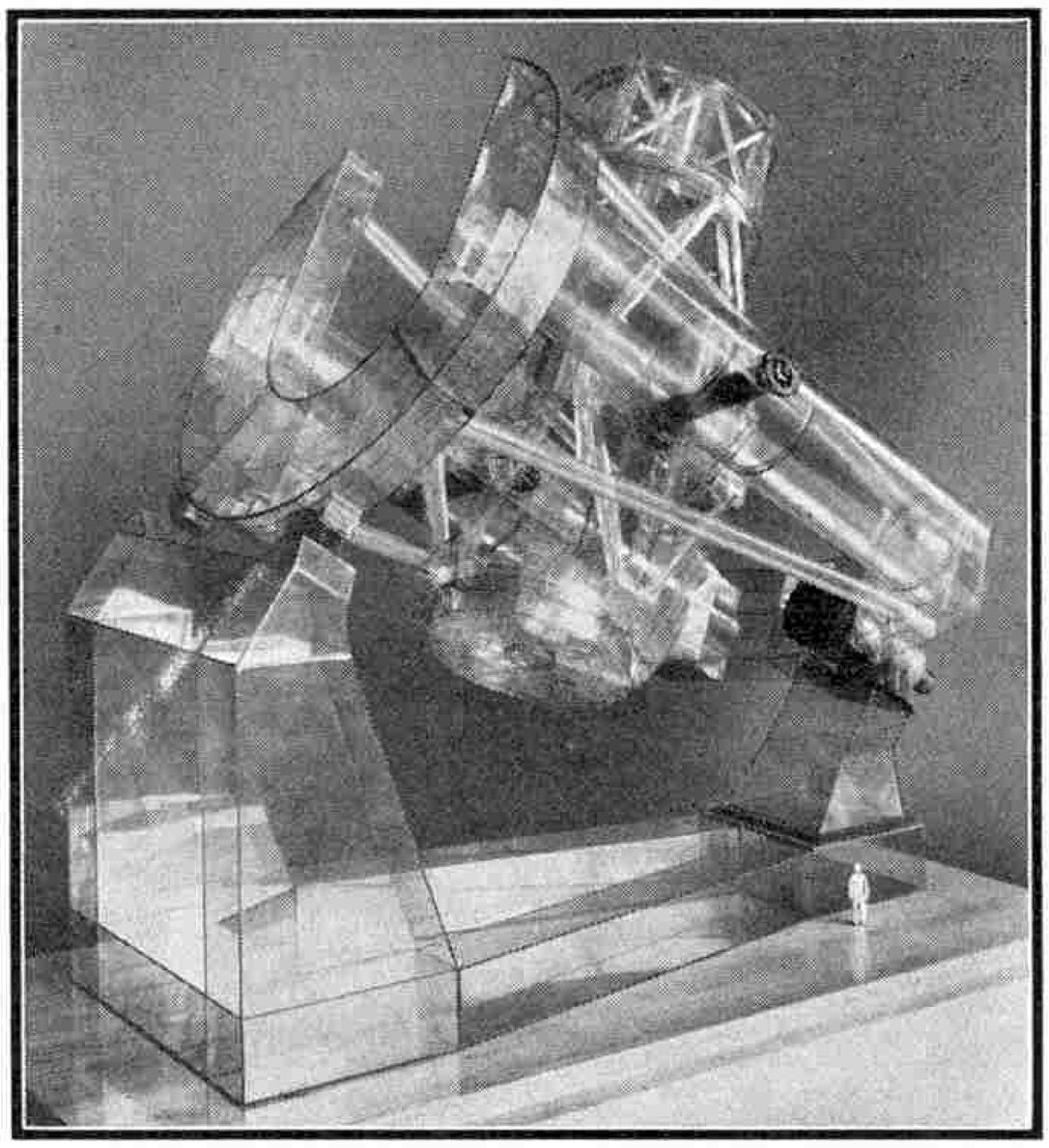
The last engine of the former G.S.W.R. 4–4–0 "325" class, No. 14513, has been condemned, as have ex-L.N.W.R. 4–6–2 tanks Nos. 6957 and 6965, and 4–4–2 "Precursor Tanks" Nos. 6785 and 6794. Other withdrawals include an ex-Caledonian 4–4–0 No. 14336 and two 0–6–2 tanks of the former G.S.W.R., Nos. 16913 and 16923. The last of the N.S. 0–6–0 "D" class, No. 1570, also has been scrapped.

The World's Largest Telescope

Bringing the Moon within 25 Miles

EVERYBODY is greatly interested in the stories that astronomers have to tell us of other worlds. These have been explored as far as is possible for such distant objects by means of the telescope, and the amount of knowledge that has been gained with the aid of this and accessory instruments is surprisingly large. Yet astronomers are never satisfied and are always hoping for more powerful telescopes. The largest of these are reflectors, in which light from the heavens is reflected from concave mirrors, and a record was created in 1918 when a telescope with a mirror 100 in., or 8 ft. 4 in. in diameter, was completed and mounted in an observatory on the top of Mt. Wilson, in Southern California. This is so powerful that buildings of the size of a New York skyscraper could readily be distinguished on the Moon if any existed there.

Soon the 100-in. telescope on Mt. Wilson will lose its distinction of being the largest ever made, for work has been in progress for some years on the construction of one with a mirror 200 in. in diameter, which will have four times its light-gathering power. When seen through the new telescope the Moon will appear as if it were only 25 miles away instead of 240,000, and objects on our satellite's surface only 30 ft. apart will be distinguished separately.



A plastic scale model of the 200-inch telescope. Comparison with the figure, constructed on the same scale, of the man standing alongside gives some idea of its huge size. For the illustrations to this article we are indebted to the Westinghouse Electric and Manufacturing Company, South Philadelphia.

A comparison with the human eye and the 100-inch telescope on Mt. Wilson reveals in a striking manner the immense gain that will follow its completion. The number of stars that can be seen with the eye is only about 3,000. With even a small telescope this number is increased many times, and it is estimated that the 100-inch telescope brought about 560 million within our reach. It is believed that the new telescope will increase this to at least 1,500 million.

The disc from which the mirror is being ground was made of special glass at the Corning Glass Works, New York State, in 1934, as described in an article on page 512 of the "*M.M.*" for September 1935. It was the largest piece of glass ever cast and two years of experimental work were devoted to preparations for making it. It was cooled to ordinary temperature slowly in an annealing chamber, a process that required nearly a year, and on its removal was 201 in. in diameter and nearly 25 in. in thickness. Its weight was then about 17 tons. It was carefully transported by rail from Corning to the California Institute of Technology in Pasadena, 3,300 miles away, and there it is now being ground and polished. This is a long and tedious task. Four tons of glass have to be removed from the surface of the mirror, which will be shaped with minute accuracy to the form of a parabola, and the work must be done slowly in order to prevent temperature rises due to grinding. A special machine weighing over 50 tons has been built to carry out this work, and it is not expected to be completed until 1940.

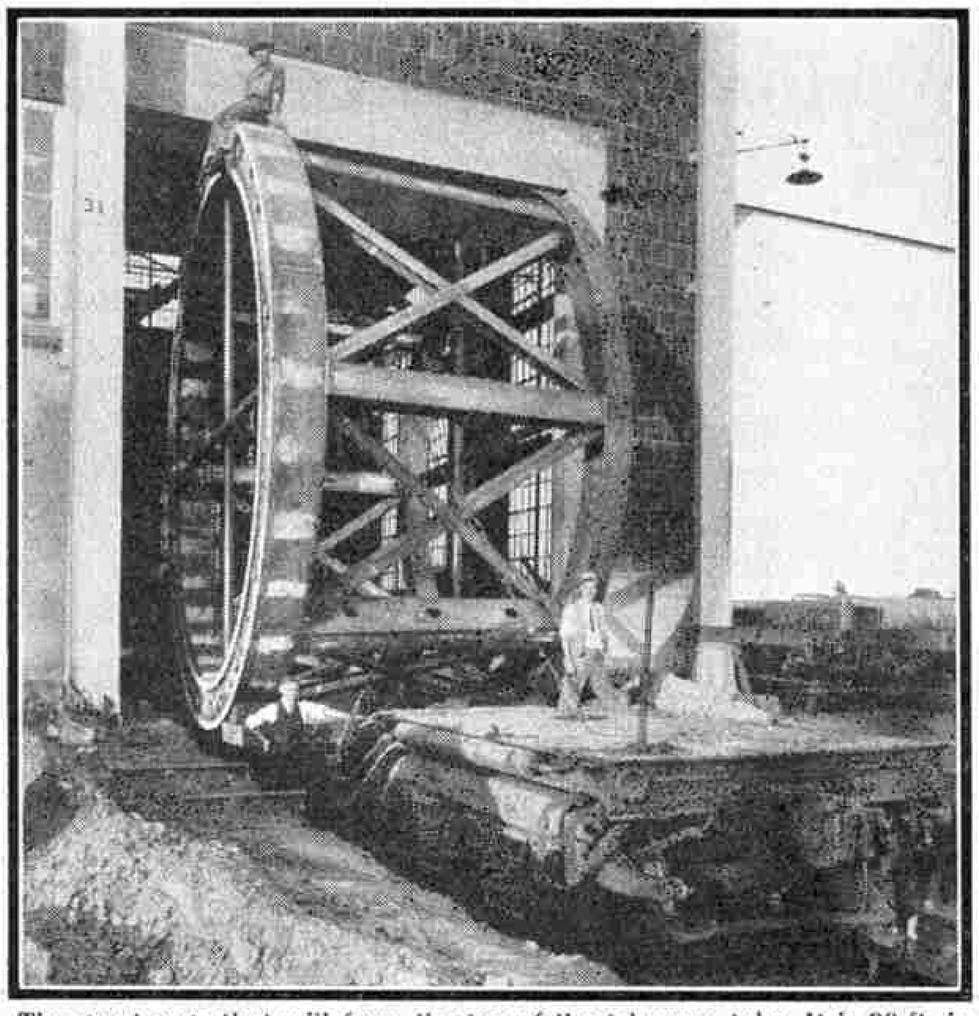
In the meantime the telescope in which the mirror is to be mounted is being prepared. It will be set up in an observatory on Mt. Palomar, which is 90 miles from Los Angeles and is 6,000 ft. in height. This site was selected after a five years' survey because of its isolation and ideal weather conditions. In its night sky there is no glare from large cities, and its atmosphere is clear, with little cloud. Temperature changes too are comparatively slight, and not sufficient to affect greatly the delicate instruments that must be used in astronomical work.

When the decision was made preparations began for housing the tiny community that will gather round the great telescope. A power plant and a radio station have been built, together with a reservoir to hold 1,000,000 gallons of water. In addition houses for the staff have been erected, and a landing ground made for aeroplanes. A new 20-mile road has been built to the main highway from the site, which also will be linked with Pasadena by an air service.

The central feature will be the observatory that is being built to house the telescope. This will be dome-shaped, with a diameter of 135 ft. and a height of about the same measurement. Its upper part will be made of steel and will rotate on a smoothly-ground rail. In the domed roof there will be an opening 30 ft. wide. Through this the telescope will point when in use, and at other times it will be covered by a sliding steel panel.

The telescope itself consists of two parts. These are the tube carrying the mirrors and eyepieces, which is as tall as a six-storey building, and the mounting or yoke that supports the tube, which is of equally large proportions. When the instrument is built up the tube will be movable in its yoke, and the mounting itself can be swung round on its axis. Thus the telescope can be brought to bear on any part of the sky by a combination of the movements. The

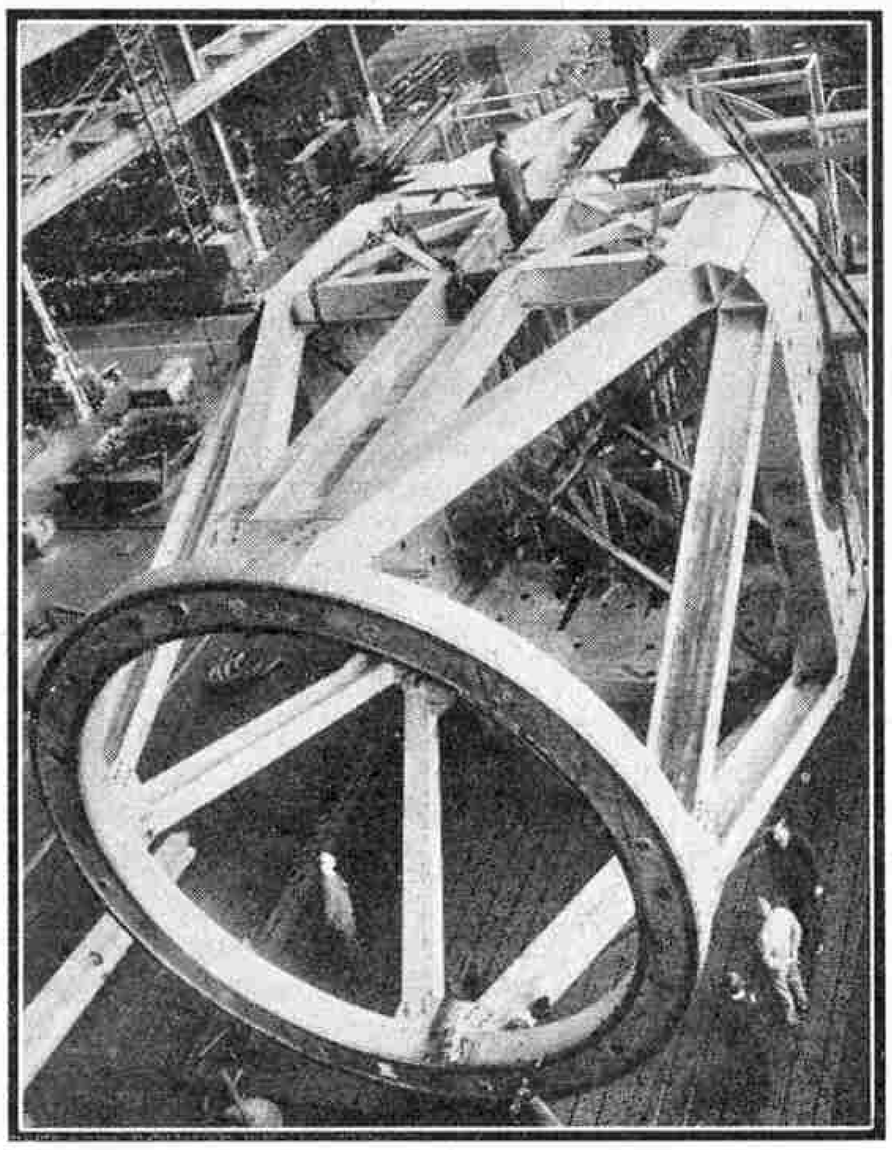
total weight will be about 440 tons, and will be supported on bearings placed on the two steel bases that rest on concrete pillars separate from the building. Yet the telescope will move easily in response to the wishes of the observer at the control board, and when set on any star or other object will continue to point to it, a driving clock then turning it at the correct speed. The bearings are to have oil pads 28 in. square, fed with oil at a pressure of 250 lb. per sq. in. maintained by pumps. When in movement the telescope therefore will literally float on oil, and little power will be required to drive it. Actually an electric motor of ½ h.p. will be used for the purpose.



The great cage that will form the top of the telescope tube. It is 20 ft. in diameter and 12 ft. in height, and weighs 26,000 lbs.

The tube and the yoke are hollow steel box-welded sections of small weight when compared to their bulk, but of great rigidity in proportion to their weight. They were built up in sections, which were annealed in specially built ovens in order to relieve the internal stresses, which might otherwise have led to distortion when they were cooled, and afterwards bolted together.

The tube is 55 ft. 4 in. long and 20 ft. 3 in. wide, and weighs approximately 112 tons. It consists of five main sections. The central section is a hollow welded steel cube, the corners of which are attached by beams to points on great circular steel rings, one at each end of the tube. The lower ring will support the specially designed steel cell that will carry the 200-in. mirror. In the upper ring there will be a revolving cage forming the top of the complete tube. This revolving cage is the largest section in the whole design, although not the heaviest. It is 20 ft. in diameter and 12 ft. high, with a total weight of 26,000 lb., or nearly 12 tons. The special furnace in which it was annealed was the largest ever built by the makers. The mounting is made up of 10 large sections and four struts, each 2 ft. in diameter. The heaviest section is the centre piece of the horse-shoe girder at one end, which weighs nearly 54 tons.



The central section of the tube of the telescope nearing completion in the Westinghouse shops. It is 50 ft. long and 22 ft. in diameter, and weighs nearly 67 tons.

The tube and the mounting are being made by the Westinghouse Electric and Manufacturing Company at their South Philadelphia works. It is expected that they will be completed by July of this year. They will then be shipped to their destination in California. The largest piece will be the tube, which will be slung in its shipping cradle and taken by rail to the docks to be transferred to the deck of a coasting steamer that will take it through the Panama Canal to San Diego. The remaining pieces are not so large, but most are so bulky that they also will have to be sent by sea.

The telescope is so large that the observers can be stationed within it in order to make their observations. To use the characteristic American description, they will "ride the tube." They will be able to work in comfort at three different points. In the ordinary type of reflecting telescope, devised by Sir Isaac Newton, the rays of light brought to focus by the concave mirror are reflected sideways by means of a sloping flat mirror that turns them at right angles to an eyepiece in the side of the tube. In the 200-inch mirror there will be no flat. Instead the rays will be brought to a direct focus within the tube, and the astronomers will work from an observer's house in the upper ring. They will reach this from a special elevator platform on the dome which will allow them to enter whatever the position that is occupied by the telescope at the time.

In certain reflecting telescopes the rays of light from the mirror are intercepted by a curved mirror and reflected back through a hole in the main mirror. This system also will be adopted in the 200-inch telescope, and an opening 40 in. in diameter was left for this purpose in the glass casting from which the mirror is being prepared. Observaters at this focus, known as the Cassegrainian, will be above the floor level, although at the bottom of the tube, and will be raised the necessary distance by means of a bucket lift driven by a motor.

In the third system that will be available a series of mirrors reflects the rays from the concave mirror through a slit into a special underground room where the temperature is kept constant. These mirrors are so arranged that the light enters the room in the same manner, whatever the position of the telescope.

All the mirrors required for the three systems are permanently attached to the tube, and they can be made to swing in or out of place as required by means of electrical control. The casing holding the reflecting mirror can be removed in order that its surface can be renewed. In telescopes so far erected this is coated with silver, which is highly polished to reflect as much light as possible.

The Rockefeller Foundation provided £1,500,000 for the construction and housing of the telescope in the new observatory on Mt. Palomar, and it will be operated by the California Institute of Technology, Pasadena.

Country Crafts in Britain

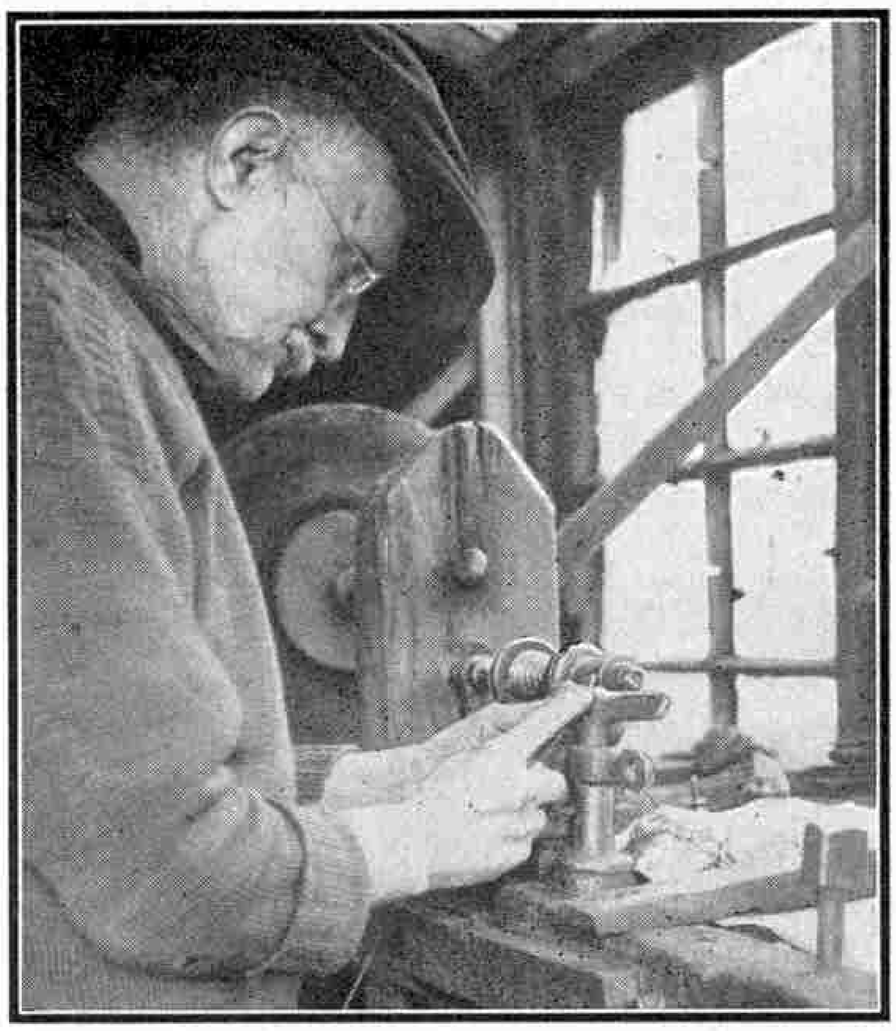
Modern Homes of Ancient Industries

By G. Bernard Wood

IN several parts of Britain there are still to be found men who earn a livelihood by using to the fullest possible extent Nature's finest tool—the human hand. The joy of being able to give to each product individual treatment is shared by all these craftsmen.

Every boy loves to try his hand at shaping a piece of wood with a penknife. Just after the Great War this urge was exploited cleverly by Mr. Robert Thompson, a woodcarver of Kilburn, North Yorkshire, who took several boys at leaving age from the small village school and began to train them as craftworkers. Some were taught to carve, others to use the adze, and the result of this commendable enterprise is now seen in a thriving community of woodcarvers.

English oak is used almost exclusively at Kilburn, and every tool employed is one that might have been handled by the craftsmen of the 15th century, whose beautiful carvings, seen in so many of our cathedrals and churches, first inspired Mr. Thompson to revive the old handicraft traditions. In such work as this there is great scope for the individual touch. A hobby or nationality can be symbolised so easily by an unhampered woodcarver. For example, an emblematical rose may appear on the front of a sideboard or writing desk intended for an English buyer, while a thistle may be used in work for a Scottish one. Recently a refectory table was made to the order of Canon Partridge of Peterborough Cathedral, whose name will be associated for ever with this beautiful piece of work, for one trestle is decorated with a miniature partridge.



A Whitby jet worker at his primitive treadle lathe. The tiny flat pieces of jet are ground and polished twice, the final polishing with sheepskin giving a perfect surface.

Many similar devices are resorted to by these craftsmen, the most curious being a 'creeping mouse." Mr. Thompson once overheard a member of his youthful community casually repeat the phrase, "as poor as a church mouse." He realised the aptness of this little creature and its activities in relation to his vocation, and ever since that moment Kilburn products have had a tiny mouse signature introduced somewhere, so well does this symbolise "industry in quiet places."

One of Britain's dying crafts is that of the making of saddle-trees, or the frames on which saddles are constructed. Since horse-drawn traffic has been superseded almost completely by mechanical transport, there remain very few outlets for saddle-trees. They are still made in Ripon, that one-time centre of saddle-tree manufacture, by Mr. William Summersgill, the only remaining craftsman of the kind, and in his Bondgate workshop he employs all the methods used there in the reign of George I.

Locally grown ash and beech supply the materials, and the only tools used are the draw-knife, adze, and chisel. The crutch itself is first shaped with the draw-knife, and then the trough that eventually carries the shaft-chain is chiselled out, and two boards are fixed, one at each end of the crutch, to provide a "fitting" for the horse's back. The last process of all is the fitting of a galvanised iron trough, prepared by a forgeman, into that chiselled out of the wood.

Another interesting use for wood is seen in the making of "treen." This is the name given to a certain type of bowl from which English folk used to eat their food. To-day "treen" takes the form of fruit-bowls, bread-bowls and receptacles for silver goods. Mr. William Lailey of Bucklebury, Berkshire, is the only man in the country who now produces this kind of ware, and he turns the articles on a primitive sort of lathe "exactly as in the days of King Alfred." Attached to the treadle of the lathe is a leather strap, which passes round the wooden axle of the machine and has its upper end fastened to the free end of a horizontal ash pole above the lathe. The other end of the pole is firmly fixed to a frame. The spindle revolves, when the treadle is pressed downward, and on releasing the foot pressure the spring pole takes charge, pulling the leather strap upward. Thus the lathe works continuously, the spindle turning first in one direction and then in the other.

Mr. Lailey uses elm for his bowls and these are shaped with tools that for the most part are native to this particular craft. For example, one of the tools enables him to cut several bowls from one piece of wood, thus obviating waste. The tool is so shaped that it makes a concave cut. It is used first for the smallest bowl, and then applied at increasing distances from the centre of the block, thus producing bigger and bigger bowls, each one outside the other.

Old as "treen"-making may be, basket-making by hand is still older. There are many different kinds of baskets, and the production of each has its own technique. For instance, Sussex is the home of trug-making. A trug is a type of basket made from willow boards and used extensively by gardeners. A curious contrivance known as a horse grips each board while the craftsman shapes it as required with a draw-knife. Another craftsman prepares the framework, consisting of rim and handle, from ash or chestnut poles. After being cut to size, these are

fixed to a jig and steamed into shape. Then the willow boards are steamed and bent, inserted within the frame, and the whole is nailed together.

Basket-makers in Suffolk use osiers, or willow rods, for their products, which range from hampers and linen baskets, to potato "pads" and watercress "flats." Acres of land around Stowmarket and Bury St. Edmunds, both in Suffolk, are a picture of loveliness with flame-coloured osiers between October and March, the harvest season. Men cut down the tall rods with sickles. Then the osiers are sorted according to length and quality, tied in bundles, and placed on end in a moist and shallow pit, where they remain until June. "Pitting" the osiers makes the sap rise, thus facilitating the stripping of the skin to reveal the pure white rod used in making the baskets. The stripping is done by pulling each willow sharply through a two-pronged metal fork, known as a "brake."

Carving the tiny mouse symbol that distinguishes the products of the village workshop of Mr. R. Thompson, the woodcarver at Kilburn, North Yorkshire.

The actual basket-makers, surrounded by a selection of rods, seat themselves on a wide board that is slightly raised from the floor at one end, and proceed to build up the baskets between their outstretched legs. Every weaving movement has centuries of tradition behind it. Each craftsman works his fingers with astonishing speed, and the output is almost incredible.

Contrasting strangely with the craft of basket-making is that of producing frames for topiary work, that is for training growing yew, box or privet into special shapes. The two crafts have one thing in common, however. This is the "weaving" of designs. The frames are made of strong wire, and the infant shrubs are planted within them, any twigs that protrude as growth proceeds being trimmed off.

Mr. H. J. Burnett of Wass, North Yorkshire, is one of the few remaining craftsmen engaged in making these entertaining frames. Using nothing more than a template for shaping purposes, a pair of pliers, and a mallet, he has created almost a whole menagerie in wire. Swans, peacocks and dogs are everyday designs, but interest really quickens when this craftsman is seen finishing an almost life-sized dancing bear, a set of frames representing a fox with hounds in pursuit, or a stag carrying on its back the Devil.

A linen basket growing in the hands of a basketmaker at Stowmarket, Suffolk. The osiers used undergo 17 processes before they are woven into baskets.

Creating fancy designs also earns a livelihood, if only during the summer months, for the jet workers of Whitby. Several of these craftsmen work their treadle lathes in primitive little huts on the East Cliff. Small, flat pieces of black amber, as jet used to be called, are ground and polished twice on the different wheels of the lathe. The second polisher is covered with sheepskin and gives a perfect surface. The machine is fitted also with a circular knife, employed to cut jet into fragmentary pieces for bracelets.

Skill is needed for all these operations, but the craftsman comes fully into his own as an artist when he inscribes designs on brooches and other trinkets. A favourite subject is the neighbouring abbey of St. Hilda. Armed only with a sharp-pointed knife, the jet-worker sits on his stool and without any sort of reference proceeds to engrave on the stone a perfect cameo of the venerable ruin.

Old as many of these crafts are, there is one that is yet older, and indeed was the first ever practised in Great Britain. This is flint-knapping. Brandon, a market town on the borders of Suffolk and Norfolk, is the only place where the craft is now carried on, and there it can be traced back to neolithic times.

The flint-knapper originally produced arrow heads and axe heads. These beautifully-modelled weapons are still made at Brandon, but only as souvenirs, and to-day the chief product is the gun flint.

The craftsman sits on a three-legged stool with a thick pad strapped to his left thigh. He selects a newly-quarried flint from the pile at his side, rests it against the protective pad, and strikes it with what he calls a quartering hammer, which reduces the lump into surprisingly neat quarters. After obtaining a number of quarters in this way, he proceeds to break them into long, narrow flakes with a lighter flaking hammer. Finally the flakes are placed on a metal "stake" and knapped, or broken, into the different gun flint sizes with a peculiar hammer that has a long narrow blade. The craftsman's thumb and forefinger come into play here for they are cleverly used as measurement gauges.

There are three gun flint sizes. Of these the pistol flint measuring 1 in. by $\frac{3}{4}$ in., is the smallest, and those for carbines and muskets are next in size.

It may be asked who wants gun flints to-day. The question is natural, for flint-lock firearms have not been used in Britain for more than a century. This type of weapon is still common in Siam, Malay, and parts of Africa, however, and the natives there gladly barter such valuable commodities as tiger skins and elephant tusks for kegs of Brandon gun flints. Thus a village that once supplied men in prehistoric Britain with flint weapons, and is mentioned in Domesday Book, now sends its products to distant parts of the world.

Books to Read

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. Postage on different books varies, but any balance remaining will be refunded.

"Map-Makers"

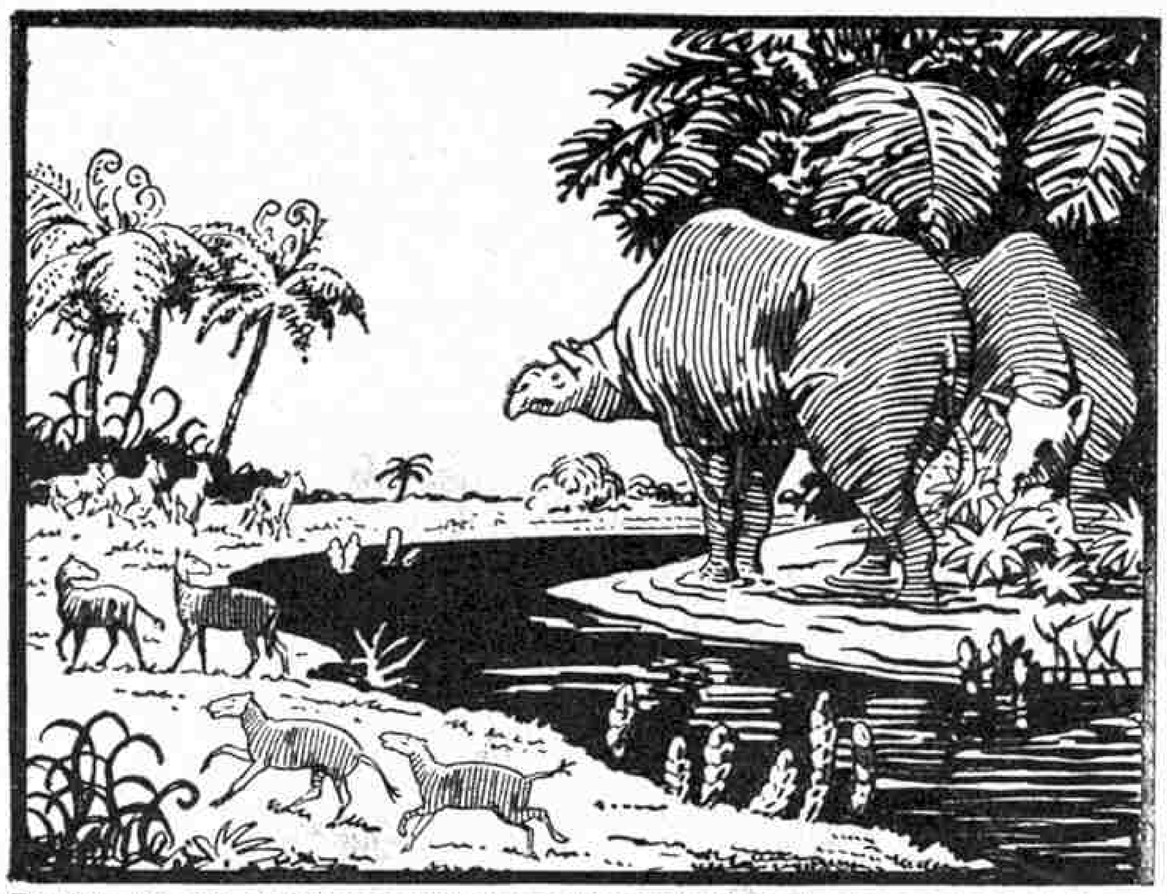
By J. Cottler and H. Jaffe. (Harrap. 6/- net)

The map-makers whose stories are told in this book are the famous explorers who opened up for us the distant parts of the Earth. The authors take us right down from the pioneers of ancient times, who first realised that the world extended beyond the narrow boundaries of the Mediterranean Sea, to the explorers of the present century, who have conquered the Poles and revealed to us the mysteries of the deserts of Central Asia and Arabia. All were inspired by the same spirit of adventure, and the tales of their achievements are told simply but effectively.

The book is divided into three sections, containing in all 18 biographical sketches. An introductory chapter deals with the earliest travellers and the men who used the information they brought back in order to begin our map-making. Then we come to the discoverers of new lands, who in a sense drew the outlines of the map of the world. Among these are Marco Polo, who travelled across Asia to China and returned by sea, Columbus, the discoverer of the New World, Vasco da Gama, who penetrated to the East round Africa, and Magellan, the first to set out to sail round the world. Their work was continued by the famous British seamen Hudson and Cook.

The next section describes how the outlines of the map were filled in, and readers follow such men as Lewis, Clark and Fremont in America, Mungo Park and Livingstone in Africa, and Burton in Arabia and the Sudan as they press forward into unknown regions. This was not the end, for later explorers found new worlds to conquer. Among the most interesting of these were Alexander von Humboldt, who first examined the causes of variations in climate, and Henry Rawlinson, who reconstructed civilisations of the past. The exploration of the depths of the ocean by William Beebe and the study of the secrets of the Earth itself by John Milne, who first studied earthquakes and volcanic action, also are well explained. A final chapter shows how the discoveries of the map-makers generally were laid down in convenient form by Mercator, whose name is so well known from the familiar map of the world known as Mercator's projection.

The book is illustrated by 40 interesting drawings.



The baluchithere, an immense creature that inhabited Central Asia in prehistoric times. From "Map-makers," reviewed on this page.

"China Quest"

By Elizabeth F. Lewis. (Harrap. 6/- net)

China is very much in the news to-day, and books that give us true pictures of the lives of the Chinese people are gladly welcomed. Mrs. Lewis knows China well from the inside, and is fully qualified to write a book of this kind. Her hero is Reds Stuart, an American schoolboy who is fired with ambition to explore China. To his great delight his father is given an important appointment in Shanghai, and there the boy penetrates into a new and fascinating world.

Reds becomes friendly with a Chinese boy from the upper gorges of the Yangtze River, who had been captured by the soldiers of one of the private armies that until recently afflicted China, but had escaped. This boy was born to understand and use machinery, and his great ambition was to become an aeroplane pilot. These strangely-assorted companions travel to various parts of China on business errands. They meet all kinds of people, from the simple poverty-stricken peasants of the countryside to government officials and ferocious bandits, and as we follow them in their adventures we become more and more interested in the mystery of China.

Humour, wisdom and exciting adventure are all to be found in the story, and we see everything, not only from the point of view of white men generally, but also through the eyes of the Chinese and their sympathisers. The result is a splendid book that every boy will find informative and at the same time highly readable and attractive.

There are four colour plates and 10 other full-page illustrations in addition to many attractive drawings showing a wide variety of Chinese scenes.

"One-Man Caravan"

By R. E. Fulton. (Harrap. 12/6 net)

The "One-Man Caravan" of the title of this book consisted of the author on a Douglas motor cycle, and his route took him from London eastward to New York. On the way he crossed the continents of Europe, Asia, and North America, and sailed across the Indian and Pacific Oceans. He encountered many unusual people in remote corners of the countries he visited, and writes so vividly of the strange scenes he witnessed that his readers have a thoroughly enjoyable time.

The origin of this astonishing journey was almost a joke. When in London and about to depart for his home in New York, the author announced on the spur of the moment that he was really going a run round the world on a motor cycle! One of those who heard him was connected with the Douglas Company, and immediately volunteered to furnish the necessary motor cycle. Then the fun began. Through the Balkans he passed on across Asia Minor into Syria. From there he crossed the desert to Baghdad, braving danger from unruly Arabs.

The lonely traveller's most exciting experiences were reserved for India and Afghanistan. In the former country he created consternation by suddenly appearing at a frontier station in Waziristan, territory absolutely forbidden to the ordinary civilian. Then he penetrated through the Khyber Pass into Afghanistan, where he made a cinematograph record of a sword dance, although he had been forbidden to take photographs in the country.

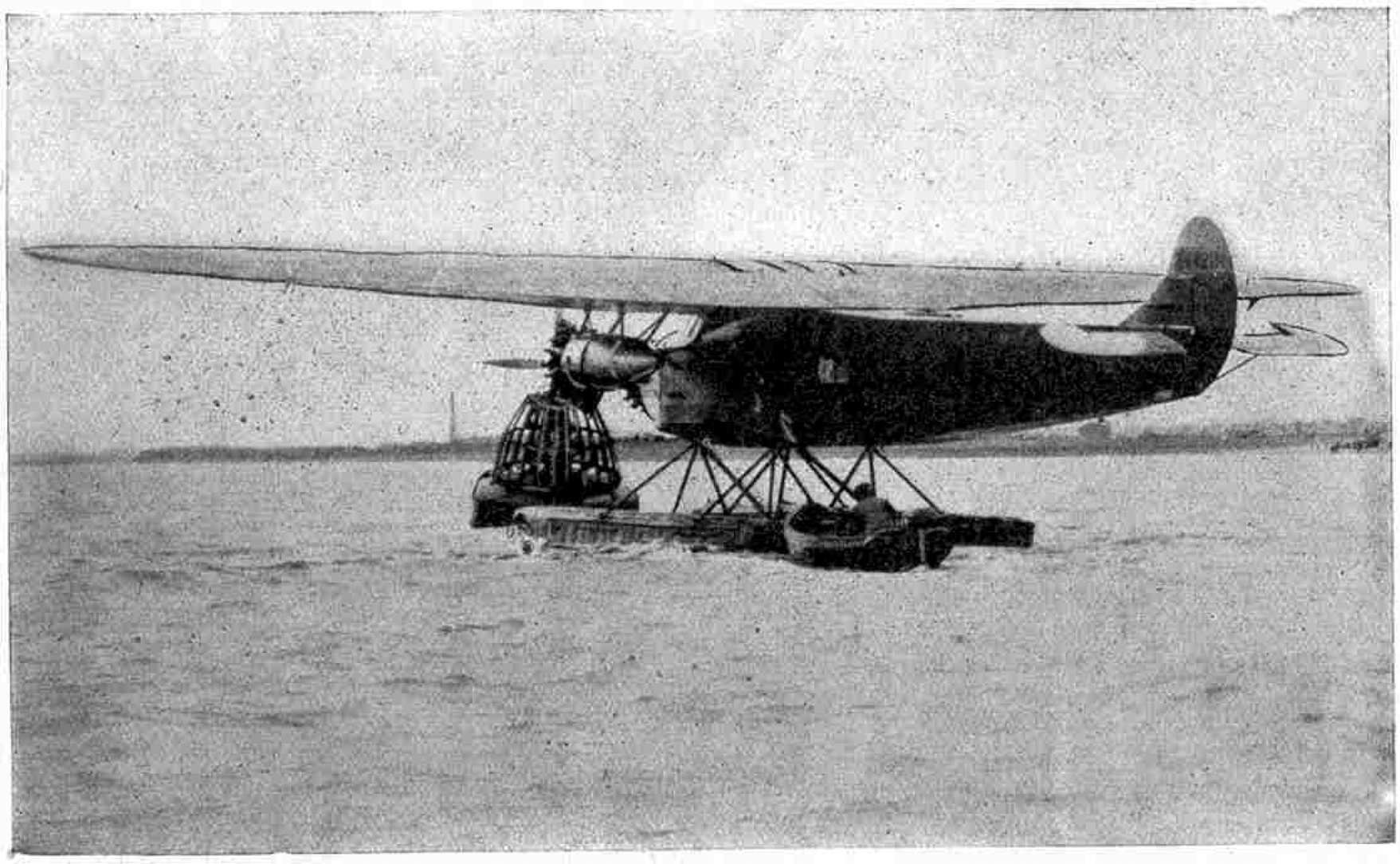
Next came Sumatra and Java, followed by Singapore and the Federated Malay States, Siam and the French colony of Indo-China. In Siam there were no roads and for most of his way had to ride between the rails of the State Railways. He was more fortunate in Indo-China, but there suffered the ignominy of being summarily arrested, stripped and thrown headlong into a prison cell. When he emerged he made his way farther eastward and reached Shanghai in a vessel provided with armed guards and fortified by means of iron grilles in order to safeguard it from the attacks of pirates. A long ride of 2,000 miles through the heart of China followed, and this was succeeded by a trip through Japan prior to departure by sea for San Francisco.

Merely to sketch out the route followed by the author suggests the wonderful variety to be met with in his pages. Only by reading his story in full, however, will the wealth of interest and excitement it contains be fully appreciated. This splendid book has 132 remarkable photographic illustrations.

"Last Flight"

By Amelia Earhart. (Harrap. 9/- net)

When this book was planned its title was intended to be "*World Flight,*" and it was to tell the story of the first flight round the world in the true sense of being a journey by air round the Earth's circumference at the Equator. As everybody knows, Miss Earhart's effort ended in disaster in the Pacific Ocean; and so the book as planned was never written. Instead we have a careful arrangement of fragments of it written on the way, along with diary and log-book entries, all sent back by cable, telephone or post. It is well illustrated by means of 27 full-page plates.



The seaplane "Friendship," in which Amelia Earhart first crossed the Atlantic by air in 1928. This illustration shows the monoplane off Barry, South Wales, at the end of the flight. From "Last Flight," reviewed on this page.

The story of Miss Earhart's earlier achievements is vividly told in the book, and reveals to us the keen and enthusiastic flyer who never deliberately sought publicity. Then we read of the months of careful preparation for the great world flight that she insisted on trying, in spite of risks of which she was well aware.

A bad accident at Hawaii after flying there from California almost wrecked her plans, and when her machine had been repaired she found it necessary to fly eastward instead of westward in order to avoid bad weather conditions. We follow her from Florida across the Caribbean Sea to Brazil, and then over the South Atlantic to the African Coast. The ocean crossing was uneventful, except for a heavy rainstorm that buffetted the aeroplane unmercifully, and then came the fascinating trip across Africa, over thick forest and sandy desert, where the few landings made enabled Miss Earhart to catch interesting glimpses of native life, on which she comments shrewdly.

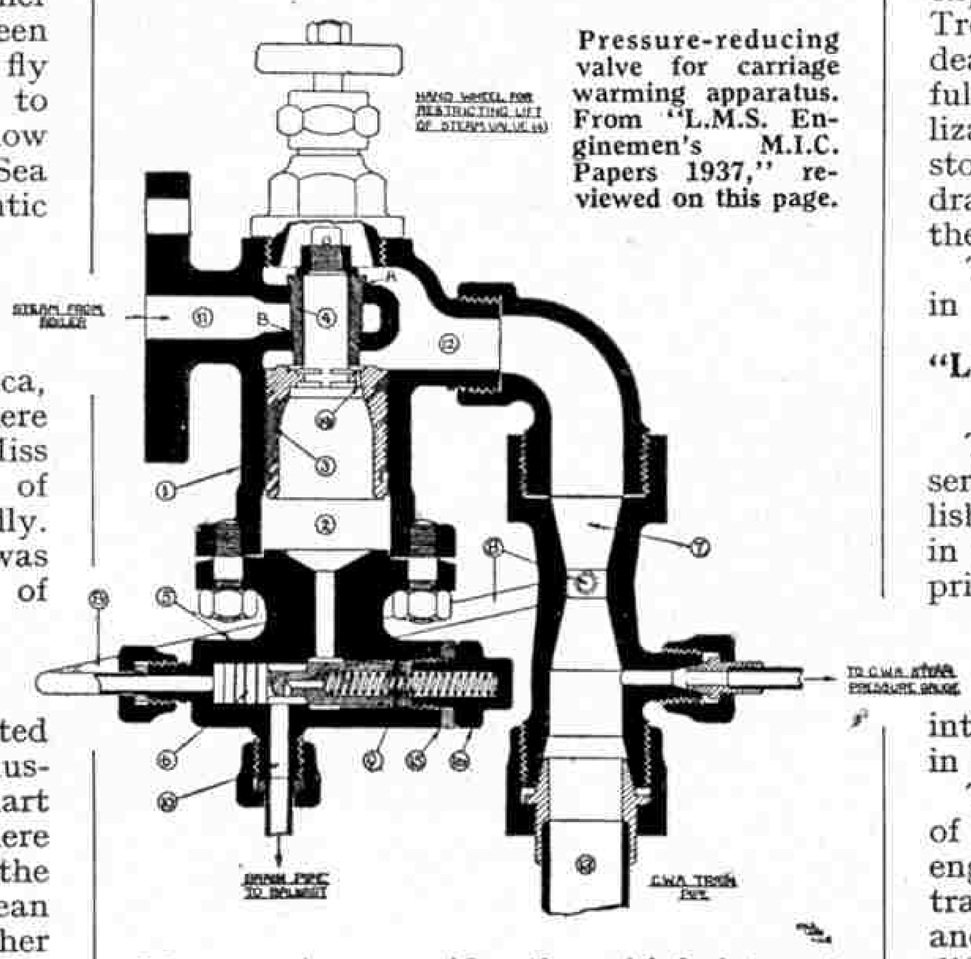
In equally efficient manner the flight was continued along the southern coast of Arabia to India, and thence through the monsoon to Rangoon and Singapore. This part of the flight was along the track made famous by those who created records between Great Britain and Australia, but at Port Darwin Miss Earhart diverged to Lae in New Guinea, and there began the most dangerous part of the flight, the trip across the Pacific Ocean with only tiny islands as marks for her navigator. Then came silence, broken only by rumours of wireless messages received from her in the neighbourhood of Howland Island; and prolonged searches failed to reveal any traces of the machine. So passed a great personality and a great pilot, whose adventurous life came to its end in the manner she herself would have chosen.

"Salt Wind from the West"

By A. R. Harris Cass. (Stockwell. 6/- net)

A story of the British countryside by a writer who understands the birds, beasts and animals distributed so profusely in it is always attractive. Here is one written with real knowledge, and with an enthusiasm that is communicated to the reader.

Mr. Cass's story centres round Jimmy the Crow, who from the security of his tree top home witnesses many strange scenes, Trutta the Trout, whose adventures and struggles to escape from his enemies provide the chief interest of the book, and Nobby Fustian, the rabbiter, who "could point out the beech tree where the badger sharpens his claws, and show the easiest route to burrows of many foxes." The activities of these three are widely varied in character, but from each the reader will learn a great deal about the beauty and drama of wild life.



Pressure-reducing valve for carriage warming apparatus. From "L.M.S. Enginemen's M.I.C. Papers 1937," reviewed on this page.

"Strange Reptiles and Their Stories"

By A. Hyatt Verrill. (Harrap. 10/6 net)

Reptiles are regarded generally with disfavour, although most of them are harmless and many make themselves useful by destroying vermin. In this fascinating volume Mr. Verrill now shows us that they are of the greatest interest in their lives and habits, while many are really graceful and beautiful. They were the first four-footed creatures to roam the Earth, and in prehistoric times attained an almost incredible size. Fortunately those of to-day are smaller and less formidable, but how strange and varied they are is suggested by one of the colour plates, which shows us reptiles that fly through the air, run on water, climb trees and bark like dogs.

Every page of the book is packed with valuable information, most of which will be new to readers. The author has included stories of personal experiences and adventures with giant snakes and other reptiles during the 40 years that he has spent in explorations and scientific expeditions in Tropical America. Reptiles that kill men, deadly snakes and friendly serpents are fully described. The strange ways of many lizards are dealt with, and the author tells stories of man-eating reptiles, living dragons, the giant reptiles of the sea and the smaller ones of streams and ponds.

There are six plates, two of which are in colour, and 46 drawings in the text.

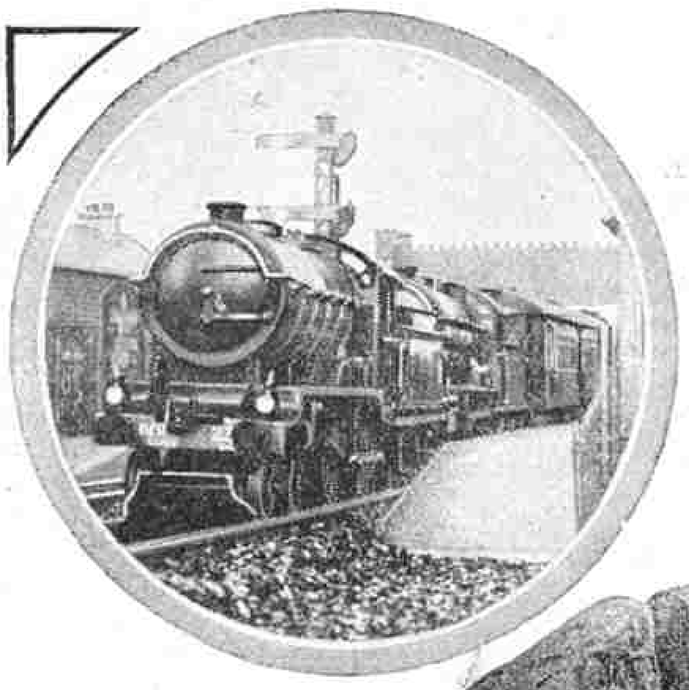
"L.M.S. Enginemen's M.I.C. Papers 1937"

(L.M.S. Magazine 4d. post free)

This booklet, the fourth of an annual series, contains reprints of articles published regularly during the past year in the "*L.M.S. Magazine.*" It is intended primarily for the use of those who are concerned with the running and repair of L.M.S. locomotives, but will appeal also to all readers of the "*M.M.*" who are interested in locomotives, and especially in those of the L.M.S.

The edition under review contains details of such parts and accessories of L.M.S. engines as brake controls, regulator valves, train heating apparatus, cylinders, valves and pistons. Care is taken to make clear the differences that exist between old and new standard designs. A particularly interesting section deals with water pick-up apparatus.

The leading dimensions of L.M.S. Standard Locomotives are given in a useful table in the centre of the booklet, and a list is given of the L.M.S. Motive Power Depots. Every part described is illustrated by means of a suitable line drawing.



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ROLLING STOCK A

You have spent many happy hours watching real trains at work. Now start a railway of your own and enjoy the thrill of operating Engines, Coaches, Wagons, Signals and Points on actual railway principles. It's the most fascinating pastime in the world!

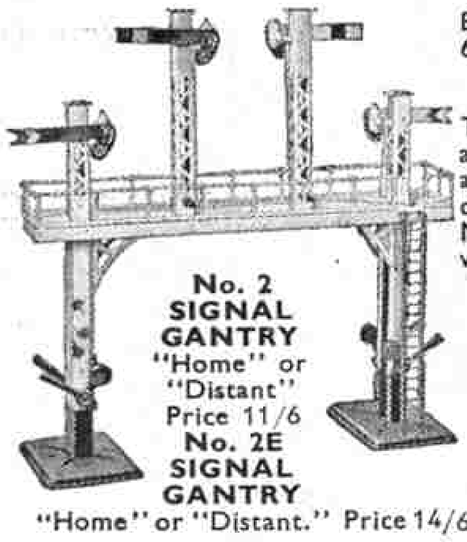
Hornby Trains have always represented the latest model railway practice.

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

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

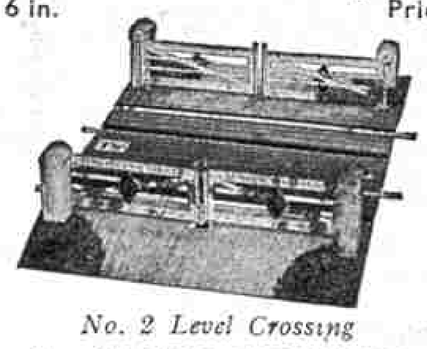
No. 2 CUTTING (CENTRE SECTION, STRAIGHT)
The addition of these Centre Sections enables a Hornby Railway Cutting to be extended to any length. They are intended to be used in conjunction with the End Sections (Cutting No. 1). Base measurement: Length 10½ in., width 6 in. Price 2/-

STATION OR FIELD HOARDING
This realistic accessory is suitable for the station platform. Price 3d.



No. 2 SIGNAL GANTRY
"Home" or "Distant" Price 11/6

No. 2E SIGNAL GANTRY
"Home" or "Distant." Price 14/6

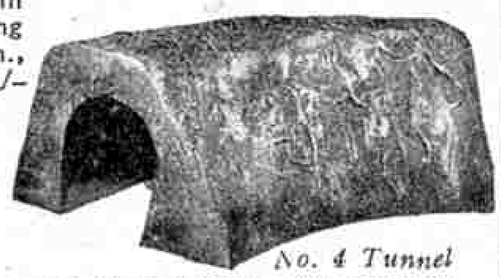


No. 2 Level Crossing

No. 2 LEVEL CROSSING
Measures 13½x10¼ in., with two gauge O tracks in position. Price 5/3

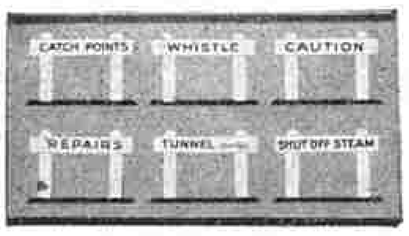
No. E2 LEVEL CROSSING (Electrical). Similar to Level Crossing No. 2, but fitted with two electrical tracks. Price 7/3

No. E2E LEVEL CROSSING
Similar to No. E2 Level Crossing but suitably fitted for electric lighting. Price 8/9

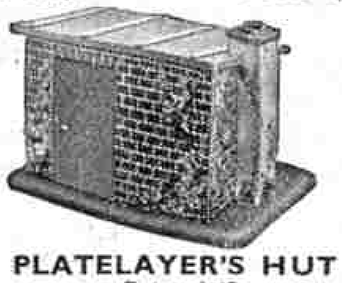


No. 4 Tunnel

No. 4 TUNNEL (CURVED)
Base measurement: Length 20 in. Width 9½ in. For 2 ft. radius track only. Price 3/9

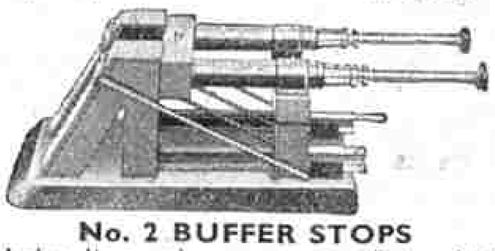


No. 8 RAILWAY ACCESSORIES
Notice Boards. Price 2/-



PLATELAYER'S HUT
Price 1/2

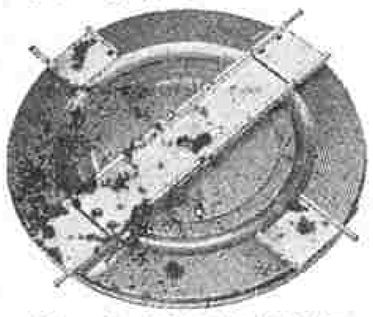
No. 1 BUFFER STOPS
(Spring type). Price 1/-



No. 2 BUFFER STOPS
(Hydraulic type). Price 4/11

LOADING GAUGE
(Illustrated). Price 1/11

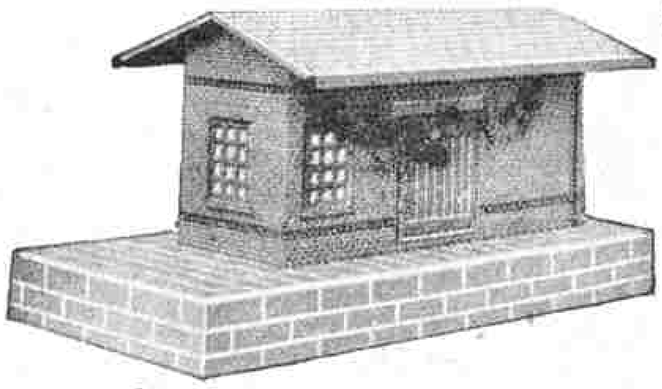
M LOADING GAUGE
Price 10d.



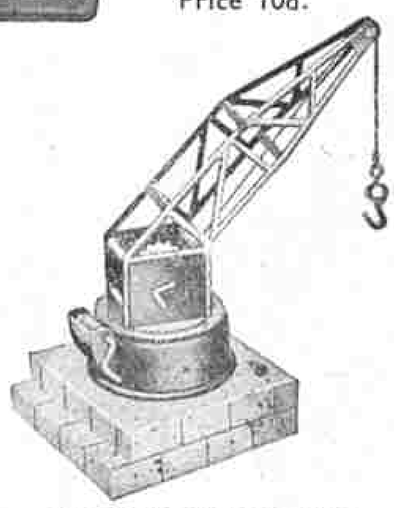
No. 1 TURNTABLE
(Illustrated). Price 1/11

No. 2 TURNTABLE
Price 4/-

No. E2 TURNTABLE (Electrical)
Similar to No. 2 Turntable, but fitted with electrical rails. Price 6/-



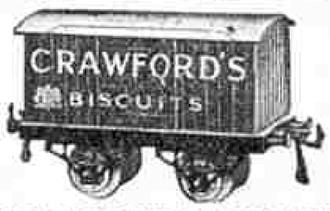
No. 1 GOODS PLATFORM
Length 13 in., height 6¾ in., width 6 in. Price 6/11



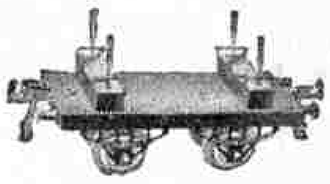
PLATFORM CRANE
Fitted with a crank handle and ratchet mechanism. Price 3/6

No. 2 STATION
Built up with three detachable sections. Named "Reading," "Wembley," "Ripon," or "Margate." Length 2 ft. 9 in., breadth 6 in., height 7 in. Price 8/-

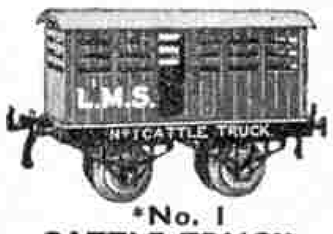
No. 4 STATION
Similar to No. 2 Station for dimensions and style but of an improved design, more strikingly coloured, and with accessible Booking Hall and Ticket Office Barrier. Price 10/6



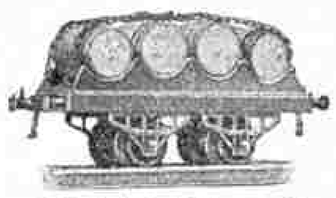
CRAWFORD'S BISCUIT VAN
Finished in red, with opening doors. Price 2/3



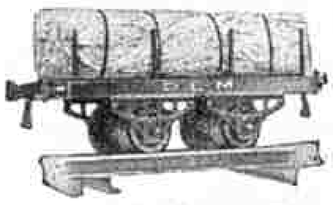
No. 1 LUMBER WAGON
Fitted with bolsters and stanchions. Price 1/3



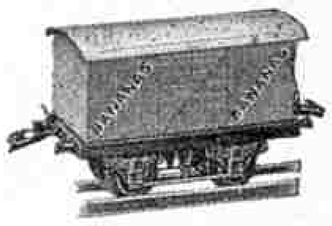
***No. 1 CATTLE TRUCK**
Fitted with sliding doors. Price 2/3



BARREL WAGON
An interesting model of a type of wagon used on Continental railways. Price 2/6

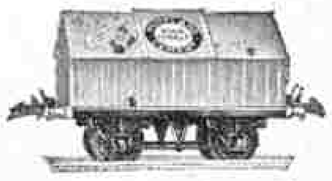


FIBRE WAGON
This is an interesting model of a type of wagon used in France and other Continental countries. Price 1/3



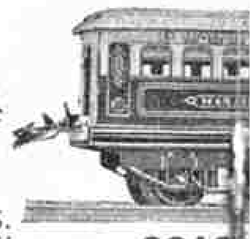
No. 1 BANANA VAN
An attractive model, finished in yellow and red. Price 2/3

GUARD'S VAN
In colours to represent L.M.S.R., L.N.E.R., G.W.R. or S.R. Price 2/6

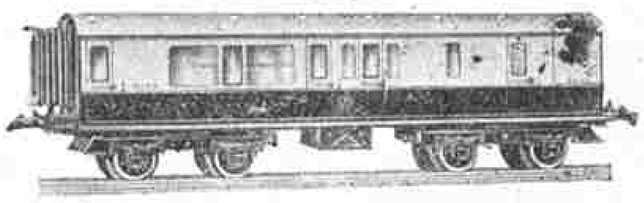


CEMENT WAGON
The door at the top opens. Finished in yellow. Lettered "Blue Circle" Portland Cement. Price 1/11

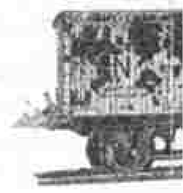
No. 2 HIGH CAPACITY WAGON
Finished in correct colours of G.W. and L.M.S. "Loco Coal" Wagons, or L.N.E.R. "Brick" Wagon. Not suitable for 1 ft. radius rails. Price 4/-



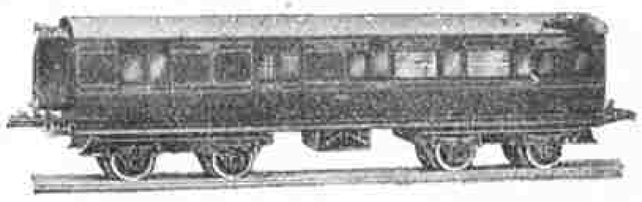
COAC
No. O PUL
Price 1



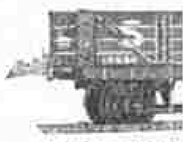
No. 2 CORRIDOR COACH
G.W. Brake-composite. Not suitable for 1 ft. radius rails. Price 7/6



No. O REFR VA
Lettered L.M.S. and S.R. Finish appropriate det



No. 2 CORRIDOR COACH
S.R. Brake-composite. Not suitable for 1 ft. radius rails. Price 7/6



***No. 1 W**
Price

* *In L.M.S., N.E., G*

MECCANO LIMITED, BIN

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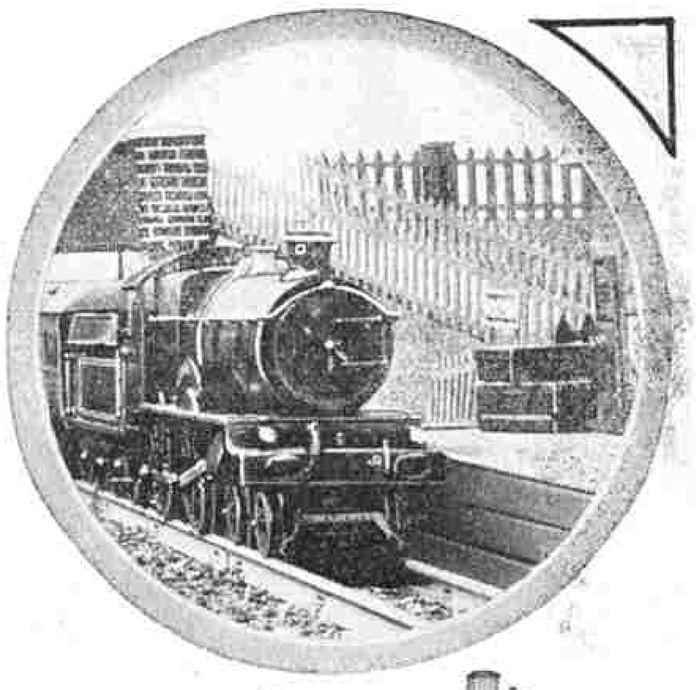
ND
KWORK

TRAINS

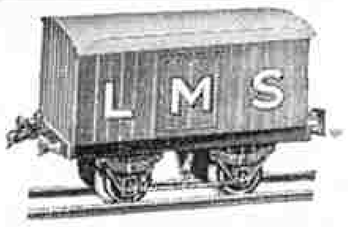
AND ACCESSORIES



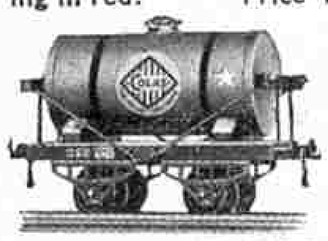
Designs are continually being improved and new items added so that the system is complete in practically every detail.

A selection of items from the splendid range of Rolling Stock and Accessories is shown below. Take Dad with you to your dealer's to-day to see these and all the others available—they must be seen to be appreciated.

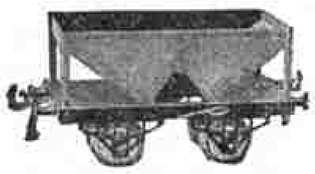
OIL TANK WAGON "CASTROL"
Enamelled green with lettering in red. Price 1/11



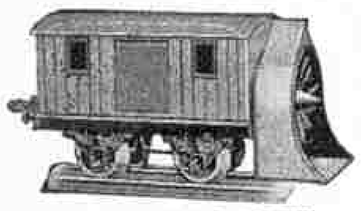
***No. 1 LUGGAGE VAN**
With opening doors. Price 2/3



BITUMEN TANK WAGON "COLAS"
Finished in blue. Price 4/-



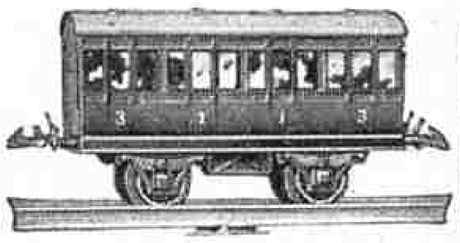
***HOPPER WAGON**
Mechanically unloaded. Finished in green. Price 3/-



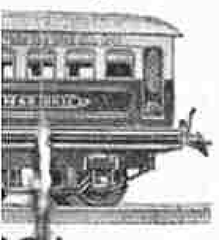
SNOW PLOUGH
With revolving plough. Price 3/11

BRAKE VAN
Finished in brown, with opening doors. Obtainable in N.E. or S.R. lettering. Price 2/9

***FLAT TRUCK**
Without Cable Drum. Price 1/6
Complete with Cable Drum „ 1/9



***COACH No. 1 PASSENGER**
Price 2/6



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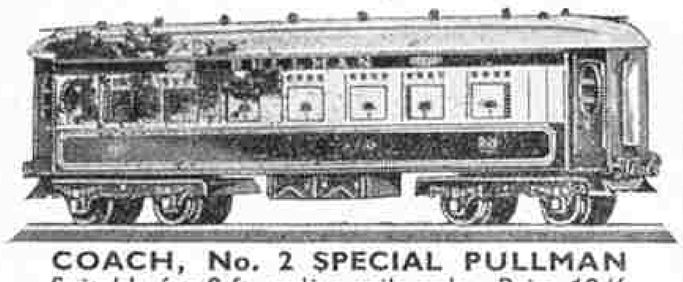
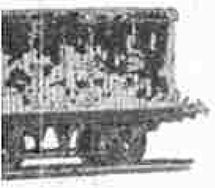
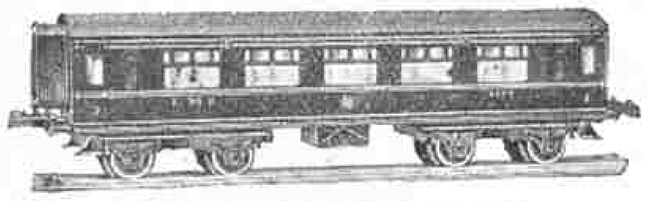


COACH, No. 2 SPECIAL PULLMAN
Suitable for 2 ft. radius rails only. Price 13/6



EFRIGERATOR VAN
M.S., G.W., N.E.
inished with the details. Price 1/6



No. 2 CORRIDOR COACH
L.M.S. First-third. Not suitable for 1 ft. radius rails. Price 7/6

I WAGON
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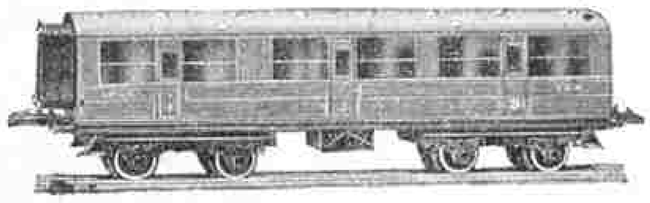
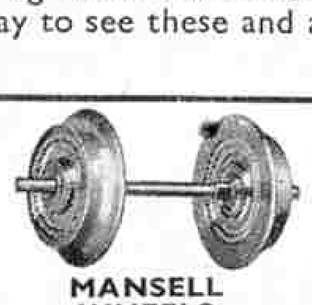


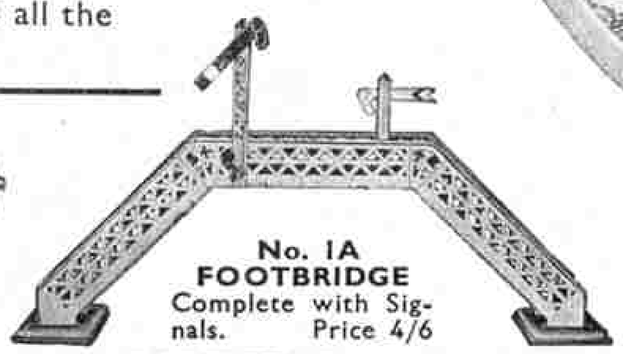
No. 2 CORRIDOR COACH
L.N.E.R. First-third. Not suitable for 1 ft. radius rails. Price 7/6

E., G.W. or S.R. lettering.



MANSELL WHEELS
These solid die-cast Wheels can be fitted to Hornby Coaches, Vans, etc.
Price per pair 3d.

DIE-CAST SPOKED WHEELS
As fitted to Hornby Tenders, and for Wagons etc.
Price per pair 3d.

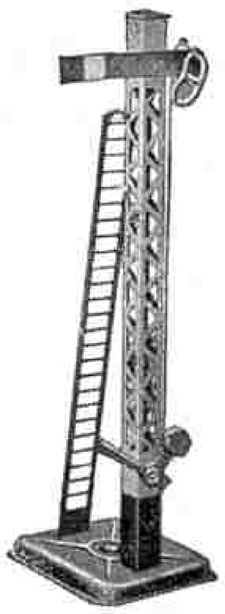


No. 1A FOOTBRIDGE
Complete with Signals. Price 4/6

No. 1 FOOTBRIDGE. Without Signals. Price 2/11

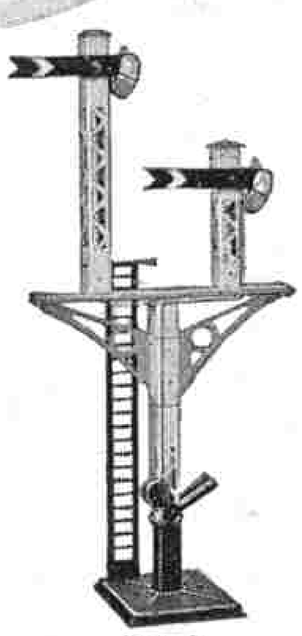
No. 1 RAILWAY ACCESSORIES
Miniature Luggage and Truck. Price 1/-

No. 2 RAILWAY ACCESSORIES
Milk Cans and Truck. Price 1/3



No. 2 SIGNAL
"Home" or "Distant."
Price 1/9

No. 2E SIGNAL
Similar to No. 2 Signal, but suitably wired for electric lighting.
Price 2/6

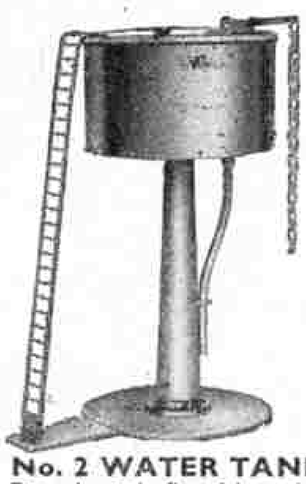


No. 2 JUNCTION SIGNAL
"Home" or "Distant." Price 5/-

No. 2E JUNCTION SIGNAL
Similar to No. 2 Junction Signal, but suitably wired for electric lighting.
Price 6/3

No. 1 SIGNAL CABIN
Price 2/6

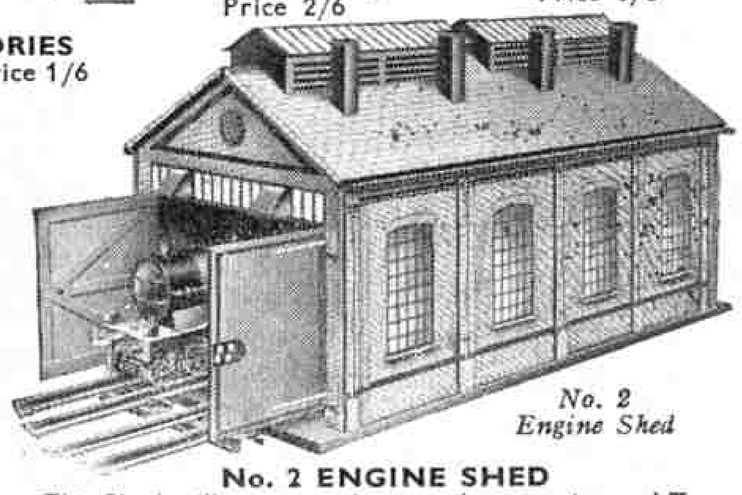
No. 3 RAILWAY ACCESSORIES
Platform Machines, etc. Price 1/6



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

No. 2E WATER TANK
Similar to No. 2 Water Tank, but suitably fitted for electric lighting.
Price 6/6

No. 7 RAILWAY ACCESSORIES
Watchman's Hut, Brazier, Shovel and Poker. Price 10d.



No. 2 Engine Shed

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

No. E2E ENGINE SHED
Similar to No. 2 Engine Shed but suitably fitted for electric lighting. Provided with electrical track.
Price 24/-

VIADUCT Price 6/9 **VIADUCT (Electrical)** Price 7/6
VIADUCT Centre Section only ... ... „ 4/6
VIADUCT (Electrical) Centre Section only ... ... „ 5/-

M STATION SET (7 pieces) Price 2/9
The components of the M Station Set can be purchased separately as follows: M Signal Box. Price 4d.
M Signals. Price 3d. M Station. Price 1/-
M Telegraph Pole No. 1. Price 3d. M Wayside Station. Price 8d.

NNS ROAD, LIVERPOOL 13.

Iodine from Seaweed

For many years the principal source of the valuable chemical iodine was the seaweed or kelp thrown up in huge quantities on the Atlantic shores of Ireland and the Hebrides by storms. The seaweed was burned to form ash, which was treated chemically to separate the iodine from it.

This process was very wasteful, much of the iodine escaping in the burning of the kelp; and for some time past iodine extracted from Chili saltpetre has been cheaper and sufficient in quantity to supply most of our needs. Now improved methods promise to make the kelp process more efficient, so that iodine yielded by it may be as cheap as that from South America. The central feature of this process is an electrostatic method of recovering iodine formerly lost by vaporisation in the fumes produced by the burning of the kelp.

In the new process selected seaweed is burned in large sheds, and the vapours are drawn into overhead pipes that lead to the electrical apparatus. This is called an electrostatic precipitator, and it works on similar lines to the device used for removing dust from industrial gases, one of which was described on page 952 of the "*M.M.*" for December 1934. It consists of vertical tubes through the centre of which run wires charged to a high voltage. This causes the iodine in the vapour to be deposited on the sides of the tubes, from which it falls when the central wires are discharged.

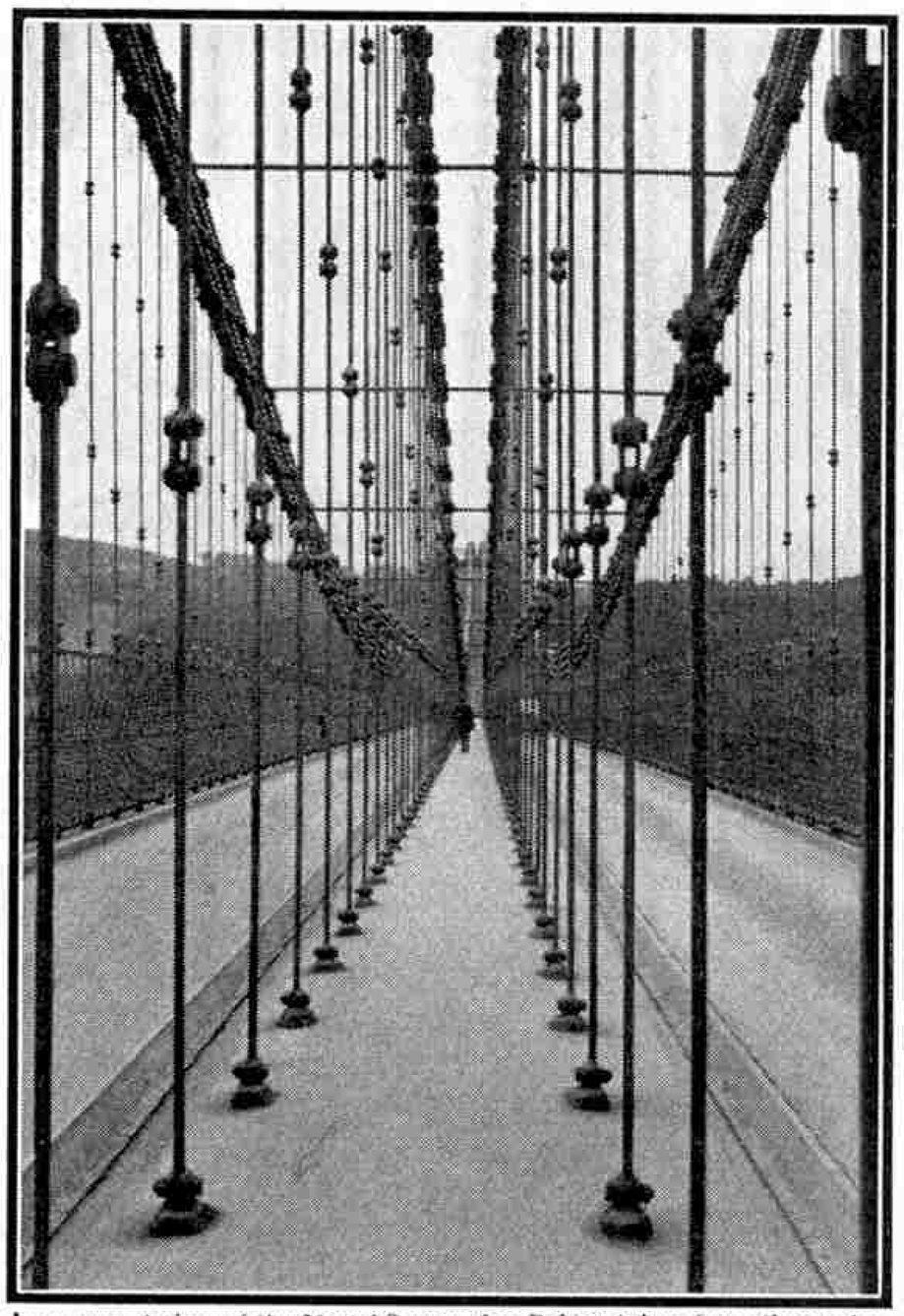
Machine to Test Bicycle Forks

To test the efficiency of a new fork that is to be incorporated in the Raleigh cycle, engineers of the company have constructed a machine that will reproduce 360 road bumps a minute. On this machine the fork was tested for eight hours a day over a period of seven weeks. This was equivalent to running some 400,000 miles. During the trial the fork received more than 7,250,000 blows but emerged successfully from the ordeal.

Road Surfaces Made of Molasses

An unusual surfacing material is used on the important road between Bangalore and Mysore in Southern India. Treatment with tar or bitumen is considered too expensive, and instead use is made of a mixture of water and molasses, the treacly material remaining after the refinement of raw sugar. This is poured over the metalled portion of the road and half-an-hour later, before it has completely dried, coarse sand is strewn upon it. The road is then opened to traffic.

The surface of such a road is smooth and dustless in the dry season, and remains hard even during the rains. Further experiments are being made with mixtures of molasses, lime and charcoal as surfacing material.



An unusual view of the Menai Suspension Bridge taken from the centre pathway at the north-west end, looking towards the mainland. Photograph by B. K. Rowell, St. Ives, Huntingdonshire.

Draining the Mediterranean Sea

Reference has previously been made in the "*M.M.*" to the plan put forward a few years ago by Herman Soergel, a German engineer, for draining the Mediterranean Sea. This immense project, which dwarfs every other engineering scheme yet contemplated, is again attracting attention. The proposal is to build a mighty barrage across the Straits of Gibraltar to prevent the inflow of water from the Atlantic Ocean, and to construct great canals from the southern shores of the Mediterranean to a large area in the Sahara Desert that is below sea level. The water from the Sea would then form a great inland lake in the desert, and irrigation schemes could be carried out to make the barren land as fruitful as a country in such a congenial climate should be. In addition immense areas would be reclaimed from the Mediterranean Sea itself, the countries that would gain most being Italy and Greece.

From an engineering viewpoint the Soergel plan is said to be quite practicable. It is claimed that the enormous expense it would entail would be amply repaid, for apart from the value of the vast areas of reclaimed land, the dams that would have to be erected would be the sites of power stations providing electrical energy for agriculture and industry. It is estimated that the barrage across the Straits of Gibraltar alone would produce 200 million h.p. a year.

Navigation would not be stopped if the plan were put into operation. Large lakes, with rivers flowing into them, would remain in the deepest parts of the Mediterranean, and these would be linked by canals. In addition locks would be provided at the Gibraltar barrage to give shipping access to the Atlantic Ocean, and special steps would be taken to adapt the Port Said entrance of the Suez Canal to the new low level of the sea.

Ages ago the Mediterranean Sea extended to Central Asia, far to the eastward. Thus it has shrunk from an ocean to an almost land-locked sea, and Soergel's plan would reduce it to a mere string of lakes.

Taxis in Ancient Rome

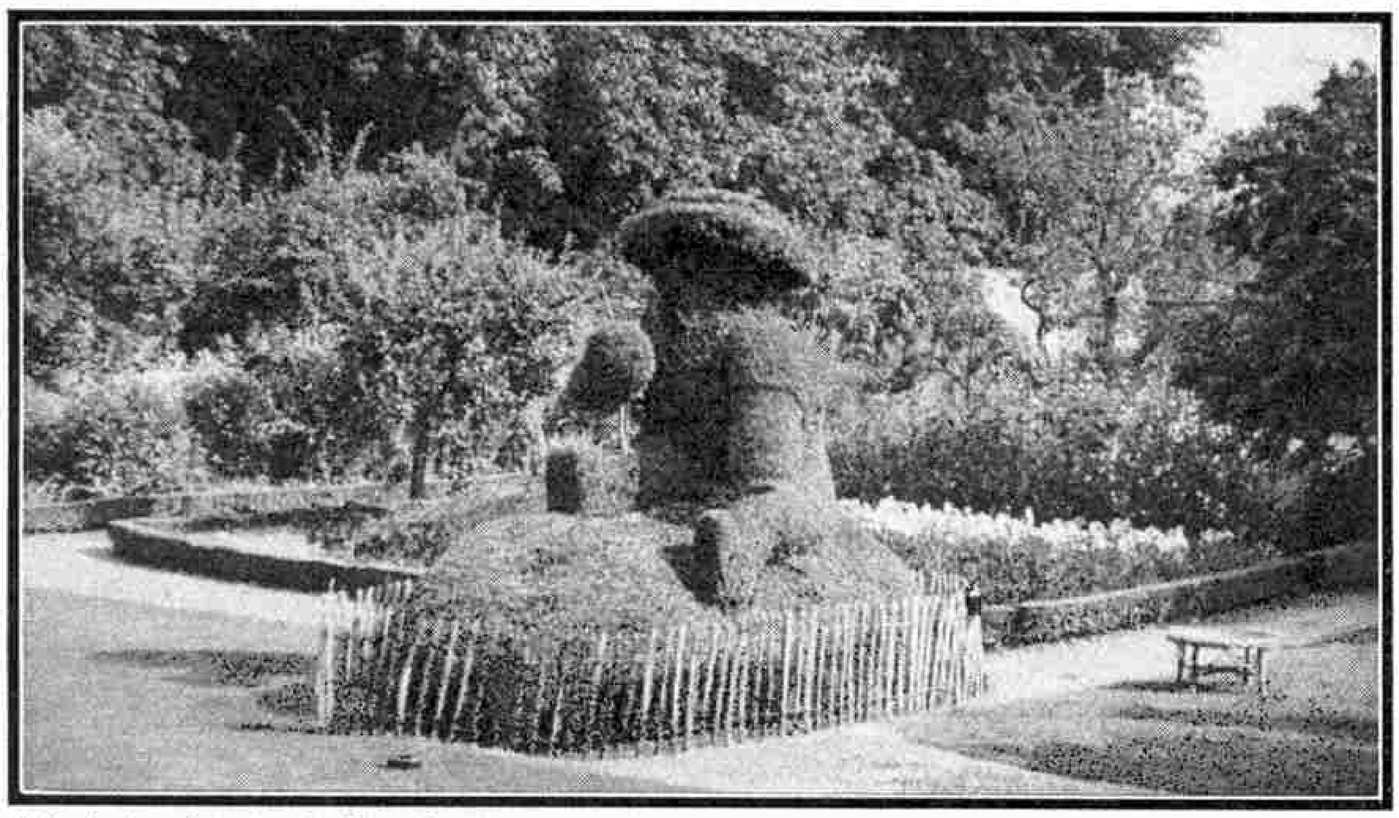
It will come as a surprise to many people to hear that the taxi was used in ancient Rome. This of course was not the motor vehicle that we know to-day. The word "taxi" is simply an abbreviated form of "taximeter," that is a device for registering the number of revolutions made by the wheels of the vehicle and so measuring the distance travelled.

Records show that the earliest Roman taximeter known dates back to 193 A.D. In that year a public sale was held of various articles belonging to a former Emperor, and among the lots was one described as a chariot fitted with an apparatus to indicate the distance covered by the wheels.

How Much is a Man Worth?

It has been estimated that the material of which the average man is made is worth about 7/6. The conclusion does not sound very flattering. It is reassuring to reflect that the sum covers only the value of a few chemicals, however, no account being taken of man's brain power and capabilities.

The material valued includes sufficient fatty matter to make seven bars of soap, as much iron as there is in a small nail, and about a tablespoonful of sugar. In addition the body contains enough phosphorus to make 2,000 matches, with small quantities of potash, magnesium and sulphur.



A bush cleverly cut and trimmed to represent a man on a haystack. It is to be seen at Wansford, Northants, on the Great North Road. Photograph by P. H. Lovell, London, S.E.22.

Making Jewellery with Indium

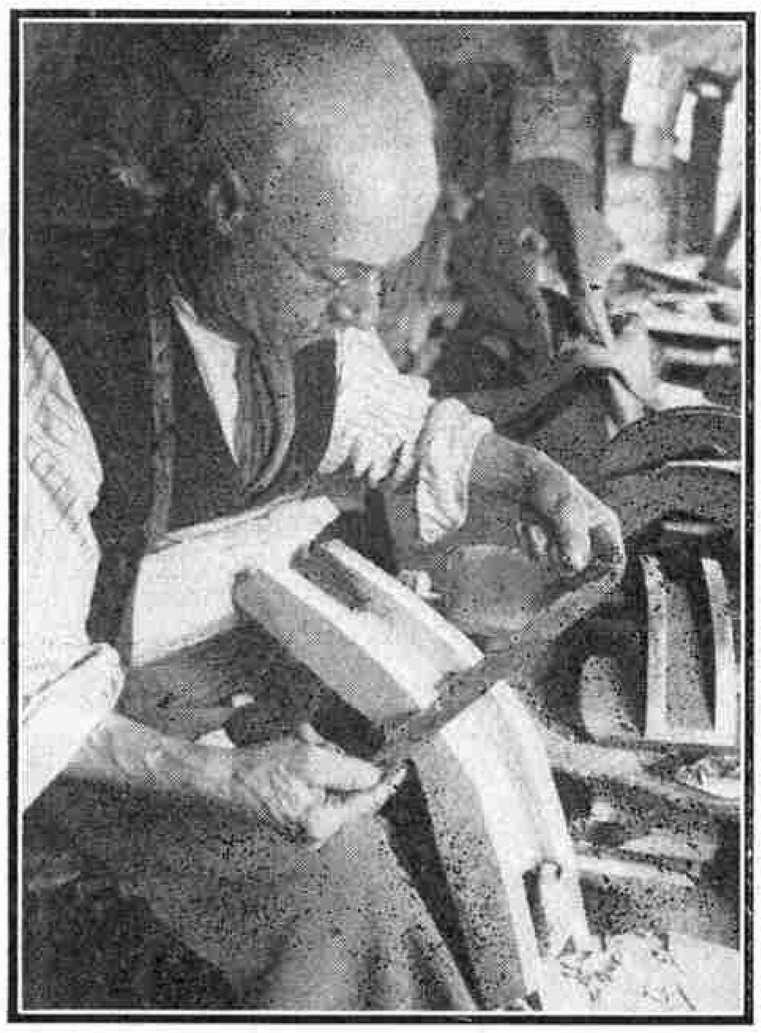
A few years ago, indium was a very rare metal little known outside the scientific laboratory, for the process of extracting it from its ores was expensive and could not be used on a large scale. A new method of extraction has now been discovered in America, however, and at the great zinc smelting plants in Arizona it is now produced at one tenth its former cost. It is a white metal with a low melting point, and it gets its name from the faint indigo blue lines that can be seen in its spectrum.

Jewellers and silversmiths will benefit particularly from the new developments, for experiments have shown that it can be used to obtain unusual colour effects. A fine sky blue colour is obtained when thin films of gold and indium are laid alternately on silver, and the article thus treated is heated to a certain temperature. Similarly beautiful rose coloured compound results on heating the metal with silver and the rare metal palladium, which is similar in many respects to platinum. It has also been discovered that "silverware" containing 42 per cent. of indium does not tarnish. In this process the indium is applied electrolytically, forming a soft coating that gradually penetrates into the silver when the article covered with it is heated.

Another possible use for indium is in the making of casts. An alloy of indium with bismuth, lead, tin and calcium has a melting point of 160 deg. F., which is little more than the temperature of the human body. This alloy therefore can safely be brought into contact with the skin when molten, yielding casts that can then be electroplated with silver or copper.

Testing 285 Coins a Minute

The Commonwealth Bank of Australia has recently installed an ingenious machine for detecting counterfeit coins. It works quickly and efficiently, dealing with 285 coins a minute. Each is tested electrically and compared with a master coin in weight, size and composition, and all that do not come within a narrow margin of the standard are unfailingly rejected. The machine indeed is so accurate that a silver coin with too large a proportion of silver in its composition was cast aside as a counterfeit although it was worth more than the standard coin.



The last of the Ripon saddletree makers. His work is described in the article on "Country Crafts in Britain," on page 156 of this issue.

Do We Read the Right Way?

An American professor has suggested that the eyes would be subject to far less strain in reading if the lines of print were printed alternately from left to right and from right to left instead of in the usual manner.

In reading an ordinary page of print the eye moves from left to right comparatively slowly, and then jumps back quickly to the beginning of the next line. If the books were printed in the new manner, however, the movements would be smooth and continuous, and it is maintained that this would reduce considerably the strain on the muscles of the eye.

Solving a Bus Problem

How to ventilate crowded buses effectively in winter is a difficult problem. If a window is opened the rush of cold air may give rise to discomfort and loss of temper, and to endure stuffiness is liable to other unpleasant results. Various schemes have been tried with good results and one of the most novel devices has recently been given a trial in Newcastle. There the ordinary wood strap-hanger rod of a bus was replaced by a perforated metal tube connected with a funnel at the front of the vehicle and sealed at the other end. When the bus was moving air passed down the tube and was distributed in small streams throughout its entire length. The plan is said to be very effective.

Traffic Photographs Taken from Balloons

The authorities of Milwaukee in the United States have adopted an unusual method of studying the traffic problems of their city. During the rush hours, balloons carrying cameras are floated at heights of several hundred feet above the busy streets. Each is attached to ropes controlled by one man, who manœuvres his balloon into position and exposes the films of the camera it carries by means of a remote control device. Later the films are developed and enlarged to any size required. With the plan views they yield in front of them, experts can study the traffic conditions at leisure, and work out schemes for making them more orderly and speedy.

Artificial Eggs

A German scientist has been successful in making eggs that in almost every respect are identical with those laid by the hen. Coloured casein mixed with an oil extract forms the yolk of the manufactured egg. The yolk is given the correct shape by means of a mould, and is then encircled by a perfect white consisting of dried albumen treated by a special process. Finally the shell is formed by pouring over the white an alkaline siliceous mixture. In appearance the result so closely resembles an ordinary egg that it is very difficult to distinguish between the real and the artificial product. The latter has two serious disadvantages, however. It cannot be hatched out, and it is so expensive that it is much cheaper to let the hen do the work.

Giant Chimney Saved by Vine

An unusual method of repairing a chimney stack has proved very successful at a power plant at Fort Oglethorpe, Georgia, U.S.A. A few years ago a crack appeared in the chimney. This gradually worked downward until it was nearly 30 ft. in length and almost 3 in. wide at the top, and it seemed certain that in a short time the chimney would collapse. Ordinary repair work would have been difficult, and eventually the engineer in charge adopted a suggestion to try planting slips of Florida vine at the base of the stack. These grew very rapidly, and in an amazingly short time they encircled the chimney and bound the bricks together. Now after four years the vine is 3 in. thick and the crack is almost closed.

Diesel Trains in the United States

Speeding Up Transcontinental Services

By Edward T. Myers

I DESCRIBED the pioneer three-car Diesel trains of the Union Pacific and Chicago, Burlington and Quincy Railroads in a previous article on page 218 of the "*M.M.*" for April 1935. In order to enable readers to appreciate further developments in Diesel traction in the United States during recent years it will perhaps be as well to remind them of the origin of these services. Some years ago air and road transport operators had attracted a great deal of business away from the railroads. In order to regain economically some of this lost custom by more efficient and attractive service, during the period of severe industrial depression, it seemed necessary to adopt a form of train totally unlike the conventional American main line equipment.

The Union Pacific Railroad desired to reduce considerably the time taken between Chicago and the Pacific Coast. At the same time the Chicago, Burlington and Quincy Railroad, usually referred to as the "Burlington Route," wished to effect economies on runs where trains of three to five cars were the rule. Tests were carried out by each company in conjunction with different firms of manufacturers of railroad equipment, and these resulted in the appearance of the Union Pacific "*M.10000*," a yellow and brown streamlined three-car Diesel-electric train with a bulbous nose; and the "*Zephyr*," also Diesel-powered, with three coaches constructed of stainless steel and finished in the natural colour of that metal, a style now very popular.

A striking view of the remarkable 17-car "City of Los Angeles" streamlined Diesel train of the Union Pacific Railroad. This and the similar "City of San Francisco" are hauled by the largest Diesel-electric locomotives in the world, recently built for this service. Photograph by courtesy of the Union Pacific Railroad.

The Burlington "*Zephyr*" train became a recognised type, and in three years the fleet of "Zephyrs" has grown from one to eight. The original "*Zephyr*" is still in service between Lincoln, Omaha, and Kansas City, and the "*Mark Twain Zephyr*" completed two years' service between St. Louis and Burlington on 28th October last. Two three-car trains known as the "*Twin Zephyrs*" that were put into service between Chicago and the Twin Cities of Minneapolis and St. Paul were replaced by trains of seven cars, and this number has now been increased to eight. On the Denver run to and from Chicago, the "*Denver Zephyrs*" are now 12-coach formations, but will shortly be strengthened by the addition of another coach. Burlington "Zephyrs" now cover 5,903 miles per day, or 2,154,195 miles per year, and the "*Mark Twain*" is credited with attaining the highest recorded speed, for a passenger-carrying Diesel train, of 122 m.p.h.

At the same time the original Union Pacific equipment has been considerably developed and there have been notable introductions in Diesel-operated streamlined trains on other systems. From experience gained with the two first trains it was possible to effect improvements in the third and fourth streamlined trains put into service on the Union Pacific. Thus in order to obtain the greatest riding comfort all the cars of the first trains, including the locomotive unit, were articulated. This led to a clash between convenience in operation and scientific progress, however. With a completely articulated train extra cars could not be added on days when traffic was heavy, nor could superfluous accommodation be removed at times when traffic was light. More important was the fact that a mechanical failure of any car would result in the whole train being laid up. So separate locomotives were built, but only partially articulated for subsequent trains.

The twin trains performing the "*City of Denver*" service were not built until considerable experience had been gained. It was found that although the public admired streamlined trains, passengers still demanded the roominess that was a feature of standard American steam-hauled stock. The pioneer streamline trains were low in build and limited in accommodation, however, and in designing the "*City of Denver*" trains the Union Pacific therefore set out to provide the maximum degree of luxury and comfort. Each train consists of 10 cars and two locomotive units developing together 2,400 h.p., with a total length of 864 ft. and accommodation for 182 passengers.

Every night the "*City of Denver*" covers 1,048 miles between Chicago, Illinois, and Denver, Colorado, in the remarkably short time of 16 hours. This includes eight station stops and entails an average speed of 65.5 m.p.h. The train is the fastest on the American Continent, for its run between Grand Island and Columbus, a distance of 62.4 miles, requires an average speed of 81.4 m.p.h.

The newest and the largest Diesel-electric locomotives in the world are those built recently for the transcontinental "*City of Los Angeles*" and "*City of San Francisco*" services. These giants can haul a 14-car train at a speed of 117 m.p.h. and they are required to make the trip from Chicago to Los Angeles in 39¾ hours. Each locomotive consists of three units furnished with six 900-h.p. engines and there are six electric generators to furnish the current required by the 12 high-speed traction motors.

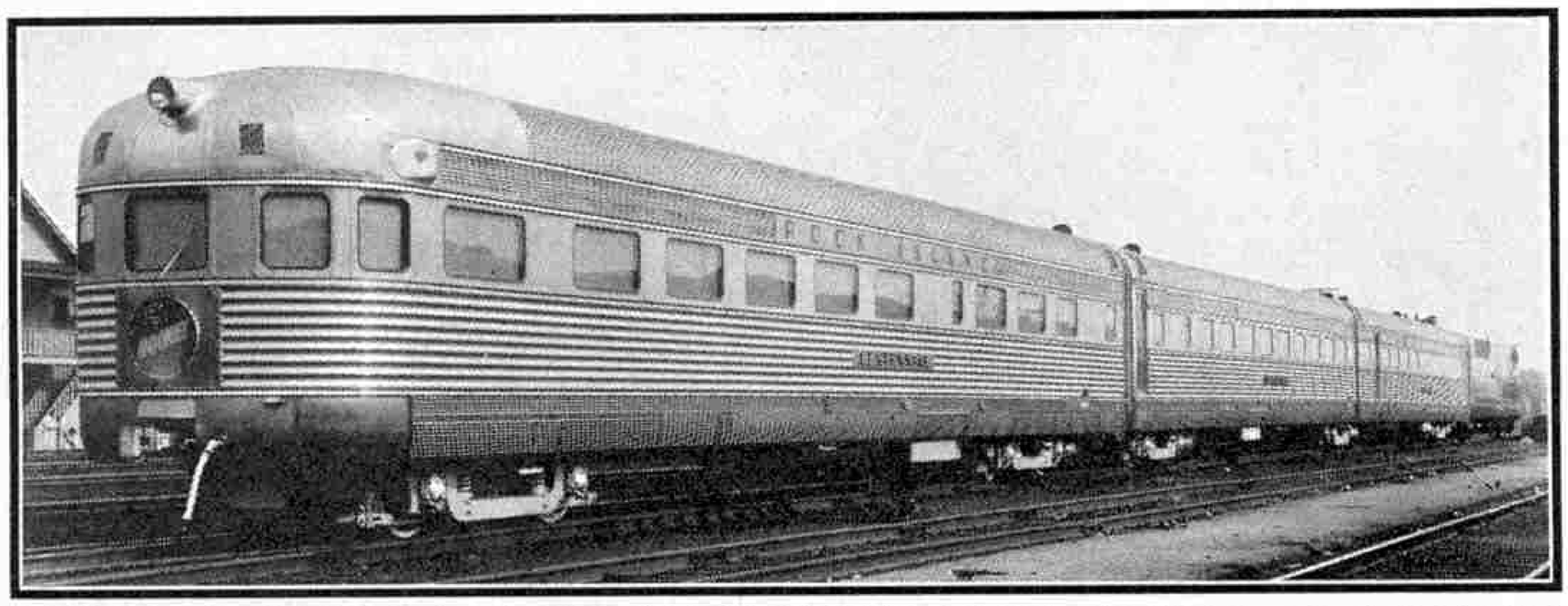
I was fortunate in being able to see these locomotives in course of manufacture in the new factory of the Electro-Motive Corporation at La Grange, Illinois. This is the first in the world to be devoted entirely to Diesel locomotive work. Let the reader accompany me in imagination, while I record my impressions of my visit to these shops.

Stepping from the quiet dignified offices into the erection shop is quite a thrill. The rat-a-tat of riveting machines, the hiss of welding, and the rumble and reverberation of heavy moving machines give the visitor a noisy greeting. Stretching out before him to a distance of 500 ft. is a vast expanse of strange forms, locomotives to be. Suddenly the building seems to shake and a rumble is heard. Overhead a 200-ton crane that spans the 100-foot-wide room is lifting a locomotive. The sight of this beautiful piece of engineering would gladden the heart of any Meccano enthusiast. The gantry moves on tracks near the skylights on either side of the long shop, and suspended from it near the "big hook" is the operator's cabin.

At the time of my visit there were down the assembly line six large locomotive bodies, each nearly 80 ft. long. These were the units to be grouped to form two three-unit locomotives for the new Union Pacific trains, "*City of Los Angeles*" and "*City of San Francisco.*" Diesel engines are manufactured in 600, 900, and 1,200 h.p. sizes, and locomotives may be built up from these units. Parts are standardized for maximum interchangeability. At the moment, the 900 h.p. size is most popular, for the use of two of these per unit allows a favourable distribution of weight in the locomotive. To keep the unit balanced and also as light as possible, weight

distribution is very important. Welding is largely used in constructing the locomotive bodies. This gives great strength with little superfluous weight, and I was interested to see that even the steelwork supporting the factory building was welded.

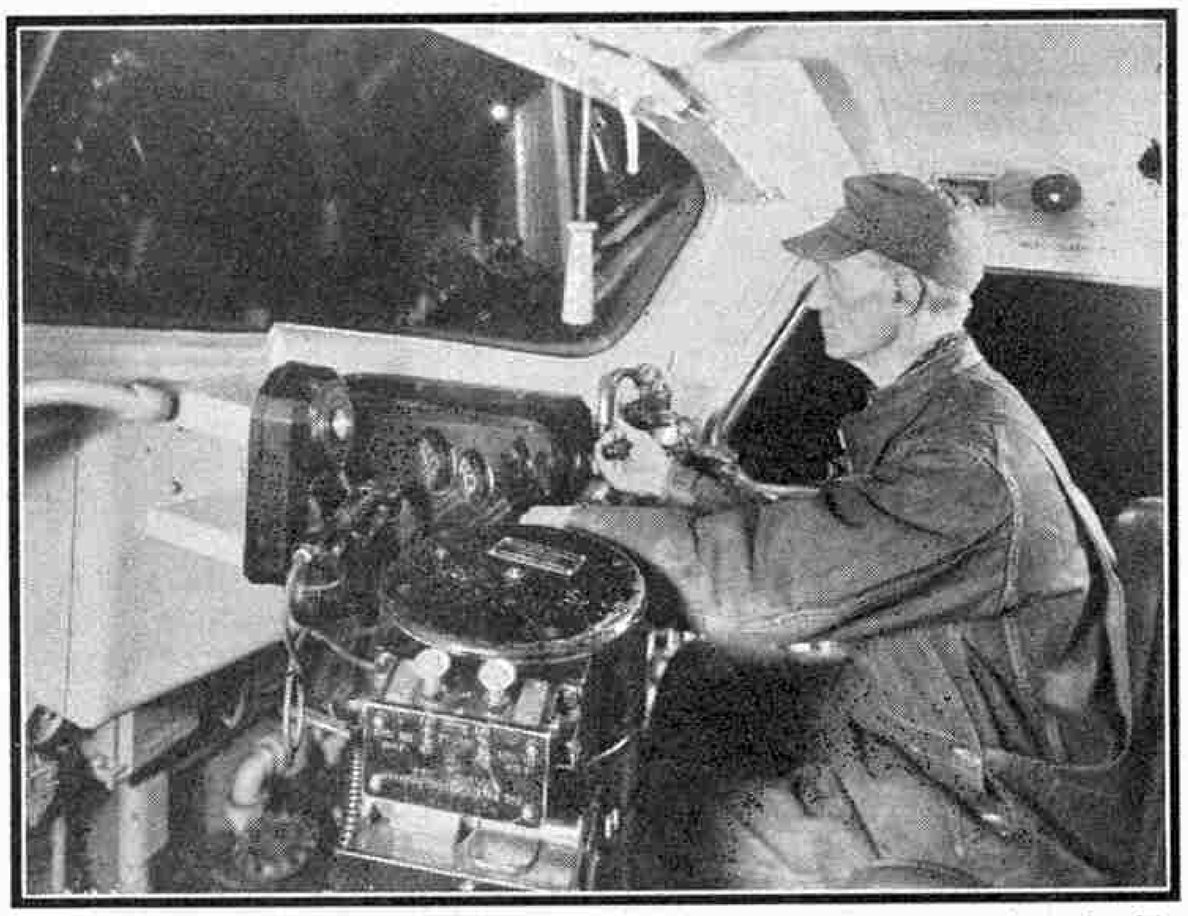
Recent changes in the locomotive design were pointed out to me. The radiators for cooling the engines have been removed from the front. This removal at first seemed illogical, for in their original position a natural blast of air is provided by the motion of the train, as in the case of a private motor car. Experience has shown that snow and ice filled the radiator grill and blew into the engine room in winter, however, and in summer much dirt and sand came in. In order to alleviate these conditions, louvres are now placed about half-way along the locomotive casing. Fans draw the air in through the radiator grill into the engine room, where part of it is drawn into the motor. This proved a happy solution to the snow and ice problem, but some dirt still came in. The parent company, General Motors, had employed air cleaners on their motor cars, however, so modified forms of these were fitted to the Diesels.



A trailing view of a United States streamlined train showing typical stainless steel construction. The train is one of the "Rockets" of the Chicago, Rock Island and Pacific Railroad, to whom we are indebted for this photograph.

One could not help being impressed by the factory. Here was a concern turning out railway locomotives on a quantity production basis. Components required for building up the locomotives were brought from adjacent departments to the assembly line. At one side were huge piles of finished electric traction motors. On another were dozens of brake cylinders. Although the Electro-Motive Corporation tries to make as many of the parts as possible in order to keep the price of the finished locomotive down, electrical and speciality parts come from standard long-organized equipment firms. When a locomotive is completed, the company is quite certain that it will run as planned, for all parts have been thoroughly tested, but a few trials are made on their private tracks in case any minor adjustments are needed in the electrical equipment.

There is no better place in which to see how cars for streamliners are manufactured than the works of the Pullman-Standard Car Manufacturing Company. At the time of my visit the aluminium cars for the new "Cities" were being assembled. These are the longest trains in the world, their 17 cars making up a length of 1,291 ft. or over one-fifth of a mile, and they are pulled by a three-unit locomotive of the type to which I have already referred.



In the cab of a streamlined Diesel locomotive. The driver sits comfortably at his work with all controls grouped within easy reach, and he has a splendid view of the road. Photograph by courtesy of the Union Pacific Railroad.

The Pullman Company has by a process of development brought design to the point where the cars are assembled from parts, as from a huge Meccano Outfit. In one department underframes were being assembled. These consist of a strong central longitudinal girder, or "keel," of aluminium alloy, with lateral cross-pieces to support the body. The end sills and two of the important interior lateral pieces are of steel for the maximum strength and safety.

Not far away riveters were assembling die-cut plates of aluminium for the car sides, and a finished car side was close by for easy inspection. Windows were die-cut in the sheets, which were riveted together by "Huck" rivets at all points except those where standard type hot-driven steel rivets were required. A "Huck" rivet looks like a small nut and bolt. It is worked cold, a special pneumatic tool driving on the circular "nuts" from the outside without any of the backing up of the head of the rivet usually necessary.

In another part of the shop, the completed roofs were stacked. They were properly curved ready to be riveted to partially-erected cars, which stood on old "shop" trucks and appeared more like ghosts of the past than new cars! A little paint and the bright window sash immediately brought out the modern streamlined appearance, however. These cars have straight sides in place of the sloping sides of the tubular bodies of previous aluminium streamliners. They are about 70 ft. long, as are those of the *"City of Denver,"* while the non-articulated cars for the *"Super Chief,"* made by Edward G. Budd Manufacturing Company, Philadelphia, were nearly 80 ft. long.

In the earlier streamlined cars, the body sheeting was continued under the car. With a return to the underframe type of construction this is not necessary and is undesirable from a maintenance point of view, so only a partial false skirt is provided. The engine trucks are thus left clear for easy inspection instead of being covered by a streamlined apron.

The interiors are finished with painted pressed wood panels trimmed with aluminium moulding, and there is a two inch layer of glass wool insulation between the exterior metal and the interior panels. Under the bright modern linoleum floor covering is a sound-deadening layer. All passenger cars are supplied with refrigerated filtered air in summer and with warmed conditioned air in winter. It has therefore been necessary to provide double windows for heat insulation, and on the Union Pacific Diesel trains, the main sashes have hermetically sealed glass in order to avoid condensation of moisture between the two panes.

Articulation is now applied most frequently to pairs of cars in order that trains may be made up according to traffic requirements. Articulation necessitates shorter cars as the distance between truck centres can be increased but little. Where couplers are required, it is customary to employ the tight-lock type, with rubber draft gear. Previous American practice on passenger as well as freight trains has been to loose-couple the cars with friction draft gear to take up the shock of starting. While this assists a locomotive materially in starting a heavy train, since only a few cars are started rolling at one time, it jolts the passengers rather badly on occasions. A skilled engineer, however, can take up this slack in such a manner as to permit a smooth start. Roller bearings, and most of the new trains are equipped with them, greatly reduce the starting friction and lessen the danger of overheating or of hot boxes.

The first of the 5,400 h.p. locomotives for the City services was exhibited in Grand Central Terminal, New York, in December last. To inspect a typical Diesel streamliner which is being exhibited for the first time is a distinct thrill. Walking alongside the locomotive, one is impressed by the suggestion of tremendous power. Its exterior finish and sweeping contours emphasize smooth speed and great strength, the fleet body lines flowing up the pilot apron, up the curved front bearing the road's insignia, across the hood, and up the characteristic windshield. In my next article I hope to describe a run on the *"Abraham Lincoln,"* a streamlined Diesel-hauled train of the Baltimore and Ohio Railroad.

Gathering the Cork Harvest

The Story of a Unique Industry

By A. C. S. Wright

CORK is one of the few vegetable products for which it is not easy to find synthetic substitutes. In its more familiar guise as a stopper for bottles, it competes successfully with rubber and glass and metal caps; but it is in the field of insulation and linoleum manufacture that cork can really be said to come in to its own. It is also valuable wherever great buoyancy and lightness are required.

It gains its resistant and resilient properties from the innumerable watertight and airtight gas-filled cells that are its sole components. Each cell has the cellulose wall impregnated and coated with a natural fat called suberin, which on drying becomes a very effective varnish. More varnish deposits between each cell hold them all together, giving the whole block a certain amount of pliability. This type of structure—a compact mass of small watertight, gas-filled units—gives the buoyancy, lightness, and great resistance to temperature fluctuations that we are accustomed to associate with cork.

Cork cells are formed on the outer bark of the trunk and branches of most common trees; but it is only in the Cork Oak, *Quercus Suber*, that we find them developing into a layer thick enough to make it worth our serious attention from a commercial point of view. In the Cork Oak the layer of cork may reach 6 in. to 8 in. in depth, although in actual practice it is stripped off long before reaching this thickness.

Separating a panel of cork six feet in length from the trunk of a Cork Oak. The sheet is gently levered off with the handle of the machado, or curved knife, with which the panels are cut.

The Cork Oak grows in the hot, arid regions around the western end of the Mediterranean, particularly in Portugal which, although only a small country, produces over 40 per cent. of the world's cork. The total annual production of cork is well over 300,000 tons, and quite a lot of cork is needed to make up a ton. The oaks are allowed to grow naturally and they form an open type of forest with trees reaching up to 50 ft. high.

The method of buying cork differs in each country. In Portugal, where there are many small holdings, dealers visit the owners and either purchase the cork crop after it has been stripped off the trees or, very frequently, lease that part of the forest for the purpose of stripping the cork themselves. Spain is still a country of big estates, and the cork is sold direct from these to the big firms, while in Tunis and French Morocco there is government ownership and the cork from the forests is disposed of at auction sales.

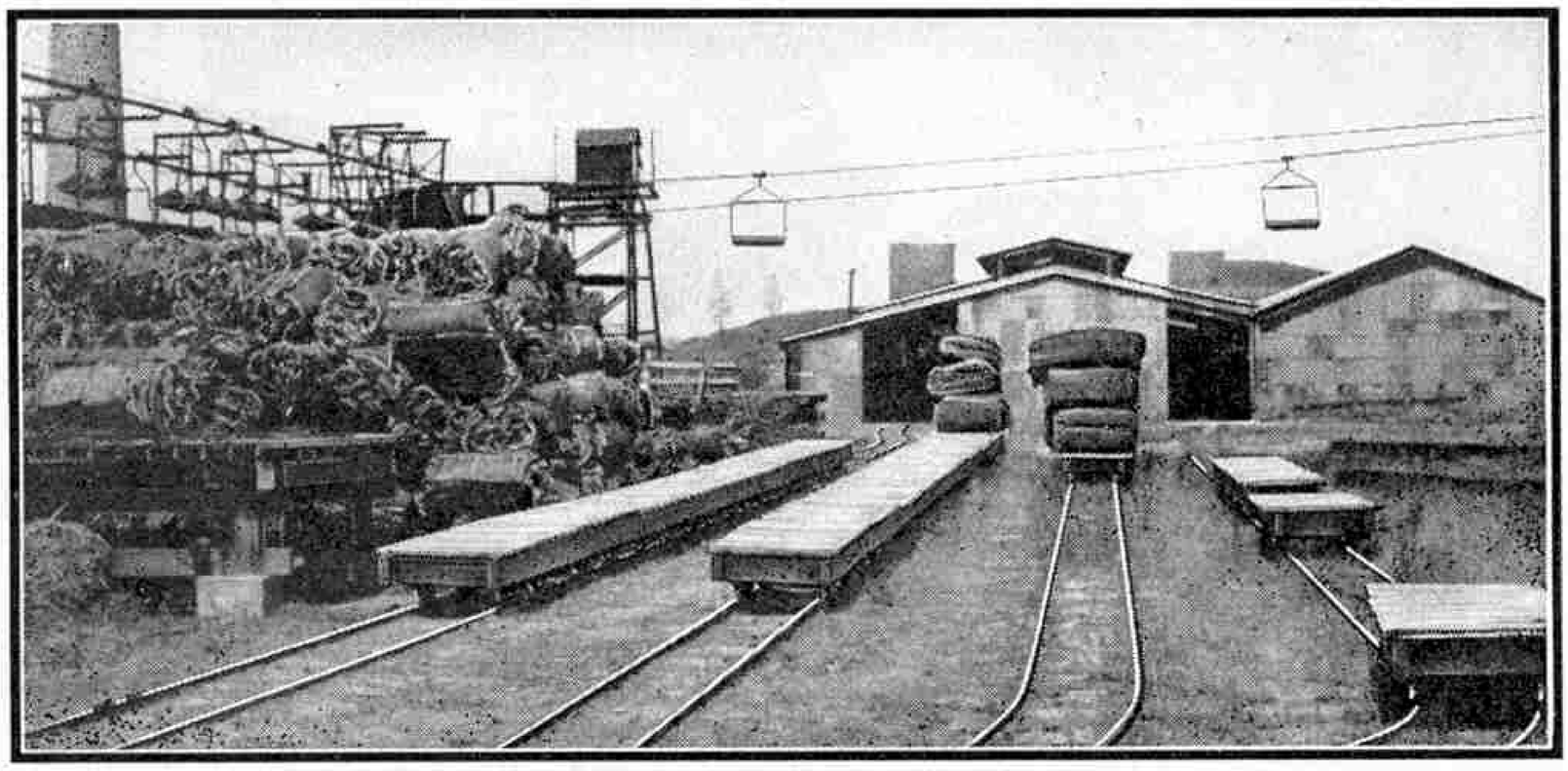
Despite the dry climate which the Cork Oak favours, the removal of the layer of cork from the trunk and branches appears to have no ill effect, and so soon as one year after the stripping a new coat of cork cells makes its appearance on the surface of the exposed inner bark. The growth of this regenerating cork is slow, and the tree will not be ready for a further strip until a period of nine years has elapsed.

In Portugal, the layer of cork begins to "give," that is to peel easily from the tissues of the inner bark beneath it, at the end of May. Gangs of men are recruited from the villages in the forest, marshalled under an experienced foreman, and set to work in the locality, stripping the cork off all the trees that bear a sufficient thickness. No cork may be stripped from trees less than 30 years old, and it is illegal to strip trees having less than nine years' growth of regenerated cork. For two months the men live a nomad life in the forests, stripping the trees as they go, and making temporary bivouacs or camps in each locality. These crude headquarters are constructed largely out of panels of cork, which serve for such diverse articles as pillows, chairs and basins for washing in. The men work from sunrise to sunset, with two hours' rest in the heat of the day—the "siesta"—and earn the equivalent of 11d. a day.

The actual stripping of the trees is done with a *machado*, which is a cross between a tomahawk and an ordinary household hatchet, with a sharp, curved blade and a tapering, wedge-shaped handle. The cork on the trunk and branches is cut into panels, care being taken to see that the cuts are not too deep, so as to leave the tissues beneath undamaged; and then each panel is gently levered off with the *machado* handle. The sheets of cork are collected into heaps and left in the Sun to dry, after which they are loaded into bullock carts for conveyance to a depot on the banks of a river—the first stage of their journey into gaskets, bath-mats, etc. When all the season's crop is gathered at the depot, and when the September rains swell the river, the cork is tied in bales and loaded on to sailing boats called *felhuas*, with long sweeps and a shallow draught, which bear the cork down to the factory at the river mouth.

The cork arrives at the factory only partly sorted, and after the boats have been unloaded by means of

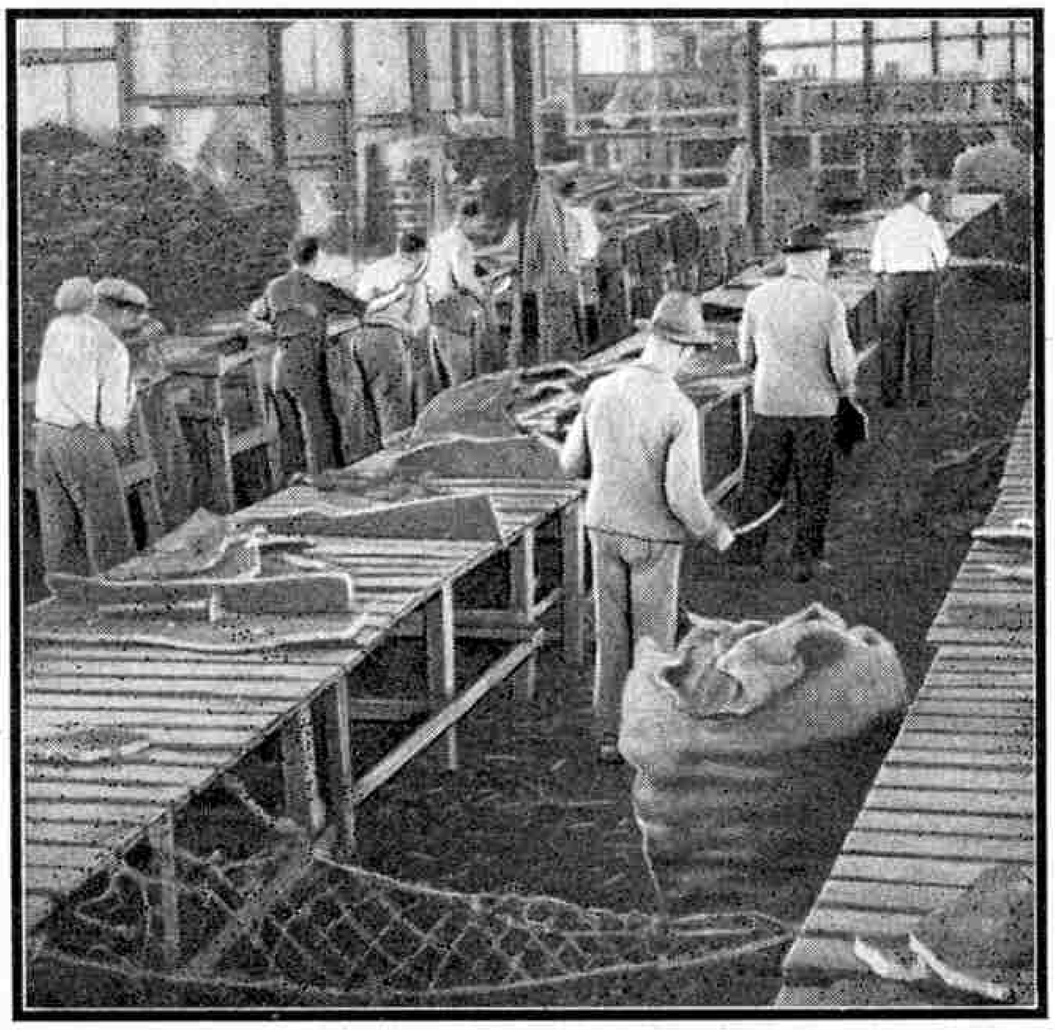
overhead trolleys on wire pulleys, it goes to the first shed where it is graded into first, second and third qualities, and *refugo*. The last type of cork is the poorest quality, and is sorted to one side and subsequently sent to be ground up. Later it is sold for about £9 per ton to grape exporters and linoleum manufacturers, or used in the manufacture of compressed cork mats, or even for tennis-court surfacing.



Aerial conveyors unloading cork from the boats in which it reaches the factory at the mouth of a river. The cork is placed on trucks in which it is taken into the sheds for sorting and grading.

The outer surface of the cork has a thin but very tough fibrous layer, which arises during the early days of the regeneration process on the tree, and which has to be removed from the ground cork. The method used is similar to that in winnowing cereals. A steady stream of ground cork is allowed to fall while a current of air of constant strength blows across it, resulting in the lighter cork particles being carried on to one pile and the heavier fibrous tissue falling undeflected.

The other qualities of cork, those not classified as *refugo*, are boiled in big copper or brick vats with salt, and this loosens the outer layer of fibres so as to permit their being easily scraped off, as well as removing any tannin in the cork. Incidentally, the salt for the process is obtained by evaporating salt water in shallow pans at the river mouth. The water is trapped during a high tide, and by building a mud wall to keep out other tides, the water in the pans is allowed to evaporate in the hot Sun, leaving behind a thin crust of salt which is scraped up and carried to the factory. After boiling the pieces of cork are scraped and dried, and then re-sorted and trimmed, finally being sent along to the planing shop where they are planed on both sides. The resultant flat slabs of cork may be used for making mats; or gaskets, corks, chives, etc., may be stamped out.



Cutting up the panels of cork, and sorting it into different grades.

Cork bottle-stoppers are of two types. If you look at an ordinary cork you will see a number of small pores running through the breadth of the cork. In the other type, called a chive, the pores run longitudinally from top to bottom through the cork. These pores, in the panel of cork as stripped from the tree, run straight through from the inner face to the outer face; from which it follows that a chive is made by punching directly into a piece of the planed cork, and a normal cork is made by punching sideways into the thickness of the panel.

Scraped but unplaned pieces of cork are used as insulating material in ships, taking the place of wool, and having the advantage that whereas wool tends to pack down with vibration, cork tends, if anything, to creep slightly upward.

The United States of America are very large importers of cork, either ground or raw. The annual despatch from Portugal and other parts of Europe is heavy, and is usually carried in 150 lb. bales as a deck cargo. Most of this cork is used in the manufacture of linoleum, and is ground up, cleansed, and mixed with wood flour plus a mineral filler. In separate vats, linseed oil is heated by steam coils and then whipped up. To this the cork mixture is added and the whole compressed, and then rolled out under pressure. The colouring matter is added before drying. To reduce the large annual imports of cork, a scheme was tried whereby cork trees were introduced into some of the Southern states, but despite the superficial similarity in climates, the experiment was not a success.

In the cork industry, the expression "planting for one's grandchildren" is very true. The young tree must be allowed to grow for 30 or 40 years before the first crop is obtained, and from then on only every ninth year yields a harvest. At the end of a century and a half the tree will have given about 14 crops, and this on the average is equivalent to about a ton of cork. The life of a healthy tree is usually continued for another century, with a yield of about another ton, although of rather inferior quality.

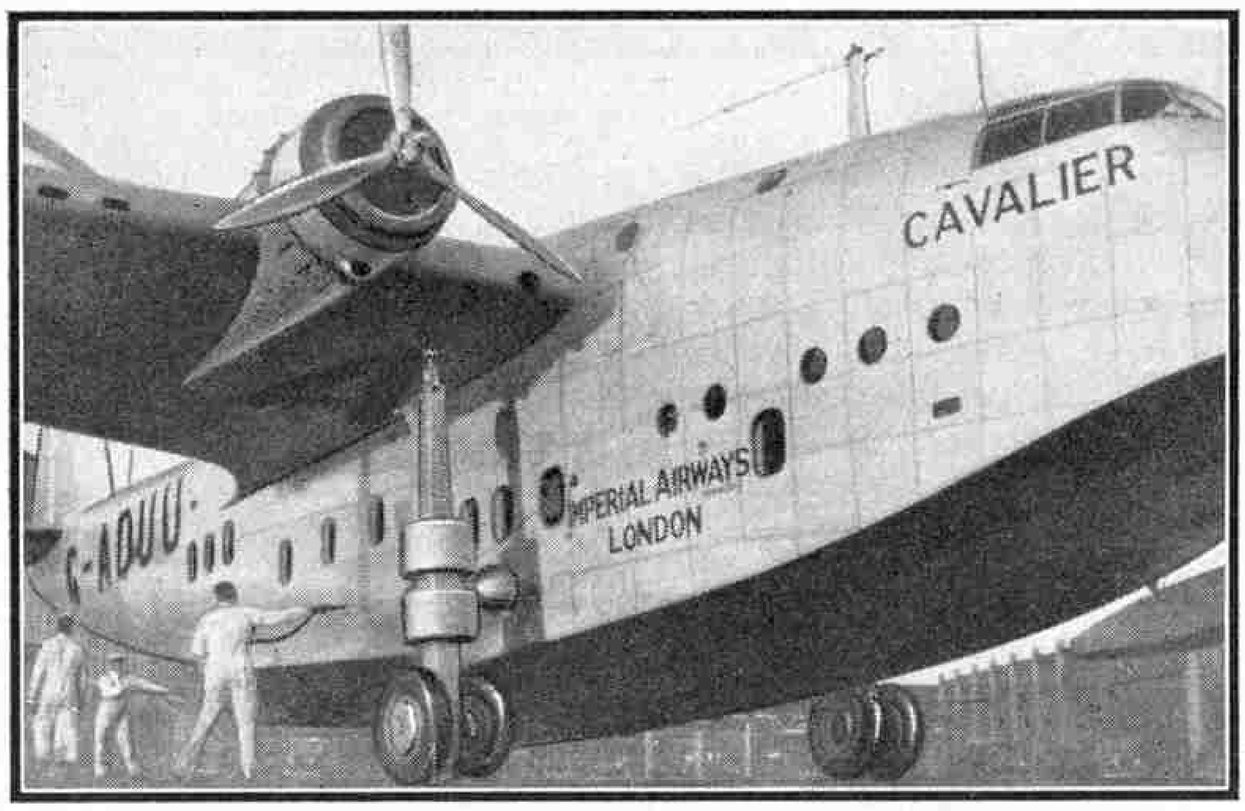
The cork industry is a very old one. Both the Greeks and the Romans knew of cork, and the latter made stoppers for their wine vessels from it. It did not come into general use for stopping bottles until near the end of the 17th century, however. Since then many other applications have been found for it, and to-day cork is employed in a wide range of industries in which its qualities make it invaluable.

FROM OUR READERS

These pages are reserved for articles from our readers. Contributions not exceeding 500 words in length are invited on any subject of which the writer has special knowledge or experience. These should be written neatly on one side of the paper only, and should be accompanied if possible by original photographs for use as illustrations. Articles published will be paid for. Statements in articles submitted are accepted as being sent in good faith, but the Editor takes no responsibility for their accuracy.

An Atlantic Air Service

On 16th June last year I was at Port Washington, the airport for New York, when the Imperial Airways flying boat *"Cavalier"* completed the first flight of the regular passenger service between the United States and Bermuda. The great flying boat appeared over the air base promptly at 4.15 after covering the 773 miles from Bermuda in the schedule time of 5½ hrs. She circled low over the crowd and alighted on the water, where she was quickly moored to a buoy. The passengers and crew then came ashore in a launch, and fast motor coaches took them to New York, 25 miles away. There the passengers went on their way, and the crew were received by officials of Pan American Airways, and entertained to dinner in honour of the occasion.



The flying boat "Cavalier" at Port Washington, U.S.A. The wheeled supports that carry the machine on land can be seen in position. Photograph by C. B. Wilding-White, Cambridge, U.S.A.

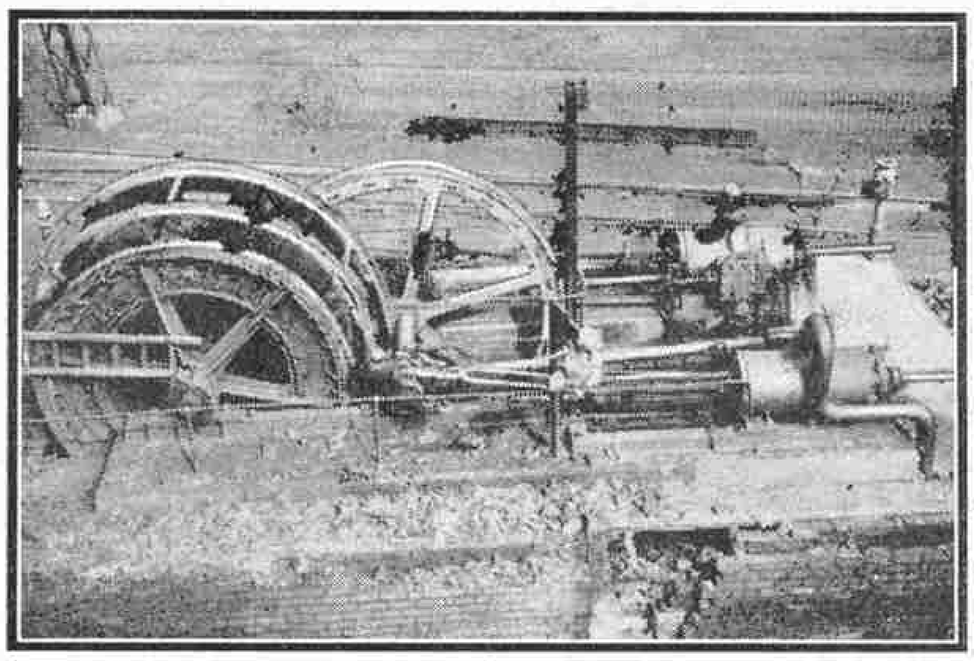
Meanwhile the flying boat was hauled out of the water and housed in a large hangar. This was done by floating three wheeled supports out to the boat and attaching them to her hull, two under the wings as shown in the upper illustration on this page and one under the tail. The boat was then towed ashore, and a tractor hauled it out of the water and ran it into the hangar.

"Cavalier" is one of the Imperial Airways fleet of Empire flying boats. She has two decks. The upper deck is reserved for the crew's quarters, and the lower one for passengers. Normally she has accommodation for 24 passengers, but in this service *"Cavalier"* carries only 16 people, the remaining space being occupied by the extra fuel required for the long flight across the Atlantic Ocean. There is a promenade deck on the *"Cavalier,"* on which passengers may stroll about, or look out of large observation windows, similar to those in a modern railway coach.

This service is being operated jointly by Imperial Airways and Pan American Airways, who are employing their Sikorsky S-42B flying boat *"Bermuda Clipper."* It began with two return trips each week, and soon proved so popular that it was increased to four round trips weekly. *"Cavalier"* now takes off from New York on Mondays and Thursdays, and the *"Bermuda Clipper"* on Wednesdays and Fridays. The fare for the flight between Port Washington and Hamilton Harbour, Darrell's Island, the base in Bermuda, is about £20 single and £36 return. Recently the New York air base for this service was transferred from Port Washington to Baltimore, which is much nearer the centre of the city.

C. B. WILDING-WHITE (Cambridge, U.S.A.).

A Veteran Colliery Engine



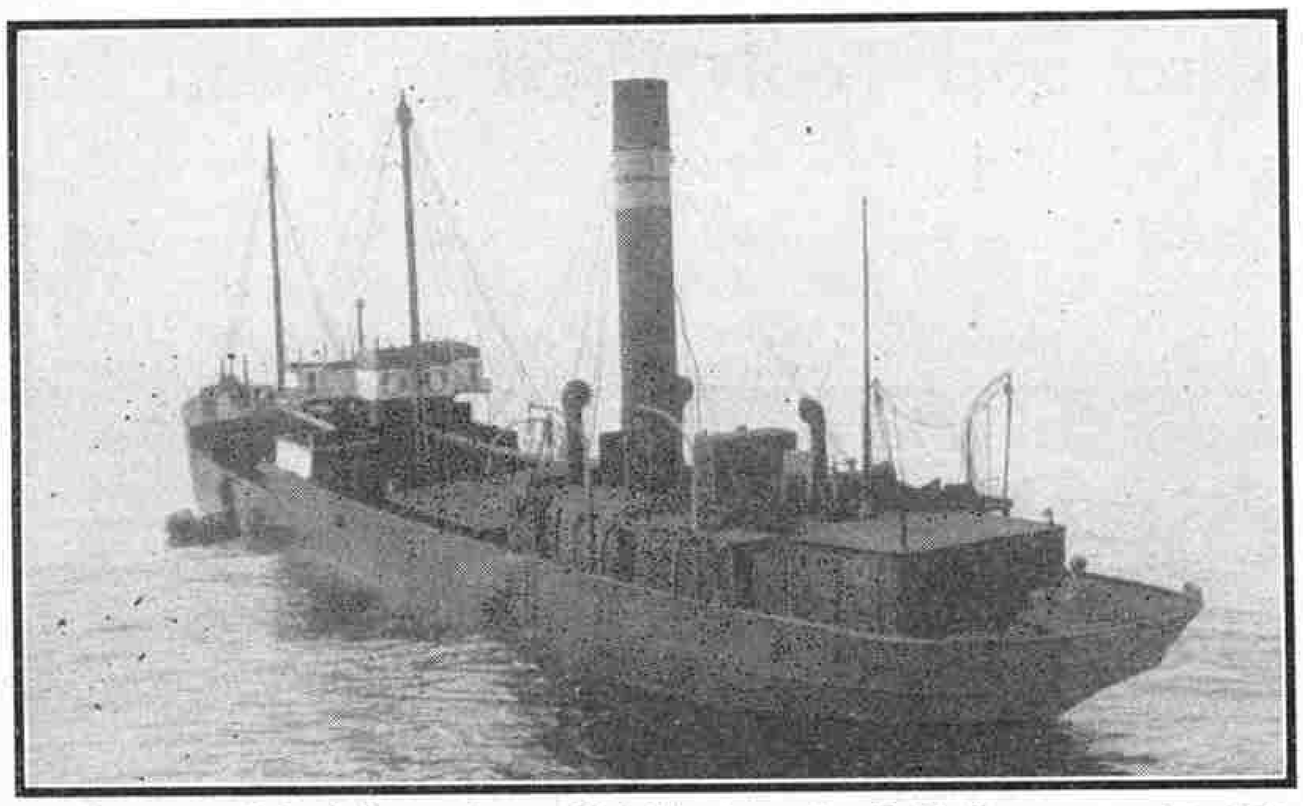
The old "jack" engine described and explained in an article on this page. Photograph by R. H. Etherington, Sunderland.

While on holiday last year, I came across the old "jack" engine shown in the lower illustration on this page. A jack engine is a geared engine for lifting heavy weights, and this particular mechanism was in use at a colliery until a few months ago, when it was broken up and replaced by an electric motor. It was employed as a "stand-by" for use in the event of the failure of the main winding engine, or to release the cage if this became fast in the shaft.

The engine must have been built nearly 100 years ago, for I was told that some of the oldest employees on the colliery could not remember its construction. One very old hand told me that it was in use when a large shaft was sunk nearly 80 years ago. R. H. ETHERINGTON (Sunderland).

In a Collision at Sea

I had a thrilling experience when on my way home on board a coasting steamer of 1,491 tons gross. The first night was fine and calm, and as there was no motion at all I slept well. Next morning I got up shortly after 8 o'clock, and on going on deck observed that there was a slight mist gathering. The mist soon became a thick fog, which clung to the ship and left all metal-work damp and cold. The steam syren commenced to sound mournful blasts and speed was reduced to "Slow Ahead," so that the ship was only creeping along. It was very eerie to sit in the dim light of oil lamps, with the muffled notes of warning sounding from above.



A small cargo vessel after being run down and holed in a fog, as described in the accompanying article. She sank before she could be beached. Photograph by L. Nash, Crail.

Suddenly there was a slight jolt, so slight that it did no more damage in the saloon than to upset one cup of tea. Other passengers and I hurried on deck, and on our port bow saw a small vessel faintly outlined in the fog. Steam was pouring from her, for the knife-like bow of the coaster had pierced her main steampipe. Our captain hailed her, and was informed that she was carrying 500 tons of coal. She had been struck in the engine room and was sinking fast.

One of our life-boats was launched and took off the wife and child of the captain of the damaged vessel. They were given our wireless operator's cabin. Some of the passengers, including myself, helped to pull the life-boat into its davits again. Meanwhile the crew of the other vessel had launched both their life-boats, and were filling them with their belongings, which included a bicycle, a perambulator and a wireless set. They rowed over to us, and were taken aboard.

After considerable manœuvring we took the sinking vessel in tow by means of a long hawser. We then headed for the nearest suitable point about 15 miles away, with the intention of beaching her, but about 1 o'clock, when we were still half a mile out, her stern was seen to be slipping under, and the tow-rope was immediately cast off. In less than 10 minutes she was right under. An explosion followed, causing a great spout of water in the otherwise calm sea. The vessel sank in nine fathoms of water.

We then turned towards our destination, where we arrived about 7 o'clock the next morning. There the cargo was unloaded and the boat was then dry-docked for repairs, for her bow had been badly twisted in the unfortunate collision. L. NASH (Crail).

A Strange Cargo

I saw a very interesting spectacle at Heysham Harbour, Lancashire, a short time ago. A circus was being unloaded from a vessel in which it had crossed from Ireland, where it had been touring. Various creatures in their cages were landed and put aboard a special train. The unloading was carried out efficiently, and I was particularly interested in the manner in which the elephants were landed. There were three of these and each in turn was brought ashore on a small platform, which was hoisted on to the quay by a crane.

The scene when the train had been loaded was almost indescribable. The elephants pushed their trunks out of the windows and "shook hands" with everybody, the sea lions were roaring, and the bears paced their cages restlessly. The hyenas were making wild noises, with the polar bears trying to outdo them. Then above all these noises the shriek of the guard's whistle was heard, followed immediately by an answering blast from the locomotive, and the train with its strange load pulled slowly out. N. H. SMITH (Horsforth).

An East Anglian windmill. The canvas sails can be furled, as shown in this photograph by J. D. U. Ward, Oxford.

Unusual Windmills

Some of the marshland windmills still standing in the Eastern Counties are not mills in the true sense of the word, that is they are not used for the milling or grinding of grain. They have waterwheels beside them, but these are not intended as an alternative means of turning millstones when there is no wind. Actually the waterwheels are turned by the sails, and their purpose is to transfer water from a dyke or stream into another channel. The combined windmill and waterwheel is thus used either for drainage or irrigation purposes.

One of these East Anglian "windmills" with a special purpose can be seen near Southwold. It is really an old salt pump that retains the framework of only two sails, and has not been used for over 14 years. It pumped water from the sea, about 100 yds. away, or from salt water dykes. An overhead gutter carried the water over a road and into large pans, where it was boiled until the water evaporated, leaving a layer of salt behind it in the pan. This was then collected and packed for sale. The business of salt production was combined with the provision of hot brine baths for the local inhabitants.

J. D. U. WARD (Oxford).

In Search of New Models

Machines and Tools Used in Road Making

IN these days of heavy high speed traffic there is great activity everywhere in road making and mending. In our towns and cities the laying of gas and water mains, electric cables or drains makes it necessary to break up roads and relay them, while existing roads often require to be given new surfaces and better foundations. In the countryside many entirely new roads are being constructed in practically all quarters. Wherever these operations are carried on, equipment suitable for reproduction in Meccano is brought into use, and it is great fun to build such models, especially those that can be put to work in imitation of the real thing.

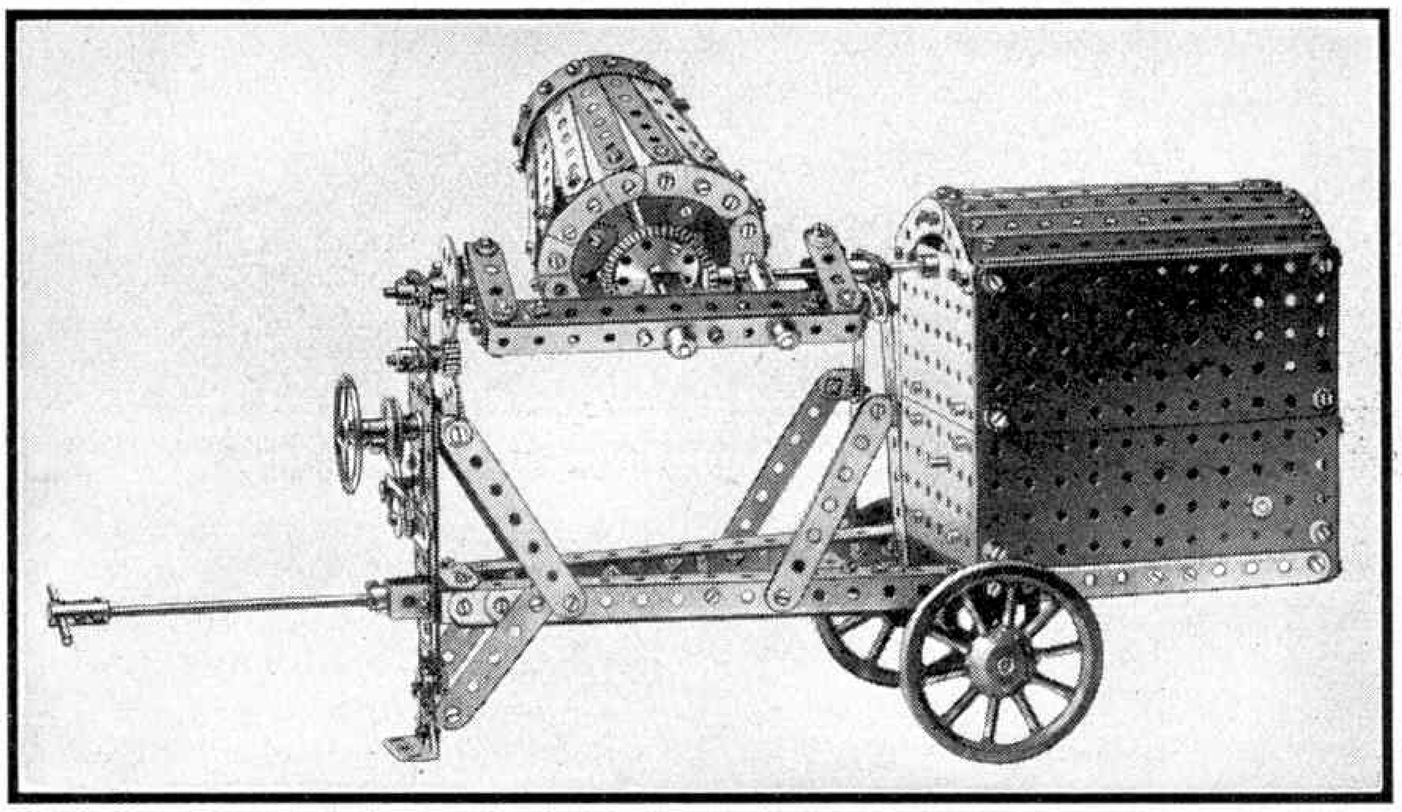


Fig. 1. A model concrete mixer that is driven by an Electric Motor and includes all the essential features of its prototype. It was built by H. Lee, Ardrossan.

Although many marvellous machines are used in this work there is still room for the workmen with spade or pick, and groups of figures using these tools make good subjects for simple and amusing working models. Some idea of the interesting effects that can be obtained in this manner is given in Fig. 3, which illustrates a very useful method of showing such models to the best advantage. The figures are mounted on a base, consisting in this case of a $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate, and are so arranged that strings can be used to give them realistic movement. The group illustrated includes one man who works away vigorously with his pick when the string attached to his back is operated by turning the handle, and two companions who show equal industry in shovelling away the spoil.

It is easy to build up figures of this kind by pivoting Strips together, and Pulleys make good heads. The movement that adds so much fascination to such figures can be provided for in a variety of ways. The simplest is to tie lengths of Cord to each figure, the point at which this is attached depending on the direction and type of movement. For example, in the model shown in Fig. 3 the Cord controlling the movements of the man wielding the pick is tied to the $3\frac{1}{2}''$ Strip that forms his body. The arms of the other workmen have to move, and in this case they are suitably pivoted and the Cord is tied to them, passing through holes in the base to a Flat Bracket pivoted to a Bush Wheel fastened on the Crank Handle. When this is worked the Cords are alternatively pulled and released, so that the body of the first figure and the arms of the others are pulled up and allowed to fall. The effect is surprisingly realistic. It would be easy to introduce a *Magic* Motor. The movement then would be uniform, and work could be speeded up in an amusing manner.

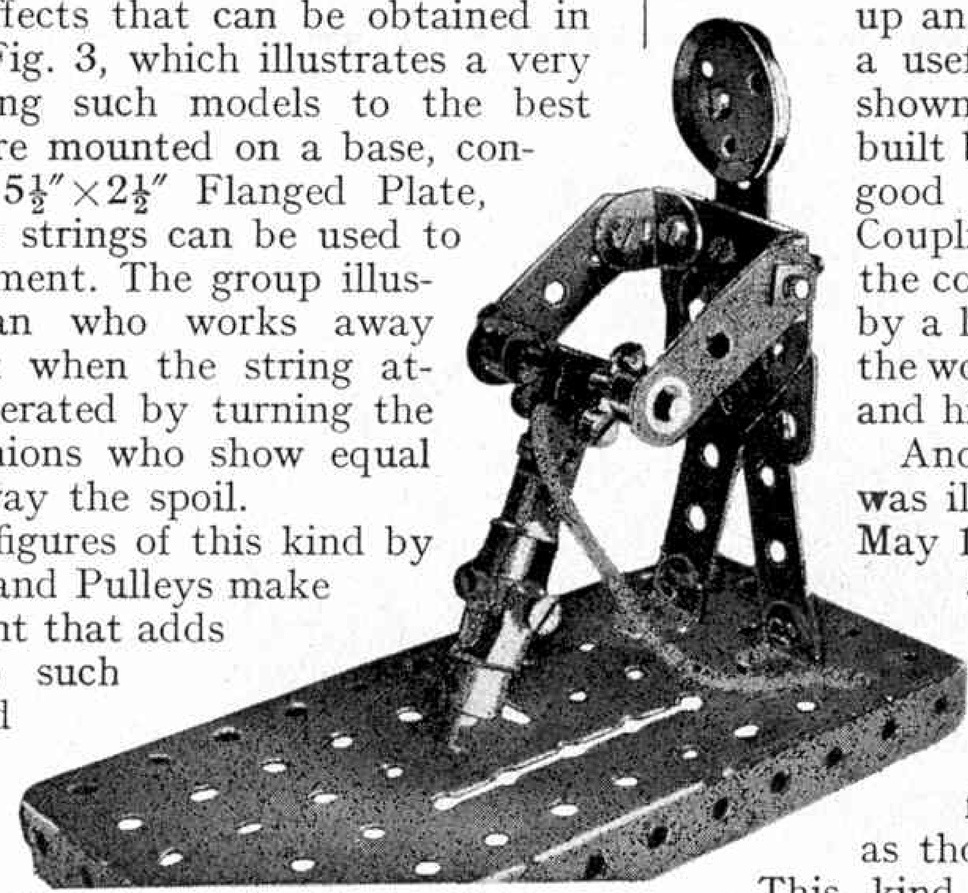


Fig. 2. At work with a Meccano drill. This model was built by J. Bailie, London, N.11, and requires comparatively few parts.

A good working model of this kind can be made of a workman using a pneumatic drill or road breaker. These tools are used for breaking up old road surfaces when these are to be renewed, or when excavations are necessary for some purpose, and a realistic model can be made up from even the smallest Outfit. The figure can be constructed in a similar manner to those shown in Fig. 3. Double Angle Strips fitted with Rods to form the handle and bit make up an easily-built but effective model drill, and a useful alternative method of construction is shown in Fig. 2. The model seen in this was built by J. Bailie, London, N.11, who has made good use in its construction of a Universal Coupling and a Coupling. The hose that delivers the compressed air to the machine is represented by a length of Spring Cord, and in this instance the workman's "body" consists of Flat Trunnions and his "legs" of $2\frac{1}{2}''$ Strips.

Another ingenious working model of this kind was illustrated on page 292 of the "*M.M.*" for May 1937. In this the figure was mounted on a $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate standing on legs consisting of $2\frac{1}{2}''$ Strips. In the space below the Flanged Plate was a *Magic* Motor, which turned a simple cam that caused the miniature drill and the figure of the workman to vibrate rapidly, as though work was actually in progress.

This kind of model is worth developing. Model-builders with larger Outfits could attempt a more detailed reproduction of the drill, and also could include the air compressor plant necessary for its operation.

Another type of rock-breaking drill that is now frequently used in road construction is that known as the Warsop Road-Breaker, which was described in the "*M.M.*" for April 1936. This tool is operated by a small two-stroke petrol engine mounted in an inverted position,

and would lend itself well to ingenious model-building.

Portable concrete mixing machines driven by petrol engines carried on the same chassis or framework are important items of modern road-making equipment and provide excellent subjects for models. They vary in size and design, and a typical example reproduced in Meccano is shown in Fig. 1. This model is the work of H. Lee, Ardrossan. It is driven by an Electric Motor concealed in the engine housing. The mixing drum is made with Strips fitted by means of Angle Brackets to the Curved Strips that form its base, and the drive is taken through the Rod on which the drum is pivoted. Tipping is effected by turning the Steering Wheel.

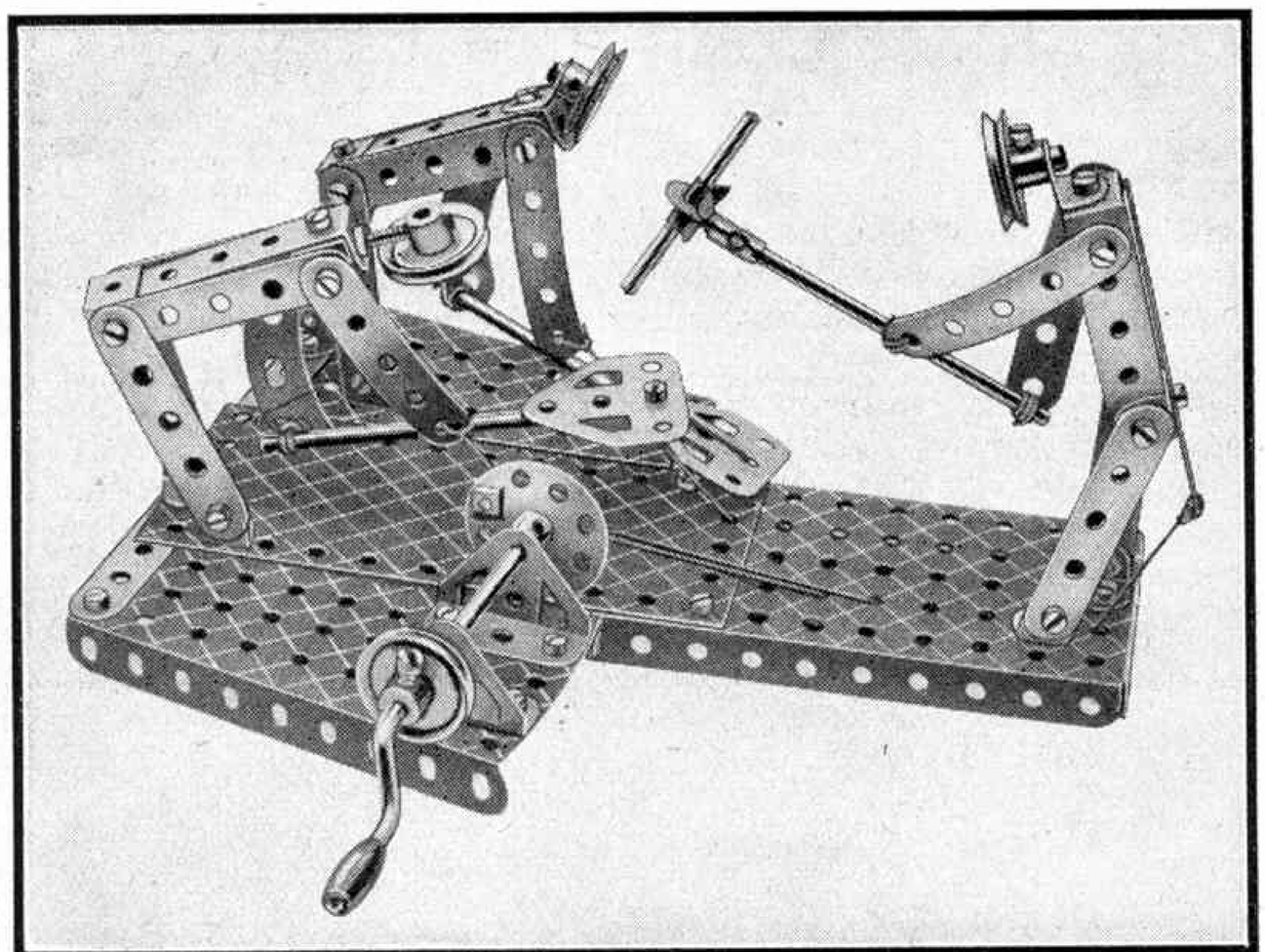


Fig. 3. A gang of Meccanitians at work on road repairs. Simple working models of this kind built from small Outfits are remarkably effective.

Owners of small Outfits should not think a machine of this type beyond their scope. A glance at the model concrete mixer illustrated on page 170 of the March 1937 "*M.M*" will give them a good idea of the best lines on which to proceed. This particular model is operated by a *Magic* Motor, which is the most suitable power unit for the purpose, as it is easy to incorporate in the housing, where it would represent the small petrol engine that drives the actual machine. In making the mixing drum Formed Slotted Strips and Semi-Circular Plates will be found useful for the top edge and the bottom, and Flexible Plates can be used for the sides.

Rollers are probably the most familiar of road making and road repairing machines. They range from giant steam rollers to the smaller ones driven by Diesel engines that are used for laying tar macadam or levelling soft ground. A roller used for light work is the prototype for the model shown in Fig. 4, which was built by R. Webber, High Wycombe. This is a good illustration of what can be done in this direction, for all the main features of the original are represented in the model.

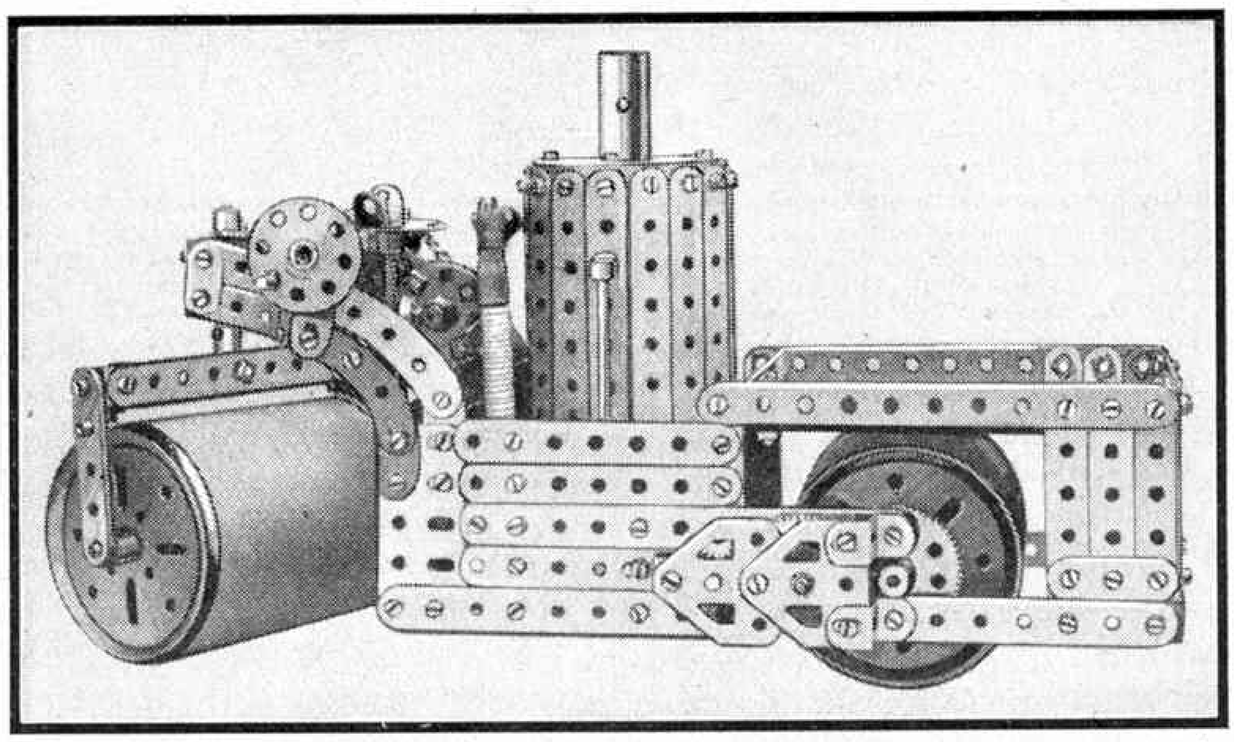


Fig. 4. The various types of rollers used in road construction make excellent subjects for models. The example here was built by J. Webber, High Wycombe.

Readers interested in roller models will find many useful suggestions for suitable subjects in the article "*The Story of the Road Roller*," which appeared in the "*M.M*" for September 1935. An excellent model of a Diesel-engined light roller was illustrated on page 547 of the "*M.M.*" for September of last year. This model is driven by a Clockwork Motor that forms the base on which the rest of the structure, apart from the rollers, is built up. One advantage of this plan is that it saves parts, which are left free for making other portions of the model. It also provides a strong and neat base.

The Boiler can be used to advantage in making the wide front roller of a model, but those who do not possess this part can adopt one of various methods. The best plan is to bend Flexible Plates to form the rolling surface, placing in each end a Road Wheel, with a Rod passed through the bosses to form the axle. Alternatively cardboard or sheets of stiff brown paper can be used. The rear wheels can be built up with $5\frac{1}{2}'' \times 1\frac{1}{2}''$ Flexible Plates, using $3\frac{1}{2}''$ Strips for spokes, or securing a 3″ Pulley in the centre of the whole by means of a $3\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip. If only a smaller model is to be built Formed Slotted Strips can be used for rims.

Model-builders with higher ambitions could try to reproduce a road making machine of the kind introduced in Germany, where they are employed in constructing great concrete highways. A machine of this kind was described and illustrated in the "*M.M.*" for April 1936. It consists of a long gantry stretching right across the road and supported at each end by bogies, the wheels of which run on rails. In use the machine follows a concrete distributor. A special beam on it levels the concrete, which is then tamped down either by a special beam or by drop hammers. An internal combustion engine drives the various movements, and as the machine slowly advances it leaves behind it a perfectly even concrete surface.

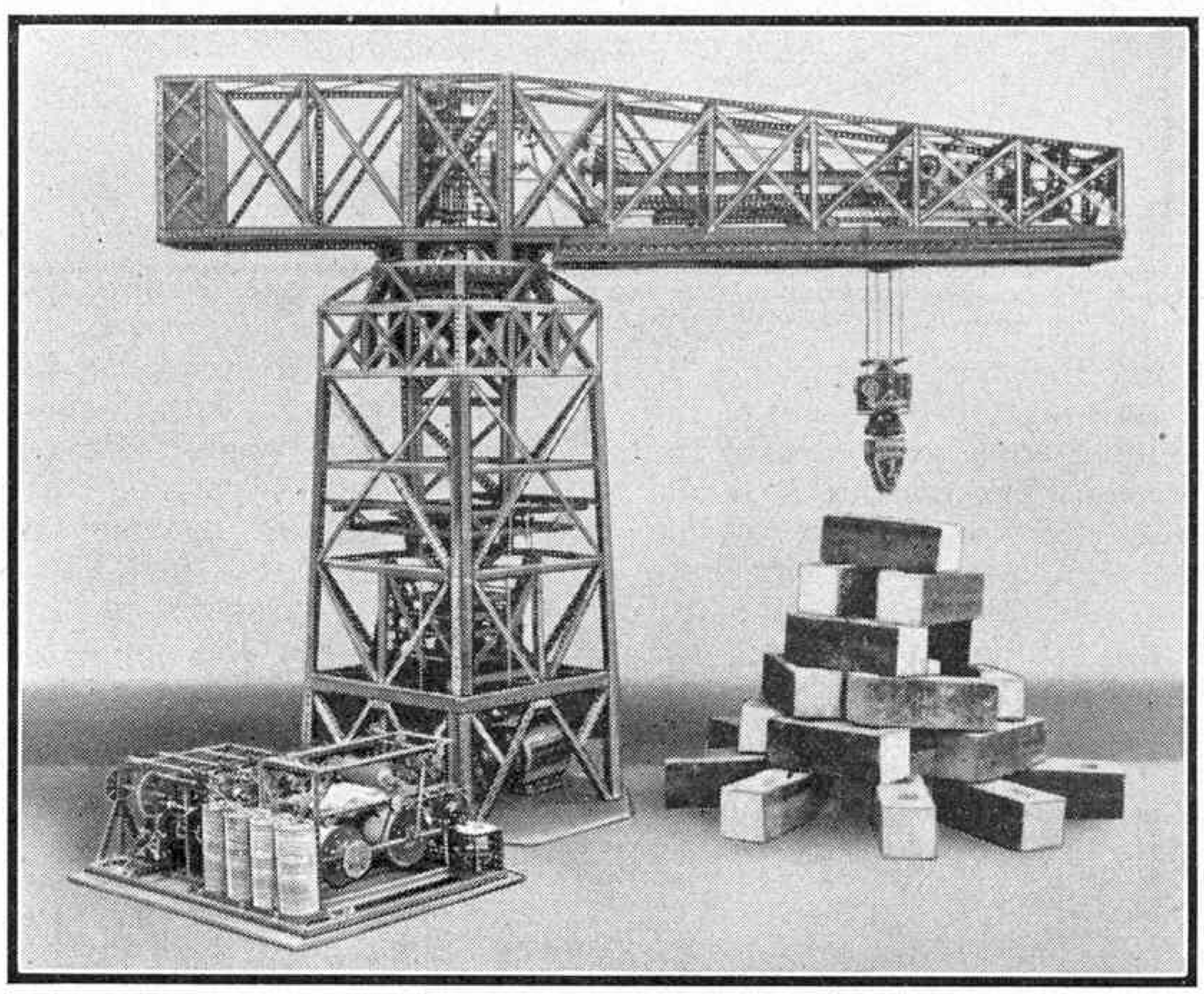
A model of one of these machines would not be very difficult to build, and its construction would provide much pleasure. The gantry itself is a straightforward piece of model-building. The tamping hammers can be represented by 1″ Pulleys, and the levelling and tamping beams might consist of Angle Girders. The mechanism for operating the hammers or the tamping beam, lifting and dropping them rapidly, can be made by fastening levers along a Rod in such a manner that the bolts fixing them in position act as cams. The oscillating movement of the beam that levels the concrete before tamping can be obtained by means of Eccentrics. Altogether the reproduction in Meccano of this machine would be a very attractive piece of work.

An Automatic Block-Setting Crane

Meccano Model Controlled by a Robot Unit

THE model illustrated on this page is a blocksetting crane of splendid design, but unlike other examples of this popular type it actually builds walls, simple dams or breakwaters automatically. Without any aid from its designer, it lifts up miniature blocks from piles arranged near it and places each in position with such uncanny certainty that anyone watching it at work might almost think it capable of thinking.

The builder of this astonishing model is Mr. Griffith P. Taylor, Toronto, who appears to have had a Wellsian vision of "Things To Come" in a world in which human labour will not be necessary for building up the creations of engineers and architects. He has named his model "Robot Gargantua." Its "brain centre," as it may be called, is the unit shown on the left in the illustration. This controls every movement and carries out each in its turn.



A remarkable model block-setting crane that automatically builds simple structures. Its movements are controlled by an ingenious robot mechanism, which is seen at the base of the tower on the left of the illustration. The model is the work of Mr. Griffith P. Taylor, Toronto.

Although the chief interest lies in the robot mechanism, the crane itself incorporates many ingenious and novel constructional features. For example, the boom swivels on a vertical pillar, inside the main tower, that is provided with two roller bearings, one fixed to the underside of the boom and the other to a point on the pillar itself and near its lower end. This arrangement is sometimes used in the construction of actual cranes of this kind, but is seldom adopted by model-builders. Another feature of the crane is that all the levers by which its various operations are controlled are grouped together at the base. The chief purpose of this is to enable them to be connected easily to the robot mechanism. The block-lifting gear and hoisting trolley are operated through a gear-box placed at the top of the boom pillar, and slewing of the boom is carried out through separate gearing situated at the base of the tower. All the movements are driven by a single motor mounted in the base.

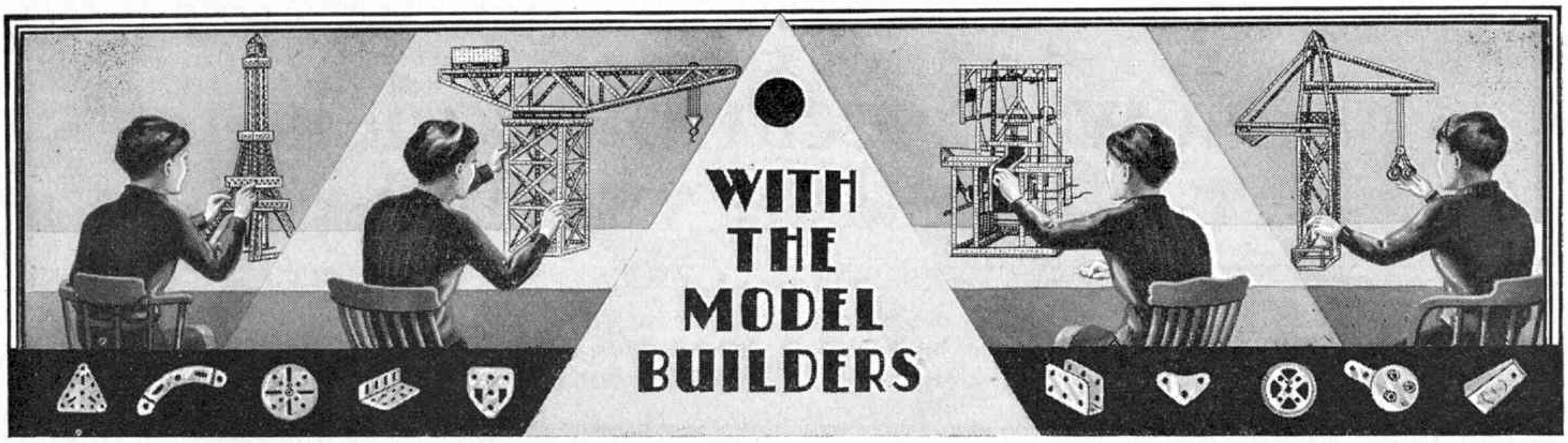
The robot unit is designed so that it can be used to control automatically, not only the crane illustrated here, but also any other type of machine, such as an excavator or a dragline, that incorporates not more than five different operations. It works by moving the control levers of the crane in their proper order.

The robot is driven by the same motor that operates the crane. Its central feature is a roll of paper punched with holes set out on a pre-arranged system. The roll resembles on a miniature scale those used for operating player pianos. It is drawn slowly over a brass drum and there passes under a row of spring brushes, which are connected in separate electric circuits and press lightly on the paper. When a hole passes beneath one of the brushes, this makes contact with the drum, and so completes the electric circuit through it. This current operates a solenoid that is used to move one of the control levers of the crane by means of a special differential drive operated by the crane motor.

A revolution counter gives the number of revolutions of the shaft of the robot and also of that driving the crane. The counter is used in preparing the paper roll, which is done in the robot itself.

The method by which the exact positions of the holes is determined is very complicated, but an outline of the process will make it clear. A simple structure is first designed and a plan drawing made, after which the layout of blocks from which the structure is to be built is considered. The number of revolutions of the robot and crane driving shafts required to transfer each block to its allotted position is then determined. In a similar manner the movements of the trolleys and of the grabbing and hoisting tackles required for the positioning of each block are calculated. These calculations are then tabulated, and the machine set accordingly.

Suppose the hoisting of a block is found to require 150 revolutions of the driving shaft. The lever that controls this operation then must first be moved to start the crane working, and after 150 revolutions have been made the position of the lever must be reversed to stop the operation. The roll of paper is placed on the rollers and set in motion. As the counter registers each required number of revolutions, as set out on the tabulated list, the mechanism is stopped and a hole is punched in the paper in such a position that the appropriate brush makes contact with the drum. In a similar manner holes are punched to control other movements, and thus the complete sequence of movements required to build the structure is recorded on the paper roll. The time taken to erect the brick structure shown in the illustration was 50 minutes.



ILLUSTRATING A LECTURE WITH MECCANO MODELS

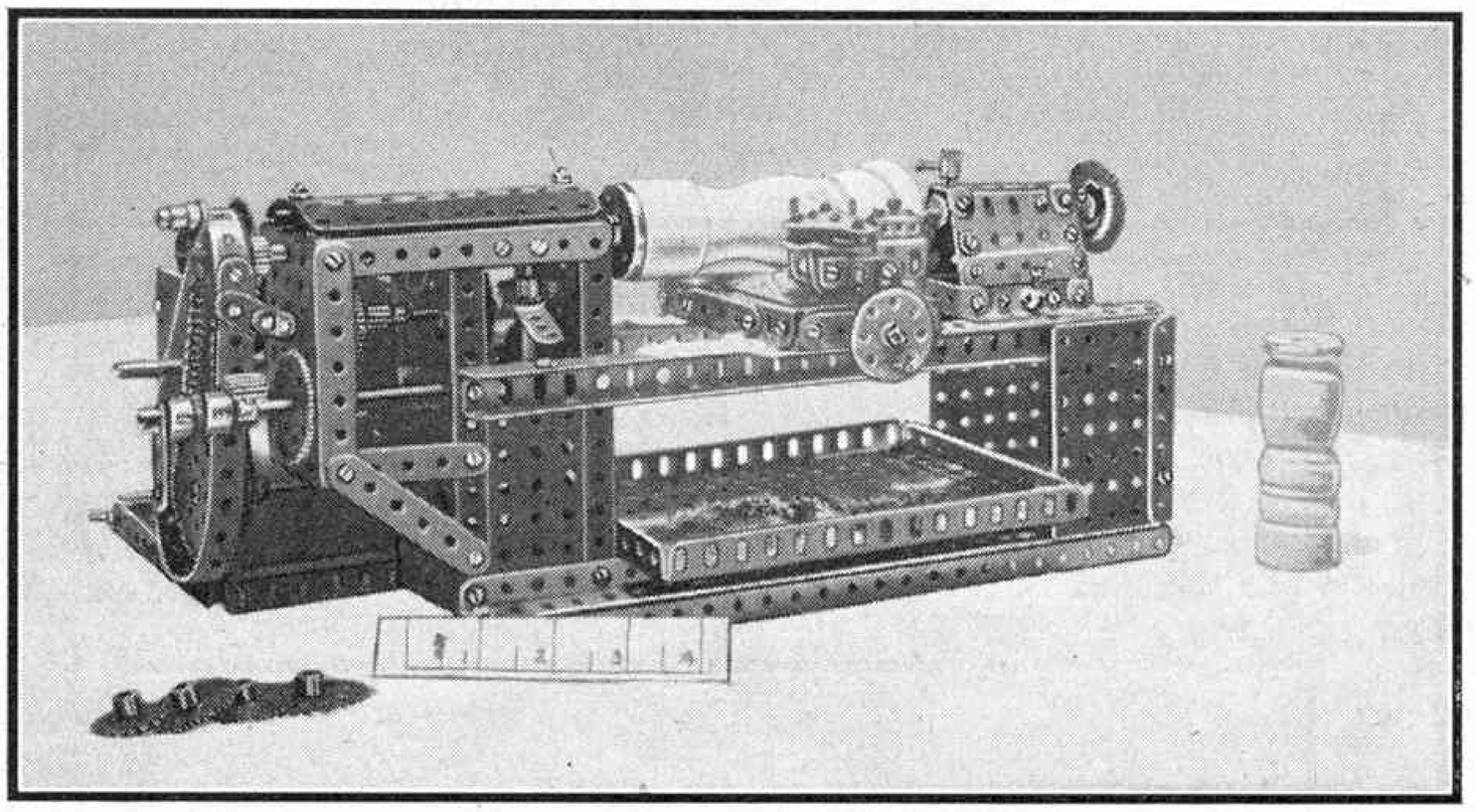
In order to illustrate a lecture that he gave to his schoolmates upon the subject of "Machine Tools," Fred Thompson, of London, S.E.1, recently constructed Meccano models of a lathe and a planing machine. He informs us that the lecture was a great success and that he found the models of very great value for illustrating various points in his talk.

Thompson's Meccano lathe is shown on this page. It is so strongly built that it can actually be used to turn small objects in soft sandstone or wood, and an example of the kind of work that can be done with it is the small stone baluster that is shown standing near it in the illustration. When working upon stone the lathe is operated by turning a crank, but when wood or wax is being shaped, power is provided by a clockwork motor.

As can be seen from the illustration, the model is constructed strongly of Angle Girders and Plates. The tailstock slides along the bed of the lathe, and can be clamped in any position, final adjustment being made by means of a handwheel. The saddle that carries the cutting tool also slides along the bed of the lathe, and is moved by a screwed rod that can be rotated through the gearbox by the motor or by turning the hand crank.

A feature of the model is the ingenious method employed for mounting the material to be worked upon. A Bush Wheel is sunk, boss inwards, into each end of the material. To each of these Wheels a further Bush Wheel is bolted, one of the Bush Wheels being mounted on the chuck and the other on a rod that projects from the tailstock. This arrangement holds the material securely and prevents it from working loose under the action of the cutting tool.

The planing machine was designed on similar lines to the well known Meccano Super Model Planing Machine, but the worktable is fitted with a neat quick return device, the design of which does credit to its builder's skill and ingenuity.



This stone cutting lathe was built by F. Thompson to illustrate a lecture on "Machine Tools" and is described on this page. A small stone baluster made on the lathe is shown on the right of the illustration.

A GRIP-TESTING MACHINE

P. Le Fevre, Harleston, who has previously submitted excellent suggestions and models, has now made an interesting model of a grip-testing machine of the kind seen at fairgrounds and amusement parks.

The mechanism is enclosed in a rectangular framework, the front of which is open. A fixed Rod is mounted vertically across the aperture, and a few inches behind this is a second Rod that can be pulled forward. The two rods are gripped tightly with the hand, and the rear rod is pulled forward as far as possible. A pointer moving across a graduated scale at the back of the machine then indicates the amount of pressure applied.

The mechanism of the model is simple and does not require any special parts for its construction. The movable rod is connected at each end to a horizontal 6½" Rod by means of Couplings. The 6½" Rods slide in bearings provided between the sides of the casing, and their rear ends are joined by a 5" Rod and two further Couplings. The 5" Rod is connected to the sides of the casing by six or more Meccano Springs, which pull it back to its original position when it is pulled forward and then released.

A length of Cord tied to the 5" Rod is threaded through a system of pulleys, and its other end is attached to the rim of a 2" Pulley. The result of this arrangement is that if the 5" Rod is moved, the 8" Rod carrying the 2" Pulley is forced to rotate. The 8" Rod carries also a Bush Wheel across which a Strip is bolted. This Strip forms the pointer and moves in front of a circular graduated scale.

USING THE ROD CONNECTOR FOR TRANSMITTING A DRIVE

T. Clarke, London, recently built a model in which he wished to transfer a powerful drive from one Rod to another in line with it. He did not possess a Coupling, and his first intention was to use a Rod Connector (Part No. 213). In practice, however, he discovered that the Rod Connector tends to turn on one of the Rods, instead of transferring the drive. Eventually he found that by pressing a Spring Clip on each end of the Rod Connector, so that the Clips overlap the ends of the Rods, the latter are joined together as securely as if a Coupling had been used. This model-building tip should prove very useful to the owners of small Outfits.

In his letter Clarke also suggests that triangular flexible plates should be manufactured. I do not think that parts of this kind would be a necessary addition to the Meccano range. A triangular plate is seldom required, and when it is the present Flexible Plate turned cornerways makes a satisfactory substitute.

A NOVEL "PENNY-IN-THE-SLOT" MECHANISM

M. F. Cowan, Calgary, Alberta, has sent me details of one of the most simple and ingenious "penny-in-the-slot" mechanisms that I have seen. A penny dropped into this falls down a slot on to a plate fitted with two terminals, which are in the form of insulated Strips. The penny makes contact between these two Strips and so completes an electric circuit that energises a magnet coil. The magnet core is formed by a short Rod that acts as a catch and prevents the drawer of the machine from being opened. When the magnet is energised, however, it pulls the Rod upward and so releases the drawer, which can then be pulled outward.

When the drawer is pushed back the movement causes a brush to sweep the penny off the terminals, thus breaking the electric circuit. The magnet then releases the Rod and the catch slips into place again.

Cowan's machine is designed for vending boxes of matches. These are loaded in a chute situated above the drawer so that the lowest box is delivered each time the drawer is opened. Cowan is now working on a safeguarding device that will measure and weigh the coins before allowing them to come into contact with the terminals. By this means he hopes to be able to prevent the machine being operated by buttons, metal discs or other substitutes for actual coins.

A NEW TYPE OF SCREWED BEARING

A novel use has been found by F. C. Cooper, London, S.W.7, for the newly introduced short Grub Screw (part No. 89c). The end of the Grub Screw is concave so that if it is screwed into the boss of a Pulley or other part, the rim of the portion protruding inside the boss forms a good substitute for a screw thread. This simple operation transforms the boss into a threaded boss, through which a Screwed Rod can then quite easily be screwed.

A Pulley treated in this way and fitted on a Screwed Rod would be very useful as a guide pulley for feeding the Cord of a crane evenly on to the winding drum. Alternatively a Coupling could be converted into a screwed coupling, or a Crank into a threaded crank. A disadvantage of the idea, however, is that the Grub Screw tends to work loose unless it is very carefully adjusted.

A USEFUL UNIVERSAL COUPLING

Owners of small Outfits will be interested to know that a Cord Anchoring Spring can be used for transferring a drive from one Rod to another. W. Davies, Birkenhead, informs us that this method is satisfactory, provided that care is taken to arrange the Spring properly on the Rods. A Rod is pushed into each end of the Cord Anchoring Spring so that the two Rods meet at the centre of the Spring. The Spring must not be strained and then it will continue to grip the Rods securely when they are rotated, even if the Rods are not in line. This type of coupling unit wastes a certain amount of the driving power, however, and for this reason is suitable only for very small and simple models.

Another simple device that Davies finds useful is a coupling connecting a sliding shaft to a fixed rod. Connection between two such shafts is usually carried out with two Bush Wheels, one of which is fitted with Threaded Pins or short Rods that engage the holes in the other Bush Wheel. The size of the Bush Wheels, however, makes this type of Coupling unsuitable for use in confined places and Davies's method will be found very useful in these instances.

The fixed shaft is fitted with a Rod and Strip Connector, to which a 2" Slotted Strip is bolted. A bolt that passes through the slot of the 2" Strip is lock-nutted to a second Rod and Strip Connector on the end of the sliding shaft.

A NEW GAME WITH DINKY TOYS

I. B. Stewart, Manchester, has discovered how to increase the enjoyment to be obtained from Dinky Toys. While examining the Dinky Toys Armstrong-Whitworth Whitley Bomber, an idea occurred to him for making the model carry out bombing operations on a miniature scale. His scheme is quite simple and no doubt will interest other owners of this Dinky Toys Aeroplane.

The bomb is an air-gun slug, which is pressed lightly into the hole provided in the floor of the fuselage for holding the gliding pin. The pin is slipped into the hole in the top of the fuselage. The operator then holds the aeroplane "bomb" over a target set up on the ground and releases the "bomb" by pressing the gliding pin downward, so that the slug is dislodged.

The most suitable type of target for this game is a circular piece of wood divided into "pockets" by means of Meccano Strips attached to the wood by Angle Brackets. Each pocket should be numbered, and the "score" can then be read off at a glance.

WHEELS FOR SMALL MODEL RACING CARS

G. Cheshire, Birmingham, has found a useful method of making realistic road wheels for miniature racing cars, of which he is an enthusiastic builder. This consists of pressing a Tyre from an Aeroplane Outfit (Part No. P44) on to the flange of a ¾" Flanged Wheel.

New Meccano Models

Three Attractive and Varied Designs

As usual in these pages, we are this month describing interesting working models that can be built with the parts included in small Outfits. These are the breakdown lorry and the petrol-engined truck illustrated on this page, which can be built from the contents of Outfits Nos. 2 and 4 respectively. The third model is larger and more complicated, yet not difficult to build. It is a particularly interesting reproduction of a special type of printing machine, every movement of which is represented in the model.

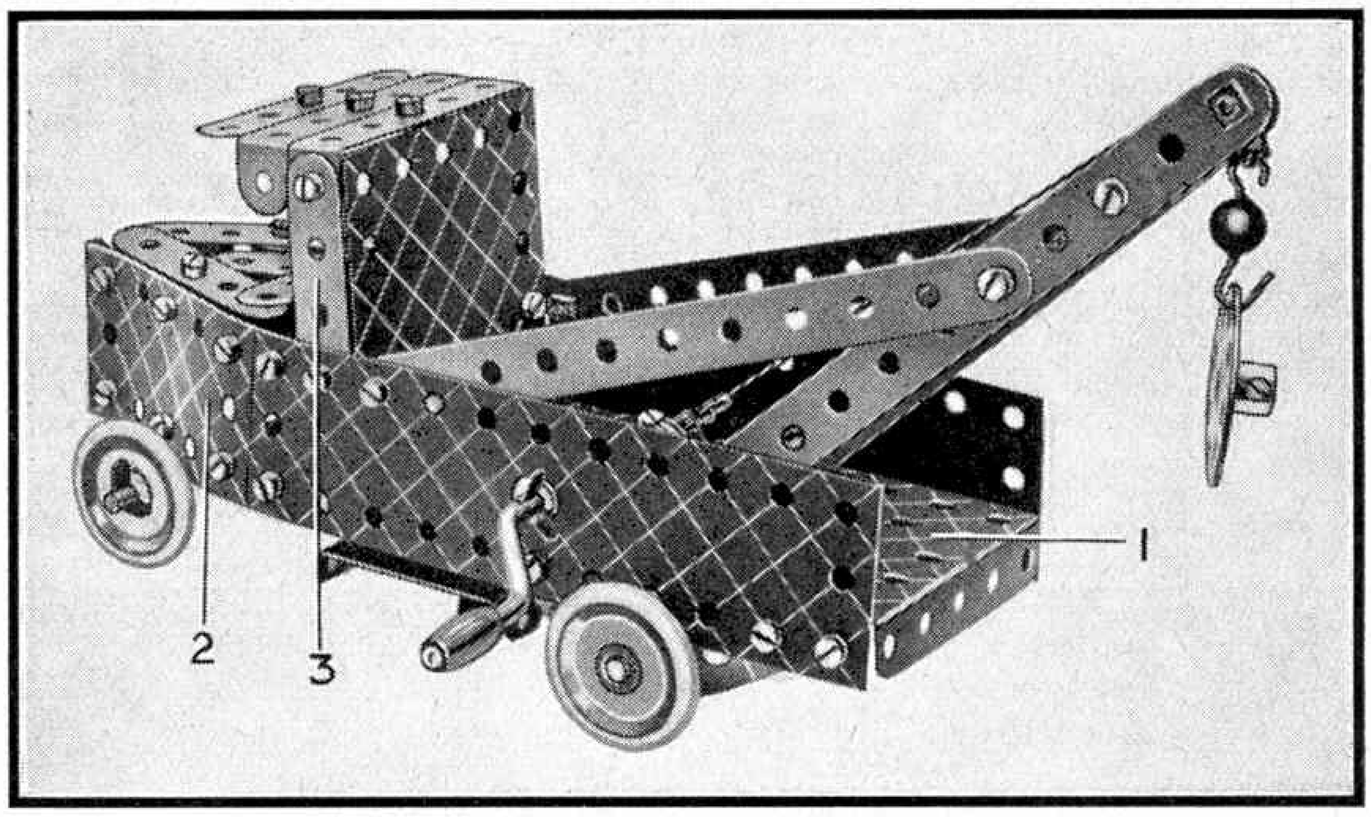


Fig. 1. This neat model motor breakdown lorry is built from the contents of Outfit No. 2. It is driven by a Magic Motor and is fitted with a workable crane.

The base of the breakdown lorry shown in Fig. 1 consists of a $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate 1. To the forward end of this two $2\frac{1}{2}'' \times 1\frac{1}{2}''$ Flexible Plates 2 are fastened by Angle Brackets to form the sides of the bonnet, and the Flexible Plates are joined by two Trunnions, which also represent the radiator. The top of the bonnet is covered by three $2\frac{1}{2}''$ Strips and a Flat Trunnion as shown.

Two $2\frac{1}{2}''$ Strips 3 are bolted to the sides of the lorry as shown, and between their upper ends is fastened a $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip. To this a second Double Angle Strip and a $2\frac{1}{2}''$ Strip are secured by a Flat Trunnion to form the roof. The back of the cab consists of a $2\frac{1}{2}'' \times 2\frac{1}{2}''$ Flexible Plate supported by Angle Brackets from the Strips 3.

The jib of the crane is built up from two $5\frac{1}{2}''$ Strips, which are attached to the Flanged Plate 1 by Angle Brackets and joined at their upper ends by a Reversed Angle Bracket. The winding handle, a $3\frac{1}{2}''$ Crank Handle, is journalled in the centre holes of the two $5\frac{1}{2}'' \times 1\frac{1}{2}''$ Flexible Plates, and to it the hoisting Cord is fastened by means of a Cord Anchoring Spring.

The front axle of the lorry is journalled in two Flat Brackets bolted to the sides of the bonnet, and the rear axle revolves in two $2\frac{1}{2}''$ Curved Strips bolted to the flanges of Plate 1. The rear axle carries a $\frac{1}{2}''$ Pulley, which is connected by a Driving Band to the pulley of a *Magic* Motor secured underneath Flanged Plate 1.

Parts required to build model breakdown lorry: 4 of No. 2; 5 of No. 5; 4 of No. 10; 8 of No. 12; 2 of No. 16; 1 of No. 19g; 4 of No. 22; 1 of No. 24; 4 of No. 35; 44 of No. 37a; 40 of No. 37b; 1 of No. 52; 1 of No. 57c; 20 of No. 90a; 4 of No. 111c; 1 of No. 125; 2 of No. 126; 2 of No. 126a; 4 of No. 155a; 1 of No. 176; 2 of No. 188; 2 of No. 189; 1 of No. 190; 1 *Magic* Motor.

Construction of the model petrol-engined truck shown in Fig. 2 is commenced by extending the longer flanges of a $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate 1 by two compound strips 2. Each strip consists of two $2\frac{1}{2}''$ Strips overlapping two holes, and they are joined at their forward ends by a 3″ Formed Slotted Strip that forms the bumper of the truck.

The engine casing is next built up. One of the side plates of this consists of a $2\frac{1}{2}'' \times 2\frac{1}{2}''$ Flexible Plate, and the other of a $2\frac{1}{2}'' \times 1\frac{1}{2}''$ Flexible Plate and three $2\frac{1}{2}''$ Strips, which are so arranged that a space is left for the Motor winding key to be inserted. The *Magic* Motor is bolted to the $2\frac{1}{2}'' \times 2\frac{1}{2}''$ Flexible Plate, and the two sides of the engine housing are joined together at their upper ends by a U-section Curved Plate. The front of the housing is formed by a $2\frac{1}{2}'' \times 1\frac{1}{2}''$ Flexible Plate secured in position by two Angle Brackets.

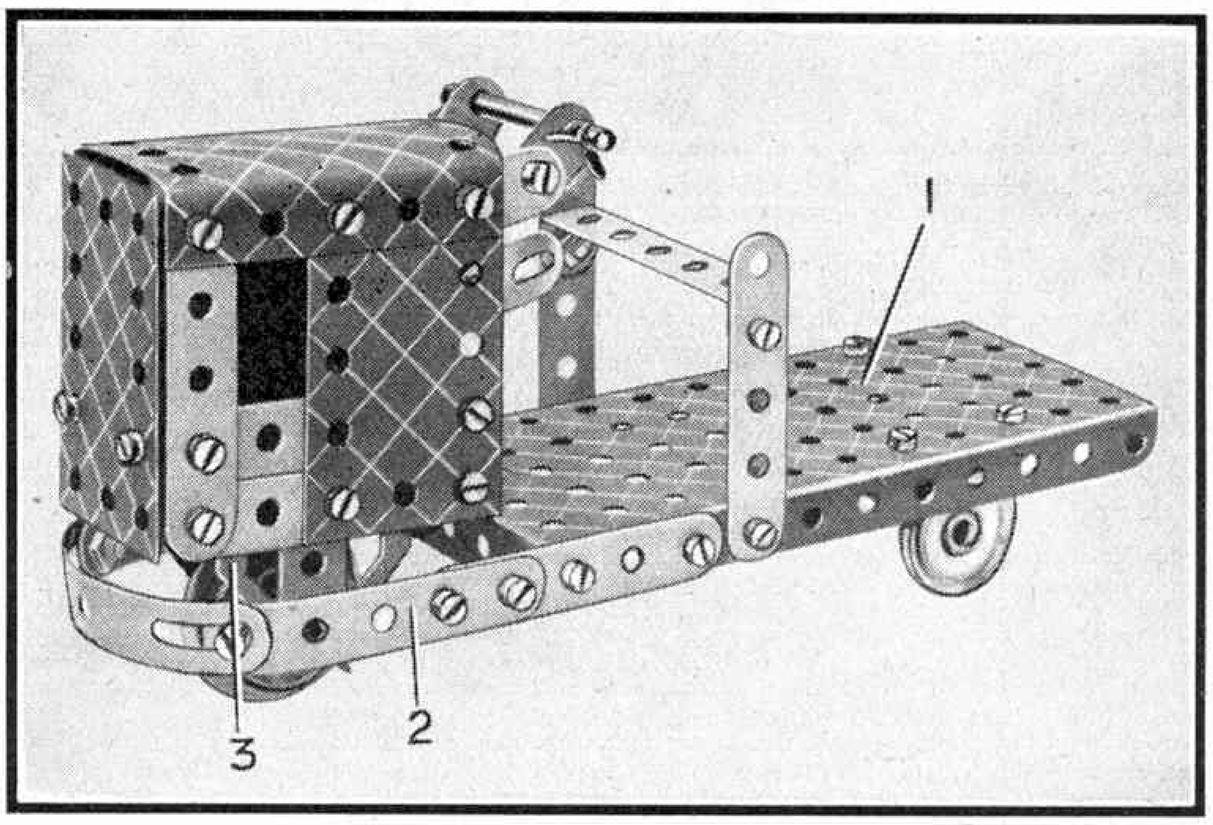


Fig. 2. This simple model of a commercial truck used for transporting goods from one department to another in factories, forms a novel subject for Outfit No. 4.

The front road wheel is a Bush Wheel mounted on a $1\frac{1}{2}''$ Rod, the bearings for which are provided by two Flat Trunnions 3. The latter are fastened to the sides of the engine housing by $\frac{3}{8}''$ Bolts, and are spaced inward by four Washers on each Bolt. The $1\frac{1}{2}''$ Rod carries also a 1″ Pulley, which is connected by a 3″ Driving Band to the pulley of the *Magic* Motor. The starting lever of the Motor is extended by a Flat Bracket to enable the Motor to be controlled more easily.

The engine housing is mounted on the truck by a $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip and an Angle Bracket. The

Double Angle Strip is bolted between the lower rear corners of the side of the engine housing, and to its centre is fastened the Angle Bracket, which also is secured to the Plate 1 by lock-nuts. The rear wheels, two 1″ Pulleys, are mounted on a 3½″ Rod journalled in two Trunnions.

Parts required to build model petrol-engined truck: 9 of No. 5, 5 of No. 10; 3 of No. 12; 1 of No. 16; 1 of No. 17; 1 of No. 18a; 3 of No. 22; 1 of No. 24; 4 of No. 35; 37 of No. 37a; 35 of No. 37b; 1 of No. 48a; 1 of No. 52; 2 of No. 126; 2 of No. 126a; 1 of No. 186a; 2 of No. 188; 1 of No. 190; 1 of No. 199; 1 of No. 215; 1 *Magic* Motor.

Constructors who like working models that have plenty of movement, and offer scope for careful adjustment, will enjoy making the fine printing machine illustrated on this page. This is a No. 9 Outfit model, but owners of Outfit No. 8 will find that they need to add only a few extra parts in order to be able to build it.

The framework of the model is constructed first. This is made by extending the flanges of a 3½″ × 2½″ Flanged Plate 1 by adding the two 5½″ Strips 2. A compound strip 3, consisting of a 4½″ Strip and a 5½″ Strip overlapping two holes, is then bolted to the free end of each Strip 2. The upper ends of the compound strips are joined by a 3½″ × ½″ Double Angle Strip, and at their centres they are connected by two 4″ Strips to two 5½″ Angle Girders 4, which are bolted to Flanged Plate 1.

The E6 Electric Motor is fastened by its flanges to a 3½″ × ½″ Double Angle Strip fixed between the lower ends of Strip 3. A ½″ Pinion on the driving shaft of the Motor meshes with a 57-teeth Gear 5 on a 3½″ Rod, which is journalled as shown, and carries a Worm between the sideplates of the Motor. The Worm meshes with a second ½″ Pinion 6 that is locked on the end of a 2″ Rod 7. Bearings for this Rod are provided by the centre holes of a Double Bent Strip and a 1½″ × ½″ Double Angle Strip, which are bolted together and fastened between the sideplates of the Motor. From the Rod 7 the drive is taken through two Bevel Gears to a 4½″ Rod journalled in two Flat Trunnions bolted to the flanges of Plate 1.

A ¾″ Sprocket Wheel on the 4½″ Rod is connected by Sprocket Chain to a 1″ Sprocket on a 3½″ Rod 8, journalled in the ends of two 1″ × 1″ Angle Brackets bolted to 2½″ × 1½″ Flanged Plate 9. The bolts hold also a 3½″ × ½ Double Angle Strip, by which the Flanged Plate is supported from the frame. A ½″ Bevel Gear on Rod 8 drives a 1½″ Bevel Gear on a 2″ Rod, journalled in the centre hole of Plate 9 and a Double Bent Strip bolted to the Plate. The 2″ Rod carries a Face Plate 10.

The 4½″ Rod is also connected by a second Sprocket Chain drive to a 6½″ Rod 11 journalled in the sideplates of the Motor. Rod 11 carries two Triple Throw Eccentrics, one at each end, both of which are used for operating the ink rollers and the platen. The platen is formed by a 2½″ × 2½″ Flat Plate 12, which is fastened by two Collars on a 4½″ Rod supported as shown. At its end the Rod carries a Bush Wheel, which is connected by a compound 3½″ Strip to the arm of the Eccentric on the left-hand end of Rod 11. The plate 13 that carries the type is fastened by two 1″ Triangular Plates to the Angle Girders 4.

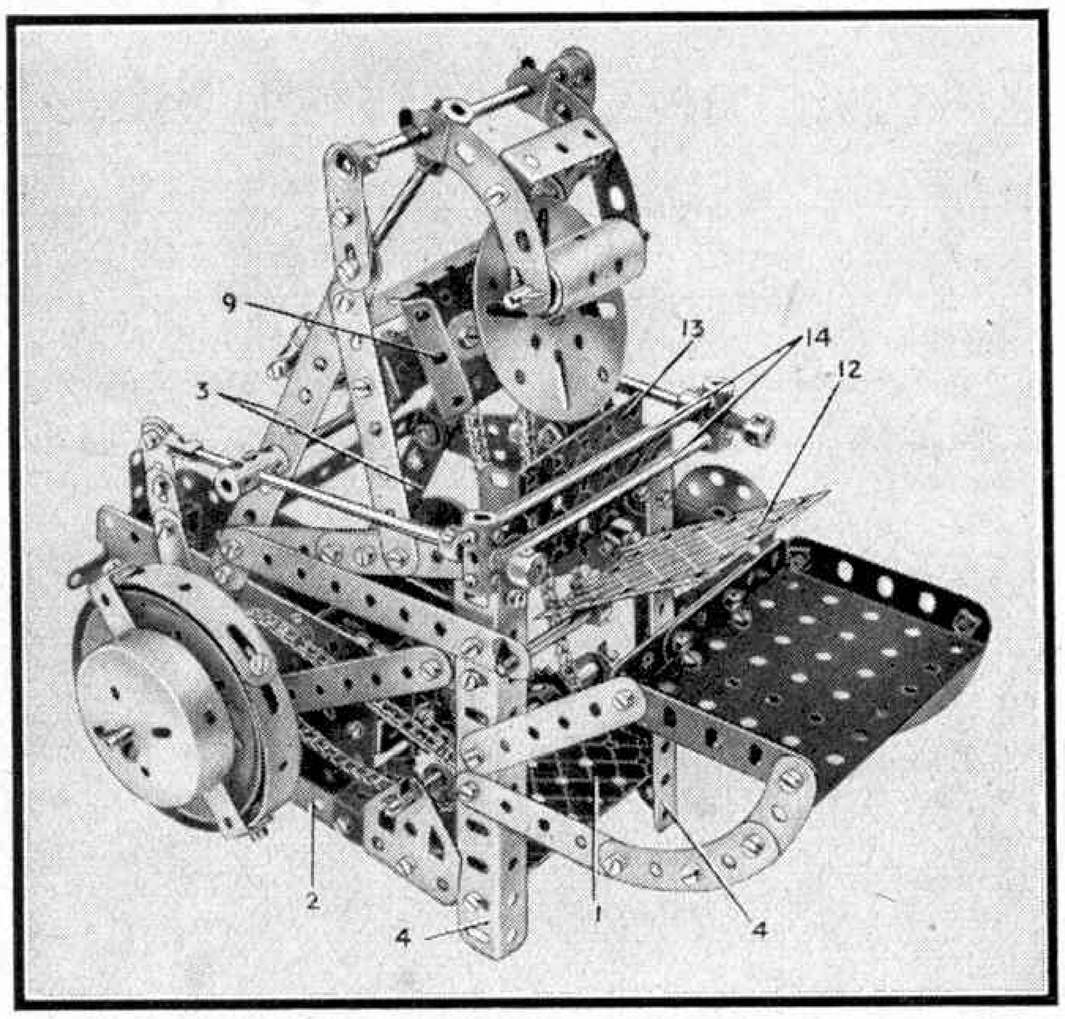


Fig. 3. An easily built printing machine that carries out all the essential movements of its prototype. It is driven by an E6 Electric Motor.

The inking roller consists of two 5″ Rods 14, fastened together at their ends by Couplings, which serve also to mount the rollers on the two arms 15. The Couplings are not locked on the arms, but each is held in position by a Compression Spring between two Collars.

The rear ends of the arms 15, one of which is a 4″ Rod and the other a 5″ Rod, are fastened by Couplings to a compound rod 16, comprising two 2″ Rods joined by a Coupling 17. The compound rod is journalled in the sides of the frame of the model. The 5″ arm protrudes through the Coupling securing it to the compound rod, and on its end is pressed a Rod and Strip Connector. The last mentioned part is connected to the arm of the Eccentric on the right-hand end of Rod 11, by two Flat Brackets bolted together. This Eccentric is adjusted so that the rollers pass over the type face as the platen is moving away from it.

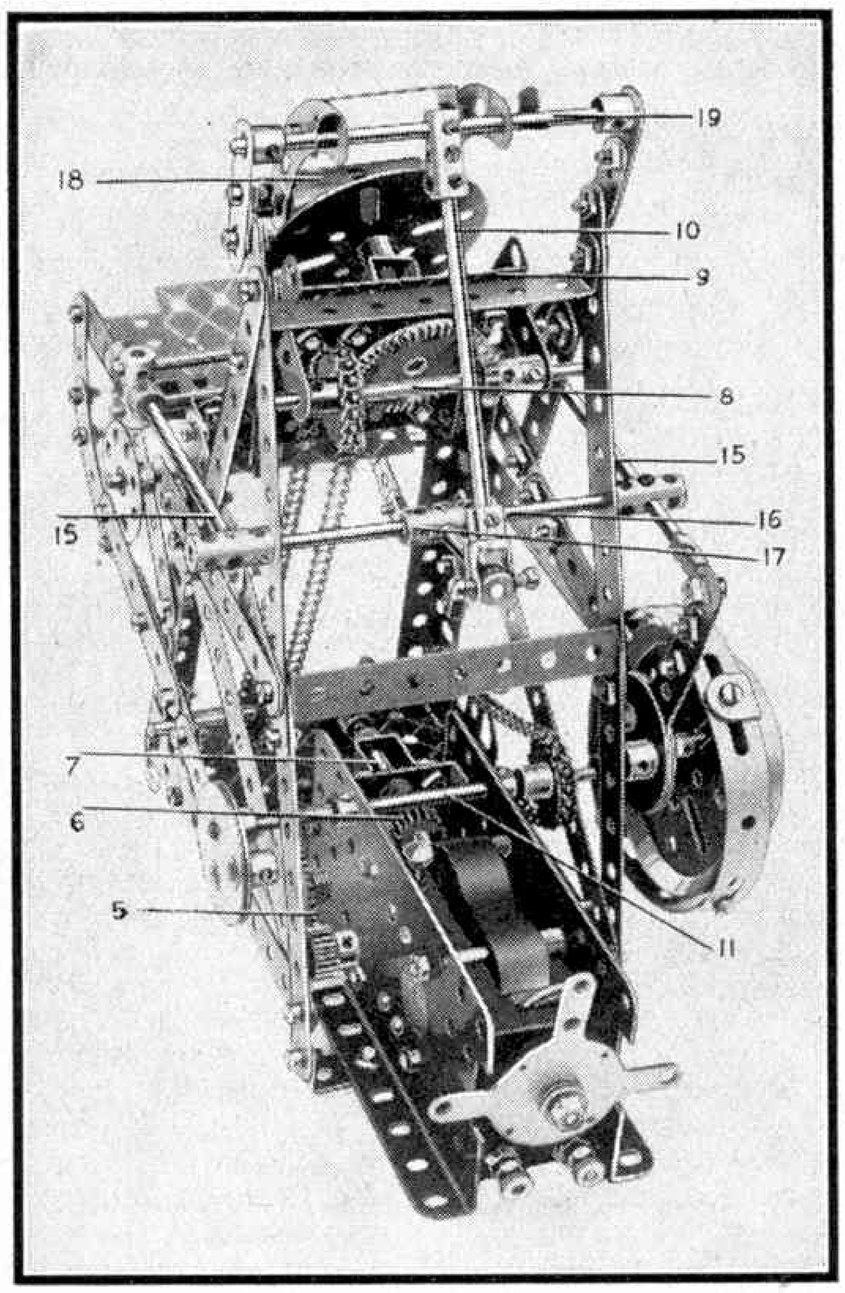


Fig. 4. A rear view of the printing machine showing how the Motor drive is transmitted to the platen and the ink table.

The ink fountain by means of which ink is fed to the ink plate comprises a Sleeve Piece 18 mounted by two Chimney Adaptors on a 2″ Rod. The Rod is held by Spring Clips in the end holes of two small radius Curved Strips, which are joined by a 1½″ × ½″ Double Angle Strip. The free ends of the Curved Strips are pivoted on a 4″ Rod 19 locked in the bosses of two Cranks, the ends of which are lock-nutted to the upper ends of Strips 3. A Coupling is placed freely on the centre of Rod 19, and connected as shown to the Coupling 17.

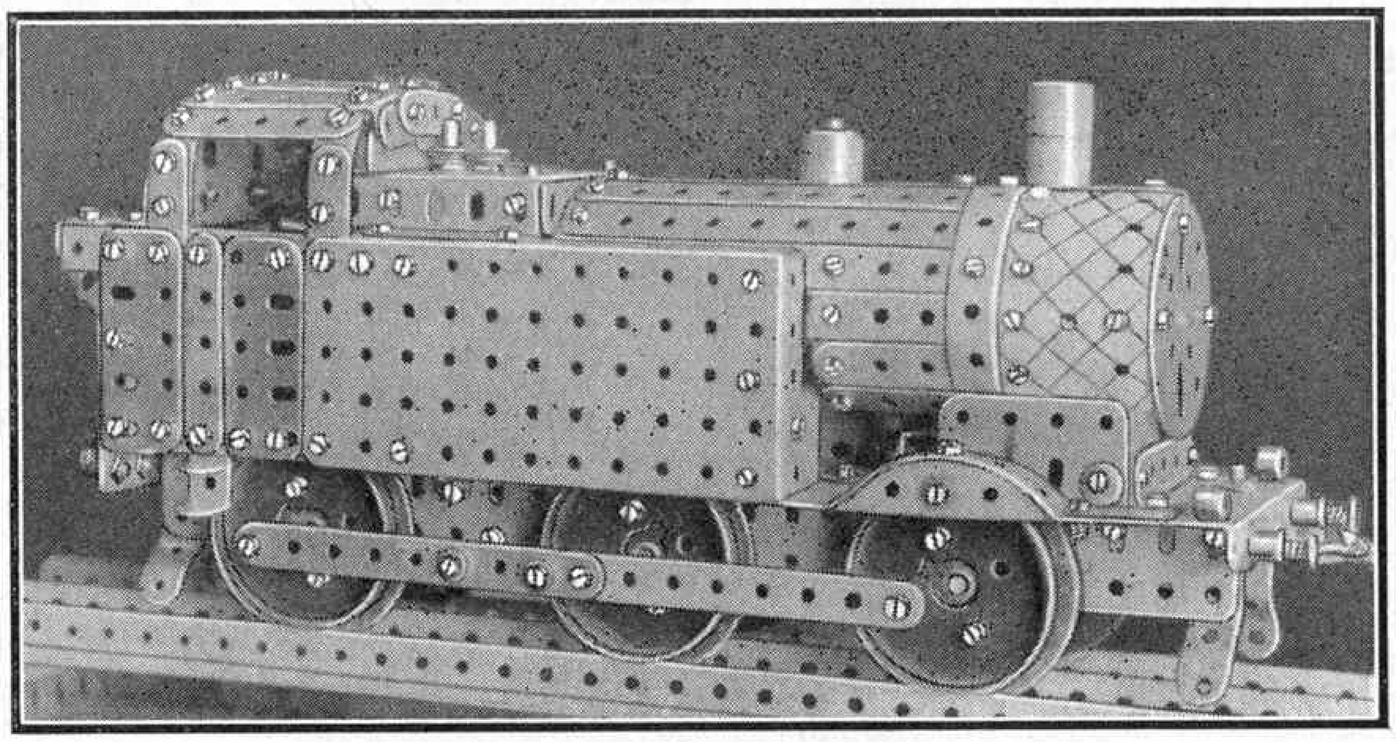
Parts required to build model printing press: 4 of No. 2; 6 of No. 2a; 2 of No. 3; 3 of No. 4; 9 of No. 5; 2 of No. 9; 6 of No. 10; 1 of No. 12; 2 of No. 12a; 1 of No. 14; 3 of No. 15; 2 of No. 15a; 1 of No. 15b; 4 of No. 16; 3 of No. 17; 1 of No. 18a; 1 of No. 19b; 1 of No. 24; 2 of No. 26; 1 of No. 27; 2 of No. 30; 1 of No. 32; 8 of No. 35; 97 of No. 37a; 93 of No. 37b; 15 of No. 38; 1 of No. 45; 2 of No. 48; 5 of No. 48b; 2 of No. 51; 2 of No. 53; 10 of No. 59; 2 of No. 62; 6 of No. 63; 2 of No. 77; 4 of No. 90; 2 of No. 90a; 1 of No. 94; 2 of No. 96; 2 of No. 96a; 1 of No. 109; 2 of No. 111c; 2 of No. 126a; 1 of No. 126a; 1 of No. 163; 2 of No. 164; 1 of No. 193; 2 of No. 212; 4 of No. 215 1 E6 Motor.

Meccano Model-Building Competitions

Special Contest for Owners of Small Outfits

This month we are giving beginners and owners of small Outfits a special opportunity of winning prizes, for we are restricting entries in our chief competition to models that can be built with the parts contained in any size of Outfit up to and including No. 3. Any kind of model may be built and entered, provided that it keeps within these limits, and those in which parts not contained in a No. 3 Outfit are used will not be eligible.

The best type of subject in a contest of this kind is one that does not contain complicated mechanism, and can be reproduced realistically with the limited number of parts. Large and elaborate models are not necessary. The prizes will be awarded to the senders of those in which the best use is made of Meccano parts, or which show most originality or skill in construction. Models must not be copied from any shown in the Manuals or other publications.



This fine model locomotive was built by Michael H. Bryant, Birstall, and was awarded a prize in a recent "M.M." competition. It is of simple construction, but is neat and realistic in appearance.

Entries will be divided into two Sections, A, for competitors under 12 living in the British Isles, B, for competitors under 12 living Overseas. Prizes will be awarded for the best models submitted in each Section, and these will be as follows. First, Meccano or Hornby products value £2/2/–. Second, products value £1/1/–. Third, products value 10/6. There also will be consolation prizes of products value 5/–, and a number of Certificates of Merit will be presented.

Actual models must not be sent. A clear photograph or a good drawing is all that is necessary. The competitor's age, name and address must be written clearly on the back of the entry, and if it is considered advisable, a short description of the model also may be submitted. Competitors must also send a list of the parts used in building their models.

Envelopes containing entries should be addressed *"Small Outfits Model-Building Contest,"* Meccano Ltd., Binns Road, Liverpool 13. Entries for Section A must be posted so as to reach Liverpool before 30th April, 1938, but entries from Overseas readers intended for Section B will be accepted until 30th June, 1938.

Competitors who decide to send drawings are advised to make their sketches on a sheet of paper not larger than this page. Many competitors are in the habit of submitting very big drawings occupying rolls of paper a yard or more in length, which are very difficult to accommodate in our files and inconvenient to handle. Neatness will be the deciding factor in the event of two entries trying for any of the prizes.

We are constantly receiving requests from model-builders for competition entry forms. It should be understood clearly that entry forms are not required for this contest, or for any of the monthly competitions announced in the Magazine.

A Competition for Models Incorporating "Suggestions"

One of the most popular features of the *"M.M."* is *"Suggestions Section,"* in which "Spanner" describes new ideas and mechanisms of interest to model-builders. Most of the mechanisms dealt with in this section each month are of such a kind that they can be incorporated in many different types of models. For example, a reader recently built a model derrick crane, in which he incorporated the simple Constantinesco gear and the automatic overload release described in *"Suggestions Section"* of the December 1936 *"M.M."*

We think that *"Suggestions Section"* can be of great assistance to model-builders in enabling them to obtain the greatest possible amount of pleasure from their hobby, and we wish to encourage everyone to experiment with the various mechanisms dealt with each month. We are therefore organising a special competition in which only models that incorporate "Suggestions" described in recent issues will be eligible. Models may be of any kind provided that at least one "Suggestion" is embodied in their construction. Only "Suggestions" that have been described in 1936, 1937, and 1938 issues of the Magazine should be used.

The Suggestions incorporated in models need not be of exactly the same construction as those in the *"M.M.,"* but may be modified to suit the Meccano parts available or the particular function it is required to carry out in the model. Ingenious modifications that improve or widen the scope of the particular Suggestion chosen, or the employment of a Suggestion for carrying out operations for which it was not originally designed, are two points that will receive favourable consideration.

The competition is open to readers of all ages living in any part of the world and entries will be divided into two sections as follows: A, for competitors of all ages living in the British Isles, B, for competitors of all ages living Overseas. More than one model may be submitted if desired, but in this case the models will be judged on their joint merits. No competitor will be awarded more than one prize.

The first, second and third prizes in each Section will consist of Meccano or Hornby products to the values of £3/3/–, £2/2/–, and £1/1/– respectively, and there also will be consolation prizes of products to the value of 5/–.

When the competitor has completed his model he should obtain an illustration of it, and this may be either a photograph or a drawing. The competitor must write his name, full address and age on the back of the illustration, together with the *"M.M."* number of the "Suggestion" incorporated in his entry and the date of the issue in which it appeared.

Entries must be addressed *"Suggestions Model-Building Contest,"* Meccano Ltd., Binns Road, Liverpool 13, and those intended for Section A must reach Liverpool before 30th April, 1938. The closing date for Section B is 30th June, 1938.

Model-Building Competition Results

By "Spanner"

"Autumn" Model-Building Contest (Home Section)

The most prominent feature of this competition was the novel character of many of the models that won prizes. Some of these are very ingenious and a few of the best are described on this page. The complete list of prize-winners in the Home Section is as follows:

1st Prize, Meccano or Hornby products value £3/3/-: C. Wiles, Tonbridge. 2nd, products value £2/2/-: W. Houghton, Daventry. 3rd, products value £1/1/-: E. Clements, Orpington.

Products value 10/6: H. Lee, Ardrossan; A. Robertson-Aikman, Steyning; G. Mansfield, London, S.E.24; A. Daniel, Lingfield; R. Edwards, Grantham.

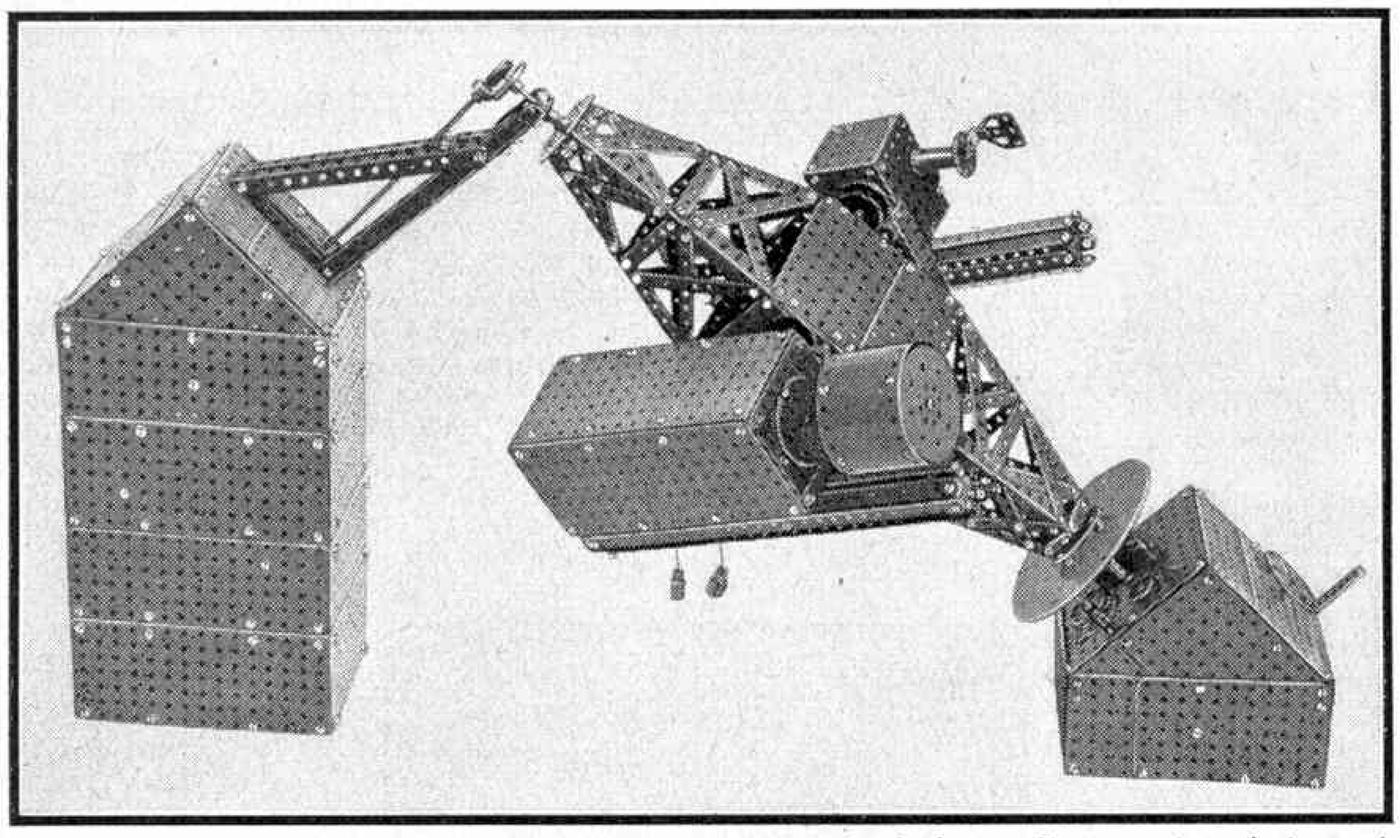
Products value 5/-: G. Atherton, Blackpool; L. Weedon, Sidcup; C. Turner, Exeter; H. Munson, Marlow; N. Jones, Rhyl; J. Rees, Swansea; E. Druce, Horwich; W. Kirshner, Gravesend; S. Killip, Ellesmere Port; N. Hughes, Liverpool 6.

Whist players and other card enthusiasts will be interested in an automatic machine for dealing out a pack of cards. This was designed by C. J. Wiles, Tonbridge, and was awarded First Prize.

The machine is one of the most ingenious that I have seen for some time. It consists of a square base carrying a superstructure, which is rotated slowly by a Clockwork Motor. The pack of cards is placed face downwards on a tray at the front of the model, and as the superstructure revolves a long india-rubber eraser, worked by an eccentric mechanism moves downwards and forwards, and pushes the top card off the pack. Four cards are dealt out for each revolution of the superstructure. As the pack becomes thinner, the tray carrying it is raised slowly, so that the uppermost card is brought into contact with the rubber.

The model is capable of dealing a complete pack of cards in 20 seconds, and it is reset ready for the next deal simply by moving a lever. The model is an excellent combination of originality of subject and good construction, and it is to these two features that it owes its success in this contest.

W. E. Houghton, Daventry, sent a fine model of the chiming mechanism of a large clock. It consists of a wood barrel carrying several thin nails. The barrel is mounted on a shaft and is rotated by a weight-driven mechanism. As it revolves the pins strike the ends of pivoted levers, each of which is connected to a bell hammer. A ratchet repeating mechanism is incorporated for the purpose of repeating the chime as many times as required, and the tune can be altered by re-arranging the positions of the nails on the barrel. Houghton is only 13 years of age, but the constructional details of his model are as skilfully and neatly carried out as those of models built by much older competitors. A model of this kind requires comparatively few parts, yet designing and building it provides a very interesting pastime, for there is plenty of scope for the model-builder to exercise his ingenuity.

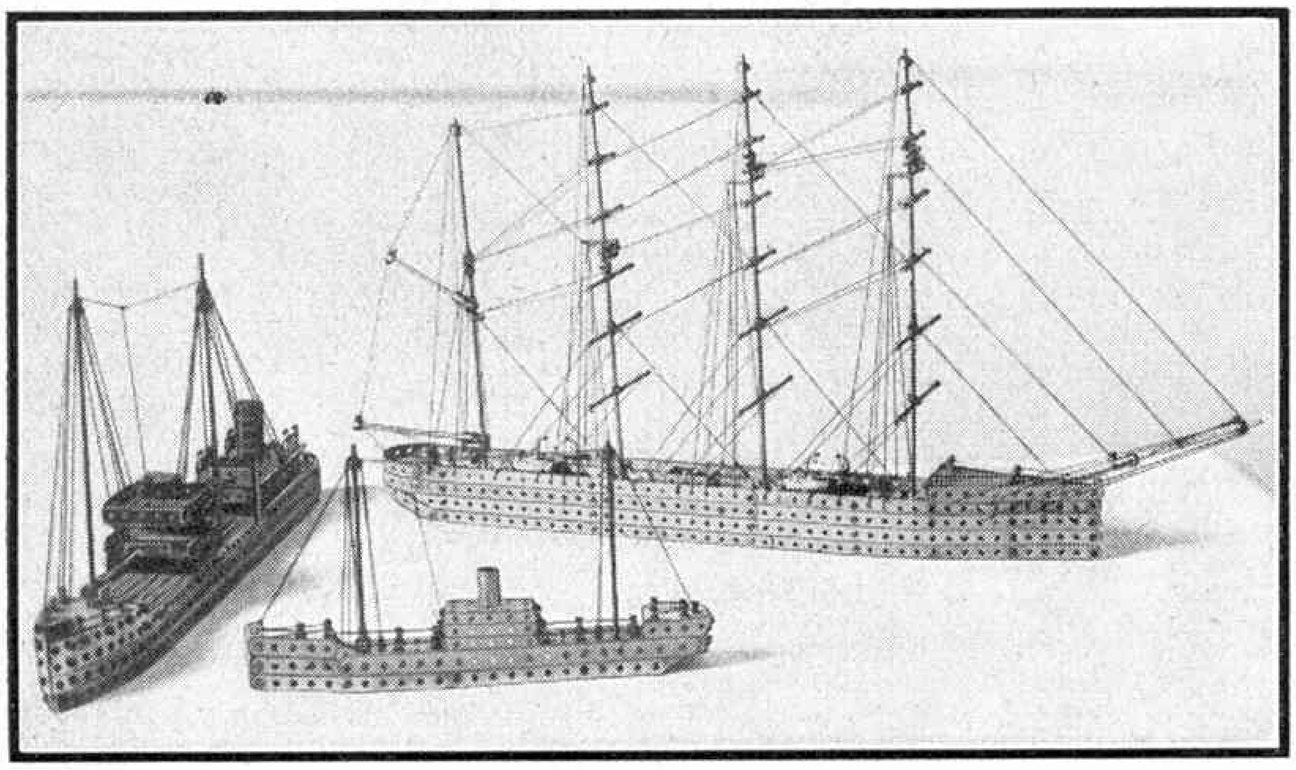


A fine model of an astrographic telescope built by E. D. Clements, Orpington. It represents an instrument used for photographing stars and other heavenly bodies, and was awarded Third Prize.

E. D. Clements, who is a regular competitor in "*M.M.*" Contests, submitted the fine model of an astrographic telescope that is illustrated on this page. The model represents an instrument that is used for photographing stars and other heavenly bodies. Very long exposures are required in this kind of work, and in order to compensate for the relative movements of the Earth and the star or other object being photographed the telescope is provided with an ingenious driving mechanism by which the tube is rotated slowly. Thus it continues to keep the object photographed in the same relative position throughout the exposure. In Clement's model a clock-type mechanism is used for driving the telescope tube, and a two-speed gear-box is provided for moving the telescope in order to train it on the required object.

A model of a 6-wheeled Luton lorry, fitted with a single plate clutch, three-speed and reverse gear-box, differentials and Ackermann steering gear, won a prize for A. Robertson-Aikman. The inclusion of small details such as number plates and an electric horn gives the model a very realistic and finished appearance.

H. Lee, Ardrossan, is the builder of the three ship models illustrated on this page. Lee is an expert builder of models of this type and has won several prizes for his work in this direction. Of the three models he submitted for this Contest I prefer the sailing ship, but I think readers will agree that they are all very creditable examples of this kind of model-building.

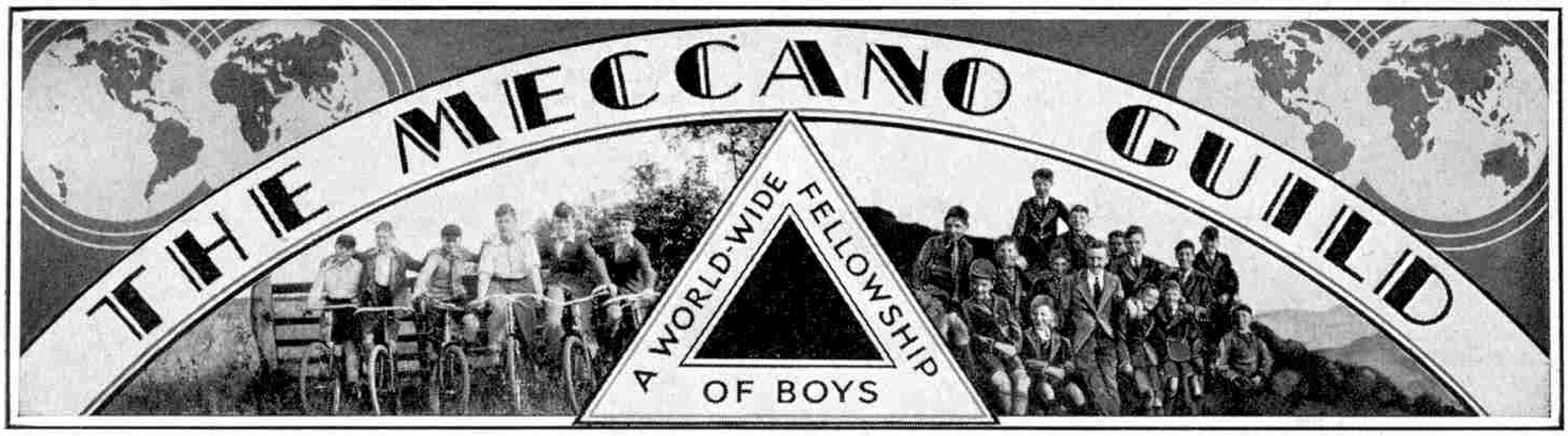


Three fine model ships that won a prize for H. Lee, Ardrossan. They are particularly interesting on account of the few parts used in their construction.

A robot that can walk a distance of about three feet, and has fingers that close and grip any small object such as a Meccano Strip thrown into them, forms the subject of the entry that won a prize for G. R. Mansfield, Herne Hill, London. The robot is driven by a Clockwork Motor, and while its mechanical features are ingenious, its appearance is rather crude.

A model of the G.W.R. locomotive "*King George V*" was notable among the models that won the smaller prizes. It was built by J. M. Rees, Swansea, and has a very neat appearance. The driving wheels and bogie axles are sprung as in the prototype, and each of the driving wheels is fitted with a contracting type brake.

Norman Hughes, Liverpool, sent a model of a swivelling dockside crane, an interesting feature of which is that the Transformer through which the driving Motor is supplied with current, is included in the superstructure of the model itself. The Motor is mounted directly above the Transformer, and drives through a gear-box, each of the various movements having its own gear train and a separate clutch and brake mechanism. The superstructure is mounted on a Roller Bearing, which provides a firm base for the model.



Planning Outdoor Pursuits

As I write the days are steadily growing longer and brighter, a reminder that it is time to look ahead to the outdoor season. This offers special problems to Leaders of Meccano Clubs. Well established clubs can arrange suitable meetings without difficulty. These include outdoor games and sports events, and visits to works, places of railway interest and seaside resorts. The officials and members of such clubs have had sufficient experience of making the necessary arrangements, and all realise the advantages of keeping together throughout the summer months.

Ways and means of sustaining interest throughout the outdoor season also can be found in small and newly formed clubs. In some cases it is possible to attract members to the club room for games or social events of some kind, or for running trains on the Hornby Section's layout. Most boys require some outdoor occupation during the summer, however, and I strongly urge efforts to meet their needs. Parties can be arranged for such pursuits as swimming, boating and rambling, and cricket can be played. Carefully planned outings also are helpful. These may be purely for purposes of enjoyment, but from experience I know that boys like to have a definite aim in view, and some interesting railway centre or junction, or a main line where famous expresses can be seen, forms a good objective for a ramble, or for a trip by road or rail that need not be expensive.

Perhaps the best plan is to make a judicious mixture, suiting events to circumstances. For instance, a particularly fine day encourages a visit to the swimming bath; on the other hand, the club room will prove an agreeable place of refuge on a wet half-holiday. The wishes of members themselves will always be a good guide. The choice of pursuit is not of special importance; the chief thing is that it should be one that members can enjoy together. Members learn to know each other better when taking part in a variety of club events of this kind, and return to winter pursuits with greater pleasure when they spend happy times together during summer.

The Correspondence Club

Every day more and more requests for correspondents in various countries reach me. At the moment the greatest demand is for pen friends in Australia, Canada, and France. Guild or H.R.C. members in these countries who have not already joined the Correspondence Club should write to me immediately for a form, and they can be sure that suitable friends will be found for them almost immediately.

I have also requests for correspondents in the United States, India, New Zealand and various European countries, and should be glad to hear from prospective members in these places.

Members can help to avoid delays in finding correspondents by careful selection of alternative countries, especially if that made the first choice is remote and sparsely inhabited. A special line for this purpose is provided on the official entry form. Inability to find pen friends quickly in certain countries then usually is due to a temporary shortage. The chief requirement of an applicant is kept on record, so that I may be able to satisfy him as soon as possible.

Meccano Club Secretaries

No. 43. D. Livesey

D. Livesey has been secretary of the Royds Hall Grammar School M.C. since its affiliation to the Guild in October 1937. The members of the club are keen model-builders and a display of a variety of excellently constructed working models, particularly engines and aeroplanes, was a feature of the recent successful Exhibition.

Winding Up the Winter Sessions

Preparations for the Exhibitions, displays or socials that mark the winding up of the second Winter Session are already in full swing. I am very glad to find that Exhibitions are more popular than ever, for I am convinced that the best thing Leaders and members of a club can do is to let the world in general know what a Meccano Club is and what great fun its members enjoy. Parents and friends of course are always eager to see the models members build, and to see their miniature railways in operation, but every effort should be made to go beyond them in order to introduce the Guild to a wider circle. This usually brings in recruits and gains useful support.

Coming Events

The Exhibition of the Mount Senior School, Newark M.C., will be held on 23rd and 24th March in the School Hall. It will be open from 6 p.m. to 8 p.m. each evening, and the price of admission is 3d. for adults, 2d. for others. Every Newark Meccano enthusiast should make an endeavour to be present. The display will include two super-models, the meccanograph and block-setting crane, on loan from Headquarters, and there will be two Hornby Railway layouts to add to the interest of visitors.

The 7th Annual Exhibition of the Old Charlton M.C. also is to be held on 2nd April, and I am including a note on this in order to give the Meccano boys of the district ample opportunity of arranging a visit to it.

This Exhibition will take place in the Assembly Rooms, Charlton Village, and will be open from 4 p.m. to 9 p.m. The admission charges are 3d. for adults, and 1d. for others, and tickets can be obtained from any club member. There will be a model-building demonstration, in addition to a display of splendid models already constructed by members. Refreshments also will be provided, and there will be musical interludes by the Charlton and Blackheath Accordion Club Band. The Mayor of Greenwich has kindly promised to attend and to present prizes and medals won by members.

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:

ABERCYNON—Mr. W. J. Howell, Selective Central School, Abercynon, Glamorgan.

ALDERSHOT—L. Haward, 5, Roberts Road, Aldershot.

ARGENTINA—A. R. Creyke, Ituzaingo 650 Dep 7, Buenos Aires.

BARNSLEY—R. Drury, 40, Croft Road, Kendray Estate, Barnsley.

BELFAST—W. Morgan, 50, Crystal Street, Belfast.

BIRMINGHAM—D. Wynne, 52, Francis Road, Edgbaston, Birmingham 16.

BRIDLINGTON—P. E. Carlton, 77, Cardigan Road, Bridlington.

CHALFONT ST. PETER—F. V. Heller, "Lovette," St. Mary's Way, Chalfont St. Peter, Bucks.

Barking M.C.—All recent meetings have been very successful, and an attractive innovation was a "Do as You Like" Evening, which aroused great interest and enthusiasm. Many excellent models have been constructed, among them being a chairoplane designed and built by the Leader. This model ran well for long periods when driven by a No. 1A Clockwork Motor. Club roll: 16. *Secretary:* R. Walling, 18, Ashburton Avenue, Ilford, Essex.

The Beeches (Jersey) M.C.—Excellent progress is maintained. The second volume of "*Our Mag*," the official organ of the club, is a very attractive and excellent production, and plans are in hand for an even better issue, to be produced at Easter. An enjoyable Party was held before the Christmas holidays, games preceding and following tea. A Christmas tree helped to create the right spirit. Several new members joined the club, and talks given by members on subjects of topical interest are great attractions. Club roll: 25. *Secretary:* A. Shepherd, "The Beeches," Jersey, Channel Islands.

Bristol Grammar School M.C.—Officials and members agreed that last Session was the most successful since the club's formation, every meeting attracting large attendances and all thoroughly enjoying themselves. Model-building has occupied most of the time, but two Hornby Nights proved very popular, members bringing their own components. Visits were arranged to Elders and Fyffes Ltd.'s boat "*Carare*," and the main Bristol Fire Station. Club roll: 15. *Secretary:* L. Stear, "Highbank," Trelawney Road, Cotham, Bristol, 6.

Cold Harbour M.C.—The Hornby track has been converted into an electric one, and members were both surprised and pleased by this arrangement, which has resulted in increased enthusiasm in club activities. A Lantern Lecture on "*Transport and Its Part in Industry*" was of great interest. Members are building more scenery of wood and paper, and future working is to be to timetable. Club roll: 16. *Secretary:* R. S. Hill, Anstie Farm, Cold Harbour, Surrey.

Exeter M.C.—The Annual Report for last year showed a decrease in membership at the beginning of the year, but records were made in the last quarter. Altogether 208 Meccano models were constructed, the most outstanding being that of the Crown made during the Coronation period. New woodwork models of naval vessels increased the club's fleet to more than 200 ships. A second football team, the Elmside Rovers, has been formed, and great enthusiasm has been shown by the members of both teams. Members are looking forward to another successful year. Club roll: 70. *Secretary:* J. T. H. Fenwick, 28, St. John's Road, Exeter.

Hornsea M.C.—Lantern Lectures, Socials and Games are popular features of the club programme. A talk on "*Waterworks*" was given by one of the members, and a prize was offered for the member who asked the most questions regarding this subject. The Senior Engineers spent a very enjoyable Social Evening making buildings for the model village which they are constructing under the guidance of D. Parker. It has been decided that the existing Senior Scientists shall cease to belong to the club, but still serve on the committee, and have a gathering at the Leader's house once a month. The existing Junior Scientists are to be called "Scientists" only. Club roll: 19. *Secretary:* P. Thom, 5, Alexandra Road, Hornsea.

Coloured Mission (Cardiff) M.C.—A very successful Anniversary Party was held during December, when games were played and a supper kindly provided by Mrs. Binstead was enjoyed immensely. A model cargo boat was on show for the benefit of visitors, who commented on the high standard of model-building attained by the members. An Exhibition is to be held this month on the occasion of the Chapel Anniversary, and members are concentrating on building models for this event. A gift of a large quantity of Meccano parts from Mr. H. Dugdale has added considerably to model-building possibilities. Club roll: 18. *Secretary:* D. H. Binstead, 37, Penhill Road, Llandaff, Cardiff.

Folkestone M.C.—Excellent progress continues to be made and many improvements have been effected. Club funds are increasing slowly, and it is hoped to maintain steady progress in this direction throughout the year. Interesting operations have been carried out on the club's Hornby layout, goods trains leaving the sidings every quarter of an hour for other stations. Weather records are to be taken and forecasts made for the shipping in "Folkestone Harbour," and another warship is to be constructed shortly for the model defensive service. Club roll: 7. *Secretary:* W. F. Cotter, 52, Hill Road, Folkestone, Kent.

Great Baddow M.C.—An interesting Film Show was given by one of the adult members, the main features being railway scenes and comedies. On Army Manœuvres Night members brought models of guns and tanks, with model soldiers to form two armies. Very realistic battles were staged, and afterwards a senior member handed out decorations to those who had distinguished themselves. A Tea was provided by the Parents' Committee and parents and friends, and this was greatly appreciated by members. Afterwards parents and friends were invited, and games and community singing were enjoyed, the evening concluding with a fine entertainment kindly given by the "Wolves" Scouts Concert Party. Small gifts of Meccano parts were presented to the members from the Christmas tree. Club roll: 25. *Secretary:* J. K. Avis, 5, Crescent Road, Great Baddow, Chelmsford.

Regent Street Central School M.C.—Interesting Lectures on a variety of subjects are one of the main features of the club programme. The Annual Concert and Exhibition held in November attracted many exhibits, and prizes were awarded in both the Boys' and Girls' Sections. An attractive forthcoming event is the Football Match against a School team. Club roll: 150. *Secretary:* J. Shepherd, 29, Bury New Road, Heywood.

Winchmore Hill Collegiate School M.C.—Several members visited the Islington M.C. Exhibition and were favourably impressed. The club's own Exhibition and Variety Show, held in December, was the best on record. Some of the models displayed were marvels of Meccano construction, and the exhibits were judged by Mr. Arthur Field, an old boy of the School and formerly an active member of the Meccano club. An extensive model railway was kindly loaned by a local Meccano dealer, and connected to the club's own track by a special Meccano bridge. The Variety Show was a triumph, and Handicrafts and Refreshment Stalls added to the attractions. The financial results of the Exhibition were excellent and have enabled many additions to be made, including permanent scenery, curtain drawing apparatus and other stage properties. Club roll: 32. *Secretary:* J. A. Piejus, 22, Woodland Way, Winchmore Hill, London, N.21.

Whitgift Middle School M.C.—Track and Meccano Model-building meetings are the main features of this club. Model-building competitions also have been held, and in one of them the chief prizes were awarded to members showing a motor tractor and a block-setting crane. Many visits of great interest have been paid, and it is hoped that the Koh-i-Noor Pencil Works at Croydon will be inspected very shortly. Club roll: 34. *Secretary:* P. Wilmer, 67, Lansdowne Road, Croydon.

Wednesbury M.C.—The majority of the meetings were devoted to preparations for the Second Annual Exhibition of Work held in December. Many attractive models were on view, and the Woodwork exhibits included many useful articles. The club's model railway was of considerable interest, the new stock purchased for the occasion being a special attraction. The proceeds of the event went towards club funds. The present arrangements include two Film Shows, a Social Evening and a Lecture on "*Liners of To-day*." Club roll: 20. *Secretary:* A. L. Morgan, 17, Cobden Street, Fallings Heath, Wednesbury, Staffs.

Members of the Rosemount (Regina) M.C. Mr. J. T. Faville, President, and Mr. E. Penny, Leader, are second and third from the left in the middle row, with J. Watson, secretary and treasurer, seated on the left. This Canadian club makes use of a very extensive stock of Meccano parts kindly loaned by the President and Secretary, and many splendid working models are shown at Exhibitions.

AUSTRALIA

Maylands M.C.—The club was entertained by the Australian Native Association, and were invited to join in games and supper. Another visit was paid to the Observatory, where the members were shown the time recording machine that automatically sends time signals to the local wireless station. A Surprise Visit turned out to be a very enjoyable evening at the theatre. Model-building for a great Exhibition to be known as "Meccanolympia" is practically finished, and as a result of members' great efforts there will be many splendid models on view. Club roll: 29. *Secretary:* H. Thomson, 13, Kennedy Street, Maylands, Western Australia.

CANADA

Rosemount (Regina) M.C.—A great demonstration is to be held in Spring, and members are determined to use up the club's extensive stock of Meccano parts in building the best array of models they have ever shown. All models are being built in the club rooms. The club runs a Model Railroad, and also a Museum, in which are displayed Indian relics, such as arrowheads, tomahawks, hammers, pottery and ancient fossils. Some of the fossils are stated to be from thirty to sixty million years old. There are also collections of birds' eggs, butterflies and other insects, coins and stamps, and an extensive Library. *Secretary:* J. Watson, 974, Athol Street, Regina.

EGYPT

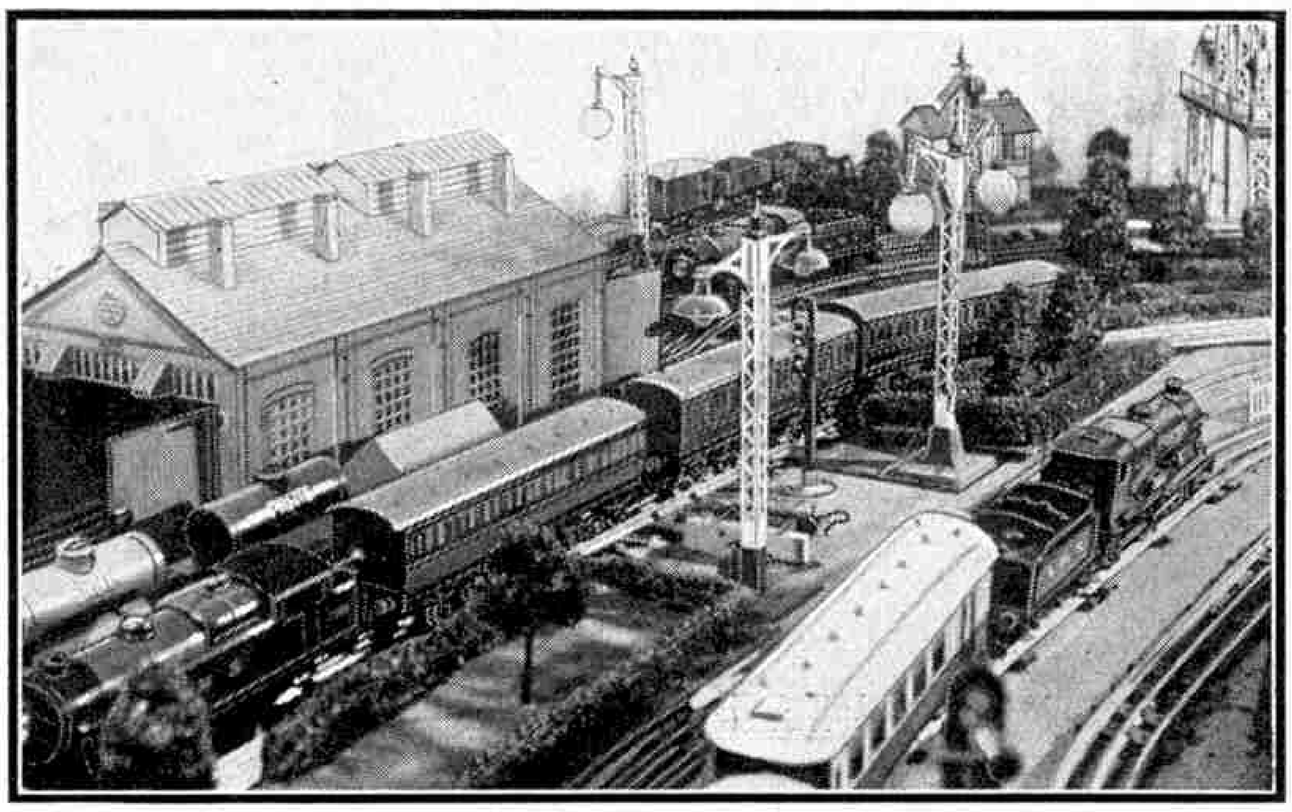
Zagazig and Misr M.C.—This club has been transferred from Zagazig to Cairo, and under its new name is now firmly established. An excellent club room fitted with electric light has been obtained, and meetings are held weekly. An interesting and varied programme has been arranged, and on one Model-Building Evening models of a Log Saw were brought by members. A visit has been paid to the premises of Roberts, Hughes and Co. Ltd., Meccano dealers in Cairo, where a very enjoyable time was spent studying Meccano models and the Hornby Train layout. Club roll: 18. *Secretary:* A. S. Mangourie, 13, Sh. Badir, Zeitoun, Cairo, Egypt.

A Hornby Layout in Belfast

Extensive System with Spiral Gradients

HORNBY railway systems do not often incorporate gradients, as it is difficult to arrange satisfactory slopes within the limited space usually available. The layout described in this article is an exception, however, for the main parts of the system are arranged at different levels and connected by two complete spiral gradients.

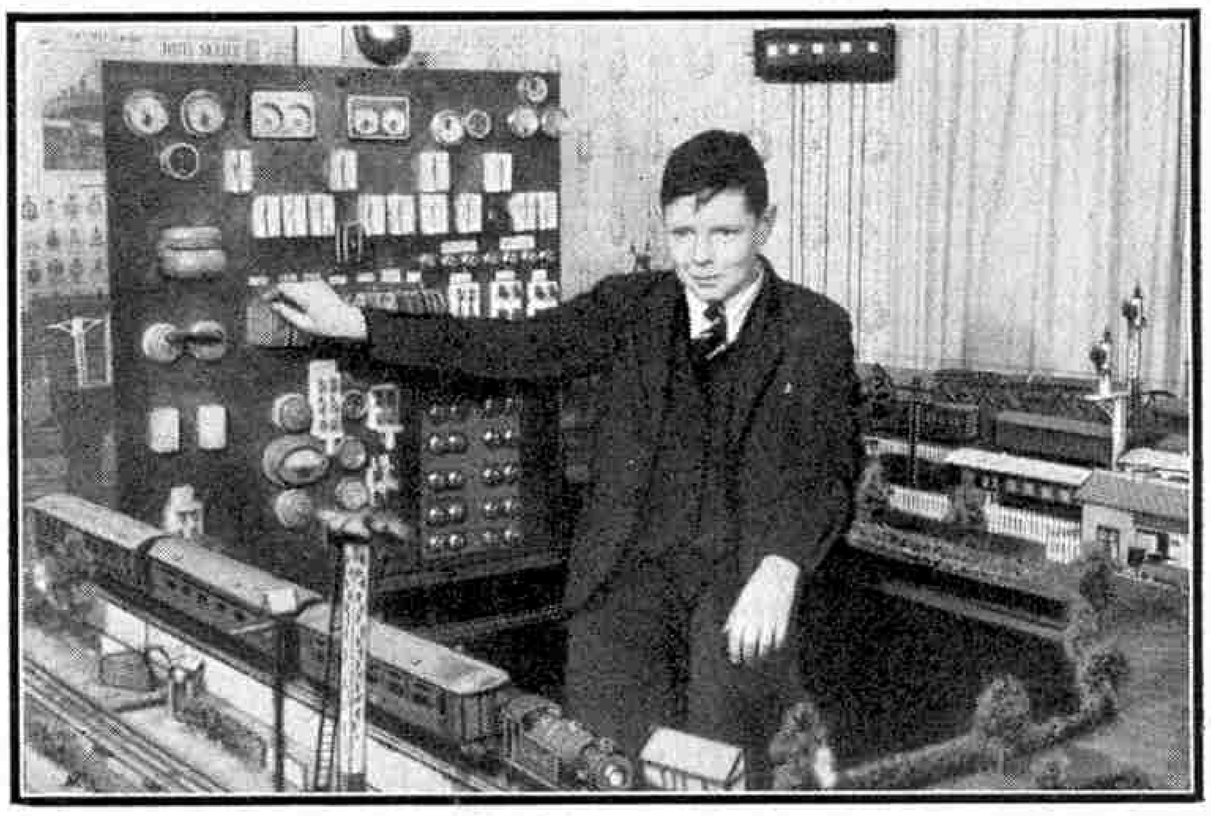
The layout has been gradually assembled by Major G. Thomson, Belfast, and his son, who are fortunate in having a large room at their disposal for the accommodation of the system. The first step in the construction of the railway was the erection of a suitable table, 25 ft. long and 12 ft. wide, having in the centre an operating space of about 6 ft. by 4 ft. The upper surface of this table forms the normal or high-level line of the system. The main part of the layout is continuous main line of three tracks following the usual oval formation, and there is also a fourth line that accompanies the other three for nearly the whole of the way round the table. A lengthy system of dead-end roads is connected to the outer main running track. One of these can also be used as a running loop by the use of a crossover connection inserted for the purpose.



A busy scene on the layout of Major G. Thomson, Belfast, showing part of the main line, the Engine Shed and some of the sidings. The scenic effects add to the realism of the system.

Crossovers or their equivalent in pairs of points play an important part in the track system, and provide the means of access between each of the continuous running tracks. Alongside the inner and outer continuous tracks on the high level are passenger platforms, which serve as independent stations as far as train running is concerned. The platform alongside the inner track is approached by a miniature road which runs through the countryside arranged in the centre part of the layout. The countryside is complete with fields, hedges and miniature animals. A farmhouse also is included, with the station-master's house, a building that is not often found on miniature railway layouts. This stands in its garden, close to the inner platform previously referred to.

Opposite one end of the operating space the outer continuous track forks into two lines, running parallel to each other, that gradually descend to the low level, 9 in. above the floor. These descending tracks make two complete spirals beneath the high-level section. On their way down they pass through a miniature tunnel, and a necessary feature is a detachable bridge that allows the operator to gain access to the centre part of the layout. At the foot of the gradient the line terminates at a three-road station. There are sidings, and an electrically-operated turntable forms an essential part of the equipment of the locomotive yard.



George Thomson, son of the owner of the layout, at the control panel. The trains at any part of the system, the operation of points and the lighting are all controlled from this panel.

This turntable is made from Meccano Parts and incorporates a Geared Roller Bearing (Part No. 167) and a small electric motor. On the upper portion of the Roller Bearing is mounted a wooden platform, forming the floor of the turntable proper, on which side girders and rails are fitted. The rails are electrified by means of copper plates under the wooden floor of the turntable and connected to "wipe" contacts fed from the rails on the main line. When the main line is electrified the turntable rails also are "live," and the engines can be run on and off the turntable as required. An ingenious feature is a magnetic stop that is released by pressing a button. A switch starts the motor, and as soon as the turntable has completed half a revolution, and an engine on it has been turned round, the magnetic stop comes into operation and holds the turntable accurately in line with the track.

The electric power arrangements on this system are on an unusual scale. On the high-level section current is supplied to the rails at 20 volts through three Meccano T20M Transformers, which feed the four continuous tracks. Each of the two lines connecting the high-level and the low-level track systems has a separate supply, a T22M Transformer being used in each case. The complete layout is controlled from a centre switchboard conveniently situated in the operating space, and the operator can move trains from one part of the system to any other without altering his position. An extensive system of sectionalisation gives separate control to each track through seven Resistance Controllers on the switchboard, and above each Controller is a fuse, together with a voltmeter and ammeter.

The points and crossovers are operated by distant control by means of 12-volt electro-magnets, and the aspects displayed by the home-made colour-light signals depend on the setting of the points. All the signals, the station buildings and the point lamps are electrically lighted. The total number of lamps is 72, and the current supply for them is taken from batteries. A separate battery supplies the power for the operation of the points. A dynamo coupled directly to a ½ h.p. motor keeps the batteries charged, and the cut-out, meters and switch of this part of the plant also are included on the switchboard, which thus forms a very comprehensive control panel.

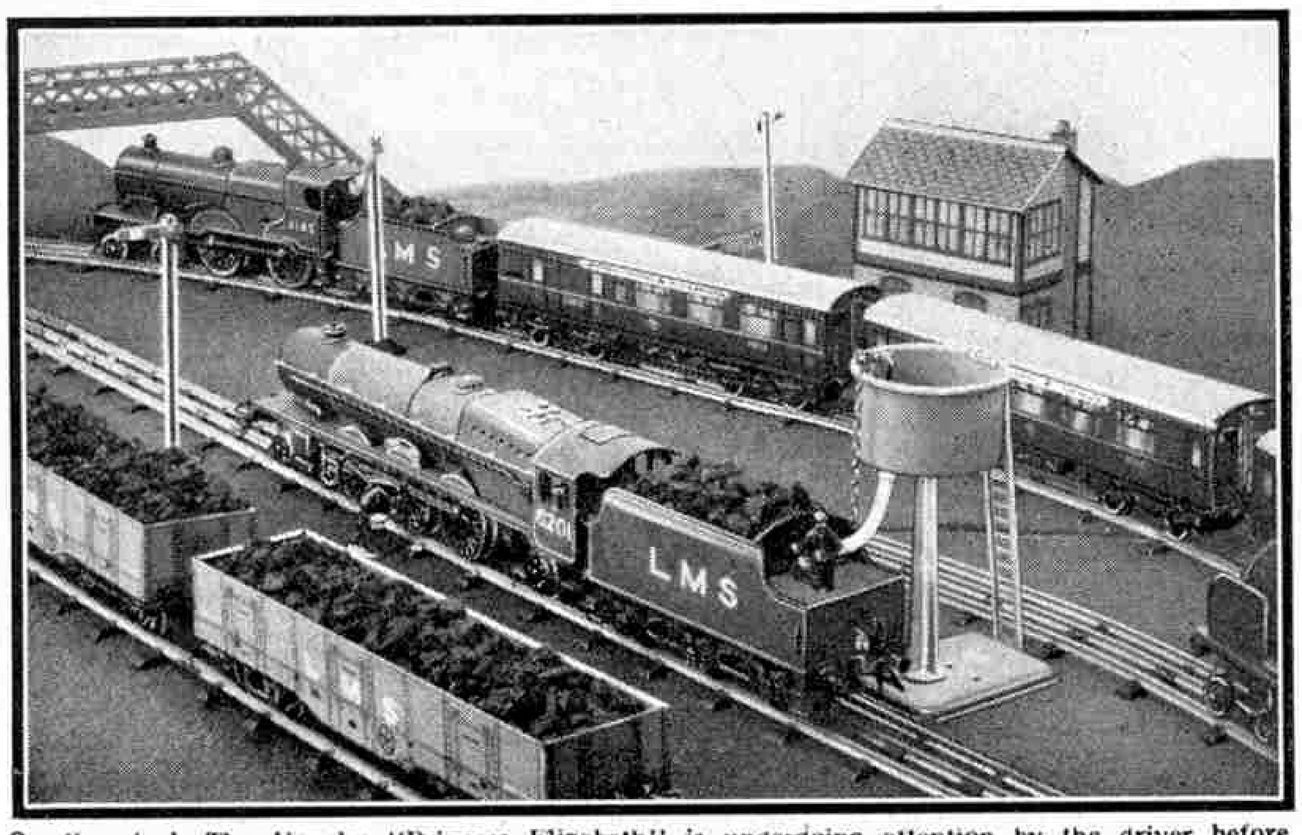
The locomotives and trains that operate the service on this line are nearly all L.M.S. models. The engines include a Hornby "Royal Scot," a Standard Compound and a No. 2 Special Tank. A complete Riviera "Blue" Train also is available, and in addition there is a Swiss-type electric locomotive, which is used in assisting trains from the lower terminus to the high-level section. Trains can be run almost indefinitely on the high level. They can then be taken down to the low level; on this section their engines can be turned and they can be brought back again, all by remote control.

Locomotive Duties on a Hornby Railway

By "Tommy Dodd"

THE arrangement of locomotive duties is a very interesting part of real railway work, and it is equally attractive in miniature to plan beforehand the work on which the different engines employed on the railway will be engaged. This indeed is necessary when timetable operation, or at least some organised form of working, is practised, for haphazard working, or merely trusting to memory, might result in a wrong move that would disorganise the running of the service.

In real practice the duties to be performed and the engines allocated to them are shown on a large board at the shed so that drivers can see what trains they are responsible for. Working notices are issued regularly giving details of any alteration in the services and any other points affecting the working of the trains.



On the shed. The Hornby "Princess Elizabeth" is undergoing attention by the driver before commencing the duties laid down on the Engineman's Job Card below.

In miniature it is necessary to have a simple means of setting out engine movements, and to enable Hornby Railway owners to do so in a realistic manner there are special pads of forms available, each of which is made out as an Engineman's Job Card, or an E.J.5 as it is marked for reference. A reproduction of one of these forms appears on this page and on it have been entered the various moves of a locomotive for a single period of working.

Time cannot be reduced to scale in the same manner as distance, and therefore it is necessary to work to actual times. This practice has been followed on the form, and in order to follow this in detail we will imagine that we are to accompany the locomotive concerned.

The first duty of the day is to run the 2 p.m. express from Burminster to Northport. The engine therefore is due "off the shed" at 1.50 p.m. and runs light, tender first, to the station. The allowance of 10 min. from leaving the shed to the departure from the main station seems generous at first sight, but light engines are liable to be delayed in favour of trains working in and out of the terminus. Another point that is evident from the Job Card is that on arriving at the station at 1.55 p.m. our engine is not immediately backed on to the train, which is waiting for it alongside the main departure platform No. 1. Instead, it is admitted to platform 4 and backed gently on to a corridor brake-composite coach that is waiting there. This has arrived at the rear of a branch train from Seaton a little while before, and has been uncoupled from it ready for our engine to pick up. Its destination boards bear the words *"SEATON AND WYNMOUTH,"* and it has to be conveyed by our train as far as Bradbury Junction, the first stop. The engine draws this coach forward and negotiating crossovers and points backs slowly alongside platform 1, where the main portion of our train is waiting.

Promptly at 2 p.m. the train leaves Burminster terminus, and a smart run has to be made if Bradbury Junction is to be reached in the minute allowed. Platform 1 is used there and a van has to be attached for conveyance to our second stopping place. At the same time the through coach has to be left, as Bradbury is the junction for Wynmouth. Immediately on arrival therefore the engine comes off the train and proceeds to No. 1 bay platform. There it collects the van and then returns to No. 1 and attaches the through coach, which in the meantime has been uncoupled from the train. The engine, with the van and the coach attached, moves forward and then backs into No. 1 bay, where the coach is left ready to be taken off to Wynmouth by a local train in a few minutes' time. The engine and van now return to the main train and at 2.3 p.m. it at last moves off on the next stage of its run.

The next stop is at Welborough, where the van that we have brought empty from Bradbury is left in a siding. At 2.5 p.m. the engine sets off on the last stage of its present journey, and the trip finishes with a rapid run into platform 4 at Northport. The train is not allowed to occupy the platform long, however, and the next move of the engine is to back it into the carriage road outside the station.

The engine is now released and proceeds to a triangular layout near the station in order to be turned round. It next moves to a siding set apart for locomotives waiting for their next turn of duty. Modern conditions demand a very intensive use of locomotive stock. At 2.15 p.m. the engine therefore is signalled away from the locomotive siding to what is known as Port Siding, near the goods yard, which receives traffic from the docks for which Northport is famous.

At Port Siding a different type of duty awaits the engine. A "fitted freight" train consisting chiefly of perishable traffic vans and containers has already been made up. This leaves at 2.18 p.m., the engine displaying of course the "fitted freight" headlamp indication, that is having one lamp in front of the chimney and another over the right-hand buffer. At Welborough the train does not pass through the station, but avoids it instead by taking a loop line, which is useful for holding freight trains and to facilitate examination.

While the train is being looked over the engine goes to the up siding and collects the van that was left in the down siding on the previous journey. This has in the meantime been loaded. The engine backs on to the train with this and at 2.20 pulls out on the remainder of its journey to the Market Yard at Burminster, a large freight traffic centre. Here the engine is uncoupled and is made to run round the train by means of crossover points and then proceeds to the locomotive yard. It is again turned by means of a triangular junction arrangement and then takes its turn at the water tank, coaling plant and at the other stages of engine disposal at the sheds.

Timetable No. 1 E.J.5

THE HORNBY RAILWAY COMPANY

STOCKLEY Branch

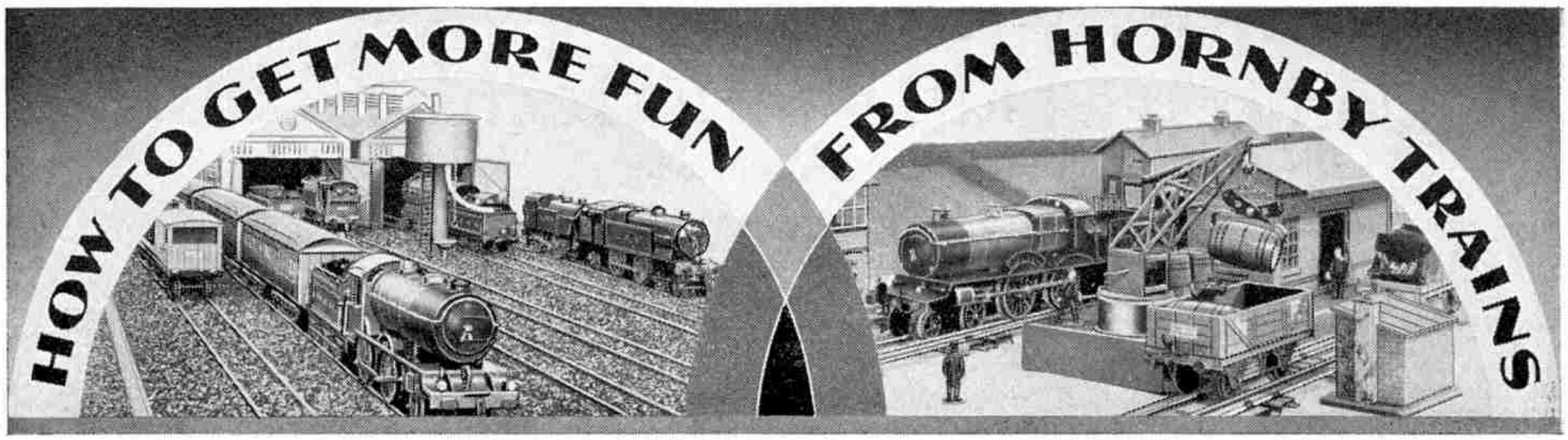
Engineman's Job Card

Engine No. 6201 Type 7P 4-6-2 Sheds CAMBURY

Time	From Platform	Class	To Platform	Time	From Platform	Class	To Platform
1·50	OFF SHED	LIGHT	4 B'MINSTER	2·15	LOCO ROAD	LIGHT	PORT SIDING
1·55	4	WITH SEATON COACH	1	2·18	PORT SIDING	FITTED FREIGHT	LOOP W'BORO'
2·0	1	Ex. PASS	1 B'BURY JUNC	2·19	LOOP W'BORO'	—	UP SIDING
2·1	1	LIGHT	No 1 BAY	2·19½	UP SIDING	WITH VAN	LOOP W'BORO'
2·12	No 1 BAY	WITH VAN	1	2·20	LOOP W'BORO'	FITTED FREIGHT	MARKET YARD
2·2	1	VAN AND COACH	No 1 BAY	2·20½	MARKET YARD	LIGHT	LOCO YARD
2·2½	No 1 BAY	WITH VAN	1				
2·3	1	Ex. PASS.	1 W'BORO'				
2·4	1	WITH VAN	DOWN SIDINGS				
2·4½	DOWN SIDINGS	—	1 W'BORO'				
2·5	1 W'BORO'	Ex. PASS.	4 N'PORT				
2·6	4 N'PORT	EMPTY	CARR. SIDINGS				
2·7	CARR. SIDINGS	—	LOCO ROAD				

(Signed) W. E. Drummond SUPERINTENDENT

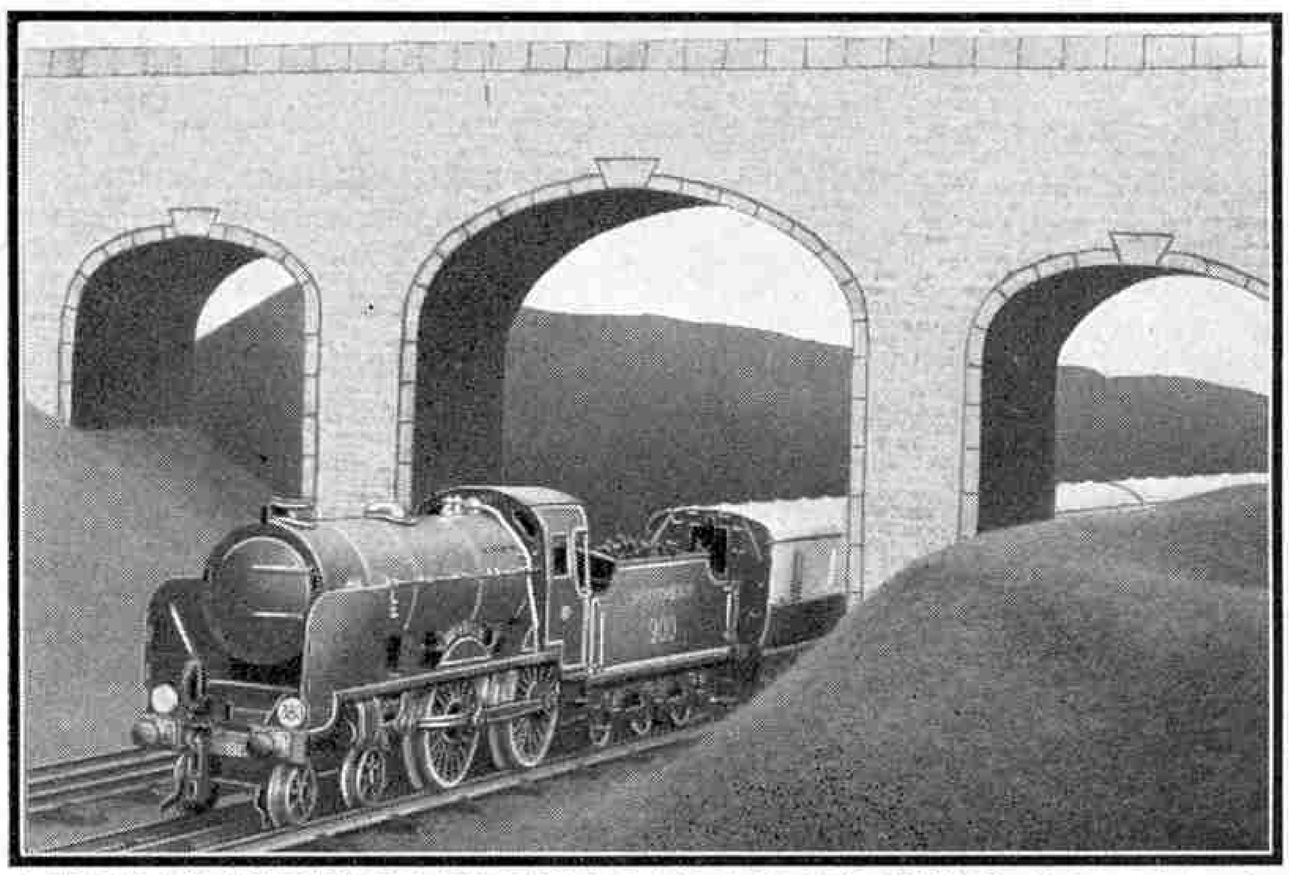
The Engineman's Job Card referred to in this article. This particular card has been made shorter than the standard ones, in order to allow of reproduction on as large a scale as possible.



S.R. LINER AND FLYING BOAT TRAIN SERVICES

ON various occasions in the past we have referred to train operations on the Southern Railway, and have given in these pages suggestions for the reproduction in miniature of actual practice by the use of Hornby components. This month we intend to deal with typical activities on the Western Section of the S.R., with particular reference to the main line to Southampton and Bournemouth. Developments in the Hornby Series and in actual practice make it possible to work out schemes that will appeal to readers generally, and will be of special interest to owners of miniature S.R. layouts.

Recent introductions into the Hornby Series have included the splendid "*Eton*" Locomotive, a most attractive model of one of the real S.R. "Schools" class locomotives. This fine engine is available both for electric and for clockwork railways, and forms a most imposing addition to stock of any S.R. layout. Other items have been the new S.R. Corridor Coaches, and that Company also is represented in the new range of No. O tinprinted Vans that became available a little while ago. In this article we shall see how this equipment can be used.



A Hornby S.R. "Schools" class locomotive at the head of a train of G.W.R. stock passing under an arched overbridge constructed of cardboard. The train represents the Birkenhead-Bournemouth through service, which is worked by S.R. engines between Bournemouth and Oxford.

The working of the real "Schools" class locomotives over the Southampton and Bournemouth route from Waterloo has now become an established feature. It is thus possible in miniature to operate with the Hornby "Schools" class locomotive a variety of trains typical of those that are found on this important main line.

Of the many trains that run in and out of Waterloo, the London terminus of the Western Section of the S.R., special interest is attached to the boat train services. There is always an air of importance about any trains that run in connection with steamship sailings, but visions of lengthy journeys to all parts of the globe are immediately conjured up by the sight of an S.R. "Ocean Liner" express. In connection with the running of boat train services in miniature, and particularly those working to and from Southampton Docks, we have received some interesting suggestions from one of our readers, A. Brown of Winchester. The special attraction of the Southampton traffic for this Hornby Railway owner is explained by the fact that the S.R. Southampton route passes the end of the garden of his house, and the hints given in the following paragraphs are based on his observations of these trains, and his practices on his own Hornby Railway.

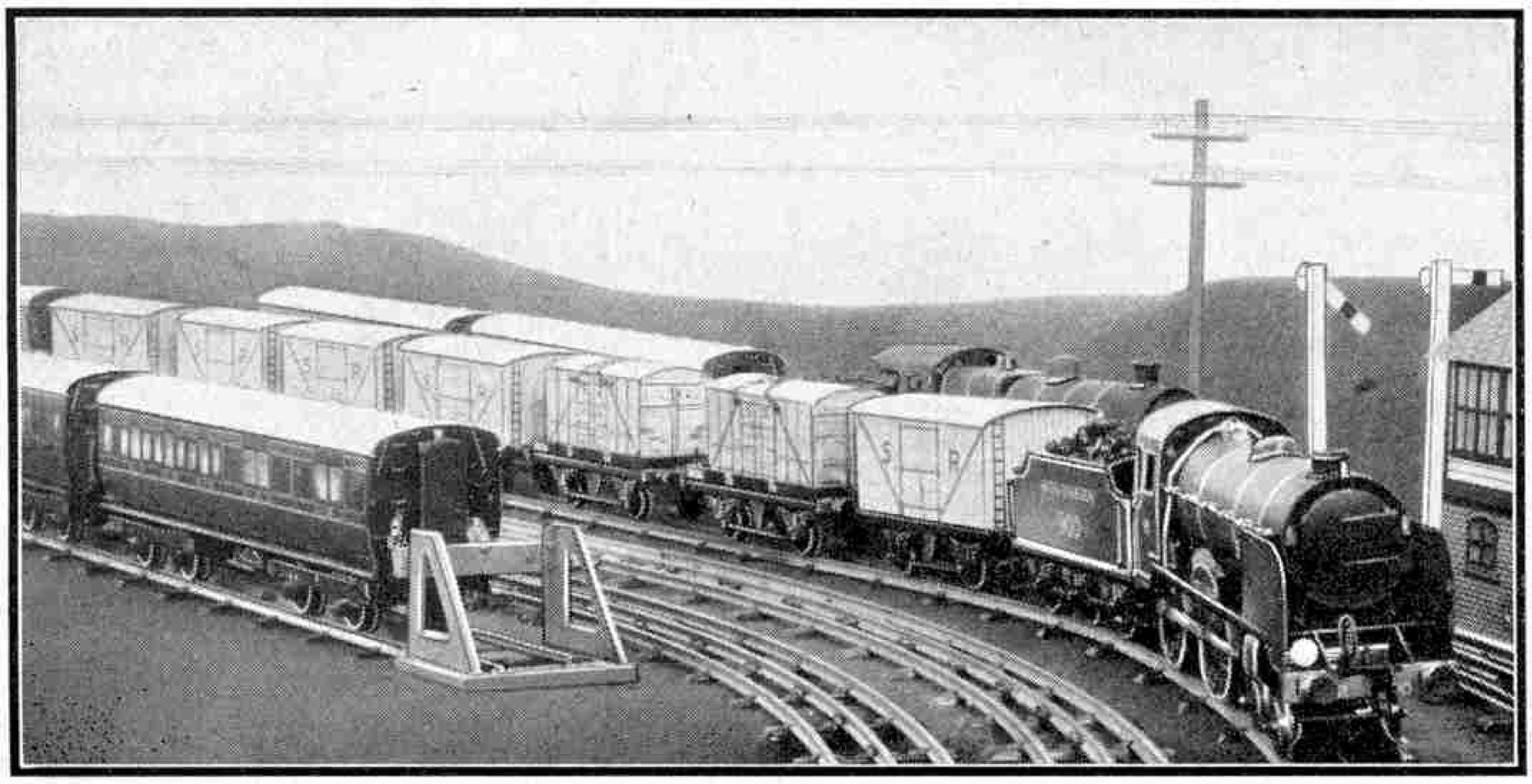
This enthusiast points out that "The operation of boat trains should be the chief feature of any miniature railway system that can be made to include a model harbour or quayside." Miniature Southampton boat trains can be made up in several different ways; a typical arrangement that Brown suggests includes one of the new S.R. Corridor Third-class Coaches and a corresponding Brake-Composite with a No. 2 Special Pullman Coach vestibuled between them. In the rear one of the four-wheeled S.R. Guards' Vans, or more if required by traffic conditions, should be attached for baggage purposes.

Such a train as this of course requires to be distinguished by the correct type of train nameboard, and it is not a difficult task for miniature railway owners to prepare special boards themselves. On the real trains these are worded alternately "*Ocean Liner Express*" and "*Waterloo–Southampton Docks.*" On a train made up as just suggested the two S.R. bogie vehicles would carry "*Ocean Liner Express*" boards, and the Pullman between them would bear the "*Waterloo-Southampton Docks*" board. A train like this will have an interesting and important air about it.

For boat train working the Hornby "*Eton*" will do splendidly; it is typical of the latest S.R. locomotive practice, and will complete the air of distinction of a miniature "Ocean Liner" train. A detail of importance is that the locomotive should display the correct head code in the manner characteristic of S.R. practice. This of course is easily possible, as miniature discs are included with the equipment of the Hornby "*Eton*" model. The locomotives of special boat trains from Waterloo to Southampton Docks, via Millbrook, carry one disc in front of the chimney and another over the right-hand buffer. For up

trains over this route the disc in front of the chimney remains, but the lower disc is transferred to the position over the left-hand buffer.

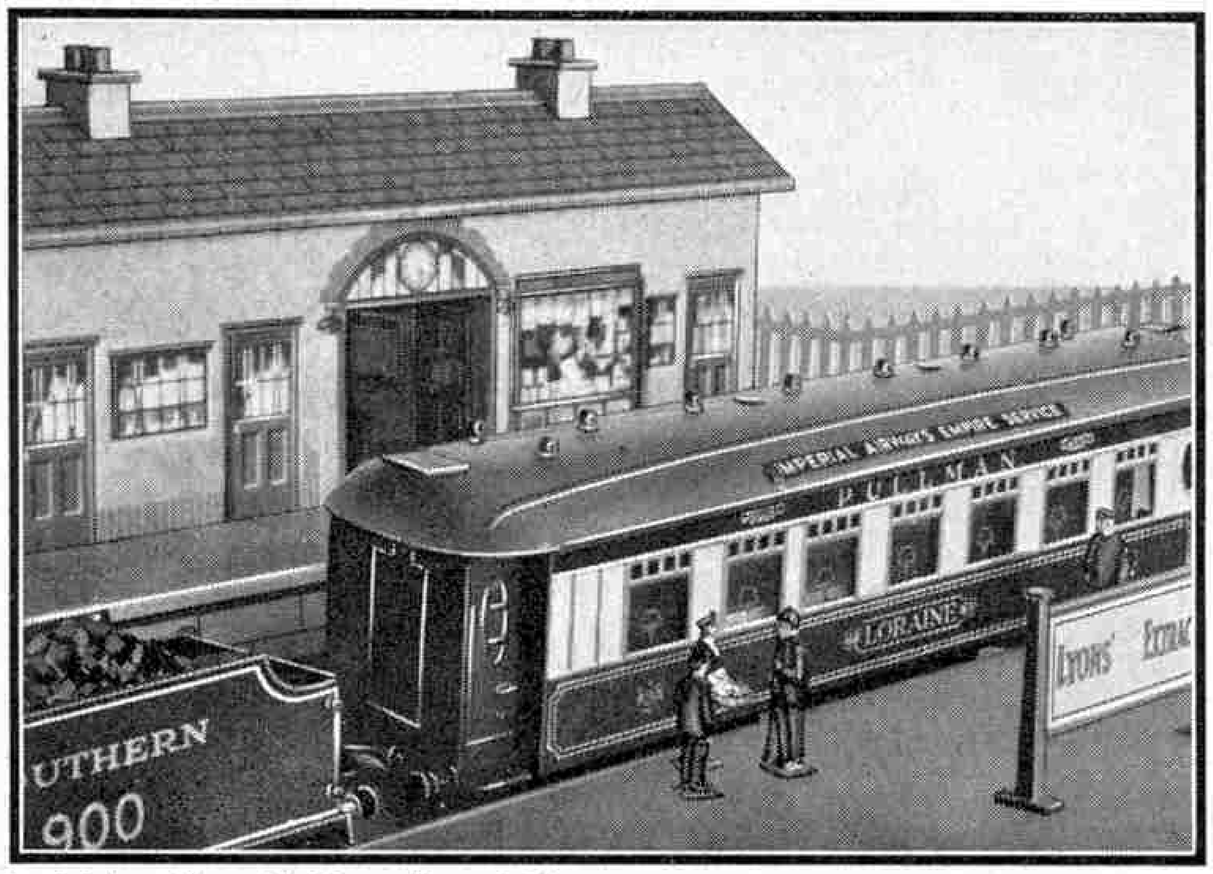
Among other trains the running of which can be copied in miniature are numerous freight trains. Of particular interest are the specials conveying fruit or meat traffic. A miniature banana special for instance would be very attractive and could be readily made up of the standard Hornby Banana Vans, with S.R. Flat Trucks and Containers. A meat special is another possibility with Refrigerator Vans; S.R. Containers can be used in this instance also.



Up from "Southampton Docks!" This "perishables" train made up of Hornby No. O Refrigerator Vans and Insulated Containers is typical of the numerous real freight trains that convey goods from overseas landed at Southampton.

Here again *"Eton"* can be the engine, or alternatively an E320 or No. 3C Locomotive in S.R. colours can be used. A miniature perishables train will be interesting and will represent the numerous services of actual practice that connect Southampton Docks and Nine Elms, the great London freight depot of the S.R. The head code for trains conveying market goods, fruit or potato traffic consists of a single white disc displayed above the right-hand buffer of the engine.

Any railway that runs boat trains must have a harbour, or quayside. The exact arrangement and the degree of completeness will depend on the layout and the amount of space available. Quite good fun can be obtained if the trains can be run along one side of a platform forming the quayside, with a suitable background on the other side representing an ocean liner or a cargo ship drawn up to the quay. If the main line is continuous the port should be situated on a line branching off the main track. A range of "hills" or other scenic features can be placed so that the marine features are screened off, as it were, from the ordinary inland country section. This is a particularly interesting feature of Brown's layout.



A miniature "Imperial Airways" special. Hornby Pullman Coaches are ideal for this service, and the roof board can be completed from the details in this article.

Turning now to another feature of S.R. Western Section service, a development of great interest has been the provision of special accommodation between Waterloo and Southampton Docks for passengers for the Imperial Airways Empire flying boats berthing at Hythe. A Pullman car and luggage van are attached to "Ocean Liner" trains between Waterloo and Southampton Docks, or if more convenient they are worked to and from Southampton Central as part of ordinary expresses. A really "long-distance" touch is given by the name-board that appears on the Pullman car, for this carries the words "Imperial Airways–Empire Service."

On a miniature railway the working of a special portion of this kind would be particularly interesting, and a correct nameboard with its novel wording would complete the realistic effect. A Hornby No. 2 Special Pullman Coach would be the best vehicle to employ for the passenger part of the special portion. A No. 1 Guards' Van, or alternatively a No. 2 Luggage Van could be employed for the passengers' baggage.

On any layout representing the stretch of S.R. main line that we are dealing with it would be necessary to include a reproduction of the regular Southampton and Bournemouth expresses. For all of these the new Hornby Corridor Coaches in S.R. colours are exactly what is required, for they represent faithfully the real "ironclads," as the steel-panelled stock is often called, that are used on these and other Western Section services. The all-Pullman *"Bournemouth Belle"* is a famous flyer on this route, and can be represented in a realistic manner on a Hornby layout with Hornby Pullman Coaches. The head code of Bournemouth trains to and from Waterloo consists of one white disc on the left-hand side of the smoke-box and another over the right-hand buffer. Its indication can be correctly displayed when the *"Eton"* locomotive is employed, for its fittings include suitable brackets in the usual positions and also at the side of the smoke-box front, the latter being a practice peculiar to the S.R.

The through working of other companies trains into Bournemouth is a regular feature. L.M.S. trains work in with their own engines from Bath and from other points, as described in the article on page 148 of this issue dealing with the L.M.S. *"Pines Express."* The through working of trains of S.R. stock and G.W.R. stock alternately between Birkenhead and Bournemouth has long been practised.

Branch News

ABBEYFEALE.—The majority of the meetings have been spent in planning and laying down the Branch track, on which suitable Dinky Toys are prominent features. Electric lights have been installed in the stations, and red and green signal lights have been purchased. The Branch has a good stock of Meccano products. Special evenings are devoted to Lectures and Games, and a Cinematograph has been purchased. A Visit was paid to the transatlantic air base at Foynes, where members saw the flying boats *"Cambria"* and *"Caledonia."* Secretary: B. Hynes, Provincial Bank House, Abbeyfeale, Co. Limerick.

ACTON.—The 1st Annual Exhibition held in December was very successful, and was very well attended. Among the attractions were the Branch track, on which trains were run very smoothly, and displays of Meccano models and railway posters. Arrangements in hand include a Cinema Show, a Lantern Lecture and the 2nd Annual Social Evening, with other attractive features. Secretary: S. W. Simmons, 7, Alfred Road, Acton, London, W.3.

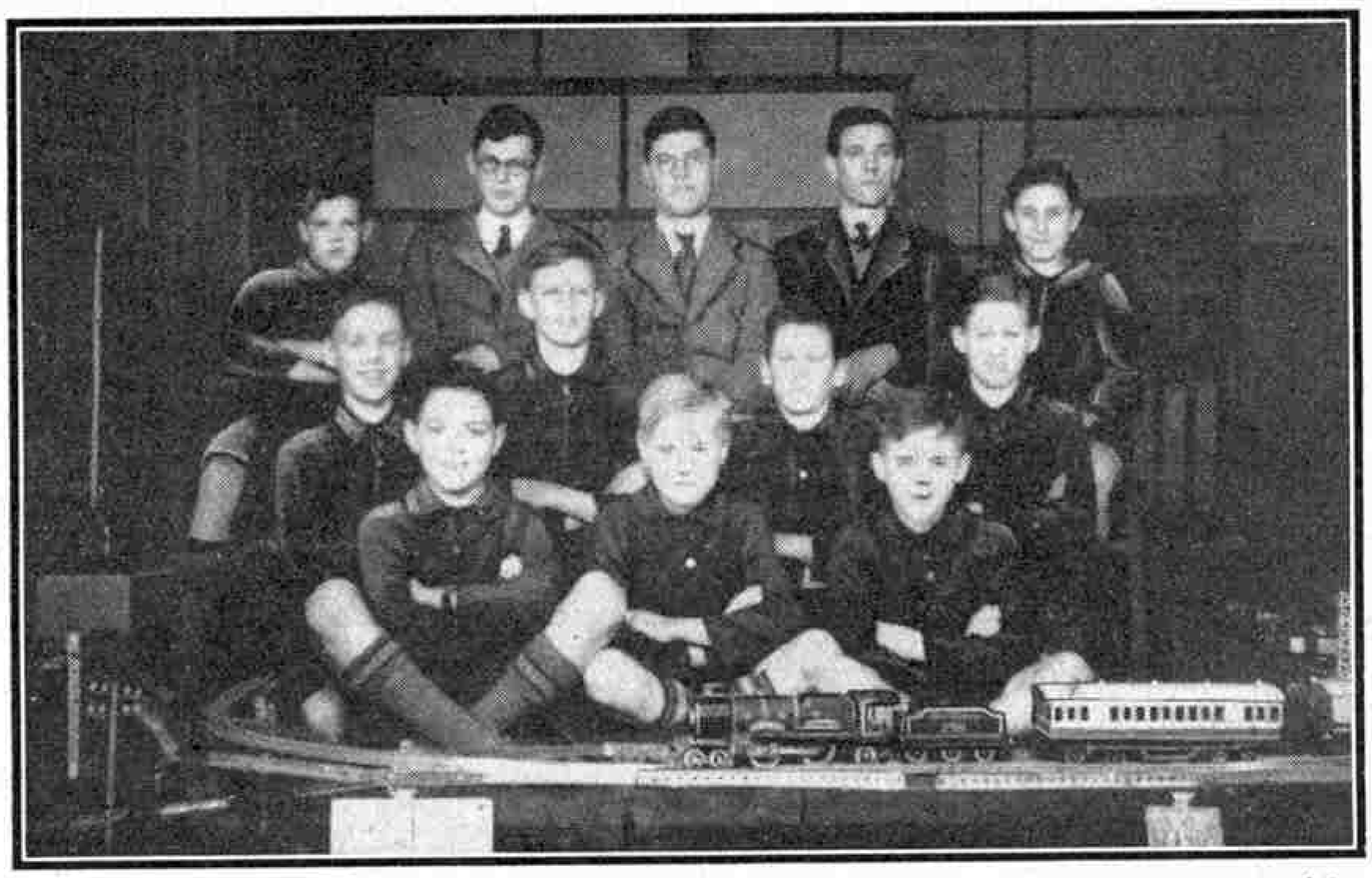
BURY ST. EDMUNDS.—Debates, Hornby Train operation, Games and Competitions are the chief items in the programme. It has been decided to produce a Branch Magazine, and also to issue a monthly agenda to each member, showing the arrangements for the month. Secretary: T. S. West, 10, Crown Street, Bury St. Edmunds, Suffolk.

CAMBRIDGE.—This newly-incorporated Branch is now well established, with Hornby Train operation as the main feature. It has been decided to raise the track from ground level by means of a wooden framework. A General Meeting has been held to enable members to submit their opinions on Branch activities as a guide to future operations. Arrangements for the future include Talks, Games and Socials. Secretary: J. E. Gray, 36a, De Freville Avenue, Chesterton, Cambridge.

HURST HOUSE.—Excellent progress is being made by this newly-incorporated Branch. Engines are run according to a schedule worked out by the Chairman with the object of giving new members experience in handling electric controls and managing trains when shunting. New rolling stock has been purchased, and this will probably necessitate the re-laying of the Branch track. Preliminary arrangements are being made for the Exhibition. Secretary: J. C. Moss, Hurst House, Hurst Road, Croydon.

ST. ANDREW'S (MONTPELIER) BRISTOL.—Membership has decreased owing to many of the members having to attend Evening Classes. New members will be heartily welcomed, and anyone interested should get into touch with the secretary at the address given below. The secretary of the Fishponds (Bristol) Branch paid a personal visit to the St. Andrew's Branch, and it was so successful that alternative visits are now exchanged by members of both Branches. Secretary: K. Bartlett, 33, Bath Buildings, Montpelier, Bristol.

BEDFORD SCHOOL.—At weekly meetings further constructional work has been carried out, in addition to timetable operation. An experimental bell system has been installed between the signal cabins at Leicester and Brent Junction, and if successful will be extended. Re-laying has also taken place in Cricklewood Yard, so that there are now three long goods roads, two of which join to form an engine run-round. The lighting system has been renewed, and a Meccano Transformer incorporated in it, with splendid results. A visit was paid to one of the L.M.S. Signal Cabins in Bedford. Members were most interested in the tablets used on the single-line portion of the ex-Midland Hitchin branch, and the process of taking up the tablet from trains passing at reduced speed was watched with interest. Preparations were made for the Branch Exhibition. Secretary: A. W. R. Coomber, 33, St. Michael's Road, Bedford.



Members of the Hurst House (Croydon) Branch, No. 337. Mr. R. Ingram, Chairman, is in the centre of the back row, with J. C. Moss, secretary, on his right and Mr. C. J. Whitehorn, treasurer, on his left. This Branch was incorporated in December last, but has already arranged an excellent Exhibition.

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 organisation should communicate with the promoters, whose names and addresses are given below:

BASINGSTOKE—J. S. Sweetman, Red Lion Hotel, Basingstoke.

BRADFORD—D. Arnott, 58, The Avenue, Clayton, Bradford.

BRISTOL—N. Jones, 22, Sandwich Road, Brislington, Bristol, 4.

BRISTOL—R. J. Mountjoy, Connaught Road Senior Boys' School, Knowle.

CRESSWELL—S. Mackenzie, 16, McKie Avenue, Cresswell, Dumfries.

DERBY—R. Walton, 114, Arthur Street, Derby.

DONCASTER—P. Threadgold, "Hill Top," Belton Road, Belton, Doncaster.

EGYPT—A. Kitroeff, 2, Rue Missala, Alexandria, Egypt.

GLASGOW—A. MacLean, 127, Terregles Avenue, Maxwell Park, Glasgow, S.1.

GUERNSEY—R. Hamilton, 1, Stanley Road, St. Peter Port, Guernsey, C.I.

HALIFAX—D. G. Helliwell, 202, Queens Road, Halifax.

LONDON—K. T. Blake, Tintagel, 5, Warboys Crescent, Highams Park, E.4.

LONDON—J. A. Vas Dias, 3, Hayland Close, Kingsbury, N.W.9.

LEOMINSTER—A. C. Smith, The Manse, Etnam Street, Leominster.

LONDON—F. H. Wedderburn, 75, Arran Road, Catford, S.E.6.

PAISLEY—J. D. Crawford, 1, Macfarlane Street, Paisley.

WALLINGTON—B. Tatford, "Hillside," 20, Ingleby Way, Wallington, Surrey.

YEADON—D. Petty, The Grange, Rufford Avenue, Yeadon, Leeds.

Branches Recently Incorporated

338. EDINBURGH—Mr. H. W. Govan, 33, Lauriston Place, Edinburgh, 3.

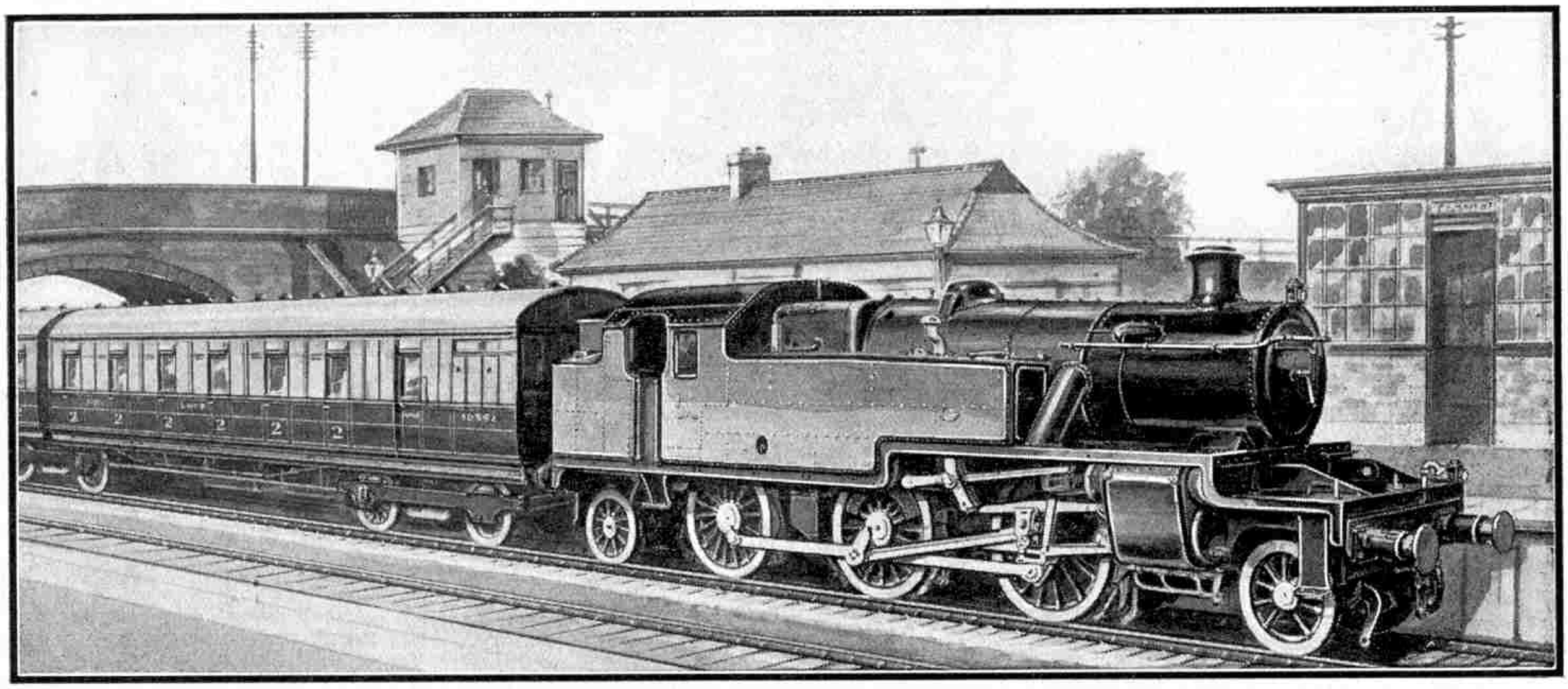
339. WOLVERHAMPTON—Mr. T. H. Isherwood, Municipal Secondary School, Wolverhampton.

Join the Hornby Railway Company and become eligible for the competitions announced on this page.

H.R.C. COMPETITION PAGE

"SPOT THE ERRORS"

Join the Hornby Railway Company and become eligible for the competitions announced on this page.



At first glance the train shown in the illustration on this page seems to be an ordinary stopping train running into a station. Closer inspection will reveal that something is wrong, however. In fact there are many mistakes, which have been purposely introduced to form the basis of an interesting contest.

An example will make the idea of the competition clear. Perhaps the most obvious error is in the disposition of the headlamps at the front of the locomotive. Under the British standard headlamp code the arrangement shown applies to the engine of a fast goods train, and would never be seen on the locomotive of a passenger train.

Other mistakes are more difficult to detect, but their discovery will prove a fascinating task that will put competitors on their mettle. Those who wish to hunt them all down will do well to divide the illustration into sections, and to examine each of these carefully, instead of rambling over the scene as a whole.

When the entrant is satisfied that he has discovered all the mistakes, he should make a neat list of them, stating at the same time how each should be corrected. This should then be forwarded to Headquarters at Meccano Ltd., Binns Road, Liverpool 13, in an envelope marked "*March Errors Contest*" in the top left-hand corner.

The contest will be divided as usual into two sections, Home and Overseas. Prizes of any goods manufactured by Meccano Ltd., to the value of 21/–, 15/– and 10/6 respectively will be awarded to the three entrants in each section who correctly spot the largest number of errors. In the event of a tie for any prize, neatness and general presentation will be taken into account. A number of consolation prizes also will be awarded to competitors whose entries are praiseworthy efforts.

Closing dates for this contest are respectively 31st March for Home entries and 30th June for entries from Overseas competitors.

Layout Planning Contest

In this contest we are asking members to submit a design for a layout incorporating a goods station and marshalling yard, with an engine shed and turntable. Details of the rest of the line are left to each competitor's own judgment, but at least one passenger station should be included. The layout must be one that can be fitted in a space measuring 20 ft. by 15 ft.

The contest will be divided into two sections, Home and Overseas. Prizes consisting of Meccano products to the value of 21/–, 15/– and 10/6 respectively will be awarded to the senders of the three layouts judged the best in each section, and there also will be several consolation prizes for designs approaching prize-winning standard.

Envelopes bearing entries should be marked "*March Layout Contest*" and posted to reach Headquarters at Meccano Ltd., Binns Road, Liverpool 13, not later than 31st March. The closing date for Overseas entries is 30th June.

COMPETITION SOLUTIONS

"OCTOBER MISSING WORDS CONTEST"

The following were the words omitted: bridges, Quebec cantilever, St. Lawrence, charter, Quebec, 1882, 17, 1907, cantilever, August, disaster, cantilever, tenders, submitted, St. Lawrence, original contractors, 1913, cantilever, cantilever, 1916, span, cantilevers, Sillery Cove, lifted, twisted, span, 17th, 1917, span, floated, pontoons, tugs, October, train, bridge, December.

"OCTOBER QUESTION CONTEST No. 9"

(1) Length over headstocks; width over body; maximum width over projections; weight. (2) The expansion in the smokebox of the exhaust steam from the cylinders. (3) When two sets of points, as in a crossover road, are operated by one lever the points are termed "double-ended," and when a lever works one set of points only, these are said to be "single-ended." (4) Between Granton and Burntisland across the Firth of Forth in 1849. (5) The same colour as the light shown when the signal is in the danger or caution position. Normally this is red, but is yellow where amber distant lights are shown. (6) Between Abbeyhill Junction and Waverley, where the gradient through Calton Hill Tunnel is 1 in 60. (7) Detonators are supplied by the manufacturers in different colours for each yearly period ending 30th June, so that the year of manufacture can be ascertained at a glance. (8) L.N.E.R.; between Selby and Hull; 18 miles. (9) One star—average speed not to exceed 35 m.p.h. Two stars—may run on fitted freight trains. Three stars—may run on fitted freight trains or passenger trains. (10) At Parkhead on the Burnhill—Stanhope branch. 1,474 ft. (11) In the original construction of railways contractors usually laid down temporary lines, which were known as "overland routes." The line constructed was distinguished from these by the name "permanent way." (12) So that the engine crew can ascertain during periods of darkness if the train is complete.

COMPETITION RESULTS

HOME

December "Christmas Joke Contest."—First: J. Mitchell (54197), New Brimington, Nr. Chesterfield. Second: E. Johnson (36769), Northwich. Third: A. F. Milburn (16322), London, E.4. Consolation Prizes: D. Fear (18477), Taunton; G. W. Hazell (55658), Wakefield; B. Miller (47648), Liversedge.

December "Drawing Contest."—First: G. L. Tredwell (36032), Wolverhampton. Second: F. Mills (31), Kearsley, Nr. Bolton. Third: P. Crane (53193), London, S.E.13.

December "Christmas Names Contest."—First: C. Macrae (28561), Glasgow, S.1. Second: C. E. Wrayford (6039), Bovey Tracey, Devon. Third: R. Ford (55332), Stoke-on-Trent.

OVERSEAS

September "Photo Contest No. 6."—First: I. Brough (9112), Balwyn, E.8, Victoria, Australia. Second: A. R. Bacon (38242), Byculla, Bombay, India. Third: P. F. Smith (54173), South Australia.

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4 ,, Jub.	6d.	10 ,, ,,	5d.
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1 ,, Jub.	2d.	3 ,, ,, Cor.	10d.
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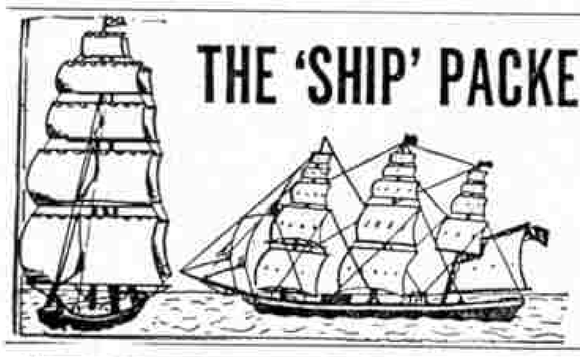
G. P. KEEF, WILLINGDON, EASTBOURNE, ENGLAND

ALL BRITISH COLONIAL APPROVALS

Fine BRITISH AFRICAN PACKET including scarce **NIGERIA, KENYA COLONY, MAURITIUS, TANGANYIKA,** etc., **FREE** to collectors sending 2d. stamp for postage, etc., and requesting selection of **ALL BRITISH COLONIAL STAMPS** on approval. **BRITISH COLONIALS** only on approval at bargain prices, including **JUBILEE, CORONATION** and **PICTORIAL ISSUES** from West Indies, Africa, Cyprus, Gibraltar, Iraq, Palestine, Papua, etc. (No stamps sent Abroad.)

C. H. SHAW (Dept. M.3), 95, Christchurch Avenue, Kenton, Harrow, Mddx.



THE 'SHIP' PACKET

This marvellous packet is offered under cost as an advertisement, **45 different stamps each with a ship on it.** A regular armada, **KOUANG-TCHEOU,** new, **SENEGAL** (Canoe), wonderful flotilla of caravels from **DENMARK** (complete set), **NEW CALEDONIA, UKRAINE, COSTA RICA,** a fleet of **7 CHINESE** junks usually sold at 10d., **TRINIDAD & TOBAGO, MAURITIUS, KENYA-TANGANYIKA, NEWFOUNDLAND, U.S.A., B. GUIANA,** set of **S. AFRICA, GREECE, POLAND, INDO CHINA, FRENCH OCEANIA, WALLIS & FUTUNA ISLANDS,** etc. Price **4½d.,** postage 1½d. (abroad 3d. extra). Purchasers of this packet asking for approvals receive **FREE** set of **3 SPAIN** (Columbus, each with his ship on it). Senders of addresses of stamp collectors receive **FREE** set of **6 VENEZUELA or 6 PERSIA, 100 BRITISH COLONIALS 1/-, 20 AIRPOST 6d., 6 TRIANGULARS 7d., 50 PERSIA 4/-, 9 POLAND New Pictorials 8d., VOLUMES OF B.O.P. CHEAP.**

H. C. WATKINS (M. Dept.), Granville Road, BARNET

WAR

Our magnificent March **FREE GIFT** contains a rare **SPANISH CIVIL WAR ISSUE** and many other new issues including several of the new reign stamps of KING GEORGE VI. One of these is the beautiful new bicoloured **FALKLAND IS.** depicting His Majesty and arch of Whales' Jawbones. Among others you will find included in this marvellous Free Packet are **EIRE** (pictorial); **TRAVANCORE** (State Service); **VICTORIA** (Queen Victoria); **RUSSIA** (Thunderbolts); **GWALIOR** (Official); **CHINA** (Chen Ying Shih); **ITALY** (Augustus); **U.S.A.** (President); **CEYLON** (obsolete); **AUSTRALIA** (Coronation Day); new pictorial **JAPAN** (Primitive Merchant Vessel); **AFRICA** (Drommedaris); **MEXICO,** etc. All above are absolutely **FREE** by sending us 2d. stamps and requesting one of our famous 'Grey' booklets of stamps on approval. **SPECIAL OFFER** of complete **BELGIUM** Charity sets: 8 Josephine 2/-; 8 Queen and Prince 2/3; 9 Badouin 3/-; 8 Astrid 2/3; 3 Royal Children 2/3. **WINDSOR STAMP CO. (Dept. M), 59, LEE ROAD, BLACKHEATH, S.E.3.**

FREE 25 COLONIAL AND FOREIGN PICTORIALS CAT. 10/-

THIS IS YOUR LAST OPPORTUNITY TO OBTAIN THIS MARVELLOUS PACKET. VALUED AT 2/6, offered as the **GREATEST** New Year's gift to genuine applicants for my well-known "Value" approvals.
JUBILEE AND CORONATION issues, **PICTORIAL INDIAN NATIVE STATES, SCARCE HIGH VALUE,** mint **AMERICAN** issues and beautiful **PICTORIALS AND COMMEMORATIVES** (mint and used) are included. **YOU** will be **DELIGHTED AND SURPRISED** at the **VALUE OF THIS GIFT.**
To the **FIRST 20 APPLICANTS** I'll also give a **SCARCE SPANISH CIVIL WAR STAMP.**
SENT BY RETURN OF POST ON RECEIPT OF 1½d. POSTAGE.

PHILIP COCKRILL, 13, MONTRELL ROAD, STREATHAM HILL, LONDON, S.W.2.

THE CROWNING PACKET

This splendid packet contains modern issues, mint and used, including **Canada Coronation,** Kenya (boat), **Cayman Islands** (map and fishes, mint), **Bermuda** (Hamilton harbour, mint), **Australia** (pictorial and New **King and Queen**), Belgium (Prince Baudouin, mint), **Grenada (the beautiful new mint King George VI),** 5 different **Canada** including the new 1937 issue, the Royal Canadian Mounted police **and also the scarce 20 cent Niagara Falls,** 5 Yugo Slavia, 5 Belgium Parcels post, and finally **2 more Coronations and 2 Silver Jubilees.**
All these good stamps for 6d. only, to genuine applicants for our approval sheets. (Without approvals, 1/-.) No sheets sent abroad unless reference given.

SHIRLEY STAMP CO., 19, SANDRINGHAM AVENUE, LONDON, S.W.20.

"DIAMONDS"

MANY RARE STAMPS have been found by purchasers of **The "DIAMOND" Packet,** which contains approx. **1,000 UNSORTED STAMPS** from Convents abroad. **1 pkt. 1/6. 3 pkts. 3/9. 5 pkts. 6/-. All post free inland.** Postage to Colonies **3d. per pkt. extra.** S. Africa and Foreign **6d. extra.** Beware of imitations.

O. NERUSH
(DEPT. "A"), 68, TURNPIKE LANE, LONDON, N.8.

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A splendid set of 4 large pictorial stamps, issued by Spanish Morocco to commemorate General Franco, will be given free to all applicants for my approval books who enclose 2d. for postage.
Particulars sent of my continuous free gift scheme. Apply early as quantity available is limited.

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(British 1840 Penny Black) for P.O. **3/6.** It is guaranteed genuine in every respect. Its companion stamp (1840, 2d. blue) for a further **5/9** (cat. 17/6)! Other "Classics" which every Collector should have are the **Cape of Good Hope Triangulars;** we offer 1d. rose (cat. 40/-) for **12/6;** 4d. blue (cat. 15/-) for **5/-;** and 6d. pale lilac (cat. 40/-) at **15/-.** Superb approvals of any country against approved English References or a deposit. **Full Lists Free.**

NORRIS & CO. (Dept. M), Norwood, London, S.E.19.

NEW KING GEORGE VI MINT SETS

5 Bermuda, 1d. to 3d.	at 1/2
7 Barbados, ½d. to 6d.	,, 2/-
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Cash with Order. Postage Extra.
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BARGAINS

Mint Cors.: Aden 11d. Bahamas, Barbados, Bermuda, Turks, Dominica, Grenada, Jamaica, Leewards, Montserrat, Trinidad, Virgins at 8d. Ascension, Honduras, S. Leone, Fiji at 9d. N.Z., Cooks, Niue at 1/2; Papua 1/6; Nauru 2/-; N. Guinea 2/6.
Used Cors.: Caymans, Falklands, Montserrat, Cyprus, Kenya, Nyasaland at 9d. Ascension, Fiji, St. Helena, Aden at 1/-.
APPROVALS suitable for serious collectors — BARGAINS.
FREE Egypt—THE EYE OF HORUS—to all purchasers of 2/6 from above offers, or to genuine approval applicants enclosing 2d. for postage.

T. R. HUGHES, 'Ibis Cottage,' AMERSHAM, Bucks.

POST FREE 6d. — **A "Worth While" Offer 1922/34** — **POST FREE 6d.**

Complete Set IRISH ½d. to 1/- Used

This fine complete set includes the rare 2½d. and 10d. values which are usually missing in most collections. To all applicants for my "WORTH WHILE" approval sheets I make this BARGAIN offer.
Send at once before these stamps become obsolete and see some of these really fine sheets of stamps.
"Worth While" sheets for stamps Worth While.

JOS. H. GAZE, 21, Atwood Road, Didsbury, Manchester

APPROVALS

Even if I did not offer a free gift it would be worth writing for my approvals. They largely consist of modern pictorial and commemorative stamps, mostly in sets although priced separately. You should write, too, for particulars of my extra free gift plan.

MALAY TIGERS

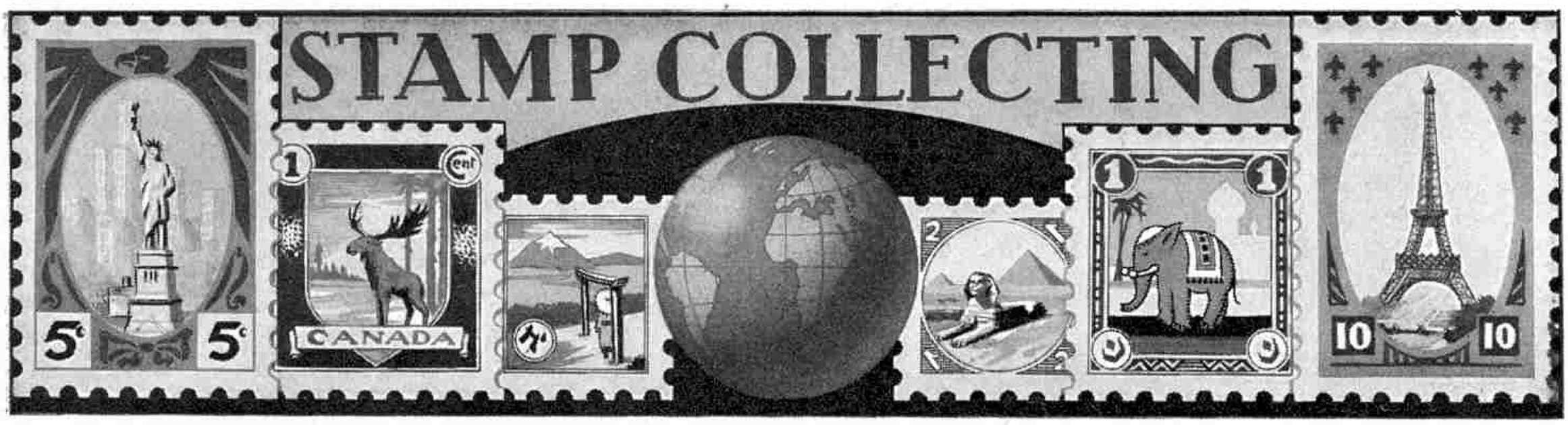
Fine set of Federated Malay States in the well-known Springing Tiger design, including the scarce 10c. purple on yellow. These twelve stamps, now obsolete, are sent free to all genuine applicants for approvals enclosing 2d. postage. (Overseas 4½d.)

THREEPENNY SETS

4 Kenya 1935. 4 Siam, ex-King. 5 Canada 1935. 4 Canada 1937, including Coronation. 4 Mozambique 1937 pictorials, unused. 6 Greece 1937 pictorials, unused. 3 U.S.A. Army. 3 U.S.A. Navy. 2 Roumania 1936 Air. All at 3d. each. The lot for 2/-. Postage extra.

Mention Meccano Magazine — **R. D. HARRISON - ROYDON - WARE** — Postage is Extra

For other Stamp Advertisements, see pages 188 and xvi



THE STORY OF SHIPPING (II)

LAST month we dealt with the early development of shipping and merchant ships. This month naval vessels claim our attention, and it is an interesting reflection that although the duties of the modern fighting ship are principally to police the high seas, the first fighting ships were the Mediterranean pirate galleys, mainly propelled by gangs of slaves chained to their oars.

A small Carthaginian galley is shown on the higher values of the Tunis 1906 series, reproduced here. This was propelled by less than a dozen pairs of oars, but a galley of normal size would require at least 25 pairs and the mighty galley of the Emperor Caligua required 1,600 slaves to propel it!

There is a remarkable similarity of design between this Carthaginian galley and the Viking galleys shown on the 5 aur value of Iceland's Parliamentary Millenary series, issued in January 1930, and on the 5c. stamp in the U.S. Norse-America Centennial issue of May 1925. All have the same long low body with a high prow and stern. It is from such early beginnings that the great naval forces of to-day have sprung.

The traditions of the British Navy go back a long way before the 19th century, but the earliest British man-o'-war found on stamps is Nelson's *"Victory,"* shown on the 6d. value of Antigua's Tercentenary issue of 1932. Nelson called at Antigua to take in supplies during his pursuit of the French Admiral Villeneuve from the Mediterranean to the West Indies and back in 1805. The final act of this epic chase was staged at Trafalgar, where Nelson crushed the French fleet, but was mortally wounded during the closing moments of the battle.

There are several interesting pictures of naval battles on stamps, notably the 4dr. Greek 1927 issue, commemorating the centenary of the battle at Navarino Bay between the Turkish Fleet and the allied British, French and Russian forces under the command of Admiral Sir Edward Codrington. This battle was the final stage in the fight for Greek independence. Another independence centenary issue, the 10c. stamp of Chile's 1910 series, shows a battle between the frigates *"Lautaro"* and *"Esmeralda"* during the Chilean war of independence. The 12c. stamp in the same series shows the capture of the Spanish frigate *"Maria Isabella."*

A modern battle picture appears on the high values of the Philippine Islands issue of 1935, an illustration of which appears on this page. This shows the scene at the battle of Manila Bay, fought between the Spanish and American fleets on 1st May, 1898. The ships shown here are the earliest steam-propelled ships in our collection, but before we dismiss the old types and turn to modern ones, there are two sailing ships that are worthy of special mention. Both are cadet training ships. One is the Italian *"Amerigo Vespucci,"* illustrated on the 50c. value of the Italian series issued in 1931 to celebrate the 50th anniversary of the founding of the Leghorn Naval Academy. The other is the Roumanian *"Mircea,"* shown on the 6l. value of Roumania's 1931 series commemorating the 50th anniversary of the establishment of the Roumanian Navy. The Roumanian stamp, as our illustration shows, provides one of the most beautiful sailing ship pictures found among stamp designs.

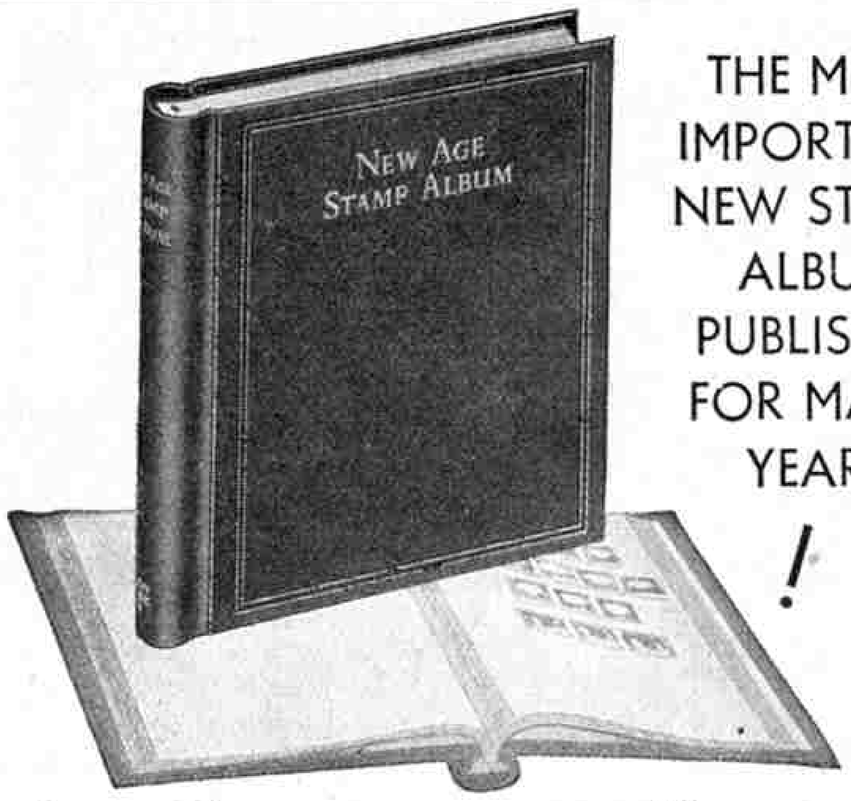
Probably the best picture of a modern warship is the 3 dr. value of the Greek 1927 series illustrated on this page. It shows the cruiser *"Georgios Averoff,"* which was built in 1911. This Greek vessel has a speed of 24 knots and carries 670 officers and men. The most up-to-date warship seen on a stamp is the Italian heavy cruiser *"Trento,"* illustrated here on the 11.25 value of Italy's Leghorn Naval Academy issue. The vessel has a displacement of 10,000 tons and is capable of a speed of 36 knots.

Battleships are represented in the collection by the Japanese ships *"Katori"* and *"Kashuma,"* both now out of commission, illustrated on the Japanese issue of September 1921 commemorating the return of the Crown Prince (now the Emperor) from his European tour, during which he was escorted by these ships. The *"Kashuma"* had a slightly greater displacement than the *"Katori,"* the respective figures being 16,400 tons and 15,975 tons. Both ships had a speed of 19 knots and carried a crew of 854 officers and men when in commission.

There are few stamp pictures of submarines, but there is one splendid specimen on the 1l. value of the Bucharest Marine Exhibition commemorative series issued by Roumania in October 1936. This stamp is also illustrated on this page. It shows the submarine *"Delfinul,"* which is 225 ft. in length, 19½ ft. in breadth and, when on the surface, draws 12 ft. of water. Its surface speed is 14.9 knots.

The Uruguayan light cruiser *"Montevideo,"* shown on the 1c. value of Uruguaya's declaration of independence issue of 1908, is a specially interesting design, for at that time this ship, with the two gunboats also shown in the picture, comprised the entire strength of the Uruguayan navy. Other South American States represented in the collection are Paraguay, with the gunboats *"Paraguay"* and *"Humaita,"* shown on the April 1931 air series and the 1 p. 50 general issue respectively; Colombia, with a picture of the 1,200 ton light cruiser *"Cartagena,"* illustrated on the 5c. 1903 issue; and Argentina, which shows a light cruiser in a view of Port Rosario on the 5c. commemorative issued in October 1902.

We cannot mention here all the ships that could be included in a naval collection, but sufficient has been shown to reveal its possibilities, and the Editor will be glad to provide a complete list for any reader who is interested.



THE MOST IMPORTANT NEW STAMP ALBUM PUBLISHED FOR MANY YEARS !

The "NEW AGE" ALBUM FOR NEW ISSUES

The many brilliant new stamps issued these days deserve a fine home, and here it is—the "NEW AGE" Album for New Issues—a brand-new Stanley Gibbons' Publication which gives you a separate space for each new stamp!

The First Annual Instalment, now on sale, caters for the issues between mid-1936 and mid-1937, and further instalments will be published every year to keep your collection up-to-date.

BRITISH EMPIRE set of leaves **5/-**
FOREIGN COUNTRIES set of leaves **6/6**
Handsome SPRING-BACK BINDER **6/6**

Prices "Postage Extra," complete set, U.K. 8d., abroad 1/8

★ **Write for Free Two-Colour Descriptive Leaflet** ★

Stanley Gibbons Ltd., Dept. S.15, 391 Strand, London

STAMP COLLECTORS *Would you like* **2 New Issues FREE** REGULARLY EVERY MONTH ?

March, April, May, June, July, Aug., Sept., Oct., Nov., Dec., Jan., Feb.

The Very Latest Stamps FREE TO YOU

JUST SEND A POSTCARD

EACH MONTH the postman will bring you ABSOLUTELY FREE two of the world's latest stamps—sparkling and up-to-date. Stamps which you are BOUND to want; stamps which may some day become the world's rarities! Thousands of collectors are already receiving these wonderful gifts month by month. You CANNOT wait any longer. Remember you need only send a postcard requesting Monthly Gifts and approvals. Send NOW.

VICTOR BANCROFT - MATLOCK

IMPROVED

THE "MYSTIC" PACKET

1000 UNKNOWN UNUSUAL UNSORTED **1/6**

(over 200 diff. guaranteed.)

Stamps on paper, etc., just as received from Convents, Missions, Banks, etc. Guaranteed unpicked. Chance of a **FIND** in every lot. Send to-day for your treasure hunt to-morrow. 3 for **4/3**, 6 for **8/-**. Abroad, extra postage. **FREE!** 25 Br. Cols. including **CORONATIONS**, to Approval applicants. Also **FREE EXCHANGE**. Enclose ptge. Overseas 3d. Dealers Supplied.

ASTLEY & CO. (M.2), NEWBOLDS, WOLVERHAMPTON

FREE THE WONDER PACKET. Ask for my approval sheets and new lists and enclose 1½d. postage and I will send you the following packet absolutely FREE—**68 FINE STAMPS** including new **IVORY COAST**, a handsome stamp, two **CORONATION COLONIALS**, **BRAZIL** airpost (curious looking stamp), **GREEK**, Red Cross, **DENMARK (SILVER JUBILEE)**, 2 new **POLISH** Pictorials (fine), **2 NEW ZEALAND** (Zoological Pictorals, new), **PALESTINE**, etc. **STAMP BARGAINS.** 10 Persia 3d., 10 Peru 4d., 100 different British Colonials 1/-, 6 Triangular 7d., 1,000 different 3/11, 45 Coronation (one from each Crown Colony) 5/-, 20 Brazil 10d. My new large list of 700 Bargains, post free 1½d. Send addresses of stamp-collecting friends and receive 6 Venezuela or 3 Ichang. **H. C. WATKINS (M. Dept.), GRANVILLE ROAD, BARNET.**

GRAND COMPETITION The KINGSMILL STAMP CLUB offers its members a grand competition this month, a simple test in which all will have a fair chance. A prize in the form of Stamps or Accessories (to be chosen by the Winner) to the value of 5/- will be given. All members will automatically receive particulars, and if you have not yet joined this club do so without delay, as only members will qualify. For particulars of joining, etc., see last month's advertisement. **G. KINGSMILL (DEPT. M.M.), NEW BARNET, HERTS.**

QUEENSLAND, MONTENEGRO, GOLD COAST, Dutch Indies, Mauritania, Spain (Ship), Iceland, New Caledonia, Canada (George VI) and 50 different others, all post free for 3d. and in addition all buyers of this packet who **ASK TO SEE MY APPROVAL SHEETS** receive a set of **SCHLESWIG FREE.** Ask for my new approval sheets. Great variety. Good discount. Write to-day and get a selection. Exchange desired with all Colonies and Dominions.

F. G. ROWE, 69, EDGEHILL ROAD, BOURNEMOUTH.

FALKLAND ISLANDS NEW ISSUES FREE

Falkland Islands in the news again with one of the first George VI sets to be issued! Large pictorial stamps showing the natural wonders of this remote colony. Be the envy of your friends and one of the first to have these stamps. We present a mint sent absolutely free to all applicants requesting approvals enclosing 2d. for postage.

WESTMINSTER STAMP CO. BANK CHAMBERS, 32a, STRAND, LONDON, W.C.2.

FREE. 50 stamps and pictorial set to approval applicants. Gosling, 21, Powling Road, Ipswich.

FREE STAMPS

100 All Different. 2 Indian Silver Jubilees. 1 Mozambique Triangular Airmail

to ALL applicants for my low-priced books of stamps. These contain stamps from ½d., and 2d. in the 1/- discount is also given. Personal attention to all orders, big or small. Let me know what you want, and please enclose 2d. for postage, etc.

C. A. RUSH, B.P.A., J.P.S., P.T.S.,
38, Queen's Avenue, Whetstone, N.20.

GENUINE BARGAIN

75 Different Foreign and Colonial Stamps selected from Collections presented to Hospital. Send 6d. and addressed envelope (unstamped) to:

SECRETARY,
Memorial Hospital Hall, Woolwich, LONDON, S.E.18.

SAVE MONEY Bargain approvals of Whole World offered to you at special prices. Thousands of attractive 'space-fillers' and many hundreds of rare items at your disposal.

CAMPBELL, HALDON AVENUE, TEIGNMOUTH.

THREE JUBILEE FREE to applicants for ½d. approvals. Cox, 14, Broadmead Avenue, Worcester Park.

Stamps on approval from ½d. upwards. Good value given. Rogers, 30, Watling Street, E.C.4.

Canada Silver Jubilee Pictorials includes Princess Elizabeth, ex-King Edward, Windsor Castle. Complete used set of 6, Fair 1/10, Good 2/-, Picked Copies 2/5. W. Barrett, 334, Silverthorn Av., Toronto, Canada.

CORONATION USED SETS—POSTAGE 1½d. EXTRA

3 Aden ...	... 1/-	3 Fiji	... 10d.
3 Basutoland	... 10d.	3 Gambia ...	... 10d.
3 Bechuanaland	... 10d.	3 Gibraltar ...	... 10d.
3 Falklands...	... 8d.	3 Grenada ...	... 9d.

J. R. MORRIS, 9, AUDLEY ROAD, FOLKESTONE, KENT.

AEROPLANE & SHIP PACKET FREE!

This huge packet contains **508 UNSORTED FOREIGN STAMPS**, many scarce from **MOZAMBIQUE** (Aeroplane), **ROUMANIA** (Airmail), **GREECE** (Steamer in Isthmus), **NEW CALEDONIA** (Schooner), **OCEANIC SETTLEMENTS** (Fishing Punt), **CHINA** (Sailing Junk), **BR. S. AFRICA** (Frigate), etc., etc. A wonderful lot all free! Just send 2d. postage and request my **FAMOUS EXTRA-LARGE-DISCOUNT APPROVAL SHEETS.** (Abrd. 1/- P.O.)

E. EASTICK, 22, BANKSIDE ROAD, BOURNEMOUTH.

FREE. 'COMMEMORATIVE' PACKET

Pictorials, Mourning Issues, etc., 12 splendid stamps to add to your collection. Just send for my splendid ALL PICTORIAL APPROVALS at ½d. and 1d. each.

M. COURT,
76, WILLOWDALE ROAD, LIVERPOOL, 9.

✦ RHODESIAN RARITY ✦

Catalogued at 4/6, but my price is just 3d. to applicants for my "SUPERBA" Approvals.

JOSEPH BAGULEY, Chalgrove Road, Hackney, London.

Sent by SWISS AIR MAIL

The celebrated 'Richemont' packets and sets, singles and covers sent on approval by Air Mail.
50 U.S.A. 1/- including many commemoratives.
50 Swiss 1/- including Charity and Air.
40 Canada 1/- including Jubilee and Coronation., etc., etc. Write for selection.

A. M. PHILLIPS,
10, Avenue Beaumont, Lausanne, Switzerland.

THE AERO-PICTORIAL PACKET FREE

This super packet containing over 40 Pictorial and Colonial Stamps only, all modern issues from **EGYPT, CEYLON, GOLD COAST, KENYA, TANGANYIKA, MADAGASCAR, SIERRA LEONE**, scarce **EUROPEANS, NORTH & SOUTH AMERICA**, etc., offered absolutely to genuine collectors sending 2d. stamp for postage, etc., and requesting selection of **AIRMAIL** and **PICTORIAL STAMPS** on approval. This splendid packet is offered entirely to introduce selections of modern stamps on approval, and if sent without approvals price will be 1/- post free. (Abroad 1/6 with or without approvals.)

C. H. SHAW, (DEPT. 3), 95, CHRISTCHURCH AVENUE, KENTON, HARROW, MDDX.

For other Stamp Advertisements, see pages 186 and xvi

Stamp Gossip

and Notes on New Issues

St. Stephen Commemorated

The 900th anniversary of the death of the saintly King Stephen I of Hungary, who was canonized in 1083, has been commemorated by the issue of 14 stamps in Hungary.

St. Stephen was born in 977 and came to the throne in 997. He showed very quickly that he possessed great qualities of leadership, and Pope Silvester VI was so persuaded of the great work the young King was destined to accomplish for his country and his church, that in 1001 he presented a crown to him and accorded Papal recognition of the Magyar nationality.

The Pope's crown is shown on the 70 f. stamp, illustrated here. For 900 years it has been the national symbol of Hungary and it was incorporated in the design of all Hungarian stamps, including the watermark, from the first issue in 1871 until 1916.

King Stephen fulfilled all his early promise and historians have since proclaimed him one of the greatest constructive statesmen in history. He entirely remodelled the administration of his country and built it up from a scattered collection of units into a united nation, in the forefront of European affairs.

The 14 stamps each depict incidents in the life of St. Stephen as follows:—1 f. and 10 f., Abbot Astrik receiving the crown from the Pope for conveyance to King Stephen; 2 f. and 16 f., St. Stephen; 4 f. and 20 f., St. Stephen enthroned; 5 f. and 25 f., St. Gellert and St. Emery; 6 f. and 30 f., St. Stephen offering his crown in homage to a statue of the Virgin Mary; 32 f. and 50 f., portrait of St. Stephen; 40 f., Virgin Mary; 70 f., crown of St. Stephen.

A Stamp Anachronism

Attention has been drawn to an interesting error in the design of the recently issued Australian set commemorating the 150th anniversary of the foundation of New South Wales. In the stamps Capt. Phillip, Governor of the new State, is shown at Sydney Cove in 1788 wearing epaulettes as part of his naval uniform.

Actually it was not until 1st June, 1795, that epaulettes became part of a British naval officer's uniform.

Interesting Egyptian Issues

The Ophthalmological Congress held in Egypt in December was commemorated by a series of three stamps, each using the design shown here. The central feature of the design is the Sacred Eye of Horus, one of the most important of the Sun Gods of Egyptian mythology. He is supported on the left by the goddess Nekhbet of Upper Egypt, shown in the form of a vulture, and on the right by the goddess Buto of Lower Egypt, in the form of a serpent.

Horus was a son of the paramount god Ra and waged continual war with Set, the god of evil. In one of their fights Set shot a bolt of fire into the eye of Horus, but Ra restored the sight and as a result of this miracle the Eye of Horus became a talisman ensuring strength and safety to the early Egyptians. The design also includes two columns of heiroglyphs flanking the central feature.

The recent commemoratives issued to mark the abolition of capitulations have puzzled several of our readers, who have written to enquire what capitulations are and what is the significance of the issue.

Privileges granted to foreign residents in Egypt in the days of the Turkish regime are known as capitulations. The nationals of no less than 15 countries enjoyed, among other things, the right of being tried for criminal offences in their own Consular courts instead of in Egyptian courts. If they were suspected of crimes their premises could not be entered by the Egyptian police without first obtaining their own Consul's authority. Furthermore, they could not be directly taxed without the approval of all the capitulatory powers!

It can readily be seen that such a system presented extraordinary handicaps to a young nation, and when independence was granted to Egypt in the spring of last year, the Montreux Conference decided to abolish these privileges. The occasion was one well worthy of celebration by a commemorative stamp issue for it was an important step in Egypt's attainment of complete independence.

* * * *

We are indebted to Mr. C. F. Bourke of Waterford, Ireland, for first-day covers bearing the Eire Constitution Day commemorative stamps, and also souvenir covers, bearing these commemorative stamps, from the Eire-Vatican city air mail.

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

A Christmas Greeting Stamp

Although pressure on our space has sadly delayed the reproduction of the special Christmas Greetings stamp issued in Austria, we think our readers will agree that the old saying "Better late than never" is well justified in this case. The design strikes a high note in beauty and in novelty.

The main features of the design are the central vase of roses and the signs of the Zodiac arranged in two panels at the sides of the nosegay. The signs can be identified quite readily. From top to bottom of the left panel and then of the right they are as follows: *Scorpio*, the scorpion; *Sagittarius*, the archer; *Capricornus*, the sea goat; *Aquarius*, the water bearer; *Pisces*, the fishes; *Aries*, the ram; *Taurus*, the bull; *Gemini*, the twins; *Cancer*, the crab; *Leo*, the lion; *Virgo*, the virgin; and *Libra*, the balance.

An Early Japanese Ship

The design of the new ½ sen Japanese issue, illustrated on this page, makes an interesting addition to the list of stamp designs depicting early ships. The picture is of a *goshuninbune*, a type of ship commonly used in the 16th and 17th centuries by Japanese merchants trading around the coasts of Siam and China and among the Philippine Islands. The type practically went out of existence as a result of a decree of 1636 prohibiting all contact with foreign countries.

Centenary of the "Penny Black"

The centenary of the first adhesive postage stamp, the famous British "Penny Black," which occurs in 1940, is to be celebrated by a great philatelic exhibition in London organised by the Royal Philatelic Society. The preliminary arrangements are now in hand, and we hope to be able to give details at a later date.

* * * *

A special series of stamps was issued recently by Dominica in connection with a special aeroplane flight promoted to raise funds for the great new lighthouse that is to be erected over the tomb of Columbus at San Domingo. There were eight stamps in the series with designs as follows: 10c. and $1, caravels of Columbus; 15c., 25. and 50c., flight of aeroplanes leaving the Island; 20c., 30c. and 75c., the Columbus lighthouse.

The Life of a Railway Ticket

How it is Printed and Issued

EVERY day thousands of railway passengers purchase tickets through the familiar booking office windows, yet probably very few have ever given a thought as to how these tickets came to exist. Each year the four British main line companies produce about 700,000,000 tickets in their own printing works. In their main features these tickets are similar for all companies. All are printed on covered millboard, which is supplied in large sheets and cut first into long strips, and subsequently into the familiar individual tickets measuring $2\frac{3}{4}$ in. long by $1\frac{3}{16}$ in. wide.

The printing of each side of the ticket is performed as a separate operation. The reverse side, on which are found "Conditions of issue," etc., is printed first, and this is usually done on the strip millboard before it is finally cut into separate tickets.

Owing to the large number of tickets that are issued each year, especially at such times as Bank Holiday periods, several printing machines are required to meet the demand. These machines are arranged so that the names of the stations between which the ticket is available and the route, fare, number and any other desired lettering on its face are printed in a single operation. The blank tickets are first of all fed into the printing machines through tubes, the single tickets passing across a bridge beneath which is placed the numbering mechanism. As the tickets pass across this bridge the numbers are printed, then the letters, such as "M" denoting "Monthly Return," or "R" meaning "Return," are impressed; following which the necessary station names are printed. The completed ticket is then passed automatically from the bridge into tubes on the opposite side of the machine, and is raised up by the next and succeeding tickets. These wonderful machines print at the average rate of 11,000 tickets an hour, and the printed tickets are taken from the tubes in batches of 250 and placed on wooden trays until the required quantity is obtained.

After the tickets have been completed they are checked by means of a special machine, which counts them at the rate of 35,000 an hour. This operation is performed by placing the tickets in a tube, above a bench, from which they pass through a short opening where the operator can watch the numbers and note whether they are in correct sequence. A dial on the right-hand side of the machine records the number of tickets that have passed the opening, and so checks the quantity as being correct. The tickets are then tied in bundles of 250, parcelled, and labelled ready for despatch in wooden ticket cases to the appropriate ticket issuing offices.

In railway stations the booking offices are equipped with large storage cabinets consisting of nests of drawers divided into compartments and labelled with the destination and class of the tickets they contain. A smaller cabinet stocked with a supply of tickets for immediate use stands on the counter. It has a series of vertical shafts into which the packs of tickets are set. At the base of each shaft is an opening through which one ticket can be withdrawn at a time on applying a finger. As a ticket is taken out from its pile, the rest drop down one place each, so that the next is ready to be taken out of the rack. The booking clerk dates the ticket he removes in a small date-stamping machine before handing it on to the traveller. The return tickets are stamped twice, once at each end, while a ticket for a single journey is dated at one end only.

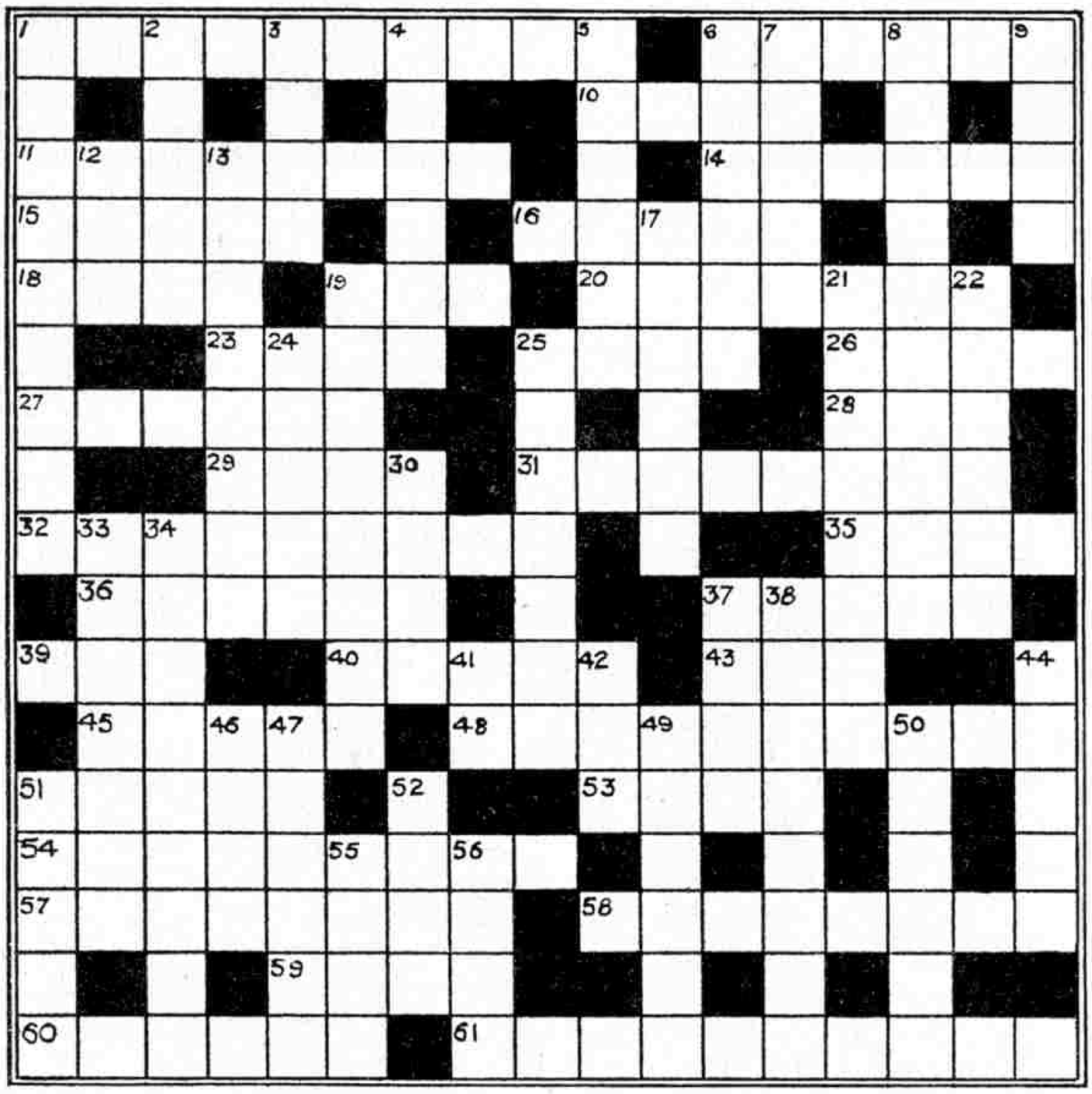
On the other side of the booking office window! The booking clerk is seen altering the dating press, the last job of the day. Photograph by G. Thornton, Southport.

After the tickets have been issued to passengers they are scrutinised by ticket examiners at the starting point, and sometimes en route, to see that they are in order. On completion of a journey they are collected from the passengers and afterwards cancelled with a cancelling punch. Each day's collection is sorted into order, and is then forwarded to the audit offices. There the tickets are compared with the account rendered by the issuing offices, and finally are destroyed.

During recent years automatic ticket printing and issuing machines have been introduced, and these are particularly advantageous where large crowds have to be dealt with in a short time. Modern examples of these wonderful machines are to be found on several London Underground stations. One of the most ingenious has been installed in the east booking office at Liverpool Street Station. On the mere pressure of a button it prints, dates and issues a ticket selected from 3,040 different types, and at the same time records the amount of money involved. The consecutive amounts are automatically added together, so that the ticket clerk can tell what the total receipts are at any moment. Similar machines were installed for the first time in the North of England at Manors East, Newcastle, in 1929.

Competition Corner

MARCH CROSSWORD PUZZLE



CLUES ACROSS

1. Existing everywhere
6. Helmet
10. Plunder
11. Boaster
14. Brand
15. Knave
16. Inscription
18. Incite
19. Accuse
20. Cigar
23. Small lake
25. Limited period
26. Sailing ship
27. Deceive
28. Form of address
29. Remainder
31. Contriver
32. Vanish
35. Regretted
36. Mohammedan potentate
37. Confide in
39. Cut away
40. Imprint
43. Fabulous bird
45. Bounds
48. Kittiwakes
51. Slow movement
53. South American capital
54. Else
57. Re-establish
58. Students at a famous college
59. Extent
60. Done by stitching
61. Fourth class in a botanical system

CLUES DOWN

1. Reproved
2. Likeness
3. Press earnestly
4. Eastern headgear
5. Sliding gate
6. Mussulman
7. Aquatic animal
8. Shameful
9. Trim
12. Steal
13. Throaty
17. Prosper
19. Intrude
21. Hinder
22. Manacle
24. Proficient
25. War galley
30. Portable shelter
33. Separate
34. Heat to excess
37. Decorate
38. Succession
41. Because
42. Friend
44. Remains
46. Periods of history
47. Small gate
49. Cured fish
50. Injure
51. Peers
52. Situation
55. Ornamental pottery
56. Site

This month we give another of the popular "*M.M.*" crossword puzzles, which are intended for amusement rather than strenuous competitive effort. This month's puzzle will be found to follow the lines of those set in previous issues in that it is fair and interesting. The clues are all perfectly straightforward, and every word used can be found in Chambers' or any other standard dictionary.

Prizes of Meccano products to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded in order of merit to the senders of the four correct solutions that are neatest or most novel in presentation. The prizes will be duplicated for the Overseas section, which is open to all readers living outside Great Britain, Ireland and the Channel Islands.

Entries should be addressed "*March Crossword Puzzle*, Meccano Magazine, Binns Road, Liverpool 13," and must be sent to reach this office not later than 31st March. Overseas readers' entries must arrive not later than 30th June.

March Drawing Contest

This month's contest is the last of this winter's series of drawing and painting competitions, and we hope every reader will make a special effort to take part.

The prizes in this competition are offered simply for the best paintings or drawings submitted during the month. The entries 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. In each section a separate set of prizes, to be awarded in similar conditions, is reserved for competitors in the Overseas section.

Entries in the March competition must be addressed "*March Drawing Contest*, Meccano Magazine, Binns Road, Liverpool 13," and must arrive not later than 31st March. Overseas closing date, 30th June.

Competition Closing Dates

HOME

March Drawing Contest	31st March
March Crossword Puzzle	31st March

OVERSEAS

Advertisement "Jig-Saw" Contest	31st March
Stamp Voting Contest	31st March
December Drawing Contest ...	31st March
January Drawing Contest	30th April
"Cover Voting" Contest	30th April
"Animalesques" Contest	31st May
February Drawing Contest... ...	31st May
March Drawing Contest	30th June
March Crossword Puzzle	30th June

Watch the Closing Dates:

Competitors, both Home and Overseas, are particularly requested to make a careful note of the closing dates of the competitions.

In sending entries to competitions that are divided into age groups, competitors should take particular care to mark their ages clearly on the back of the entry. It is not sufficient merely to indicate the age group, as age allowances are given to ensure equality of opportunity for the younger competitors.

COMPETITION RESULTS

HOME

January Drawing Contest.—First Prizes: Section A, J. E. A. Burley (Birmingham 6); Section B, D. A. Jobson (London, S.E.6). Second Prizes: Section A, S. Jones (Chester); Section B, B. Tarrant (W. Croydon). Consolation Prizes: D. Bailey (Birmingham 21); E. G. Belton (Birmingham, 29); H. Gaskell (Preston); J. P. Hurman (Bristol, 6); J. Laing (Dunstable); E. Parr (Newcastle); P. E. J. Wells (Aston-on-Trent); S. Wilkinson (Hull).

"Cover Voting" Contest.—1. B. Jones (Prestatyn). 2. J. Morris (London, W.13). 3. W. R. Collier (Gateshead). 4. H. Cole (Wakefield). Consolation Prizes: W. S. G. Ballance (Brentwood); R. N. Barfield (Slough); J. F. Burrell (Bristol 7); D. Latimer (Bury); S. J. Oates (Stanmore).

OVERSEAS

October Drawing Contest.—First Prizes: Section A, S. D. Kurlawalla (Bombay); Section B, N. P. Meegama (Colombo). Second Prizes: Section A, J. M. Demanuele (Valletta); Section B, T. P. Morris (Salisbury, S. Africa). Consolation Prizes: H. Toller (Ottawa); T. Rogers (Quebec).

"Hidden Advertisements" Contest.—1. R. W. Roddick (Rosario de Santa Fe). 2. S. P. Scott (East London, S. Africa). 3. J. Lyons (Penang, S.S.). 4. A. Marshall (Vancouver, B.C.). Consolation Prizes: R. Green (New Westminster, B.C.); C. P. Barnard (Johannesburg).

"RUN AWAY AND PLAY!"

"Daddy," said a little girl, "If a doctor doctored another doctor, would the doctor doing the doctoring doctor the other doctor in the way the doctored doctor wanted to be doctored, or would the doctor doing the doctoring doctor the other doctor in his own doctoring way?"

* * * *

Reporter (attending a fashionable wedding): "Can you find me a seat?—the Press."
Verger: "I am afraid not, sir—the squash."

* * * *

The Scotchman was making plans for his new home when a friend asked him why he had left the roof off one of the rooms.
"Oh, that's the shower."

* * * *

Client: "Has this dog a good pedigree?"
Salesman: "If he could talk he would not speak to either of us."

* * * *

Teacher: "What happened to Babylon?"
Tom: "Destroyed."
Teacher: "To Nineveh?"
Tom: "Destroyed."
Teacher: "To Tyre?"
Tom: "Punctured."

* * * *

Mr. Jones was planting potatoes and little Joan was following him around. The allotment was a large one.
"Here you are, Daddy," she called at last, "I've picked up all the potatoes you kept dropping."

* * * *

Author (in letter): "I am a very quick worker. I got through the enclosed article in an hour and thought nothing of it."
Editor (replying): "I got through your article in half the time and thought just the same."

* * * *

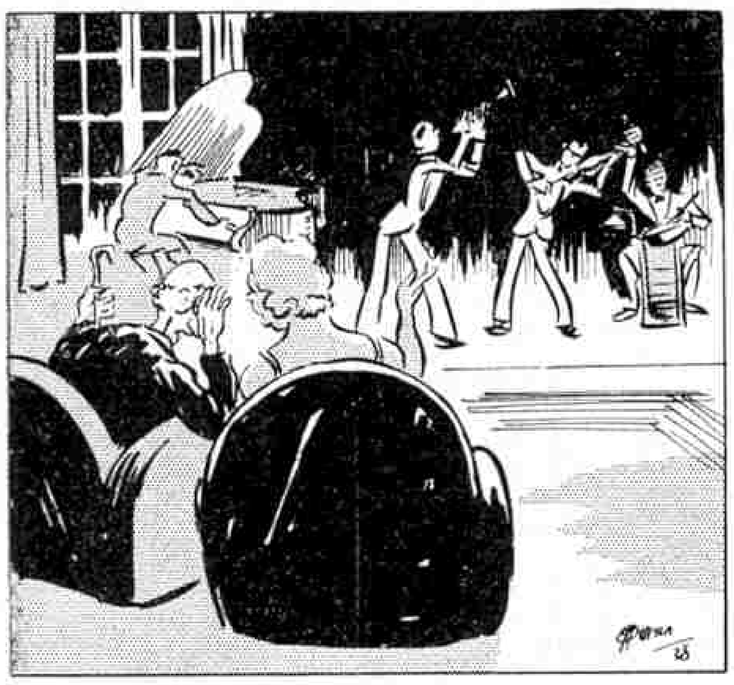
Mr. Smith: "Hello, Jones, got a new car?"
Mr. Jones: "Yes, I went into a garage to use the telephone, and I didn't like to come away without buying something."

* * * *

Eager Playwright: "I wish I could think of a play to fill the audience with tears."
Theatre Manager: "I wish you could think of one to fill the tiers with audience."

* * * *

TWO POINTS OF VIEW



While the orchestra was playing, the hostess sat down beside an elderly guest.
"Don't they play beautifully," she said.
"Pardon?" enquired the old gentleman.
"I said what a lovely orchestra."
"Sorry, I can't hear a word you're saying. This beastly band is making so much noise."

ALL SQUARE

Doctor: "You're a long time paying my bill."
Patient: "Yes, doctor, but you were a long time curing me."

* * * *

The old lady was talking over matters and expressed her approval of the League of Nations.
"I think," she said, "it is a very good thing, but it seems a pity to have so many foreigners in it!"

* * * *

A BROAD HINT

Photographer: "Do you want a large or a small picture?"
He: "A small one."
Photographer: "Then don't smile, please."

* * * *

A man was shown into a business man's office. His face was a mass of whiskers, beard, moustache, and spectacles.
"What did you say your name was?" asked the manager.
"Smith," replied the visitor.
"Ah, yes," said the manager; "your name is familiar. May I ask—er—what is your face?"

* * * *

Youth (entering large store): "What have you in the shape of motor tyres?"
Shopwalker: "Life-belts, children's hoops, and doughnuts."

* * * *

"Now, Clarke," said the history teacher, "what do you consider the greatest accomplishment of the Romans?"
"Learning Latin, sir."

* * *

Teacher: "Now, we are going to have an intelligence test. Will someone ask a question?"
Voice from Class: "Yes. How long is a short circuit?"

* * * *

Motorist: "My wife is tired of the coat you made her last winter."
Tailor: "Indeed."
Motorist: "Yes, she's tired of it, but she likes the fur collar. I was wondering if you could just jack it up and run another coat under it?"

* * * *

A Scotch farmer who had been elected to the School Board visited the village school, and decided to test the intelligence of one class.
"Now, boys, can any of you tell me what naething is?" he asked.
After a moment's silence a small boy in a back seat arose: "It's what ye gi'd me the other day for holding yer horse."

* * * *

Tim: "What part of a fish weighs the most?"
Jim: "Scales."

* * * *

THIS MONTH'S "HOWLER"

A parable is two straight lines.

A LIGHT-HEAVYWEIGHT

"Well, mum," said the tramp, "the reason I can't get a job is because I'm what they calls an unhappy medium—too light for heavy work, and too heavy for light work."

* * * *

Guard: "Your ticket is to Brighton and this train is going to Crewe."
Old Lady: "Goodness gracious. Does the driver know?"

* * * *

Farmer: "Where do you wash?"
Camper: "In the spring, of course."
Farmer: "I said where, not when."

* * * *

Gent.: "What do you mean by saying your occupation is gone?"
Tramp: "They've pulled down the wall I used to lean against."

* * * *

Explorer: "One night when I was in the jungle I shot an elephant in my pyjamas."
Bored Friend: "Good gracious! How did it get there?"

* * * *

Impatient Diner: "Waiter! How long is my sausage going to be?"
Waiter: "About four and a half inches."

* * * *

Father: "I hope my son's getting well grounded in languages."
Teacher: "Grounded! Why, he's utterly stranded in them."

* * * *

A farm worker set out on his cycle for a town a few miles distant. He was a long time getting there.
"I come to one of those signs what said 30," he told a friend, "so I waited 30 minutes, but it didn't change, so I chanced my luck and rode on."

* * * *

A Yankee was on a walking tour in Scotland. Darkness had fallen and he was struggling along a narrow road when he met a Highlander.
"I guess, friend, I sure am lost!" he said, plaintively.
Scot: "Is there a reward oot for ye?"
American: "Nope."
Scot: "Weel, ye're still lost."

* * * *

1st Wrestler: "Wow! you're biting."
2nd Wrestler: "Well, do you expect me to swallow you whole?"

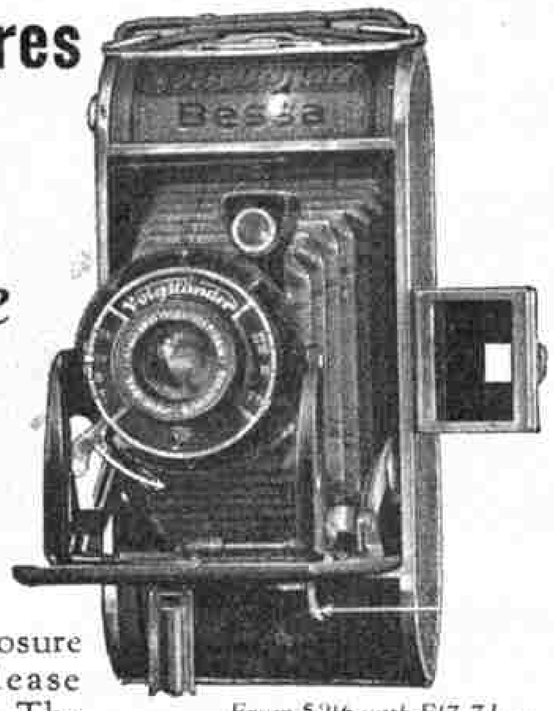
* * * *

A TALL ORDER

"Shine, please, boy," said the six-foot-five soldier to the shoeblack.
The boy looked down at the vast expanse of boot before him. "Bert," he called out to another boy, "Gimme an 'and—I've got an army contract!"

OPTICAL CRAFTSMEN SINCE 1756

Better features for Better pictures— *that's the Bessa!*



Here's a camera that makes good snaps simple and certain. You hold it in two hands at eye-level and make the exposure with the trigger-release under the baseboard. The Frame-finder Bessa has another advantage, too—it gives you the choice of 8 full-size or 16 half-size pictures on standard 3¼" x 2¼" film. Then there's the lens and shutter and the design and construction. The name Voigtlander means that all these are as perfect as possible. See this Frame-finder Bessa at your dealers or write for full details.

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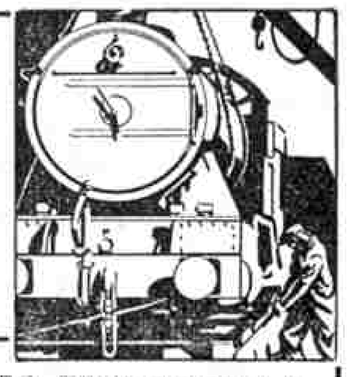

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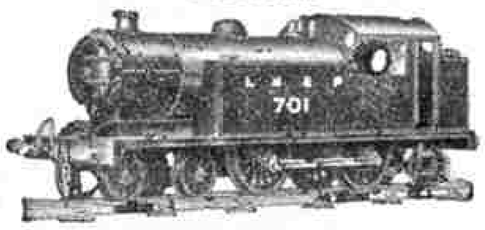

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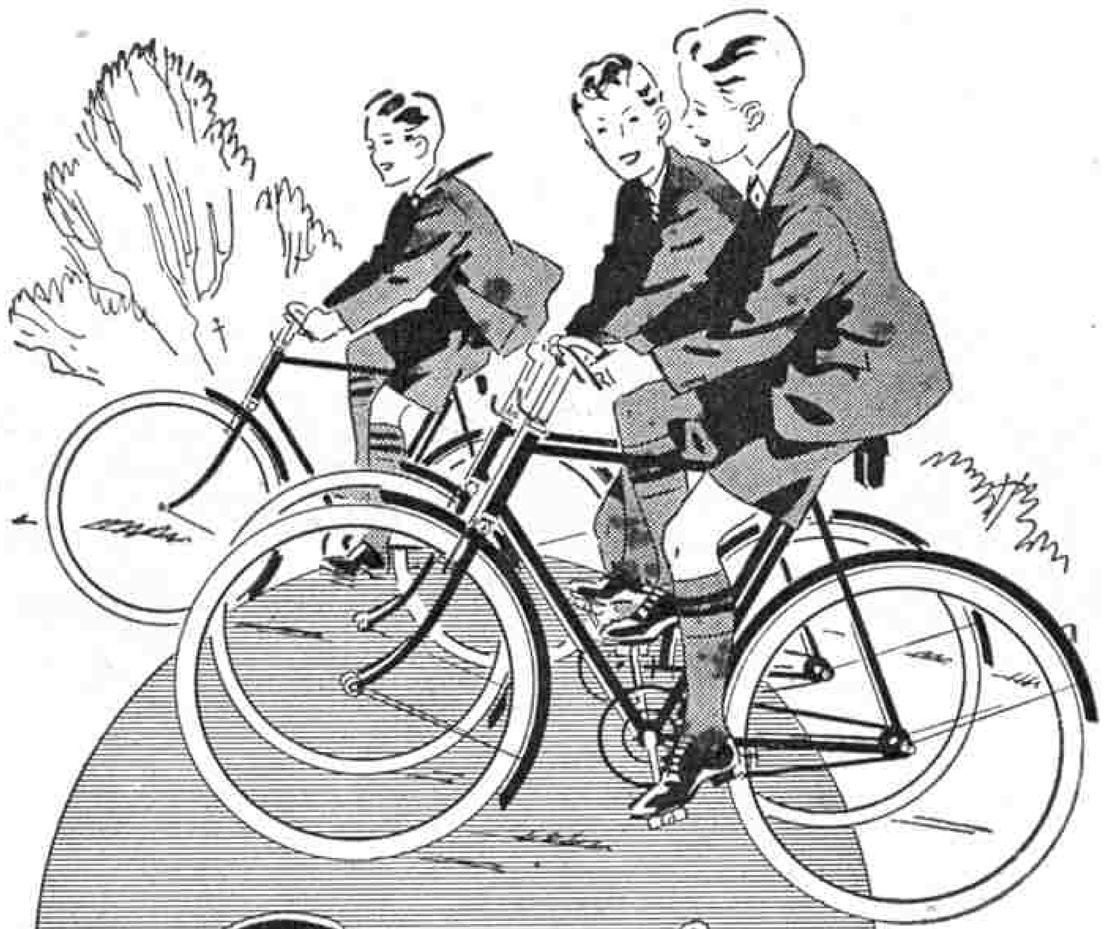
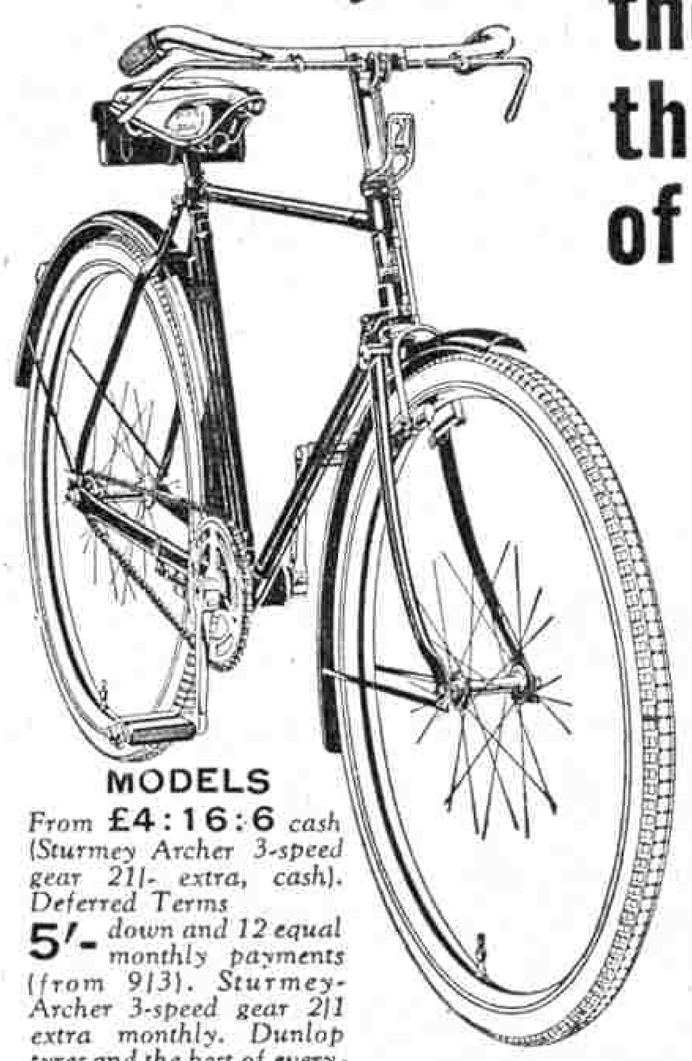


Spot the RALEIGH Boys- They ride up the hills with the greatest of ease . . .



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THE ALL-STEEL BICYCLE
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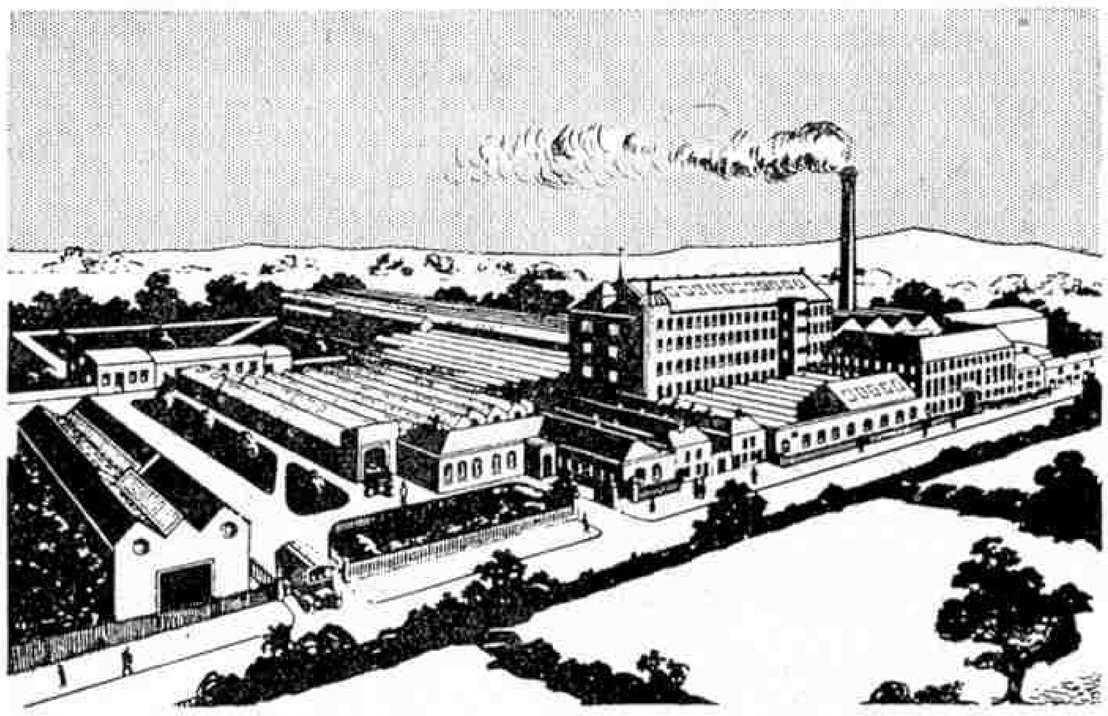

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Seccotine is recognised all over the world as the strongest and most effective adhesive obtainable. Use it with reliance and confidence on all your making and mending problems. All surfaces—wood—metal—china—glass—cardboard, etc., respond equally well to Seccotine treatment. Remember only a little is needed each time you use it.

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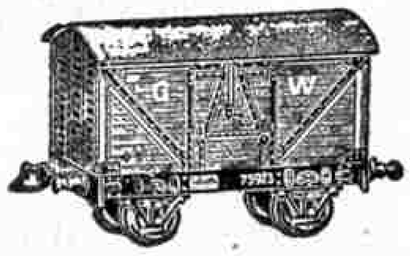
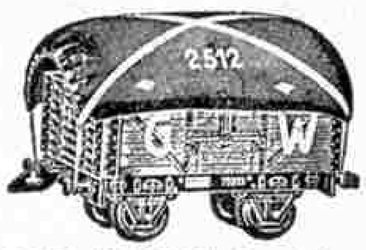


COVERED WAGON. A splendid model with plenty of detail. 5¼" long. Price **1/6.** Postage 6d.



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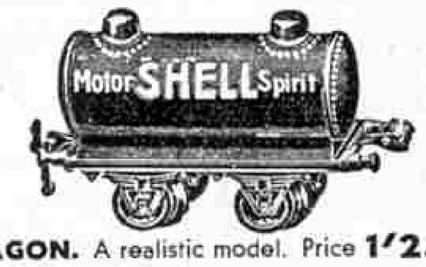
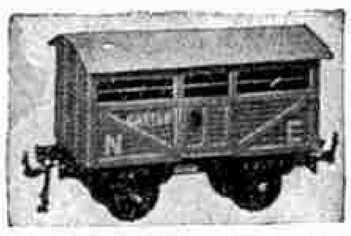


PETROL WAGON. A realistic model. Price **1/2.** Postage 6d.



CATTLE WAGON. Fitted with flap doors. Price **2/3.** Postage 6d.

BRAKE VAN. A good strong van. Price **2/3.** Postage 6d.

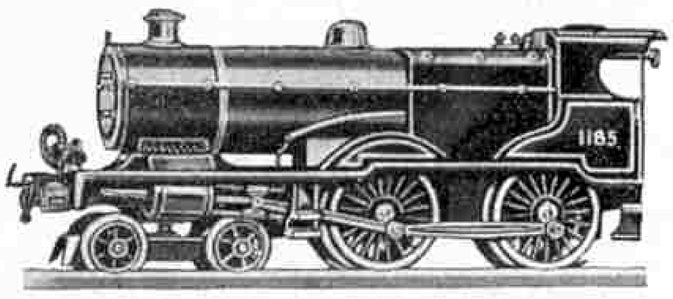
Buy **now** whilst stocks last as these cannot be repeated.

Send for BOND'S GENERAL CATALOGUE, price 6d. Its 200 pages will interest you.

BOND'S O' EUSTON ROAD LTD., 357, Euston Rd., N.W.1

'Phone EUSton 5441-2 Established 1887

PART-EXCHANGE SCHEMES FOR MECCANO PRODUCTS



Hornby Locomotives

No matter what the age or condition of your old Locomotive, you can exchange it under our "Part-Exchange" Scheme.

The allowance that will be made for your old Locomotive is shown in a list of Part-Exchange allowances for Hornby Locomotives that is obtainable from any Meccano or Hornby Train dealer, or direct from Meccano Ltd. Please note that the price of the new Hornby Locomotive you purchase **must not be less than double the Part-Exchange allowance** made for your old Locomotive.

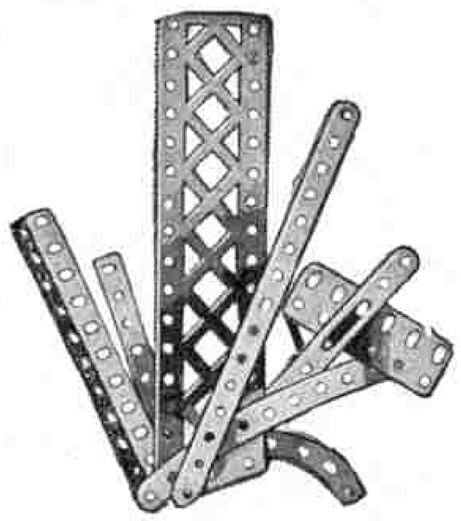
HOW THE SCHEME WORKS

Suppose you have a No. 1 Tank Locomotive that you wish to exchange. You see from the list that its exchange allowance is 5/9. You then look at the Hornby Train catalogue and choose one of the new Locomotives, the cost of which is not less than 11/6—that is, not less than double the Part-Exchange allowance we make for your No. 1 Tank Locomotive.

You decide to have, say, a No. 2 Special Tank Locomotive, the price of which is 21/–. Pack up your old No. 1 Tank, take it to your dealer, with 15/3, and he will exchange it for the new model that you require.

If it is more convenient you can send your old No. 1 Tank to us for exchange. In this case you deduct 5/9 from 21/– (the price of the new No. 2 Special Tank), and enclose 16/3, that is 15/3 plus 1/– for carriage on the new locomotive. Address your parcel to Meccano Limited, Special Service Department, Binns Road, Liverpool 13.

We cannot accept more than one old Locomotive in exchange for a new Locomotive. Tenders cannot be exchanged.



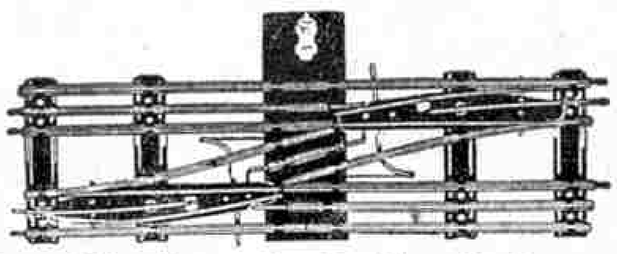
MECCANO PARTS

We undertake to exchange any damaged Meccano parts for similar new parts at half the current list price, no matter how old or how much damaged the parts.

Send them to Meccano Limited, Special Service Department, Binns Road, Liverpool 13, together with half the cost of the new parts, plus the return postage, which will be exactly the same as that you paid on the parcel of old parts.

Parts cannot be taken in exchange for Outfits.

The part-exchange scheme cannot be applied to any other Meccano products.



HORNBY TRACK

Hornby Clockwork Rails, Points and Crossings can be exchanged for Electric, on a piece-for-piece basis, the allowance being half the current list price of the Clockwork track returned.

Send your Clockwork track to Meccano Limited, Special Service Department, Binns Road, Liverpool 13, together with the cost of the new track less half the price of the old track, plus the return postage, which will be exactly the same as that you paid on the parcel of old track.

This applies to Hornby Track only, not to Hornby Accessories fitted with rails.

MECCANO
PARTS & ACCESSORIES

REAL ENGINEERING PARTS IN MINIATURE

Meccano parts, many of which are here illustrated, combine to form a complete miniature engineering system with which practically any movement known in mechanics can be correctly reproduced. New parts are always being introduced in order to keep Meccano model-building in line with the most modern engineering requirements. The greatest care is taken in the designing of these parts to ensure that they function exactly as their counterparts in actual engineering practice. Ask your dealer for the latest complete illustrated price list.

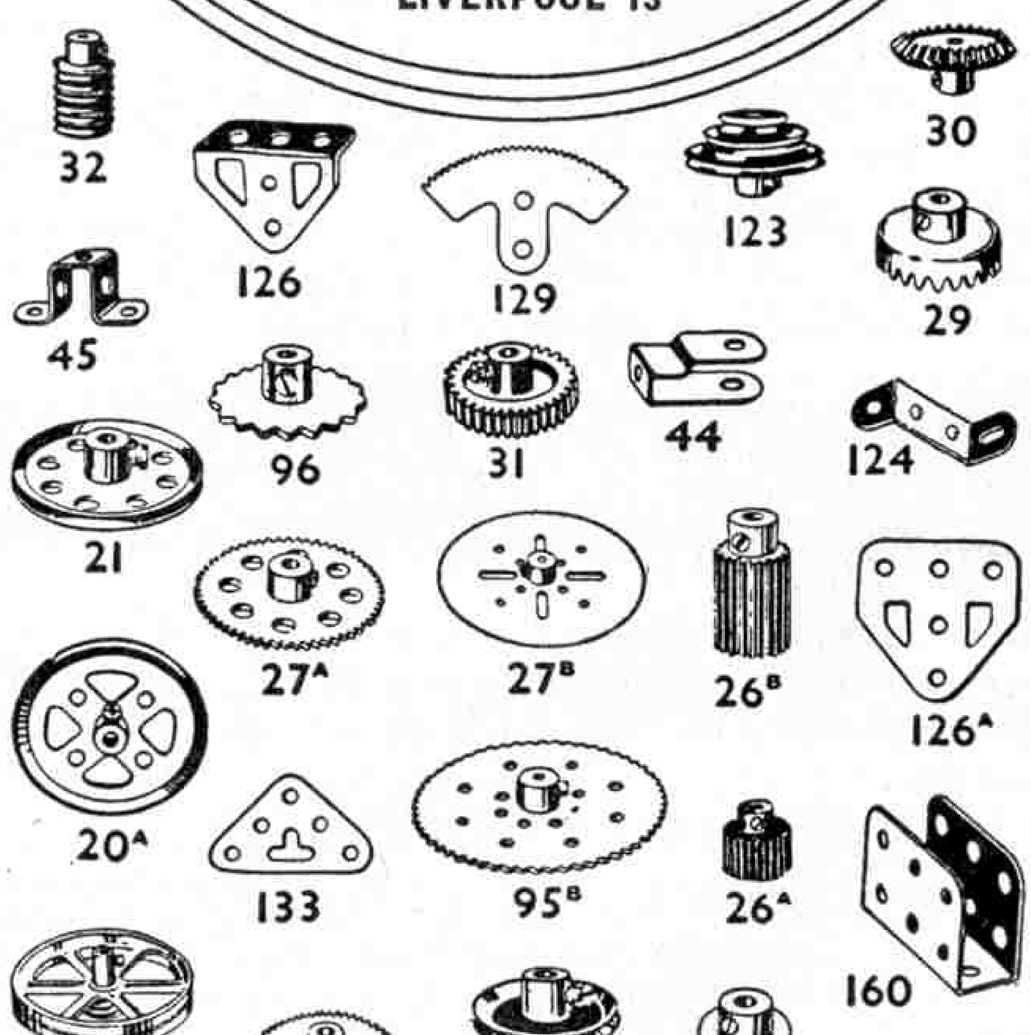
MECCANO LTD., Binns Road
LIVERPOOL 13

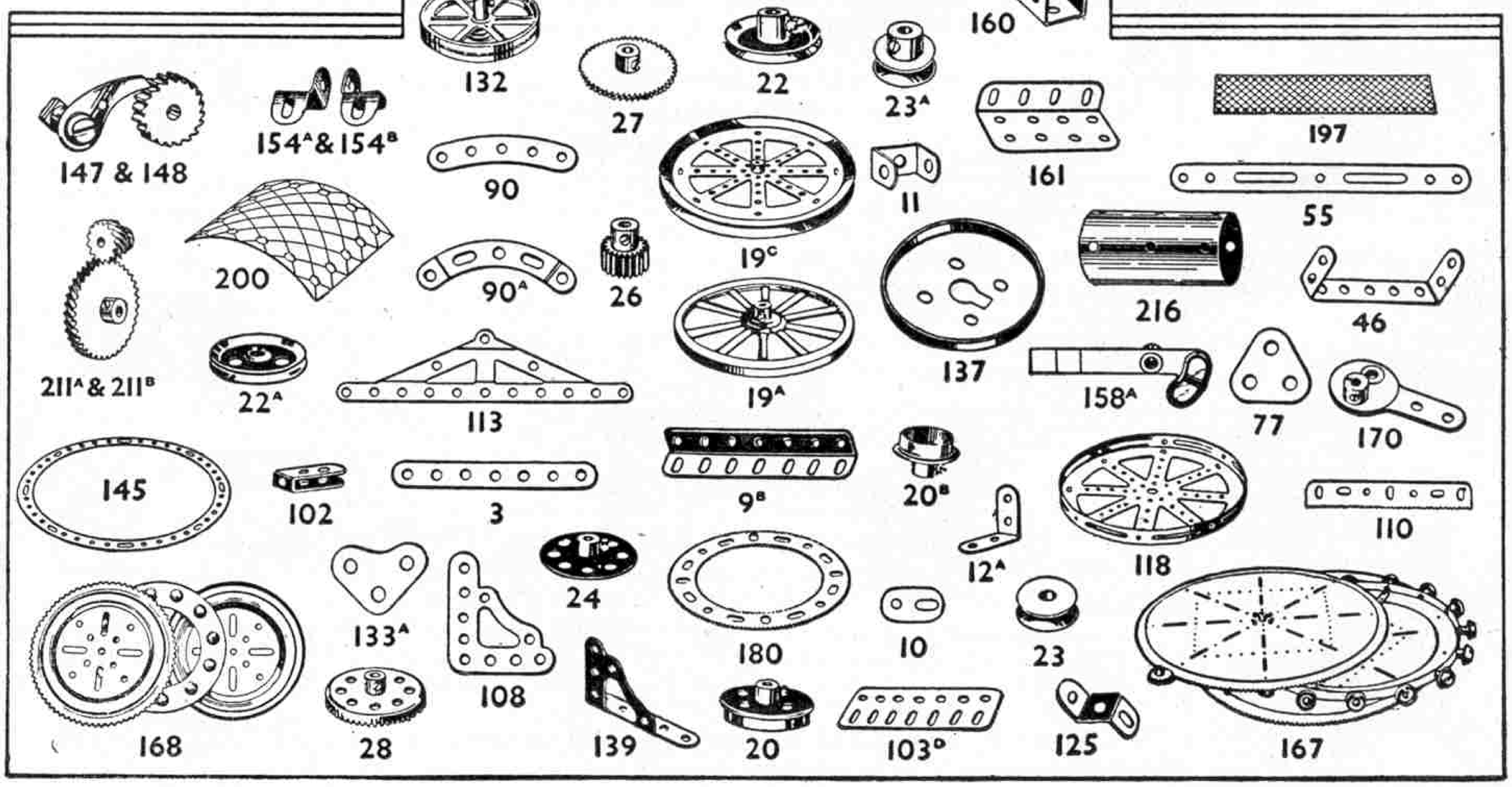
PRICES OF PARTS ILLUSTRATED

No.			s.	d.
3.	Perforated Strips, 3½" ...	½ doz.	0	5
9b.	Angle Girders, 3½"	"	0	9
10.	Flat Brackets	doz.	0	1
11.	Double Brackets	"	0	3
12a.	Angle Brackets, 1" x 1" ...	"	0	8
19a.	Wheels, 3" diam., with set screws	each	0	6
20.	Flanged Wheels, 1⅛" diam.	"	0	3½
20b.	" " ¾" "	"	0	2½
	Pulley Wheels			
19c.	6" dia. with centre boss and set screw	"	1	9
20a.	2" " " "	"	0	3½
21.	1½" " " "	"	0	3
22.	1" " " "	"	0	2
23a.	½" dia. with centre boss and grub screw	"	0	2
22a.	1" dia. without centre boss and grub screw	"	0	1
23.	½" " " "	"	0	1½
24.	Bush Wheels	"	0	2½
26.	Pinion Wheels, ½" dia., ¼" face	"	0	3½
26a.	" " ½" " ½" "	"	0	4½
26b.	" " ½" " ¾" "	"	0	6
	Gear Wheels			
27.	50 teeth to gear with ¾" Pinion	"	0	4
27a.	57 " " " ½" "	"	0	5
27b.	133 " " " ½" "	"	1	3
28.	Contrate Wheels, 1½" diam.	"	0	6
29.	" " ¾" "	"	0	4
30.	Bevel Gears, ⅞", 26 teeth	"	0	6
31.	Gear Wheels, 1", 38 teeth	"	0	9
32.	Worms	"	0	3½
44.	Cranked Bent Strips ...	"	0	1
45.	Double " " ...	"	0	1
46.	" Angle Strips, 2½" x 1"	½ doz.	0	8
55.	Perforated Strips, slotted, 5½" long	doz.	1	3
77.	Triangular Plates, 1"... ...	each	0	1
90.	2½" Curved Strips, 2⅜" radius	"	0	1
90a.	2½" Curved Strips, cranked, 1⅜" radius, 4 to circle ...	"	0	1

PRICES OF PARTS ILLUSTRATED (Cont.)

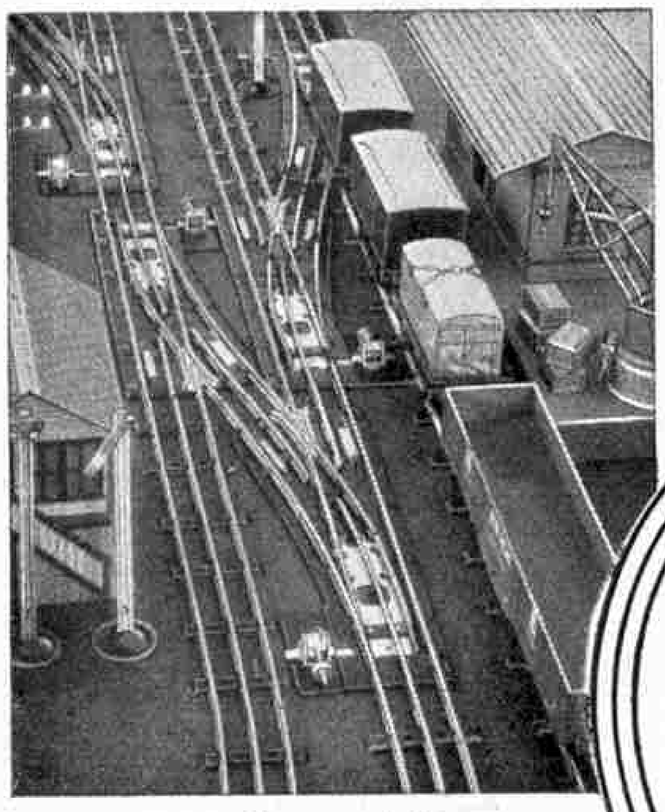
No.			s.	d.
95b.	Sprocket Wheels, 56 teeth, 3" diam.	each	0	7
96.	Sprocket Wheels, 18 teeth, 1" diam.	"	0	3
102.	Single Bent Strips	"	0	1
103d.	Flat Girders, 3½" long ...	½ doz.	0	9
108.	Architraves	doz.	1	9
110.	Rack Strips, 3½" long ...	each	0	2
113.	Girder Frames	"	0	3
118.	Hub Discs, 5½" diam. ...	"	1	0
123.	Cone Pulley	"	1	0
124.	Reversed Angle Brackets, 1"	½ doz.	0	4½
125.	" " " ½"	"	0	3
126.	Trunnions	each	0	1½
126a.	Flat Trunnions	"	0	1
129.	Rack Segments, 3" diam....	"	0	5
132.	Flywheels, 2¾" diam. ...	"	2	0
133.	Corner Brackets, 1½" ...	"	0	1
133a.	" " 1" ...	"	0	1
137.	Wheel Flanges	"	0	2½
139.	Flanged Brackets (R.H.) ...	"	0	2
145.	Circular Strips, 7½" diam. overall	"	1	0
147.	Pawls, with Pivot Bolt and Nuts	"	0	3
148.	Ratchet Wheels...	"	0	4
154a.	Corner Angle Brackets, ½", right hand	½ doz.	0	3
154b.	Corner Angle Brackets, ½", left hand...	"	0	3
158a.	Signal Arms, Home	each	0	5
160.	Channel Bearings, 1½"x1"x½"	"	0	2
161.	Girder Brackets, 2"x1"x½"	"	0	1½
167.	Geared Roller Bearings ...	"	20	0
168.	Ball Bearings, 4" diam. ...	"	3	0
170.	Eccentrics, ½" throw ...	"	0	9
180.	Toothed Gear Ring, 3½" diam. 133 external teeth, 95 internal "	"	1	0
197.	Strip Plates, 12½" x 2½" ...	"	0	7
200.	Curved Plates, 1 11/16" radius	"	0	1½
211a.	Helical Gears, ½" (Can only be used together)	"	0	10½
211b.	" " 1½" (Can only be used together)	"	2	3
216.	Cylinders, 2½"	"	0	3½





HORNBY SOLID STEEL RAILS

Although our standard tinplate rails are the acknowledged best of their class, we have felt that in order to do justice to the speed and hauling power of our locomotives, especially "PRINCESS ELIZABETH" and E420 "ETON," a drawn steel rail was essential. Our object was to produce the perfect miniature railway track, and we have achieved our aim in the new system of electric steel rails and points that we introduced recently. These rails are of the very highest quality, yet are sold at reasonable prices. We are confident that they will give satisfaction, not only to Hornby Train users, but to all model railway enthusiasts. The track is joined up by means of fishplates which are supplied with each rail.

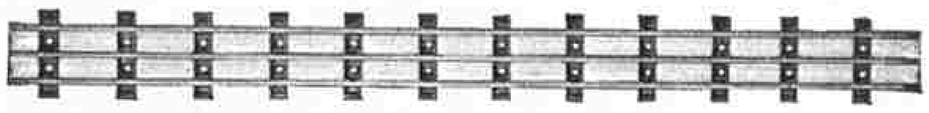


Many owners of Hornby Railways with tinplate rails will want to add solid steel track to their layouts. To enable them to do this special Adapting Pieces are available.

AP Adapting Pieces, per box of six ... **1/-**

QUALITY FEATURES OF NEW ELECTRIC SOLID STEEL TRACK

1. RAILS. Solid drawn steel section, zinc coated to prevent rust and to ensure good electrical contact. The space required for a circle made up of 10 Curved rails is 6 ft. 8 in.
2. SLEEPERS. Pressed steel, of similar design to the steel sleepers used on actual railways. Each sleeper is pierced so that the track can be screwed down to a wood base.
3. POINTS. On solid base, providing the greatest possible rigidity. Lever movement simple and positive. Right-hand and Left-hand points available.

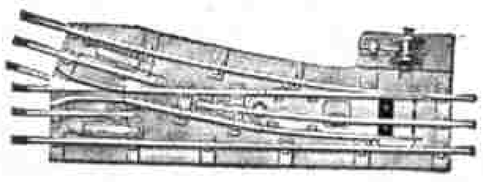


ELECTRIC STRAIGHT RAILS

EB3	Straight Rails (Length 23 in.)	each **2/8**
EB3½	Straight Half Rails	" **1/7**
EB3¼	Straight Quarter Rails	" **1/-**
	TSR Electrical Terminal for Solid Section Rail	per pair **4d.**

ELECTRIC CURVED RAILS

EA3	Curved Rails	each **2/8**
EA3½	Curved Half Rails	" **1/7**



ELECTRIC POINTS. (Hand Operated)

EPR3	Right-hand Points	each **8/3**
EPL3	Left-hand Points	" **8/3**

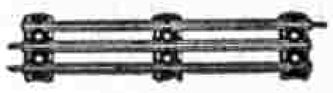
FISHPLATES

FP	For joining up track	Price, doz. **6d.**

Manufactured by
MECCANO LIMITED
BINNS ROAD
LIVERPOOL 13

The **PERFECT** *track for Electric Model Railways*

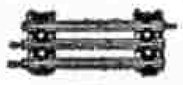
HORNBY RAILS, POINTS and CROSSINGS



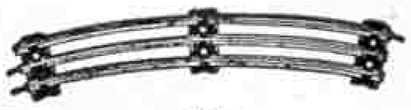
EB1

ECR

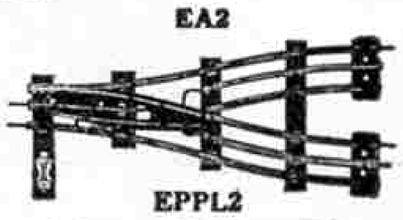
EA2¼



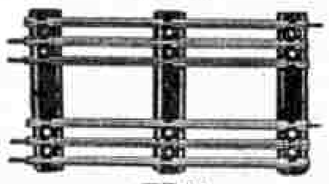
EB½



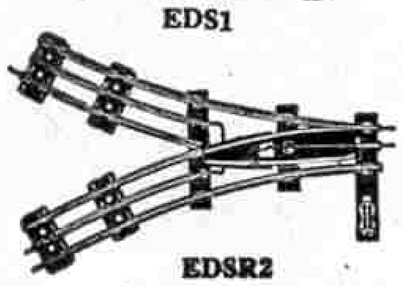
EA2



EPPL2



EDS1



EDSR2

GAUGE O, 1¼". HORNBY SERIES.

Hornby Rails, Points and Crossings are built for hard wear and for smooth running.

There is practically no limit to the number of rail formations that can be built with them. Their adaptability is well shown in the booklets "How to Plan your Hornby Railway" and "Hornby Layouts–100 Suggestions," both of which may be obtained from your dealer, price 3d., or from Meccano Ltd., Binns Road, Liverpool 13, price 4d.

A SELECTION OF RAILS, POINTS AND CROSSINGS

FOR ELECTRIC TRAINS

EB1 Straight rails	per doz. 6/-
EB½ " half rails ...	" " 5/-
EA2¼ Curved quarter rails (2 ft. radius)	" " 4/6
EA2 Curved rails (2 ft. radius)	" " 6/-
EPPR2 Parallel points, right-hand	per pair 7/-
EPPL2 Parallel points, left-hand	per pair 7/-
These points can be used with either 1 ft. or 2 ft. radius track.	
EPR2 Right-hand points (2 ft. radius)	per pair 8/-
EPL2 Left-hand points (2 ft. radius)	per pair 8/-
EPR1 Right-hand points (1 ft. radius)	per pair 6/6
EPL1 Left-hand points (1 ft. radius)	per pair 6/6
EDS1 Straight rails, double track	½ doz. 8/6
EDSR2 Double symmetrical points, right-hand (2 ft. radius)	per pair 7/-
EDSL2 Double symmetrical points, left-hand (2 ft. radius)	per pair 7/-
EDSR1 Double symmetrical points, right-hand (1 ft. radius)	per pair 7/-
EDSL1 Double symmetrical points, left-hand (1 ft. radius)	per pair 7/-

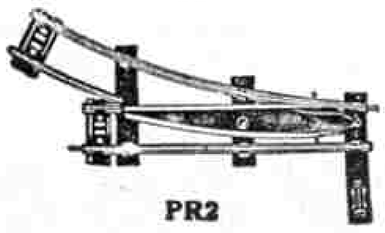
FOR CLOCKWORK TRAINS

B1 Straight rails	per doz. 4/-
A1 Curved rails (1 ft. radius)	" " 4/-
PR1 Right-hand points (1 ft. radius)	per pair 3/6
PL1 Left-hand points (1 ft. radius)	per pair 3/6
PR2 Right-hand points (2 ft. radius)	per pair 3/6
PL2 Left-hand points (2 ft. radius)	per pair 3/6
CA2 Acute-angle crossings (for 2 ft. radius track)	each 1/6
PPR2 Parallel points, right-hand	per pair 4/-
PPL2 Parallel points, left-hand	per pair 4/-
These points can be used for either 1 ft. or 2 ft. radius track.	
DC2 Curved rails, double track, 2 ft. radius only ...	½ doz. 6/-

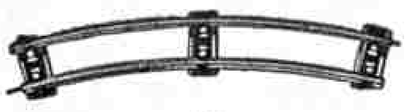
Ask your dealer for an illustrated price list.

MECCANO LIMITED, Binns Road, Liverpool 13

B1

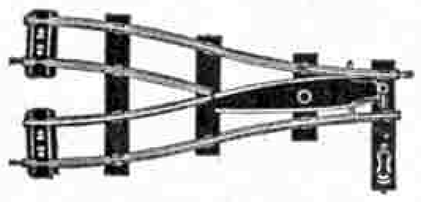


PR2

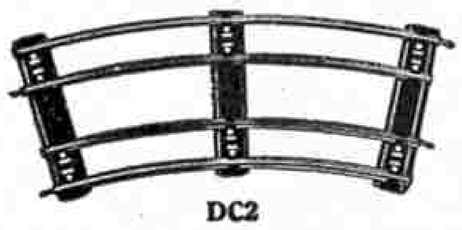


A2

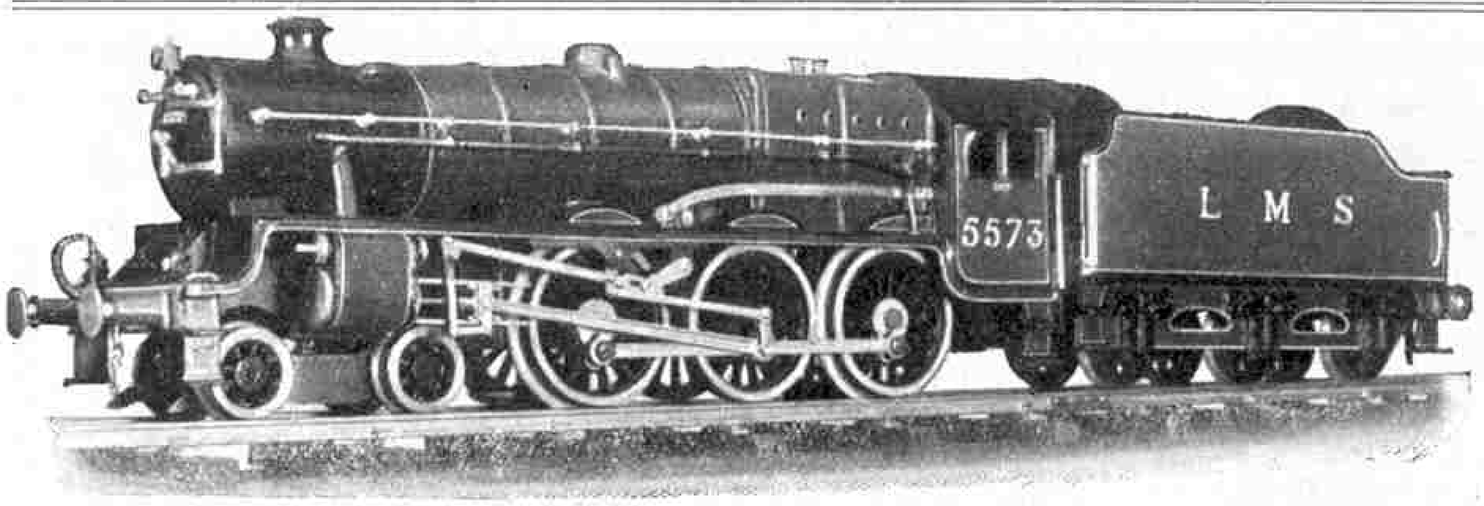
CA2



PPR2



DC2



HERE IS ONE OF OUR BARGAINS! 9 only, L.M.S. 4-6-0 5XP locomotives No. 5573 fitted with electric motor for A.C. current, 20 volts, complete with controller for distant control. Usual price £8-15-0. **BARGAIN PRICE £5-10-0.**
(Two of the above are in the Silver Jubilee colours.)
Also gauge "O" Goods Rolling Stock in wood, the 7/- to 10/6 Vehicles are reduced to 5/6. Wonderful value.

GENUINE BARGAINS FROM STOCKTAKING

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A.17 Model Railway Equipment. **S.17** Model Ships and Ships Fittings.
6d. each Post Free.
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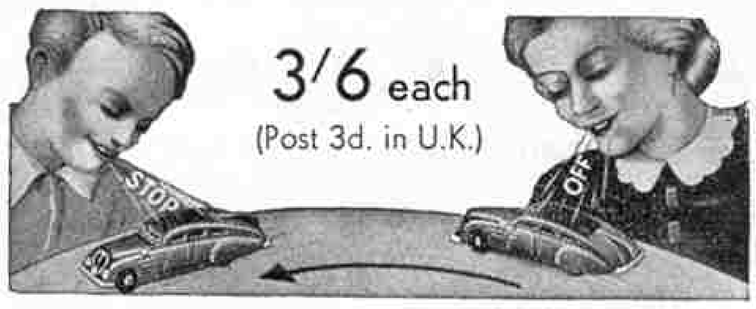
The Schuco Command Car

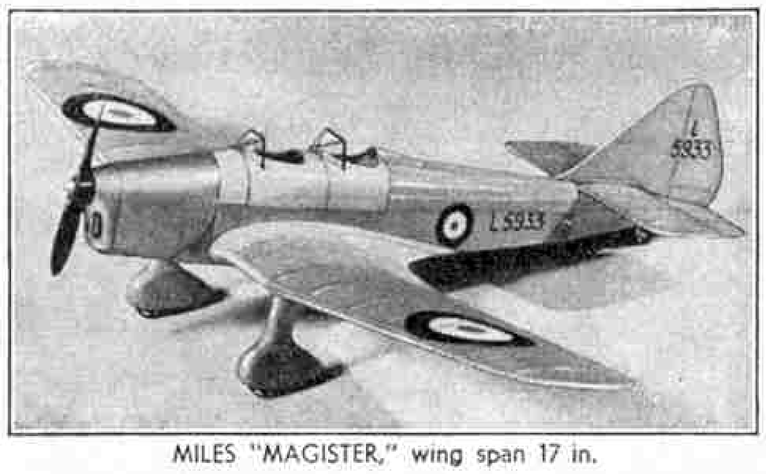
This amazing car really obeys your voice! Say "GO" and it goes! Say "STOP" and it stops! Can be adjusted to run straight or in circles, backward or forward. You can even open the bonnet to watch the mysterious mechanism inside. Supplied complete in carton with full instructions.



This superb toy and also anything else you see now, or in the future, in this Magazine can be obtained from RAVENS, the only toy firm that pays carriage (in U.K.) on all orders over 5/-.

RAVENS THE TWIN TRAIN SPECIALISTS SOUTHEND-ON-SEA

SCALE MODELS *that* FLY!



MILES "MAGISTER," wing span 17 in.

By Aeromodels Ltd.
(1/24th full size)

We stock these splendid models, the very finest of their kind. The Kits are absolutely complete, with full instructions, while the finished models are really excellent flyers.

Prices
"TIGER" or "LEOPARD" MOTH and MILES "MAGISTER," Complete Kit **3/6.**
HAWKER "FURY," **4/-.**
Postage 6d. extra.

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THE BOYS' ARCADIA
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Build your own engine

Only a few hand tools required.

Stuart No. 10.
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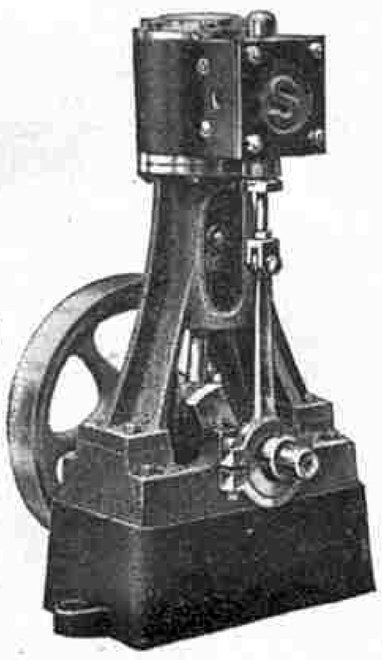

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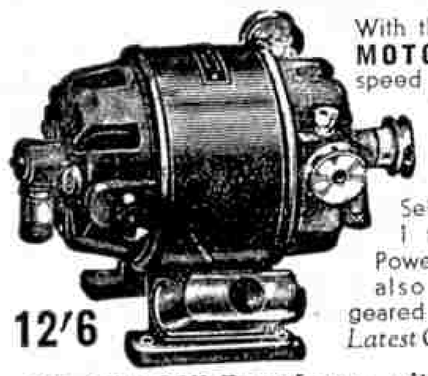

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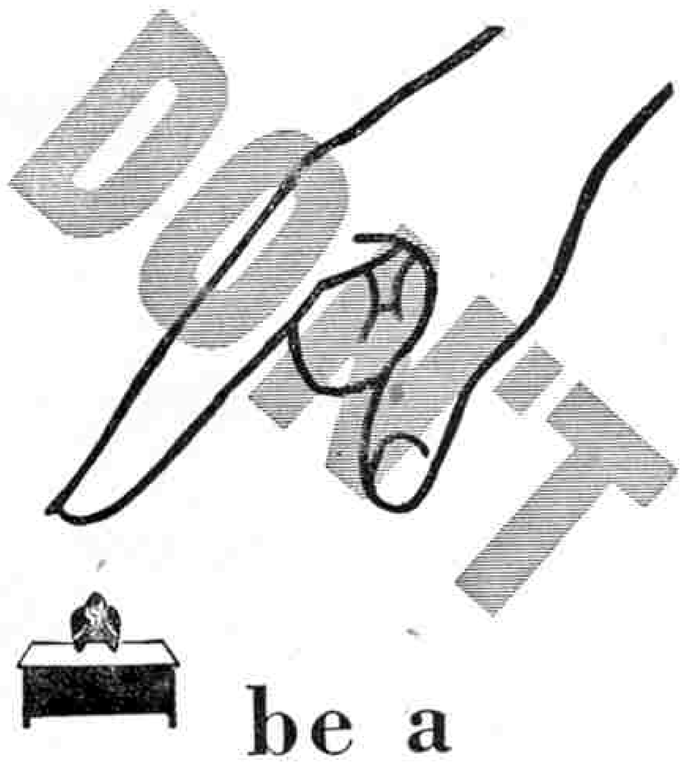

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Readers should note that all advertisements of Hornby Trains and other Meccano products included in this column relate to items no longer featured in the catalogue. Advertisements of current products cannot be accepted for this column.

Sale or Exchange. "M.M.'s," September 1923 to January 1934, unbound, in good condition. Offers for part or whole to—18, Nansen Road, London, S.W.11.

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Free. 36 "M.M.'s" given to purchaser of £3 worth Red-Green Meccano. Good condition, including 7/6 Clockwork Motor. All for 30/-.—Cook, 10, Cromwell Road, Finchley.

Wanted. 20-volt Gauge O model of G.W.R. "King George V."—Wild, 21, Normanton Road, Croydon.

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"M.M.'s," November 1925-August 1936 inclusive, bar April 1926. Offers.—Nichols, Allerton, West Mersea, Essex.

Stamp Collection, Books and Magazines for disposal. Write for list.—Smith, 29, Roydon Grove, Lincoln.

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Sale. Chemicals and Apparatus. Cheap. Write List.—Cotterell, 81, Bescot Road, Walsall.

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"Meccano Magazines," 1929-31, Bound, 1932 loose. All beautiful condition. Offers.—L. Barham, High Street, Falmouth.

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EDITORIAL AND ADVERTISING OFFICE:—
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No. 2 "	6	0
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No. 4 "	12	6
No. 5 "	18	0
No. 6 "	24	0
No. 7 "	35	0
No. 8 "	66	0
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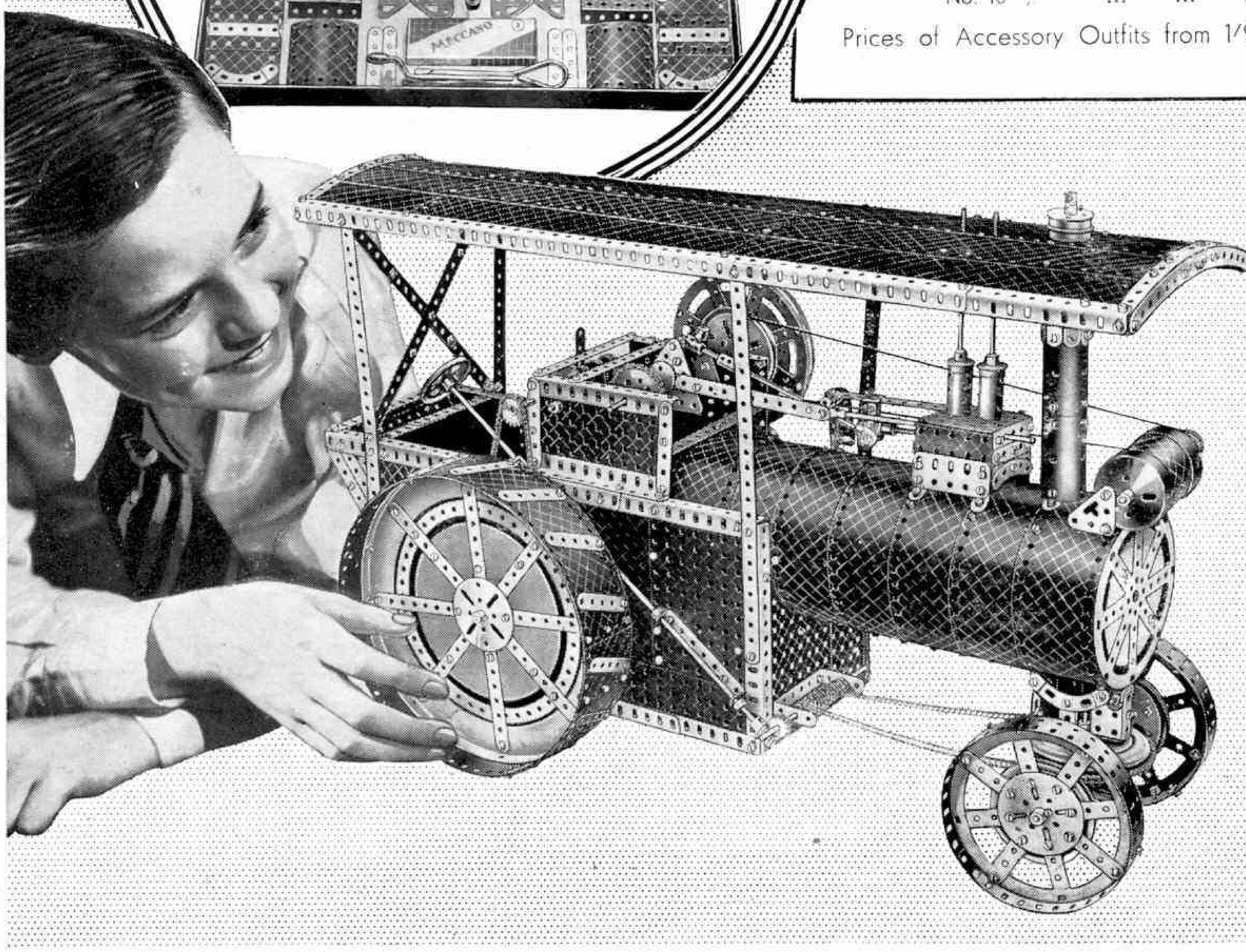

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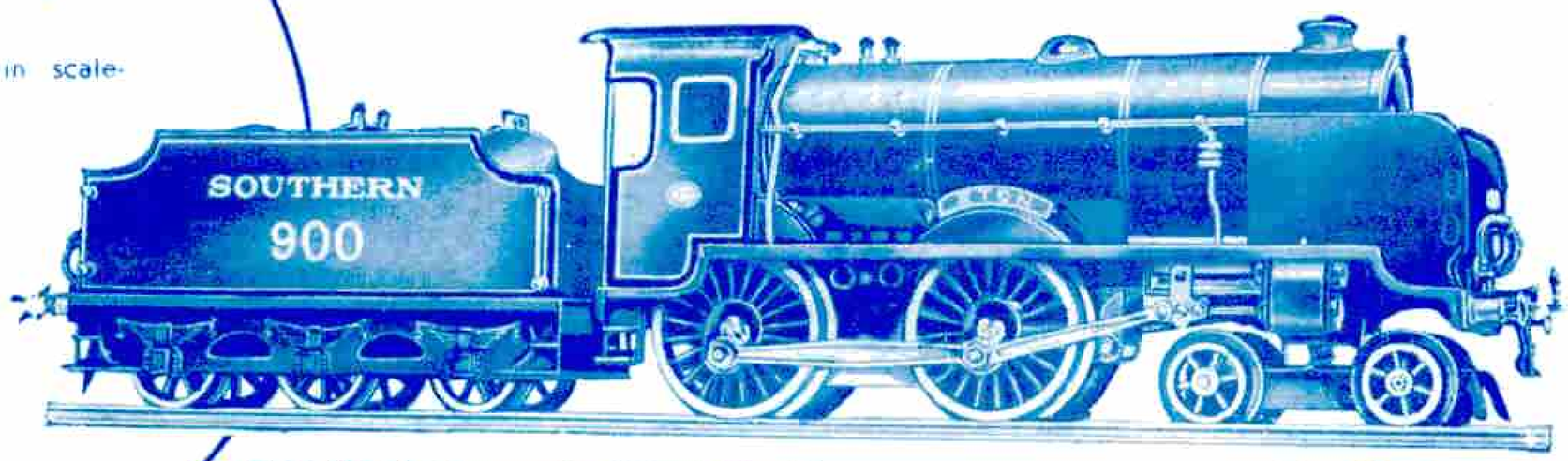

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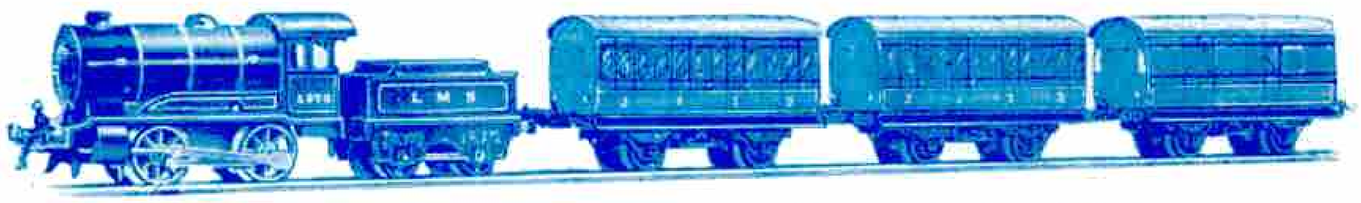

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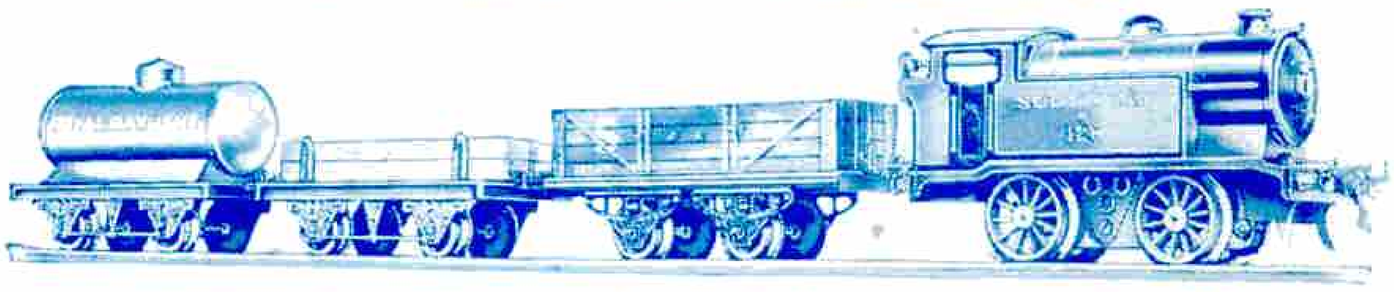

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