VOL. XX. No. 4. APRIL 1935

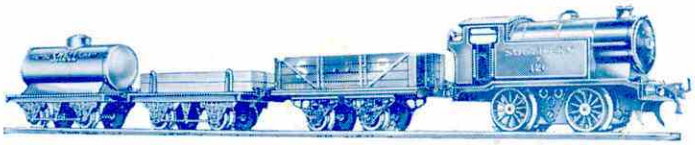
MECCANO MAGAZINE

6D.

WORLD'S LARGEST LIFT BRIDGE
(see page 206)

HORNBY ELECTRIC & CLOCKWORK TRAINS

Fine fun on the line — with a Hornby!



EM320 Tank Goods Set (20-Volt Electric) ... ... Price 24/-

Hornby No. 1 Passenger Set (Clockwork) ... ... Price 25/6

Hornby E220 Mixed Goods Set (20-Volt Electric) ... ... Price 47/6

Hornby No. 3C Riviera "Blue" Passenger Train Set (Clockwork) ... Price 58/6

Hornby No. E220 Special Pullman Set (20-Volt Electric) ... ... Price 75/-

Prices of Hornby Electric Trains Sets from 15/- to 75/-
Prices of Hornby Clockwork Trains Sets from 4/11 to 65/-

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!

From the day of their introduction Hornby Trains have always represented the latest model railway practice. Designs are continually being improved and new items added so that the system is complete in practically every detail. There are Locomotives for all duties, driven by electric motors or by clockwork. There is Rolling Stock of all kinds including Pullman Cars, ordinary Coaches and Guard's Vans for passenger services, and numerous Wagons and Vans for freight working.

The Accessories are now better than ever before, while the Rails, Points and Crossings enable an endless variety of layouts to be constructed, both for Electric and Clockwork Trains.

Ask your dealer for a copy of the latest Hornby Train price list.

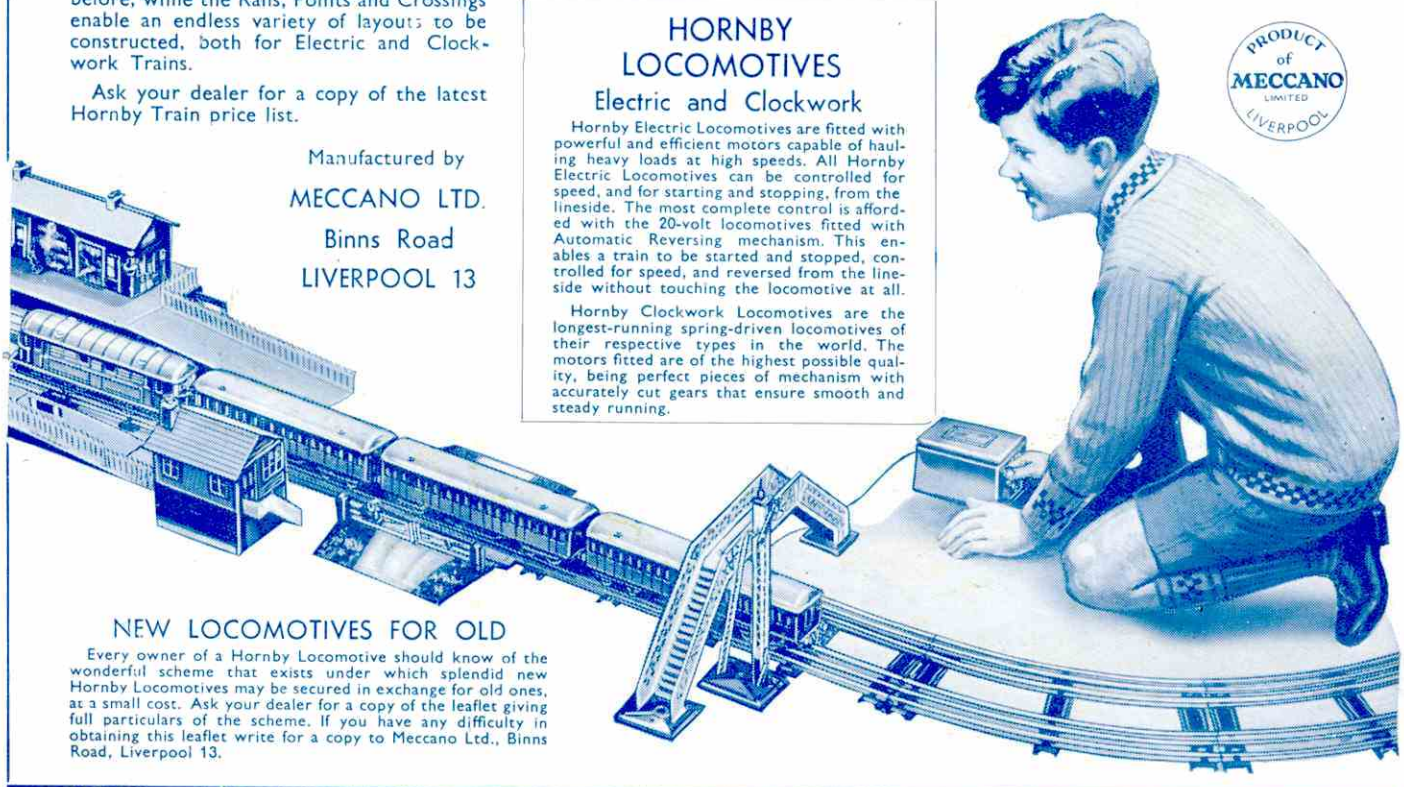
Manufactured by
MECCANO LTD.
Binns Road
LIVERPOOL 13

HORNBY LOCOMOTIVES

Electric and Clockwork

Hornby Electric Locomotives are fitted with powerful and efficient motors capable of hauling heavy loads at high speeds. All Hornby Electric Locomotives can be controlled for speed, and for starting and stopping, from the lineside. The most complete control is afforded with the 20-volt locomotives fitted with Automatic Reversing mechanism. This enables a train to be started and stopped, controlled for speed, and reversed from the lineside without touching the locomotive at all.

Hornby Clockwork Locomotives are the longest-running spring-driven locomotives of their respective types in the world. The motors fitted are of the highest possible quality, being perfect pieces of mechanism with accurately cut gears that ensure smooth and steady running.



NEW LOCOMOTIVES FOR OLD

Every owner of a Hornby Locomotive should know of the wonderful scheme that exists under which splendid new Hornby Locomotives may be secured in exchange for old ones, at a small cost. Ask your dealer for a copy of the leaflet giving full particulars of the scheme. If you have any difficulty in obtaining this leaflet write for a copy to Meccano Ltd., Binns Road, Liverpool 13.

Hamleys News

·HAMLEY·BROTHERS·LTD·ESTABLISHED·1760·

200-202, REGENT STREET, LONDON, W.1 OUR ONLY ADDRESS

Number Twenty-four *April, 1935*

FISHING, GOLF, TENNIS OR PHOTOGRAPHY?

A REALLY GOOD MINIATURE CAMERA

"CORONET" MIDGET CAMERA

For waist-coat pocket or handbag, size 2½ in. x 13/16 in. x 1 in., weight 1¾ ozs., bakelite case, obtainable in four colours: walnut, green, rose and black. F.10 meniscus lens, instantaneous shutter, working at 1/30th second, safety catch on shutter, direct brilliant lens-view finder, 16 mm. roll film, 6 exposures 6d. Develop and one 3½ in. x 2½ in. enlargement of each 1/6. Solid leather cases in assorted colours to match, price 1/–.

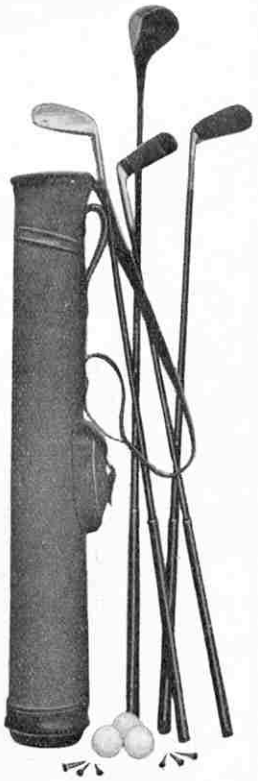
Camera, **5/6** Case, 1/– Film, 6d. 6 exposures

"DINKY TOY" CAR AND HAMLEY GARAGE

Accommodation for two cars. Strongly built of wood, imitation slate roof and brick walls. Size: height 2¾ ins., length 8 ins., width 5½ ins. Complete with two petrol pumps in correct colours, and car.

Price **1/11**

Whatever your game we have the right equipment and latest gadgets. If you're taking up a new one this year, you'll need a practice apparatus like our tennis trainer, while if you're an experienced player you will be interested in all the up-to-date equipment to be seen in our sports department.



JUVENILE GOLF SET

Complete set of steel shafted clubs. Consisting: Brassie-Iron, Mashie and Putter, three golf balls, tees and bag. Suitable for boys and girls age 10-14 years. Price **57/6** Other prices: 45/–, 37/6, 15/6

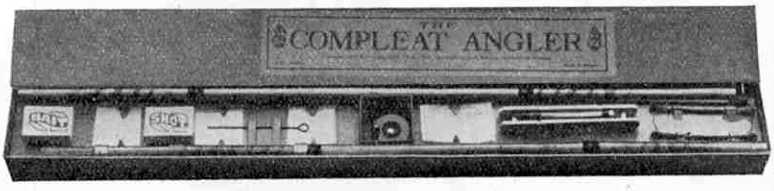
THE COMPLEAT ANGLER

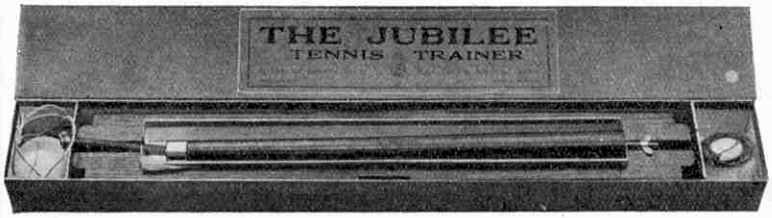
A useful outfit, containing all equipment essential for embarking on the fascinating hobby of fishing.

No. 1. 9 ft. jointed rod, large furnished line, reel, water cord, bait, sinkers, hooks. Price **8/6**

No. 2. 7 ft. 6 in. rod, line, cord, reel, hooks, etc. Price **5/11**

Postage 1/– extra.





JUBILEE TENNIS TRAINER

Ideal for novice or expert. A compact and portable trainer, easily erected or dismantled. Can be used on small lawns, and is a sound method of practising the various tennis strokes. Complete with spare ball and elastic. Price **10/6**

THE "ELECTROSTATIC" AEROPLANE

MADE BY THE "F.R.O.G." PEOPLE

The makers of "Frog" aircraft are delighted to be able to tell you of their thrilling new invention, the "Electrostatic" aeroplane.

IT CAN'T GO WRONG

The set consists of an ebonite wand, 12 gliders, woollen cloth and booklet of instructions.

THEY'LL "LOOP-THE-LOOP"

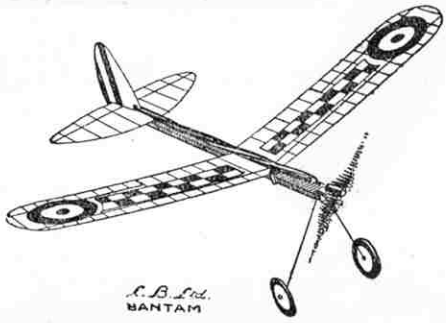
With practice these little gliders can be made to "loop-the-loop," do "Immelmann" turns, and most of the aerobatics done by real aircraft.

THE SET COMPLETE COSTS ONLY

2/6

THE "BANTAM"

A LIGHT 'PLANE FOR "OUTDOOR FLYING"

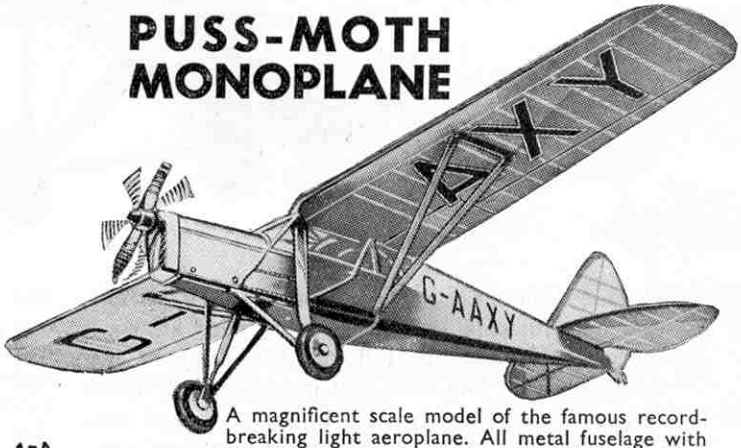


This splendid model will fly for 200 ft. anywhere out of doors. Wings have the markings of a famous squadron.

COMPLETE WITH PATENT HIGH-SPEED

2/6

PUSS-MOTH MONOPLANE



A magnificent scale model of the famous record-breaking light aeroplane. All metal fuselage with bulk-head reinforcement, hollow wings of special design and construction. Dual motor coupled to gear box, transparent cabin and roof lights. "Frog" patent quick detachable fittings and high-speed mechanical winder. The model aeroplane "par excellence." Including full equipment as specified.

The Puss-Moth is sold complete with patent high-speed winder box, spare motor, insertor rod, gear box oil, elastic lubricant and illustrated flying manual. Wing Span 18 ins. Flies 600 ft.

17/6

Patented all over the world

ON SALE AT ALL GOOD TOY SHOPS & STORES

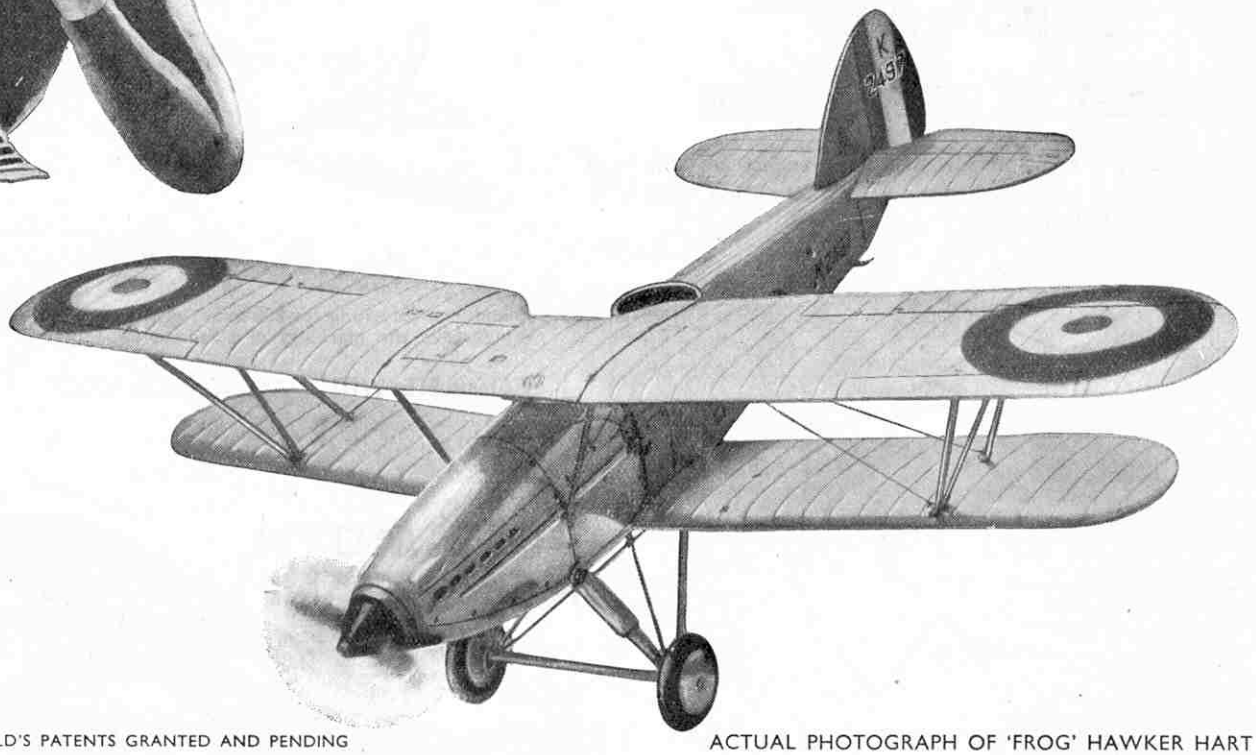
Have you joined the "F.R.O.G." Club? If not, write for particulars

Designed and made in England by
THE INTERNATIONAL MODEL AIRCRAFT LTD.

Sole Concessionaires:

LINES BROS. LTD., Tri-ang Works, Morden Road, S.W.19

Seen the new HAWKER HART? It's made by the FROG people!

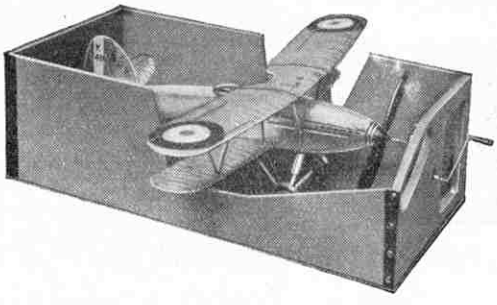


WORLD'S PATENTS GRANTED AND PENDING

ACTUAL PHOTOGRAPH OF 'FROG' HAWKER HART

The most famous military aeroplane in the world—the most formidable aerial weapon ever known—there's little need to tell you the name of the Hawker Hart. And now you may own and fly an almost exact reproduction in miniature of this wonderful fighter! The very latest 'Frog'—the flying scale model Hawker Hart—is waiting for you at your local shop to-day!

This 'Frog' Hawker Hart is designed (like the real machine) for short distance bombing. Every detail has been carefully considered to give complete realism to this wonder 'plane. There is actually a miniature Vickers-Scarff gun mounting ring before the observer's cockpit and a life-like instrument board in the pilot's cockpit. And the flying performance of this new machine is remarkable. Come and see the Hawker Hart now!



Complete with extra strong HIGH-SPEED WINDER-BOX, lubricant for Gearbox and motors, triple insertor rod, spare motors and profusely illustrated flying manual. **42/-**

SPECIFICATION

Telescopic spring-loaded under carriage. Unique fuselage built up on a reinforced structure of steel, duralumin and timber, covered either with aluminium, alloy sheet or a cellulose-paper—the only material capable of reproducing the exact form, shape and appearance of full-size aeroplane parts. Wings reinforced with internal ribbing and attached to fuselage with quick detachable fittings. Triple, 4-strand motor and watch type gearbox. Precision cut airscrew and spinner.

Wing Span, 18.75 ins. Overall Length, 15.36 ins.

Average Length of Flight, 700 ft.

Owners of a 'FROG,' PUSS MOTH or HAWKER HART are eligible for the handsome badges, price 6d. each, when the proficiency tests have been passed.

ON SALE AT ALL GOOD TOY SHOPS AND STORES

Made by INTERNATIONAL MODEL AIRCRAFT LTD., LONDON, S.W.19

Sole Concessionaires: LINES BROS. LTD., *Tri-ang Works, Morden Road, Merton, S.W.19*

Rather! And I've already won my FROG Pilot Badge with it

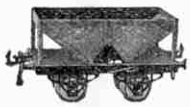
HORNBY ROLLING STOCK

Hornby Rolling Stock includes almost every type in use on the big railways, and a selection of the splendid range available is illustrated on this page. The various items are modelled on realistic lines, strongly built and beautifully finished.

Ask your dealer to show you the full range of Hornby Rolling Stock.

PETROL TANK WAGON "PRATTS"
Finished in buff. Price 2/-

BRAKE VAN (French Type)
Lettered "NORD." Beautifully finished in colours. Opening doors. Price 4/-



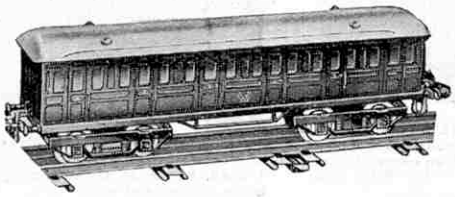
***HOPPER WAGON**
Mechanically unloaded. Finished in green. Price 3/6

JACOB'S BISCUIT VAN
Finished in brown, with opening doors. Price 2/9

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

CABLE DRUM
(British Insulated Cables Ltd.) ... Price 3d.

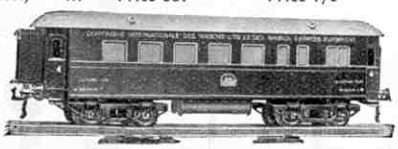
TIMBER WAGON No. 1
Beautifully finished. Price 1/6



COACH, METROPOLITAN C
As supplied with Metropolitan Clockwork Train Set ... ... Price 7/6

COACH, METROPOLITAN LV
As supplied with E36 Metropolitan Electric Train Set ... Price 11/6

TROLLEY WAGON
Finished in red and green. Suitable for 2-ft. radius rails only ... ... Price 3/11



COACH, RIVIERA "BLUE"
"Dining" or "Sleeping"
This is a beautiful model, substantially built and well finished. Suitable for 2-ft. radius rails only. Price 12/6

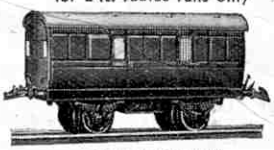
COACH, CONTINENTAL "MITROPA" No. 3
Similar in design to the above. Beautifully finished in red with white roof, and lettered "Mitropa" in gold ... ... Price 12/6

***BREAKDOWN VAN AND CRANE**
Beautifully coloured in green and blue, with opening doors. Suitable for 2-ft. radius rails only. Price 5/11

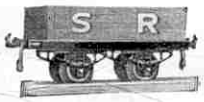
SNOW PLOUGH
With revolving plough. Price 3/9

SIDE TIPPING WAGON
Lettered "Robert Hudson Ltd" Price 2/-

TIMBER WAGON No. 2
Beautifully enamelled in green and red. Suitable for 2-ft. radius rails only ... ... Price 2/6



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

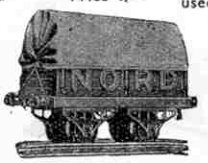


***WAGON, HORNBY No. O** ... Price 1/6
***WAGON, HORNBY No. 1** (illustrated) Price 1/9

TANK CAR, AMERICAN TYPE
Model of the type of oil tank car used in America ... Price 1/9

***LUGGAGE VAN No. 2**
Fitted with double doors. Suitable for 2-ft. radius rails only. Price 4/6

CABOOSE, AMERICAN TYPE
Modelled on the type of brake van used on American railways. Price 2/6



WAGON, COVERED (French Type)
This wagon is fitted with frame and sheet. Lettered "NORD" ... Price 2/5

MILK TANK WAGON "UNITED DAIRIES"
Finished in blue and white. Price 4/6

CEMENT WAGON
The door at the top opens. Finished in bright red. Price 2/6

CHOCOLATE VAN "CADBURY'S"
Beautifully finished in blue with white roof. Price 2/9

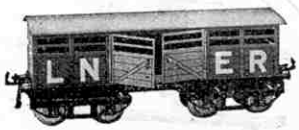
PULLMAN CAR
Imported from U.S.A. Product of Meccano factories.

American Type (as illustrated). Yellow or green, with orange or bright red roof. Lettered "Washington" or "Madison" ... Price 1/6

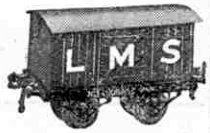
Continental Type. Red with white roof. Lettered "Mitropa" No. O. Price 1/6

BRAKE VAN
Finished in brown, with opening doors. Obtainable with N.E. or S.R. lettering. Price 2/11

LUMBER WAGON No. 1
Fitted with bolsters and stanchions. Price 1/6



***CATTLE TRUCK No. 2**
Fitted with double doors. Suitable for 2-ft. radius rails only ... Price 4/6



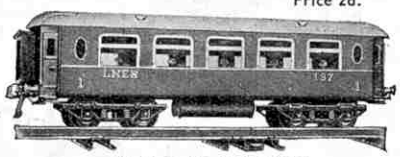
***LUGGAGE VAN No. 1**
With opening doors. Price 2/9

CARR'S BISCUIT VAN
Finished in blue, with opening doors. Price 2/9

PETROL TANK WAGON "REDLINE-GLICO"
Finished in blue and red. Price 2/-

BOX CAR, AMERICAN TYPE
This is a model of the type in use on American railways Price 2/6

TARPAULIN SHEETS
Lettered L.M.S., G.W., N.E. or S.R. For fitting to Hornby Wagons, Price 2d.



COACH, No. 2 SALOON
Realistic model. Beautifully finished in correct colours of L.M.S.R. or L.N.E.R. Saloon Coaches. Suitable for 2-ft. radius rails only ... Price 9/6

BITUMEN TANK WAGON "COLAS"
Finished in blue Price 3/6

BARREL WAGON
This is a model of a type of wagon used in France and other European countries. Price 2/6

WAGON (French Type)
Lettered "NORD." Price 3/3

WINE WAGON DOUBLE BARREL
This model represents the French double-barrel type of Wine Wagon. Beautiful finish. Price 4/6

ROTARY TIPPING WAGON No. 0
Price 1/6

ROTARY TIPPING WAGON No. 1
Finished in blue and pale gold ... ... Price 2/6

In L.M.S.R., L.N.E.R., G.W.R., or S.R. lettering.

MECCANO LTD - BINNS ROAD - LIVERPOOL 13

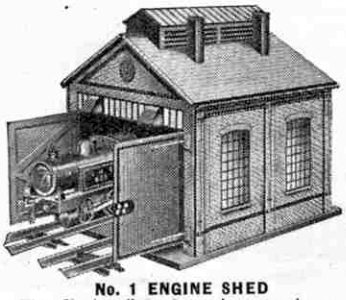
Hornby Series

HORNBY ACCESSORIES

Gauge O

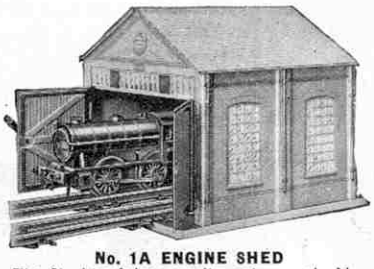
No. 1 SIGNAL "Home" or "Distant." Price 1/–

No. 2 SIGNAL "Home" or "Distant." Price 2/–



No. 1 ENGINE SHED
This Shed will accommodate any Locomotive and Tender with an overall length not exceeding 8¾ in. Price 15/–

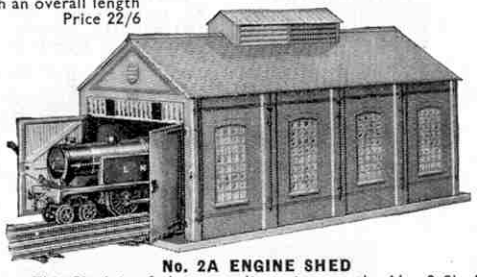
No. 2 ENGINE SHED
This Shed will accommodate any Locomotive and Tender with an overall length not exceeding 17½ in. Price 22/6



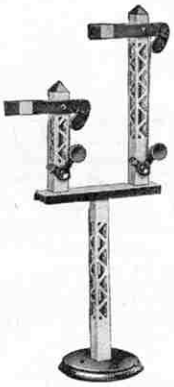
No. 1A ENGINE SHED
This Shed is of the same dimensions as the No. 1 Shed, but is of simpler design, and has doors at one end only. Price 10/6

No. 1 SIGNAL, DOUBLE ARM Price 1/6

No. 2 SIGNAL, DOUBLE ARM Price 2/6



No. 2A ENGINE SHED
This Shed is of the same dimensions as the No. 2 Shed described above, but is of simpler design. Price 17/6



No. 1 JUNCTION SIGNAL Price 2/9

No. 1E LAMP STANDARD Electrical (Single as illustrated) Price 3/6

No. 2E LAMP STANDARD Electrical (Double) Price 4/3

No. 1 LAMP STANDARD (Single) Price 3/6

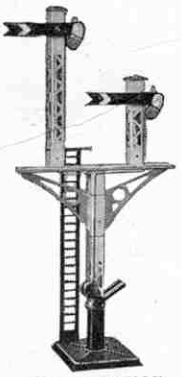
No. 2 LAMP STANDARD (Double, as illustrated) Price 4/6

MECCANO GRAPHITE GREASE (For Springs) Price, per tube 6d.

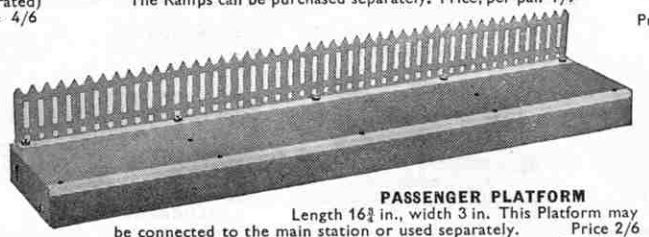
ISLAND PLATFORM
Length 32¼ in., height 6¾ in., width 3 in. Price 6/6
The Ramps can be purchased separately. Price, per pair 1/9

M TELEGRAPH POLE No. 2 Price 4d.

TELEGRAPH POLE Price, per pair 3/6

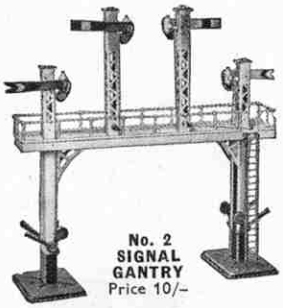


No. 2 JUNCTION SIGNAL Price 4/9

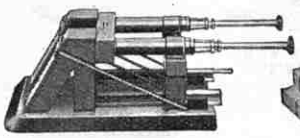


PASSENGER PLATFORM
Length 16¾ in., width 3 in. This Platform may be connected to the main station or used separately. Price 2/6
The white Paled Fencing can be purchased separately. Price, per length 6d.

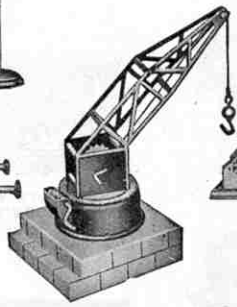
No. 1 SIGNAL GANTRY Price 4/11



No. 2 SIGNAL GANTRY Price 10/–



No. 2 BUFFER STOPS (Hydraulic type). Price 5/6

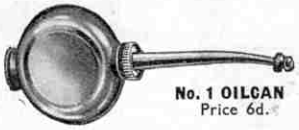


PLATFORM CRANE
Fitted with a crank handle and ratchet mechanism. Price 3/11

No. 1 FOOTBRIDGE
Without Signals. Price 2/11
No. 1A FOOTBRIDGE
Complete with Signals. Price 4/6

STATION OR FIELD HOARDING
This realistic accessory is suitable for the station platform, or for fields adjacent to the track. Price 6d.

TUNNEL (Metal) Price 3/11



No. 1 OILCAN Price 6d.

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("K" Type). The oil is ejected drop by drop by depressing the valve. Polished copper. Price 3/6

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All Hornby Accessories are beautifully finished in attractive colours.

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First of all, study carefully the latest Hornby Train Catalogue, and select from it the new up-to-date Hornby Locomotive you want. Then pack up your old Hornby Locomotive and send it to us addressed "Special Service Department," Meccano Ltd., Binns Rd., Liverpool 13. Your order for the new Locomotive and the necessary remittance should be enclosed. You can easily ascertain how much to send by deducting the part exchange allowance indicated in the list given here from the price of the new Locomotive, and adding 1/– for postage on the new model you purchase. It is important to note that the catalogue price of the new Hornby Locomotive you purchase MUST NOT BE LESS THAN DOUBLE THE PART EXCHANGE ALLOWANCE MADE FOR YOUR OLD LOCOMOTIVE.

If you prefer to do so, you can effect the exchange through your dealer, who will be very pleased to give you any further information you require.

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M1/2 Locomotive	2/3
George V Locomotive (*These models were identical*)	3/3
No. OO Locomotive	
M3 Tank Locomotive	3/9
M3 Locomotive	4/3
Zulu Locomotive	5/3
No. O Locomotive	5/3
Zulu Tank Locomotive	6/3
No. 1 Tank Locomotive	6/3
No. 1 Locomotive	6/3
LEC 1 Locomotive (Swiss Type)	6/3
No. 1 Locomotive, fitted for Hornby Control	7/6
No. 1 Tank Locomotive, fitted for Hornby Control	7/6
No. 1 Special Locomotive	8/3
No. 1 Special Tank Locomotive	8/3
No. 2 Locomotive	10/–
No. 2 Tank Locomotive	10/6
No. 2 Special Tank Locomotive	10/6
Metropolitan C Locomotive	10/6
No. 2 Special Locomotive	11/3
No. 2 Locomotive, fitted for Hornby Control	11/3
No. 2 Tank Locomotive, fitted for Hornby Control	11/9
No. 3C Locomotive	12/–
No. 3C Riviera "Blue" Locomotive	12/–

ELECTRIC MODELS

EM16 or EM120 Locomotive	4/3
No. 1 Electric Tank Locomotive, Permanent Magnet	7/6
EM36 or EM320 Tank Locomotive	8/3
LST M3/20 Tank Loco (20-volt)	8/3
EO6 or EO20 Locomotive	11/–
E16 or E120 Locomotive	12/–
E16 or E120 Tank Locomotive	12/–
LST 1/20 Tank Locomotive (20-volt)	12/–
LE 120 Loco (Swiss Type), 20-volt	12/6
LST 2/20 Tank Locomotive	12/6
E3/20 Locomotive	12/6
E3/20 Riviera Locomotive	12/6
LE120 Locomotive	12/6
EPM16 Special Tank Locomotive	13/9
Metropolitan L.V. Locomotive	15/–
E26 Special Tank Locomotive	15/–
E36 Metropolitan Locomotive	15/–
E120 Special Locomotive (automatic reverse)	15/–
No. 2 Electric Tank Locomotive	15/–
E120 Special Tank Locomotive (automatic reverse)	15/–
E36 Locomotive	16/3
E36 Riviera "Blue" Locomotive	16/3
E220 Special Tank Locomotive (automatic reverse)	16/3
LE2/20 Locomotive	16/6
LE220 Locomotive (automatic reverse)	16/6
E320 Locomotive (automatic reverse)	17/6
E320 Riviera Locomotive (automatic reverse)	17/6
E220 Special Locomotive (automatic reverse)	18/9
Metropolitan H.V. Locomotive	20/–

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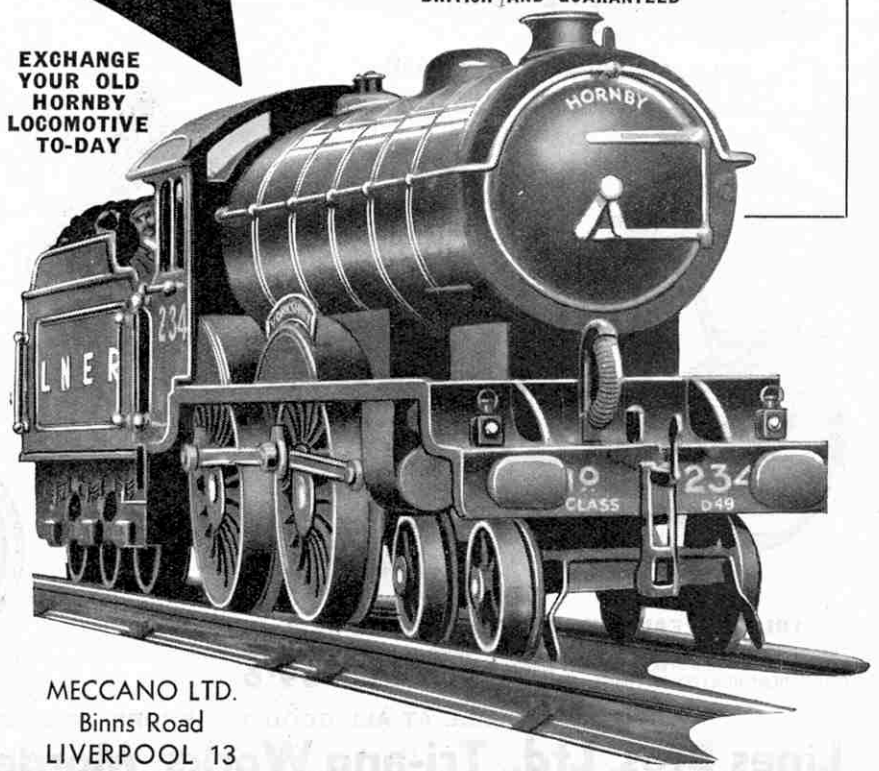

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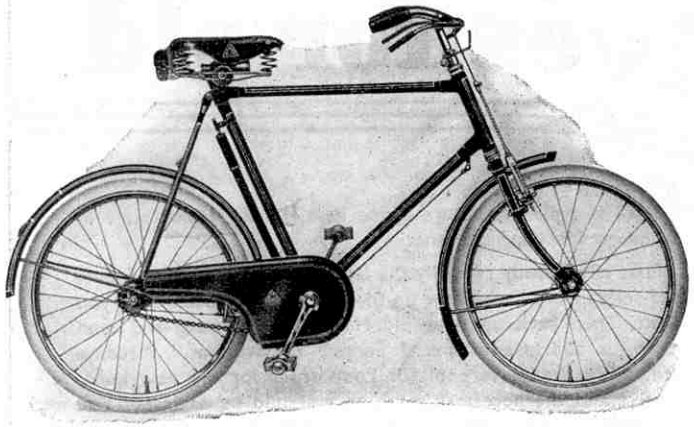
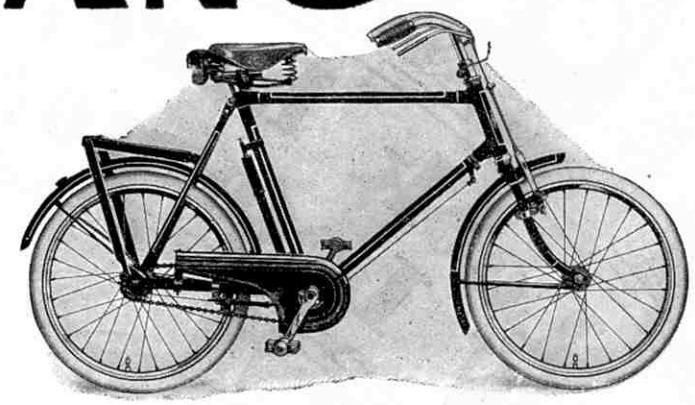
Dependable TRI-ANG Cycles



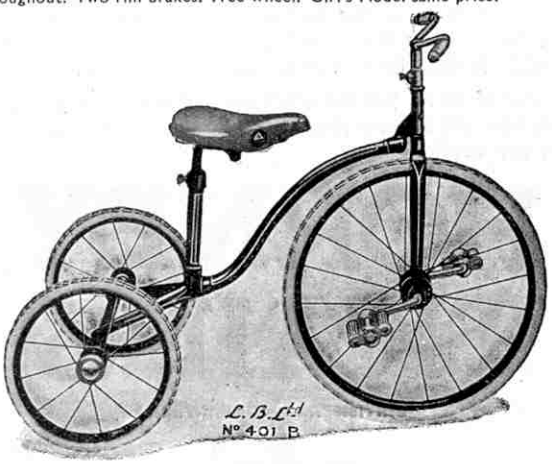
"TRI-ANG UNITY" JUVENILE CYCLE No. 14 (BOY'S)

18 in. Frame for ages 8-12. Finest quality British tube. 18 in. x 1¾ in. Dunlop pneumatic tyres. Three coil leather saddle. ½ in. x ⅛ in. roller chain. Ball bearings throughout. Two rim brakes. Free wheel. Girl's Model same price. **59/6**



"TRI-ANG UNITY" JUVENILE CYCLE No. 9 (BOY'S)

Frame of best quality weldless steel cycle tubing. Adjustable ball bearings throughout. 16 in. x 1⅜ in. Dunlop pneumatic tyres on rustless tangent spoked wheels. Two rim brakes. Raised Handlebars. ½ in. x ⅛ in. cycle roller chain. Three coil saddle. CHROMIUM PLATED FITTINGS. Black or blue. Girl's Model same price. **57/6**



TRI-ANG JUNIOR TRIKE No. 401B

Strong cycle tube frame. Enamelled black. Gold lines. Adjustable saddle. Thick white auto tread tyres. Nickel plated fittings. **21/9**

TRI-ANG TRICYCLE No. 5
NOW FITTED WITH REAR MUDGUARDS

Cycle chain drive with free wheel. Frame of best quality weldless cycle tubing. 14 in. wheels with 1⅜ in. sponge tyres. Rim brake. Ball-bearing pedals. Coil spring saddle. Finished black or blue cycle enamel. Gold lines. CHROMIUM FITTINGS. **59/6**

TRI-ANG "FAIRYCYCLE" (Regd.) MODEL No. 2

Tubular frame. 14 in. wheels. 1⅜ in. grey imitation pneumatic tyres. Ball bearing pedals. Rim brake. Two coil saddle. Chain cover. Stand. CHROMIUM PLATED FITTINGS. Black or blue. **39/6**

TRI-ANG SCOOTER No. D

Strong steel frame. Stove enamelled red. Nickel plated handles. Rubber grips. Tangent spoke wheels. 10 in. x ⅞ in. white ribbed tyres. Hardwood step, varnished and lined. Takes apart. **9/6**

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MECCANO MAGAZINE

Editorial Office:
Binns Road, Liverpool 13
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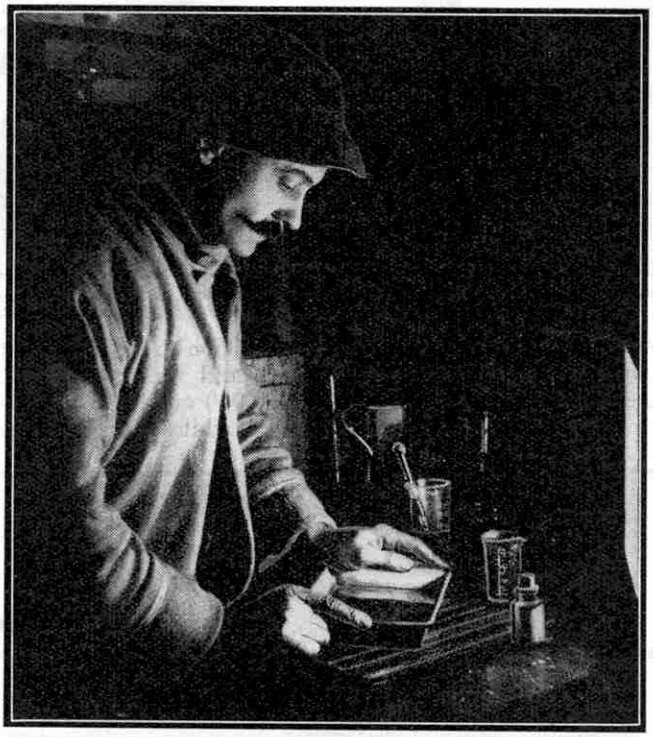
Volume XX. No. 4
April, 1935

With the Editor

Passing of a Famous Photographer

By the death of Mr. H. G. Ponting we have lost a great photographer, who perhaps is best known as the man who brought home to our eyes and minds the magnificent but tragic journey in which Captain Scott reached the South Pole. Mr. Ponting was the official photographer to the expedition on which Scott met his death, and his pictures of scenes in the Antarctic have never been excelled as revelations of the beauties of snow and ice in regions that few of us will ever see.

Ponting began his active career as a war correspondent in the Philippine Islands, and was with the Japanese armies in Manchuria during the Russo-Japanese war. Afterwards he spent three years in Japan and established a great reputation by his wonderful photographic studies of Japanese life. His adventurous spirit then impelled him to accept eagerly the invitation of Captain Scott to accompany his second expedition to the Antarctic in 1910. Never before had a professional photographer of Ponting's attainments penetrated into polar regions, and he was entranced by the light and colour of the scenes in the great white land round the South Pole. He made a masterly pictorial record of the expedition, including a film of Scott's departure on his march over the Great Ice Barrier to the Pole itself; and secured also wonderful pictures of the snow-covered mountain ranges of Victoria Land, of vast Antarctic icebergs, and of the penguins, seals and other living creatures of the far south. His one thought was to record every phase of the strange new land, and on one occasion his zeal almost cost him his life. A school of killer whales broke up an ice floe on to which he had pressed in his eagerness, and he only avoided being thrown into the icy sea, where these fierce creatures were waiting to attack him, by hazardous jumps from one floating fragment of ice to another.



Mr. H. G. Ponting at work in his dark room in the hut in which Scott's last Expedition wintered in the Antarctic. Our photograph is reproduced by courtesy of Burroughs Wellcome and Co.

Ponting was keen to accompany Captain Scott to the Pole itself, but this was not possible. He was largely responsible for the pictures taken on this tragic journey, however, for Scott and his companions were his pupils, and development of the exposed films found in the tent in which they died on the return journey showed that they had been well trained. Several of these photographs, together with others taken by Ponting himself, were reproduced in the series of articles on "*Exploring The Antarctic*" that appeared in the "*M.M.*" during 1931. In giving the necessary permission, the famous photographer told me how delighted he was that his pictures were to be used to illustrate for British youth the story of the heroism of Scott's party in their tragic march across the Great Ice Barrier.

Thames Barrage Schemes

Two interesting schemes have recently been suggested for the erection of a barrage across the Thames. One of them is a comparatively modest proposal for converting the river above London Bridge into a great lake of practically still water by building a dam there. The second is more ambitious, for it involves constructing an immense barrier across the river at Woolwich, in order to convert the Thames, with its docks, into a vast closed harbour for ocean shipping.

A dam at London Bridge would give a length of 19 miles of water between London Bridge and Teddington that always would be at the same level. The mud flats that now appear at low water would no longer be seen, and navigation would be easy on the broad waterway that would take the place of the tidal river. Possibly an airport for flying boats and seaplanes also would form part of the scheme.

The magnitude and range of the second proposal make it even more fascinating. At Woolwich the Thames is 1,500 ft. wide, and a dam built there would have to be more than 2,300 ft. long, for causeways would be necessary at each end. Giant locks would give access to large ocean-going vessels, which could enter or leave the harbour at all states of the tide, and when inside the great barrage could be manœuvred through the narrow dock entrances without fear of being swung round by tidal currents and damaged by collision with masonry walls. The depth of water would be 17 ft. above the present low water mark, and as it would never vary, the work of the Port of London could be carried on more easily and swiftly.

This great scheme would have the additional advantage of providing means of crossing the lower reaches of the Thames, for the dam would carry a roadway and a railway that would cross the locks on lift or swing bridges. The need for improved communications between the north and south shores of the river at this point has long been felt. A tunnel like that recently completed under the Mersey between Liverpool and Birkenhead would cost about £3,000,000, and a high-level bridge could scarcely be built for less than £10,000,000. A dam at Woolwich, with the necessary locks, would involve about £2,000,000, and the addition of the roadway and railway would require a further expenditure of about £1,000,000, so that in comparison the new scheme is by no means costly.

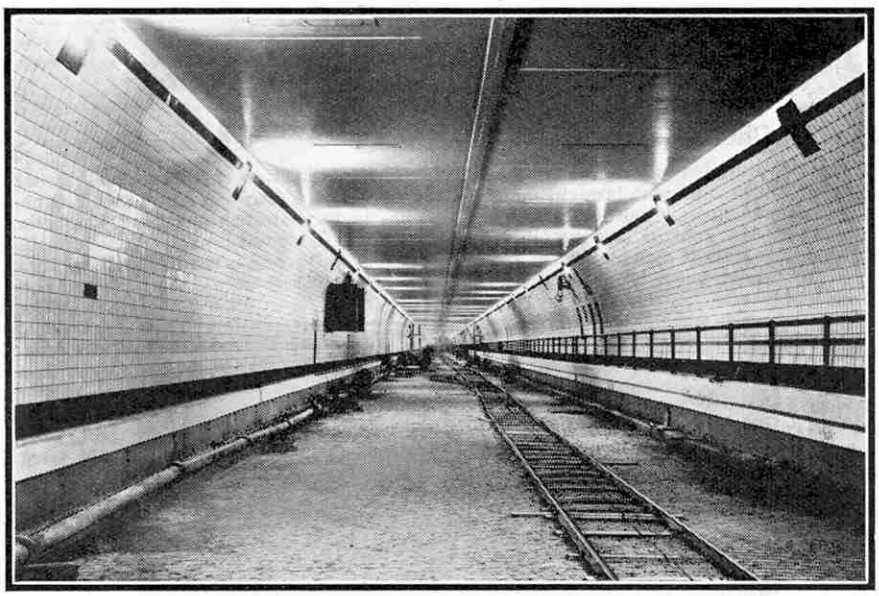
These schemes offer undoubted advantages, but it remains to be seen whether either of them will be carried any further. It is certain that many Londoners would strongly oppose any serious attempt to cut off their great river from the tidal waters that for centuries have borne the ships carrying so much of the world's trade.

Tunnels Under the Scheldt at Antwerp

Engineers' Fight with Underground Floods

THE publicity that was given to the construction of the tunnel connecting Liverpool and Birkenhead under the River Mersey rather obscured the building and opening of two very interesting tunnels under the River Scheldt at Antwerp.

The Mersey Tunnel, which is the largest under-water tunnel in the world, is confined to the use of vehicles, but at Antwerp two tunnels have been provided, one for vehicles and another solely for pedestrians. The vehicular tunnel is the longer of the two. It is 6,924 ft., or nearly 1½ miles, in length, 28 ft. 5 in. in internal diameter, and 14 ft. 9 in. in height from road to roof; as compared with the Mersey Tunnel, which is 11,254 ft. long with a road through it 36 ft. in width. The pedestrian tunnel at Antwerp is 630 yds. long and 14 ft. in internal diameter.



The vehicular tunnel under the River Scheldt at Antwerp, nearly completed, but before the roadway was laid down. The illustrations to this article are published by courtesy of Société des Pieux Franki.

The amount of traffic crossing the Scheldt has been increasing for many years, and the need for some method of speeding up this cross-river traffic has been intensified recently because a great deal of time and money has been devoted to developing the town on the left bank of the river. When the matter was reviewed it was decided that a tunnel was more suitable than a bridge, and eventually a contract was placed for the construction of two tunnels, as it was thought better to have separate ones for vehicles and pedestrians.

This illustration shows a set of escalators installed in the pedestrian tunnel.

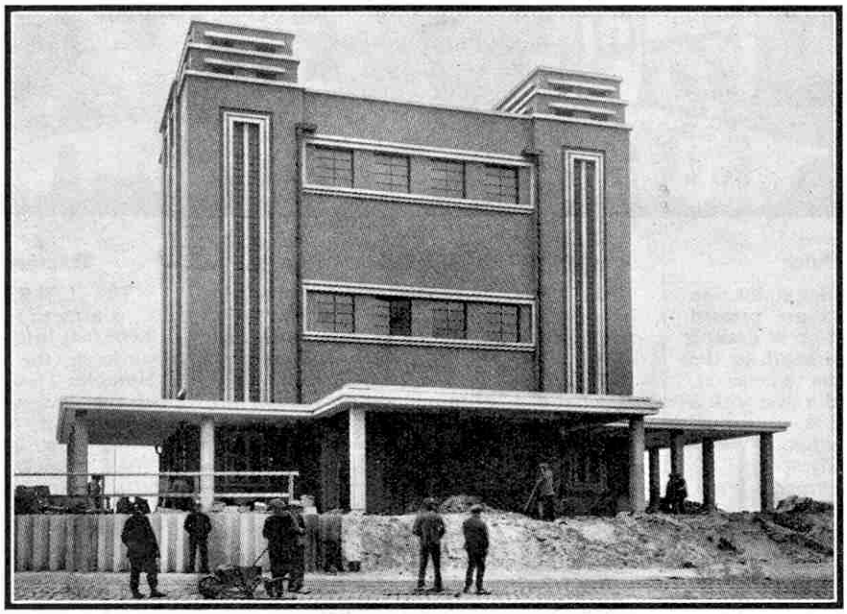
Work on the tunnel intended for vehicles was begun on 1st March 1931, the actual boring being started on 9th November in the same year and finished early in February 1933. The pedestrian tunnel was started on 28th June 1931 and the boring was completed in two months. In the contract it was stipulated that both tunnels should be completed in no more than 1,000 working days, but the work progressed so rapidly that it was possible for the tunnels to be opened about 12 months earlier than was scheduled. Both tunnels have been built by a well-known Belgian firm of engineers, Société des Pieux Franki.

Some idea of the magnitude of the work can be gained from the fact that in the construction of the tunnel for vehicles some 30,000 tons of cast iron segments were used, in addition to 800 tons of steel girders, 1,210 tons of nuts, bolts and washers, and 22,000 tons of cement. About 3,000,000 cu. ft. of spoil was removed from behind the shield while the tunnel was being bored.

The vehicular tunnel has been built in three main constructional sections, consisting of two open approaches, two reinforced concrete tubes, and a central section, or tunnel proper, which is lined with cast iron. Each of the two approaches to the tunnel is 186 yds. 2 ft. in length, and has been excavated so that at no point does the gradient exceed 3.5 per cent., or about 1 in 28. The approaches are U-shaped in section and are built wholly of reinforced concrete. The subsoil over which they have been laid is very loose, and in order to prevent any subsidence of the completed structure it was necessary to provide solid foundations. Special piles varying in length from 15 ft. to 30 ft. were therefore embedded in the ground, 320 being

required to support each section. The approaches are a little wider than the tunnel, so that fast vehicles can leave the main line of traffic immediately on emerging into the open air.

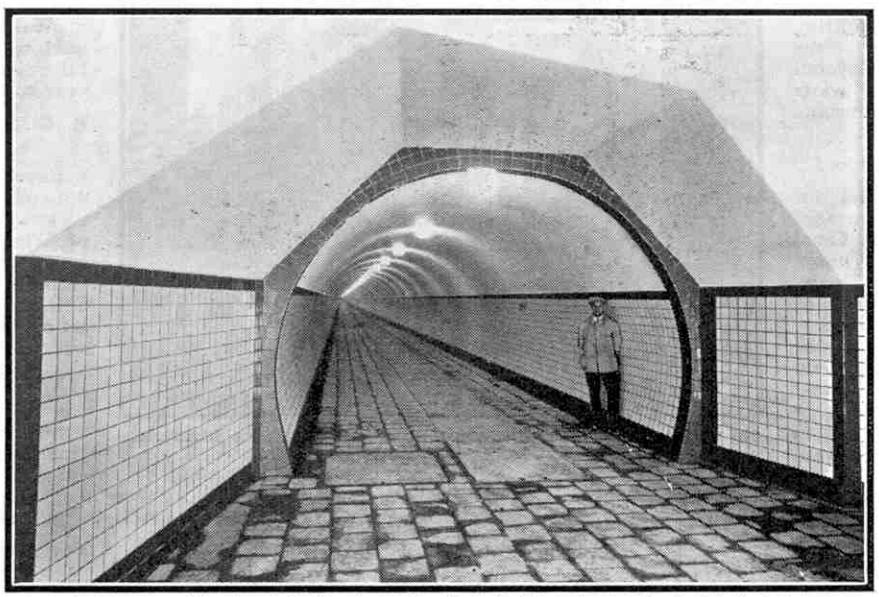
The most difficult work of the whole undertaking was the construction of the two concrete tubes forming the second section of the tunnel. These tubes had to be driven at a distance of 65 ft. below ground level, and had to be taken right up to the banks of the river. A preliminary geological survey of the route was of course made, and it was discovered that the workings would pass through water-bearing strata which, if penetrated, would flood them and cause great danger to the men at work.



The impressive building that faces one of the entrances to the vehicular tunnel.

After much consideration by the engineers it was decided that the best plan would be to prepare cuttings going down to the required depth, and then to build up the tubes with concrete, after which the cuttings would be covered in once more. To keep out the water while all this was being done, sheet piles were driven along the side of the cuttings and electric centrifugal pumps sunk to a depth of 90 ft., thus draining thoroughly the area in which the work was being carried on.

Although the tubes are not actually under the river, it was realised that as soon as the piles were removed the tubes would be completely covered with water, and so special precautions had to be taken to ensure their impermeability. This was done by spreading a thin layer of concrete covered with a heavily bituminised jute over the bed and walls of the tube, and then protecting the whole work by masonry. This masonry was further protected by pitch-covered concrete.



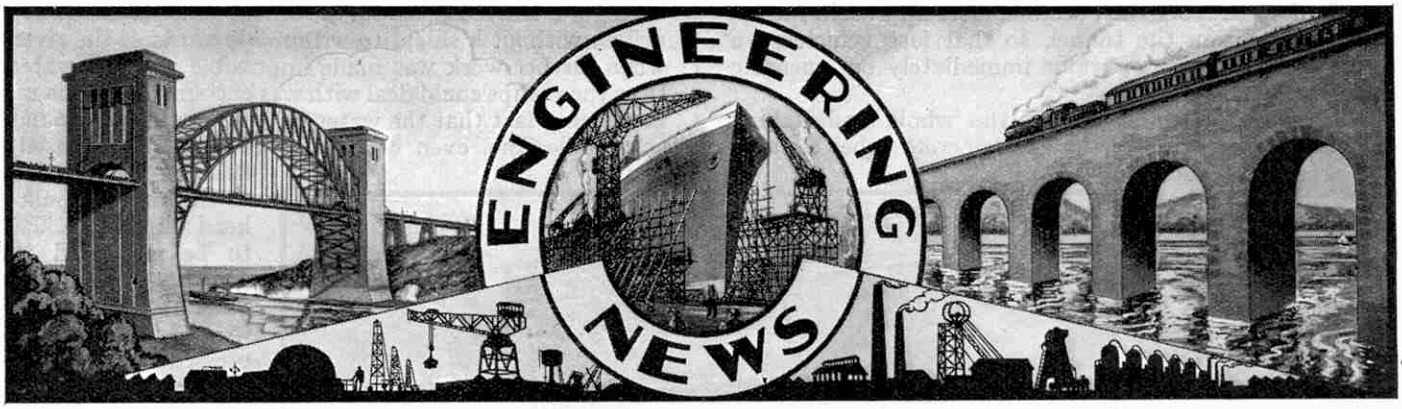
An interior view of the tunnel that has been driven for pedestrians, showing its absolute straightness.

The actual boring under the river, which constituted the main section of the work, is 1,351 yds. in length, and was driven with the aid of a shield in the usual manner. The shield employed was 275 tons in weight and was moved forward as necessity arose by means of hydraulic jacks. It was used from the left bank of the river, but a boring was started also from the other bank, a tunnel being driven without a shield to within 300 yards of the river when further work was made impossible as more water than the pumps could deal with was encountered. It is an interesting fact that the water-bearing strata were found so troublesome, even when the shield was being used, that for some parts of the work a bulkhead and air lock had to be employed in addition, the actual "face" then being worked under compressed air. A striking feature was that the greatest danger of flooding was experienced not when the boring was under the middle of the river, as might have been expected, but when the workings were near the banks.

As the boring was made it was lined with cast iron segments placed in position with the aid of a special telescopic arm operated hydraulically. They were then secured together by means of bolts, after which all the joints were caulked with lead and the outside of the segments was heavily coated with pitch. Gravel and cement was then injected through special holes to form an internal lining all the way round the tube. The tunnel is 30 ft. 10 in. in external diameter and 28 ft. 5 in. in internal diameter.

The road through the tunnel is made of reinforced concrete and is 22 ft. 2 in. in width. It is supported by steel girders let into the walls of the tunnel at a height of about 6 ft. above the base. On one side of the road there is a raised path a little over 2 ft. wide, along which the engineers and workmen can walk from place to place without interfering with the traffic. The walls of the tunnel are faced with glazed tiles, and all electric cables, water mains and drains are carried in ducts arranged in the concrete lining.

Lighting is on the direct system, as it was considered that this gives greater light for lower current consumption than diffused lighting. Lamps are arranged at intervals of 26 ft. along most of the length of the tunnel, 150 watt units being employed. They are fitted in the walls just below the level of the roof. In order to (Continued on page 264)



A New Magnetic Clutch

A new form of magnetic clutch, in which two conical members are pressed together magnetically when it is desired to transmit power from one shaft to the other, has recently been put on the market. On the driving shaft is keyed a disc with a conical inner face. There is a slight amount of axial freedom. A loose piece permits the adjustment of the faces, while springs tend to push the two rings apart. Another double-coned piece of the opposite hand is attached to the driven shaft. Outside the complete assembly there is a stationary casting fitted with a field coil. The new clutch is manufactured by the Power Plant Company Ltd., West Drayton.

To operate the clutch it is only necessary to switch current on to the coil to pinch the cones together and transmit the drive. The clutch is made in various sizes, and some idea of its dimensions may be gathered from the facts that one for transmitting 10 h.p. at 100 r.p.m. weighs 267 lb., and is 13¾ in. in overall diameter. It requires 100 watts for its excitation, and it transmits the drive very smoothly.

Nicaragua Canal Plan Revived

The 32-year-old proposal for a Nicaragua Canal to supplement the traffic of the Panama Canal has been revived by Mr. Vinson, chairman of the House of Representatives Naval Committee, at Washington, U.S.A. In a few years' time the locks of the Panama Canal, he said, would not be large enough to accommodate with safety some of the ships now being built. A Nicaragua canal would have great advantages, both commercially and from the point of view of national defence. It would be 172 miles long, and would cost about £144,400,000.

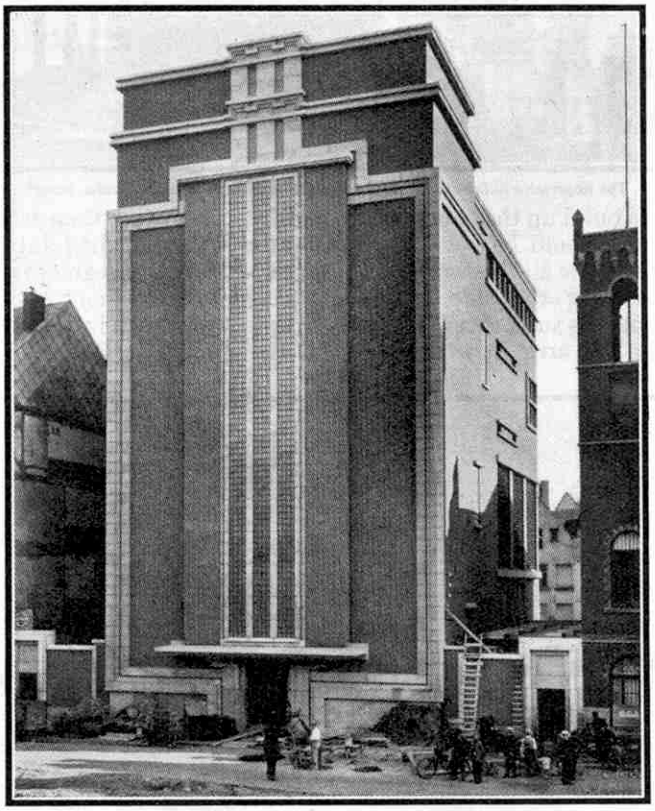
Air for British Coal Mines

As a result of careful calculations it is estimated that approximately 5¾ tons of air are passed through the workings of British coal mines for every ton of coal raised. In round figures this amount corresponds to about 1,250,000,000 tons of air per year. The circulation of this enormous quantity of air necessitates powerful fan equipment, and it will be seen from this that ventilation forms a very important item in mining costs.

New World's Land Speed Record

On 7th March Sir Malcolm Campbell in his all-British racer *"Blue Bird"* set up a new world's land speed record at Daytona Beach, Florida. On the southward run over the measured mile *"Blue Bird"* roared along at 272.727 m.p.h. and this speed was increased to 281.030 m.p.h. on the northward run, giving an average of 276.816 m.p.h., or 4.708 m.p.h. above the previous record of 272.108 m.p.h., made in 1933 by the same driver. On the northward run the mile was covered in 12.81 secs. and Sir Malcolm travelled at the highest speed that has ever been reached on land by a human being, his speed over the measured kilometre in this direction actually being 281.374 m.p.h.

Sir Malcolm also set up new records for the flying kilometre, five miles and five kilometres, his average speeds for these distances being 276.160, 268.474 and 252.396 m.p.h. respectively.



The entrance hall to the new tunnel for pedestrians that has been driven under the River Scheldt at Antwerp. See article on page 202.

Transporting 3,000,000 Bricks

The L.M.S.R. are now carrying out a contract for the transport of over 3,000,000 bricks from a Lancashire brickworks to the bottom of a tunnel under Mumbles Head, near Swansea. A feature of the transport system adopted is that not a single brick is touched by hand intermediately. The bricks are of a special type and are being used to form the lining of giant subterranean tanks for the Swansea main drainage scheme. Every day five wagon-loads of the bricks, which are loaded in special containers, leave the works at Accrington (Lancs.). On arrival at Swansea the containers are unloaded by crane on to a lorry, which conveys them to the head of the working shaft at Mumbles Head. Here the containers are lifted off the lorry and lowered down the shaft on to trolleys running in the tunnel beneath, which carry them to the working face many feet underground. The work will necessitate 6,000 container-loads, and will take a year to carry out.

A Giant Torpedo Controlled by Radio

Experiments have been carried out off the coast of Sandown, a strategic point on the Isle of Wight, with a huge torpedo controlled entirely by radio. The torpedo has a speed of nearly 50 kilometres per hour, and is exploded either by contact with the ship's side or by an electric spark generated by radio. Control can be effected from the shore or from a warship.

Successful experiments on a small scale have been made on previous occasions, and have shown that the radio control is quite practical and satisfactory.

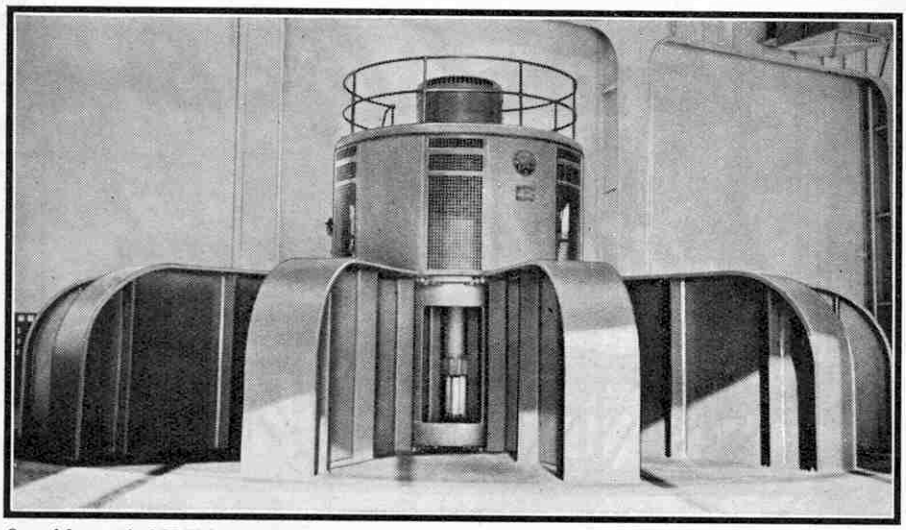
A New Steel Finishing Process

An American firm has placed on the market special salts, an aqueous solution of which will produce a jet black, scratch-proof surface on steel in about five minutes. No baking, spraying, plating, or other complicated procedure is required. A welded steel container is used for the liquid, which is heated to a temperature of 130 deg. Cent., and the parts to be blackened can be handled on racks, in bulk, in baskets or barrels, according to their nature. The finish will not chip or discolour.

15,000-Ton Forging Press for Russian Steelworks

A giant hydraulic forging press capable of exerting a maximum pressure of 15,000 tons is now in operation at a big steelworks in the U.S.S.R. This remarkable tool has an overall height of 83 ft. and a total weight of about 3,500 tons, and can accommodate forgings up to nearly 16 ft. in diameter. The press was constructed by Schloemann Aktiengesellschaft, of Dusseldorf, and is designed to forge ingots up to a weight of 300 tons. It is for the heaviest work of this kind that the maximum pressure of 15,000 tons will be utilised; but for dealing with smaller work, and for finish-forging, two smaller pressures are provided. There are three main rams, the centre and largest of which exerts a pressure of 6,000 tons, while the two smaller rams each exert a pressure of 4,500 tons. By means of this arrangement a pressure of 6,000 tons can be obtained with the centre ram alone, 9,000 tons with the two outer rams acting together, and 15,000 tons when all three are working simultaneously.

The press can make five strokes a minute when carrying out heavy forging and a maximum of 15 a minute on light work. The design of the press was determined to a great extent by the loading gauges of the various railway systems over which the parts had to travel in their journey from the builders' works to the steelworks in Russia, the maximum weight of any part being limited to 110 tons.



One of five vertical 77,500 kVA 13,800 volt Generators in Dneproges Power Station on the Dnieper River, U.S.S.R. Each generator is coupled to a waterwheel. Photo. by courtesy of the International General Electric Co. of New York.

Demolition of Famous London Bridge

Work has been in progress for some months past on the demolition of Waterloo Bridge, one of London's most famous bridges. The bridge was designed by Rennie and was opened on 18th June, 1817. The piers and abutments rested on a wooden platform, which in turn was supported on 12 in. piles driven into the bed of the river. The superstructure consisted of nine elliptical arches, each of which were covered with corbel stones. Excluding the approaches the bridge was approximately a quarter of a mile in length, and its beauty has been the subject of much favourable comment.

In 1924, when the bridge had been in use just over a century, the settlement of the foundations increased rapidly, and became so serious that the bridge was closed for repairs. The question then arose as to whether it would be advisable to replace the old bridge by an entirely new structure. Actually, however, 10 years elapsed before a decision was reached, and it was decided that the old bridge must go. Demolition operations began in June 1934 with the removal of the balustrades and the pavement of the roadway, leaving the crowns of the arches exposed. This work was comparatively simple, but the task of demolishing the great arches which is now in progress presents many difficulties, and special precautions are being taken to avoid setting up dangerous unbalanced thrusts as the work proceeds.

The work of removing the piers and foundations is not expected to offer any great difficulty, and will be effected inside steel cofferdams. Round these cofferdams staging will be built, and this will support cranes for loading the material into barges. All the work will be carried out in such a manner as to cause a minimum of interference with the Thames traffic.

A streamlined fire engine constructed for the Lancaster Corporation by Merryweather and Sons Ltd., London, W.C., to whom we are indebted for our illustration. The principal features of the engine were described on page 136 of the "M.M." for March, 1935.

A New Liquid Fuel Development

At the Cardiff works of Wyndham Marine Patents (1928) Ltd., a demonstration was given recently of a new process for the manufacture of liquid coal consisting of a colloidal solution of fine particles of coal and Anglo-Persian oil fuel. The plant demonstrated was designed to produce about 100 tons of liquid fuel per week of 160 hours, and the mixing and grinding of the washed coal and oil was effected by mechanical means.

Welding with Coal Gas

Metal cutting by means of an oxy-acetylene jet is now used to a great extent in many branches of engineering, and in view of the utility of the system considerable interest has been aroused by the introduction of a new process known as the oxy-ferrolene process. In this acetylene is replaced by impregnated coal gas, resulting in considerable economies, among other advantages.

As a result of impregnation the ignition point is lowered, and the propagation of the flame is retarded, effecting a considerable increase in its cutting value. It is stated that the cut is narrower with impregnated coal gas than with acetylene, and that the edges of the metal are not hardened. A saving in cost of from 33⅓ per cent. to 40 per cent. is claimed as compared with acetylene, and less oxygen is stated to be required. We understand that although the new process is more suitable for cutting than for welding, good results can be obtained in the welding of the lighter gauges of metal. The new process is marketed by the Oxy-Ferrolene Co. Ltd., London.

In the impregnating process the coal gas is delivered to a small electrically-driven compressor, which raises the pressure in the line to about 5 lb. per sq. inch. The gas then passes through a small cleaner to a horizontal pipe terminating in a cylinder, which acts as a receiver to damp out pulsation and give a steady gas flow. The impregnating material, which is a liquid, is contained in a large tank. It is delivered through a pipe-line, provided with a regulating valve and filter, to a vessel that corresponds to the float chamber of a carburetter, and which regulates the height of the liquid in a jet in a vertical branch of the horizontal pipe already referred to. The jet is arranged to impregnate the gas to saturation point. The impregnated gas is finally delivered to a dry meter, which may be coupled with the original pipe-line in cases where the ferrolene system is installed in place of an existing acetylene plant.

Concrete Bridge with 500 ft. Span

A reinforced concrete bridge, which is said to be the widest single span bridge in France, has been put into service at La Roche Guyon. The span has a length of a little over 500 ft.

Concrete has been used in many other famous bridges and is rapidly replacing all-steel construction.

New Vertical Lift Bridge at Middlesbrough

THE vertical lift bridge across the River Tees at Newport, Middlesbrough, opened in February 1934 by the Duke of York, is the first bridge of this type to be erected in this country, and is claimed to be the largest of its kind in the world. It has a span 265 ft. 4 in. between the bearings of the moving portion, and carries a roadway 38 ft. wide between the kerbs, in addition to two footpaths each 9 ft. in width. When the moving portion is raised for ships to pass, the navigable waterway, which is 250 ft. in width, has a clearance of 120 ft. between high water level and the steelwork of the bridge. When the span is down there is a clearance of 21 ft. The bridge took nearly three years to build and the work cost nearly £500,000, including the cost of the land.

The scheme of which the new bridge forms the principal part has been carried out to the order of a Joint Committee of representatives of the Durham County Council and of the Middlesbrough Corporation, and provides communication between Newport and Haverton Hill Road. This road forms a connection between Stockton-on-Tees and Billingham, and has recently become of increasing importance owing to the industrial development in Billingham and the neighbouring districts.

To effect communication with Haverton Hill Road an approach road was constructed across some low-lying ground on the north side of the river. This approach is carried on an embankment of blast furnace slag for a length of more than 3,000 ft. Half way along the embankment it was found necessary to construct another bridge in order to carry the road across the Billingham Beck branch of the London and North Eastern Railway. This bridge is built of steel, with five spans, and it is the first highway bridge in the country the structural work of which has been erected entirely by welding. On account of the peaty nature of the subsoil, and in order to avoid disturbance of the rail tracks, the five spans of the bridge are supported partly on octagonal reinforced-concrete piles 18 in. in diameter, and partly on 4-in. diameter cylinders, all of which were sunk to a depth of 70 ft. The bridge is 216 ft. in total length, and carries a 38 ft. roadway with a 9 ft. footpath on each side. These widths of roadway and footpath are standard also for the lifting bridge and throughout the approaches.

From the embankment, the lifting span is reached over three approach spans of plate-girder construction, while on the south approach there are two spans of similar construction followed by a 154-ft. span carried on double warren trusses. Continuing along the south approach, there is a reinforced-concrete box abutment, a skew span of 68 ft., and finally a 500-ft. length of embankment on a falling gradient, built between two concrete retaining walls.

The illustration above shows the new vertical lift bridge at Middlesbrough in position for vehicles to pass over it. The bridge is the first of the vertical lift type to be built in this country, and is claimed to be the largest of its kind in the world. The photographs illustrating this article are published by courtesy of the engineers, Messrs. Mott, Hay and Anderson.

The lift span, which weighs 2,700 tons, is suspended from two supporting towers, and is arranged so that it can be lifted and lowered vertically between them to allow boats to pass. To enable the span to be lifted in this way without the necessity for extremely powerful engines, it is provided with four steel counterweight boxes, to which it is connected by means of 80 wire ropes that pass over eight pulley sheaves arranged at the top of the towers. These sheaves are steel castings 15 ft. in diameter, and are mounted on roller bearings and protected against the weather by a number of hoods. The counterweight boxes, which hang vertically, are partly filled with burr concrete, a material in which the customary stone aggregate is replaced by steel punchings ; and the remaining part of the weight required is made up of cast iron blocks to enable final adjustments in weight to be made.

The two towers that support the lift span are each 156 ft. in height. As the counterweights exactly balance the span, the towers have to carry a combined moving weight, or load, of 5,400 tons, half of which is taken by

each tower. This load is a vertical one and therefore it is borne by the vertical front legs of the towers, which form guiding surfaces for the ends of the lifting span. The remaining portions of the towers are merely bracing supports for the front legs, and transverse and longitudinal wind bracing.

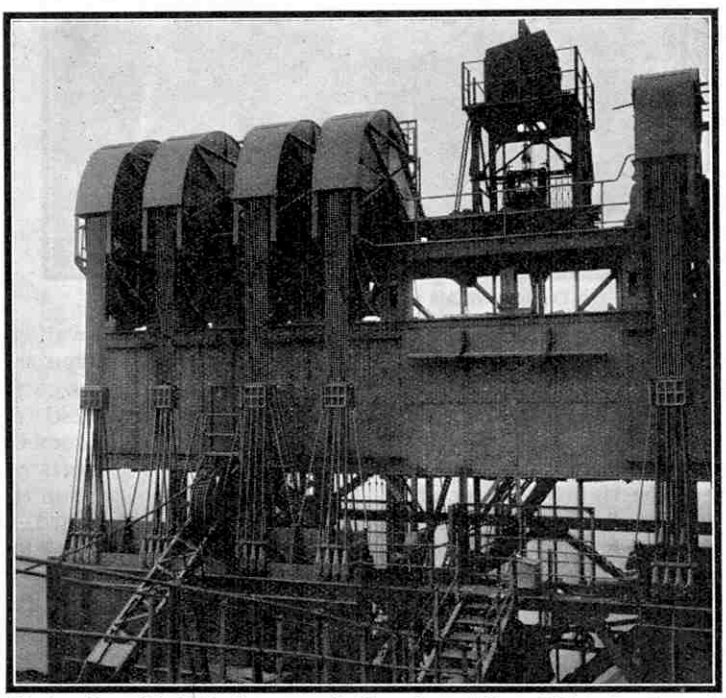
A close-up of the lift span showing the machinery house, below which the operator's cabin is situated.

Each of the towers is supported on a foundation that consists of four cylinders, arranged in two pairs, that have been sunk into the bed of the river to depths varying between 75 ft. and 90 ft. below high water level. The front pair support the two vertical legs just referred to and are of massive construction. The bottom 24 ft. of each of these front cylinders is a steel caisson of 27 ft. diameter that was sunk into position under compressed air. The remainder, or upper portion, consists of a series of cast iron cylindrical segments bolted together and filled with concrete as they were being sunk. The rear pair of cylinders support the curved rear legs of the tower, and as the weight imposed upon them is much less they are smaller, being only 10 ft. in diameter above the bed of the river and 14 ft. in diameter below. The four cylinders are protected from damage by shipping by what are known as "dolphins." These are made of timber and consist of piles sunk into the river, joined by crossbracing and covered with special sheeting.

The bridge is electrically operated from a control cabin slung beneath the machinery cabin which is situated centrally on top of the lift span. The necessary power is obtained from the high-voltage A.C. mains of the Middlesbrough Electricity Department, and is fed to a sub-station built near the south approach to the bridge, where it is transformed to low-voltage current. It is then passed to vertical conductors that extend up the face of the south tower, and collector shoes engaging with them convey the current to the machinery cabin. Inside this cabin it is converted into direct current and is then led to the two motors that, through geared shafts, operate the four winding drums. Emergency operating plant for use in the event of a failure of the electricity supply consists of a Thornycroft petrol engine in the machinery cabin, that can drive the drums, and windlasses and gearing for raising and lowering the lift span by hand.

The construction of the vertical lift bridge and its approaches was begun in March 1931, the engineers being Messrs. Mott, Hay and Anderson, of London, S.W.1, and the constructors, Dorman, Long and Co. Ltd.

It is not known when the first vertical lift bridge was built, but during the 19th century several short span bridges of this type were erected across canals in Europe and America. It is interesting to note that one of the earliest really important vertical lift bridges to be planned was intended to span the River Tees near the site of the present structure, but the design was rejected. This proposed bridge had a lifting span 200 ft. long that could be raised 40 ft. and was to be moved up and down by withdrawing water from and adding it to a tank that formed part of the counterweight of the bridge. The first large vertical lift bridge was erected over the South Chicago River at Chicago in 1894. It had a lifting span 130 ft. long which, when raised, provided a vertical clearance of 155 ft.



The top of one of the bridge towers, showing the pulleys, which are 15 ft. in diameter, and the hoods to protect them from the weather.

Some excellent examples of modern vertical lift bridges span the reconstructed Welland Canal in Canada. The height of lift of the bridges ranges from 108 ft. 2 in. to 115 ft. 2 in., and the combined weight of lifting span and counterweight is from 1,036 to 2,054 tons. The width of the lifting span of some of the bridges is 20 ft. and that of others 30 ft. The bridges vary in minor details, but in general design each consists of two vertical towers and a horizontal span that is moved up and down between them by cables worked from the machinery house at the centre of the span, as is the case with the Middlesbrough bridge.

The Marvels of Nest-Building

Bird Architects at Home and Abroad

By Eric Hardy, F.Z.S.

IF you take a note-book and walk down a hedgerow, through a wood, or round the garden, and jot down a description of every nest you see, your list will include cup-nests, domed nests, nests on the ground or at the top of the bush, nests at the forks of the trunk or at the tips of the branches, nests of leaves, feathers, grasses or moss, and nests in holes. If you could go round the world with your note-book you would find many curious nests, and you would find many birds that build no nest at all.

In Britain the terns and plovers on the seashore, the lapwings in the fields, the nightjars in the woods and the guillemots and razorbills on the cliffs make no nest, but lay their eggs on the bare ground, while abroad such birds as the ostriches, kiwis, ground-pigeons, penguins and many others make no more than a depression in the ground for their eggs. The cuckoo is notorious for laying its egg in another bird's nest. It is not true that the cuckoo lays its egg on the ground and then carries it into the pipit's nest with its beak, as the old nature books say. The cuckoo lays straight into the nest like any other bird, and one cuckoo will keep to a certain area throughout the summer, laying as many as six or seven eggs in a season, and return to that district the next summer. A reward of £500 for proof of the cuckoo carrying its own egg, made some years ago, was never claimed, and a reward of £100 for such proof still exists.

A Cuckoo's egg laid among the eggs of a Hedgesparrow.

The story of the cuckoo carrying its egg arose from its egg-thieving habits. The cuckoo is a great egg-thief, and after laying its own eggs in a pipit's or wagtail's nest it takes one of the eggs of the rightful owner and flies away with it to eat it elsewhere. Thus people seeing it with the stolen egg think it is carrying its own. All cuckoos do not lay their eggs in strange birds' nests, however. The rain-cuckoos of the West Indies, for instance, build their nests in high trees, while the yellow-billed cuckoo of America, which has been taken ten times in England, once in Scotland and twice in Ireland, and the black-billed cuckoo, which has visited Britain twice, also make their own nests.

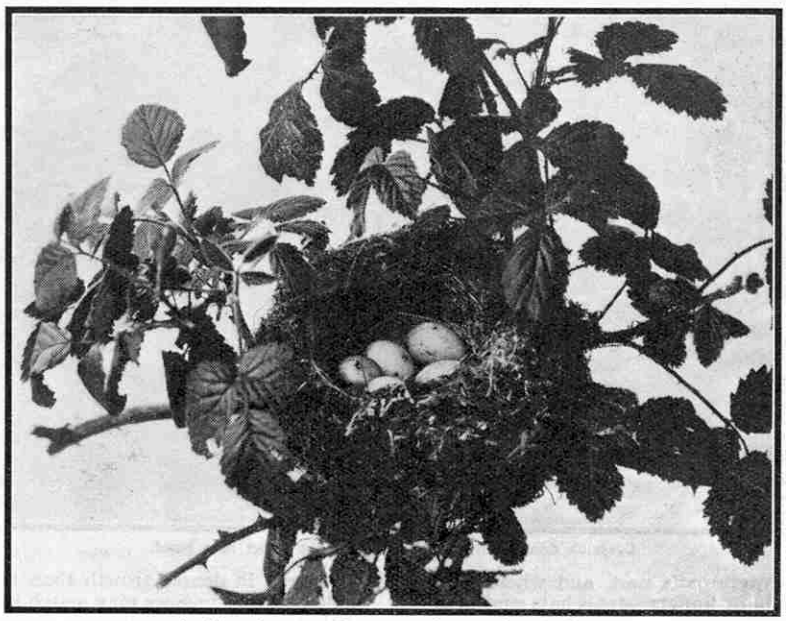
Many birds, instead of making a nest of their own, appropriate the old nest of some other bird, and you will find kestrel hawks, sparrow-hawks, hobby-hawks, kites, honey-buzzards and long-eared owls nesting in the old nests of crows. Some birds that normally build nests occasionally lay their eggs without any nest at all, and in recent years the common starling has developed a habit of laying odd eggs on the ground when it could not find a hole for its nest. Thrushes, blackbirds, robins and buntings also have been known to do this strange act.

Some birds use the shelter of a hole for a nest, and in rabbit-burrows on the sandhills or the tops of the rocky islands are found the eggs of puffins, shelducks, stock doves and shearwaters. The dipper or water-ouzel builds a beautiful nest of moss inside a hole in the bridge or rocky bank of a mountain stream; the tawny owl lays its round, white eggs in a hole in an old tree, the barn-owl in an old building, and the little owl in a rabbit hole or a broken limb of a tree. Tree-sparrows, known by their brown heads instead of grey heads like house-sparrows, usually make their nests in the tops of pollard willows. Wrynecks, tree-creepers and nuthatches make their nests in little holes in the trunk of a tree, and the nuthatch, which looks like a little blue and grey kingfisher that can run up and down the tree-trunk, plasters the entrance with mud to suit its size, as does the hornbill in Africa. Robins build in holes in hedge-banks; redstarts in holes in a field gate-post; wagtails in holes in rocks and walls, and parrots and woodpeckers in holes in trees. If you search for birds' nests in holes you often come across curious examples, for robins and wrens often build in old teapots in the garden, buckets and plant-pots; and sometimes titmice nest in pumps, letter-boxes and all sorts of queer places.

Nests vary in size from the smallest nests in the world, that of the humming bird, about the size of a nutshell or a thimble, and that of the Indian tree-swift, which is only the size of half a nutshell, to the great nest of the golden eagle, used year after year until it measures three yards in diameter and would fill a cart, often so big that it topples over into the glen in the first gale. The smallest British nest is that of the gold-crest, the smallest bird in Europe, and is like a little hammock slung between the pine-twigs, and but two or three inches across. Many birds like rooks, herons, storks, gulls, cormorants, flamingoes, pelicans, and weaver-birds build their nests together in great colonies, but the sociable weaver

bird of South Africa goes further and builds a great "boarding house" of grass, sometimes including almost the whole of the tree, in which a considerable number of birds take "flats" or compartments for their eggs. When you find one linnet's nest in the countryside, there are often others close by, for linnets like to nest in little groups near each other.

Some birds, like the grebes, moorhens and coots, build their nests floating on the water, and others burrow into the banks and cliffs, like kingfishers, puffins and storm-petrels. Then there is the beautiful bag of moss and lichens the long-tailed titmouse hangs in the middle of a furze-bush, and the deep cup of moss and grass the golden-oriole, a beautiful thrush of Central Europe and a rare visitor to the denser woods of England, hangs at the extremity of a branch. The reed-warbler by the lake-side hangs its cup between three or four stiff reed stems over the water, as the harvest-mouse hangs its nest-ball between the corn-stalks of the field.



Looking down on the eggs and nest of a Chaffinch.

Birds make a wide choice in the materials for their nests. Many large birds like rooks and herons use big sticks, lining the nest with softer grass; and with smaller birds like greenfinches, grass stalks or straws form the main structure. Moss is largely used by titmice, chaffinches and goldfinches; leaves by nightingales, and the little tailor bird of India, which sews two or three leaves together with thread or straw and lays its wee eggs inside. The eider and many other ducks make their nests almost solely of the down they pull off their breasts; a magpie builds its nest of thorny sticks, while mud is used by swallows, flamingoes, and albatrosses. Thrushes line their nests with a cup of hard mud, and blackbirds with mud and grass above it, whereas chaffinches use a considerable amount of feathers and horse-hair and usually place their nest on a horizontal fork towards the end of the bough. The missel-thrush also nests in the fork of a bough, but usually where the bough joins the trunk. Some birds, such as rooks, herons, falcons and eagles, use the same nest year after year, adding to it each time, whereas most birds build a new nest for each brood, though they nest near the same locality each year even if they migrate far in winter. Extra nests are built by wrens and oyster-catchers during the courting season, and are called "cock-nests." The moorhens build two or three nests and as each brood hatches, move it into the new nest, where the male bird carries on the feeding and the female bird lays a new clutch of eggs in the old nest. In the reeds of the Broads, bitterns build a special platform some distance from the nest, and when the young bitterns are growing the food is always left at this "dining-table," where the young ones seek it, and thereby gain the use of their wings and legs in travelling through the reeds.

Song Thrush perched on the rim of its nest in a hedgerow.

The average nest, like that of a thrush or swallow, takes its owner about a fortnight to build, but if the bird is a migrant and arrives very late it may rush the job through in a few days. The commonest nests are cups, like those of thrushes and blackbirds; but the simplest of all nests are built by the wood-pigeons, being merely thin platforms of sticks on which the two white eggs are laid. Other birds build a domed nest, as the magpie in the tree tops, the willow-warbler and chiff-chaff in the grasses beside a wood or thicket, and the house-sparrow when it builds in a tree instead of a hole. Perhaps the most interesting of nests is that of the edible swift, a ledge-shaped nest of hardened saliva built in the darker recesses of caves of Ceylon, Madagascar, New Guinea and Malay. These nests are harvested annually for the celebrated birds'-nest soup considered such a delicacy in Shanghai and other parts of China, just as the nest of the eider duck in Scotland and Europe is harvested for eider-down bed-covers. Another curious nest is built by the Australian brush-turkey, which also nests at Whipsnade Zoo. This bird kicks a great pile of stems and rubbish into a mound in the wood, and then lays its eggs in the centre and leaves them to hatch in the fermented leaf-mould, which produces natural heat.

There is really no place where birds' nests are unknown in Britain. On the tops of the highest snow-covered mountains of Scotland the ptarmigan builds; at the bottom of the pit-shafts in many mines the house-sparrows have built their nests with the straw from the pit-ponies' stables; and in the middle of city slums many more birds

than starlings and sparrows are found nesting. About 200 kinds of birds nest in the British Isles, and quite 100 of these are common nests. In the hedgerow, the song-thrush's nest is known by its blue eggs spotted with black, and plain mud lining, while the blackbird's nest is lined with grass, and its eggs are peppered with red and brown spots. The wren builds a nest near the bottom of the hedgerow, like a large cricket ball with a hole at one side; while the robin gets inside a hole between the roots in the bank or ditch-side, bundling in plenty of feathers and wool and leaves, and laying little creamy-buff eggs, peppered with small pinkish spots. A loose-built nest among the cut grasses or twigs at the bottom of the hedge, and containing beautiful blue, unspotted eggs, is that of the hedge-sparrow, which is not a relation of the house-sparrow, but of the warblers. In holes in the trunks of the hawthorns or in gateposts we shall find the nests of the tom-tits, built of moss and feathers, and with little white eggs with pink spots at one end. Where a bed of nettles adjoins a hedgerow, we should find a whitethroat's nest, and where there are plenty of furze bushes, nests of linnets, stonechats and long-tailed tits should be looked for.

Common Coot beside nest floating on the water of a pond.

Walking across the open ground, we shall find the nest of the yellow-hammer or yellow-bunting, the bird that sits singing: "A little bit of bread and no cheese" from the hedge-top. This is built of hay, roots and moss, and lined with hair, on the ground at the foot of the hedge. The nests of the buntings are always known by the wavy lines on the eggs, and these birds are called "Writing Masters" in country jargon. The skylark's nest is but a loose nest of grass and roots placed in a footprint and sheltered by a tuft of grass. Very similar is the nest of the meadow-pipit or titlark, whereas the nest of the lapwing consists of nothing more than the hoof-print it finds in the meadow, in which it lays its three larger, pear-shaped brown eggs blotched with black. When we are near a lapwing's nest the parent birds fly overhead, swooping up and down and crying plaintively "pee-wit" to lure us away. To find a lark's nest we must watch where the bird rises, not where it lands, and search the grasses carefully with our hands. In hayfields the nests of the whinchat and corncrake are commonly found on the ground in Midland and Southern counties, but they have become rarer in the north in recent years. On the ground near a clump of furze bushes we may look for the stonechat's nest. The stonechat is like a black-headed robin with a white collar, and it lays dull, greenish-blue eggs, speckled at one end. The partridge's nest is in the thick herbage near a hedge, built scantily of grass and containing ten or more polished buff eggs, like bantams' eggs, or like those of moorhens but without any spots. The pheasant's nest usually contains about eight eggs of a brownish-olive colour.

A pair of Bullfinches and their nest.

Entering the wood, we look in the trees on the outer sides, or on the edges of the drives, rather than the darker recesses, for our nests, and if day by day we have seen a cock bird singing from the same perch we may be sure he has a nest not far away. If we see birds fly by us with food in their beaks we know they are carrying it to their broods, and if we watch where they go we shall find their nests. For missel-thrush nests we look where the branches join on the boughs of the trees about twenty feet high, and for wood-pigeons' and for turtle-doves' to the topmost branches of the hawthorns and other trees where a thin platform of twigs is all we shall find, but this is very noticeable outlined against the sky, even if the bird does not announce its presence by its cooing.

The bullfinch, a stout, red-breasted bird with a black head and grey back, likes plenty of cover in the plantations, and builds its untidy nest among the brambles, where it is hard to reach. Its relative, the goldfinch, like the chaffinch, builds a much more beautiful nest of moss instead of twigs, and on the bough of an orchard or garden fruit tree. If it is a pine-wood, we may find the nest of the crossbill, high up in the trees and lined with grass and wool. The jay, one of the gaudiest birds in the wood, and one whose screech is an alarm cry for other birds, is usually silent when we approach its nest. It builds much lower and in denser growth than the magpie or the kestrel. Any hollow tree we pass we may search for owls' nests, by first pushing a stick down or rapping sharply on the outside, for if an owl is inside its beak may cause serious harm to an intruding hand. If we see a nightjar or a woodcock flit through the wood, the former in the south of England and the latter in the north, we search the leaves where it arose for the two eggs, light coloured in the case of the nightjar and darker with the woodcock, laid on the dead leaves. We shall not find the woodlark's nest in the wood, for despite its name, this bird does not frequent woods, and usually builds on the ground like a skylark.

Now let us take a journey north, to the moors and mountains. On the moors we look for the nests of the twite or moorland linnet, the merlin hawk, the ring-ouzel, and the grouse on the ground. On the mountain-side, the rocky sides, or high trees, may often contain nests of ravens, buzzards, carrion-crows or the dashing peregrine falcon, while by the mountain streams we search for the nests of the grey and pied wagtails among the rocks and stones, and the beautiful moss-house of the water-ouzel or dipper, a little sooty-brown bird with a white chest and chestnut belly, that bobs up and down on the stones in mid stream. If we see a dipper flying with moss in its beak towards a bridge across a stream, we should find its nest in a hole where a brick has fallen out, for this is a favourite nesting place of the bird. We may also find the grey wagtail nesting in a quarry, where the cuckoo will lay its egg in the nest among the stones.

The nests we find commonly by the waterside of ponds, streams and lakes include the moorhens, an early nest in the reeds, plainly visible and containing up to thirteen large, buff, speckled eggs, the nest being built of plaited reeds; that of the mallard or common wild duck in the reeds and island banks of the bigger lakes, often, too, in an old tree-stump; the kingfisher's in the bank, and the sedge-warbler's and reed-bunting's by the side of the water or ditch. On a moorland tarn or sand-dune slack great galleries of black-headed gulls, many hundreds in number, have become (Continued on page 252)

Mysteries of the Potter's Wheel

Survival of an Ancient Hampshire Craft

By J. C. Campbell

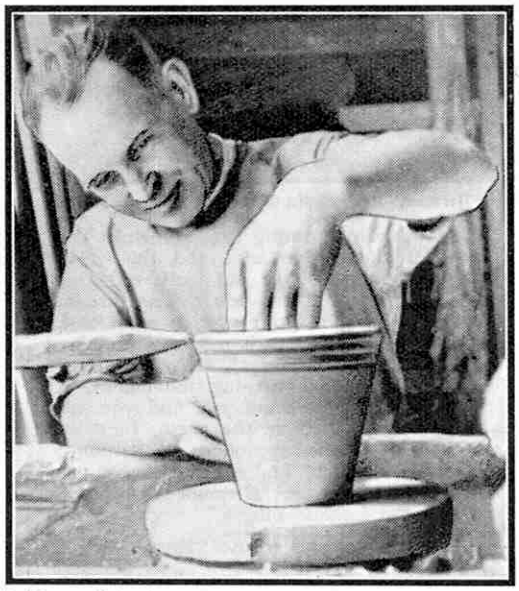
THERE is an ancient pottery on the sun-bathed slopes behind Fareham, from which it overlooks a vale of ploughed fields shut in on the far side by a pylon-crowned chalk ridge. The existing records of this pottery go back to 1800, but it is known from ancient maps that it has been there at least since 1650. Despite man's worship of the machine, the industry of making porous pots has not yet been conquered by a mechanical contrivance, although for many years science has been trying to find one; and the methods used at the Fareham Pottery have not materially altered since pottery began, and are as simple as they are effective.

A corner of the pottery at Fareham, Hampshire, showing one of the kilns.

Let us first pay a visit to the beds of the raw material, which are situated so conveniently at the very back door of the works. There the clay is dug out, and left in heaps to dry before being taken to the mixing shed, where it is damped down and mixed with sand. The amount of sand added varies, and the men who carry out this work can usually judge their needs by the feel of the clay on the shovel. There are no hard-and-fast rules, and experience is the only guide.

The only machine in the pottery is in the mixing shed. This is a mechanical mixer that delivers the clay ready for work in a strip about 15 in. wide and 6 in. thick. The strip is cut into lengths of convenient sizes, and these are stacked until required. A mixer driven by a horse walking round and round in a circle was used before the introduction of this machine, and had to be turned night and day continuously by two horses, working alternately, in order to keep up the supply of clay. The machine works only two days a week to supply all that is needed.

The next stage is the shaping of the pottery by the "thrower," as the workman who does this is called, and is perhaps the most interesting feature of work in the pottery. The simple tools used would be the despair of any self-respecting engineer, although they would delight the heart of a Heath Robinson; but the beautiful work the potter produces with them is adequate testimony to their efficiency. They comprise two notched sticks, one for gauging the height of the vessel being formed, and the other for checking its width; a long wire, such as is used for cutting cheese; and various knife-like trimmers. The wheel is too well-known to need description. It is usually made of beech wood, and lasts many years; in fact one wheel has been known to serve three generations of throwers.



A "thrower" shaping a plant pot on his wheel. The stick on the left marks the height required.

The amount of material required for an article is weighed in large scales, the weights being bricks and half-bricks. The thrower moistens the surface of his wheel in order to prevent the clay from sticking to it, dips his hands in the warm water at his side, and slaps the piece of clay on the revolving table. Two capable and pliant hands caress the revolving lump, and to a visitor a vessel of some kind seems to have grown mysteriously in a second from the shapeless mass he has seen thrown on the wheel. A deft turnover of the rim, a cut round with a trimmer, and in less time than it takes to write about it a perfect sample of the potter's art has been made. So soft and pliant are the hands of the men who work these miracles that there is a saying "Shake hands with a potter in the dark, and you shake hands with a gentleman."

At each end of the potter's sheds are fires in brick ovens, and over them rows of shelves stacked with drying pots. The articles must be "white" dry before firing, and in summer drying is done out-of-doors. Work to be glazed is prepared with a special material conforming to the Factories Act, which forbids the use of the old-fashioned "lead glaze," because of its poison content.

At last the pots are dry enough to be fired in the kiln. This is closed after filling and the fires are started. Coal is first used in the giant furnaces, 20 ft. in length, and the glowing fire is pushed farther and farther back as the firing continues. It is fed for 50 hours or so, and then bundles of faggots are rammed in. As they burn the heat is so intense that some of the iron fire-bars themselves begin to melt.

After the final burst of heating, all possible inlets, including the furnace doors, are sealed up, and the kiln and its contents allowed to cool down. This is the most important part of the process, for if the kiln were opened too early, or air allowed to rush in, the contents would be ruined. Finally all is ready, the kiln is emptied, and the vessels are examined. The faulty ones are rejected and sold as rubble; the rest are stored in sheds until required. There they present an amazing variety, including bread pans, flower-pots of all shapes and sizes, casseroles, jugs, and huge shallow pans for milk. Almost any kind of porous pottery from a flower-pot to a chimney pot, and from a saucer to a jar big enough to sit in, can be seen in the store rooms.

In the Channel Islands "Fareham" is a household word, for most of the tomato growers obtain their pots from the Fareham pottery. These are shipped in special containers supplied by the Southern Railway, so that after being packed at the works they are not handled again until they reach the buyer. By this means a great saving in time and breakage risks is effected.

The potter's wheel is one of man's oldest inventions and its origin is lost in antiquity. For most kinds of work "throwing" has been replaced by speedier methods, but old potteries in which it is used exclusively are still found in various parts of the country.

How long this ancient pottery at Fareham will survive none can tell. It is the last of several that once flourished in the district. The introduction of enamel and glass kitchen ware, and the increasing use of gas and electricity for heating purposes, means less work for the potter, and in addition there is difficulty in replacing the "throwers," for in this mechanical age few young people are willing to enter the industry.

Impressions of an Air Trip to Paris

Last year Imperial Airways carried 20,176 passengers from London to Paris, and 20,490 in the reverse direction. Month by month traffic on this route increases, and the service frequently has to be duplicated. Many passengers by air record their impressions, and in a recent issue of "*Imperial Airways Gazette*" a passenger gave the following interesting account of his trip from Croydon to Le Bourget, the French air port near Paris, in the company's luxurious air liner "*Heracles*."

"The '*Heracles*' has begun its flight with a run, lasting about eight seconds, across the aerodrome. Looking out of the windows, you see the huge wheels rise clear, spinning with the momentum acquired from a speed of a mile a minute. The four engines drone powerfully; the great white wings spread out on either side blot from your view sections of road and hedge below. Towns and meadows, woods and streams pass slowly beneath you, seeming small in comparison with the vast bulk of the '*Heracles*' all around you.

"The aerodrome is quickly out of sight—but, to the officer in the wireless cabin, not out of sound. The control tower at Croydon knows exactly where you are, and will be in constant radio communication until you land. The earth below may appear to pass slowly, but that is due to the optical illusion caused by your distance from it; your actual speed is now 100 miles an hour. Soon the Channel is beneath you, and for 30 or 40 minutes you look down on blue water, with ships like toys trailing long white wakes behind them. Then the French coast, and a scene quite unlike the view you had in England. Surrey, Kent and Sussex had resembled a multi-coloured quilt—the whole surface cut up into varied shapes of different hues by hedges, roads and gardens. Northern France appears a great flat plain, with immense yellow fields intersected by narrow ditches or long white ribbons of roads. . . .

"All the time the engines hum contentedly and you can see the effortless turning of the big airscrews. Amidships, you may look from a porthole along the length of the wings, and gain an impression of immense steadiness and power. The sound is no greater than that of an express train; the saloons, in fact, are quieter than a railway dining car. Suddenly the note of the engine falls, and the wings begin to slant. You can only tell this by looking at them; you yourself seem to be as level in your seat as ever. You look down. The earth is nearer, and there below you is Le Bourget, the Air Port of Paris. A gradual turning movement, a long smooth glide, and you find yourself skimming just above the grass. Inch by inch the wheels approach the ground; then they touch, and after a few more hundred yards the '*Heracles*' draws up beside the landing offices."

The Imperial Airways air liner "Heracles," in which the flight from London to Paris described on this page was made.

Improvements to the "Hornet"

Improvements have recently been carried out to the world-famous American Pratt and Whitney "Hornet" engine, the geared and supercharged type of which now develops 750 h.p. at 7,000 ft. This engine is of the nine-cylinder radial type, the cylinders being disposed in one bank. It is 54½ in. in diameter, 51 in. in length and 1,005 lb. in weight, and has the most modern attachments.

D.H. "Comet" Developments

The fine performances of the de Havilland "Comet" monoplanes in the MacRobertson Air Races last autumn have attracted the attention of foreign Governments. Two machines of this type have been bought by the French Government, and will be used for experimental crossings of the South Atlantic and for other long-distance flights. One of them is the actual machine in which the competitors K. Waller and O. Cathcart-Jones accomplished the double trip to Australia and back in 10 days.

The Portuguese Government have purchased the "Comet" used in the MacRobertson Races by Mr. and Mrs. Mollison, who, it will be remembered, flew from Mildenhall to Baghdad at an average speed of 200 m.p.h. The machine is to be used for a flight from Lisbon to Rio de Janeiro, via the Cape Verde Islands and Natal, Brazil.

Fast Machines for Jersey Air Service

The delivery is expected to be completed this month of six D.H.86 express air liners purchased by Jersey Airways Ltd., who operate a service between London and St. Helier, in Jersey, by way of Portsmouth and Southampton. This type of machine has a cruising speed of 145 m.p.h. and is claimed to be the fastest 4-engined commercial aeroplane in operation.

The D.H.86 has a span of 64 ft. 9 in. and a length of 43 ft. 11 in. The four 190/205 h.p. D.H. "Gipsy Six" engines are carried in nacelles mounted in the leading edge of the lower wing, and give the machine a maximum speed of 170 m.p.h. at 1,000 ft. There is excellent accommodation for 14 passengers.

These important additions to the company's air fleet are to be supplemented by four twin-engined de Havilland machines of the type known as "Dragon Rapides."

New Record Flights

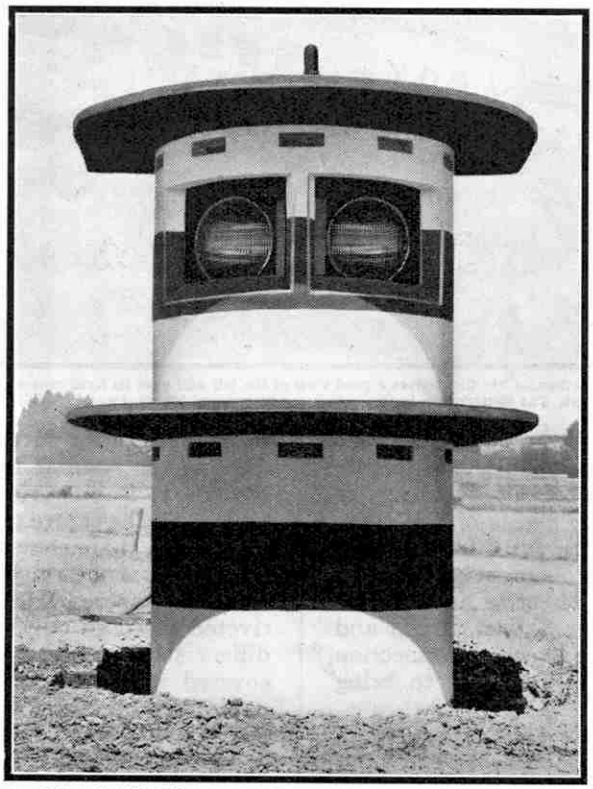
In the United States a Douglas machine owned by Eastern Air Lines has set up a new record for a commercial aeroplane flying on the transcontinental route Los Angeles, California, to Newark, New York. The machine accomplished the trip in 12 hr. 3 min. 50 sec., at an average speed of 216.3 m.p.h., reducing the previous record by 58 min. 10 sec. At times the machine reached an altitude of 7,000ft. Only one stop was made, at Kansas City, during the flight.

Farman F.190 high-speed transport aeroplane, the type of machine used in the record flight from Marseilles to Antananarivo, the capital of Madagascar. Photograph by courtesy of Avions Henri et Maurice Farman.

A new record for the flight from Marseilles to Antananarivo, the capital of Madagascar, was recently set up by M. Gaston Génin, one of the senior pilots of Air France. The machine used was a Farman F.190, powered by a 300 h.p. Lorraine Algol engine. Génin covered the distance in 3 days 13 hr. 18 min., an improvement of 18 hr. 12 min. on the previous record, set up in November 1931 by MM. Goulette and Salei in a machine of the same type and power. The recent flight was made by way of Garbes, Cairo, Juba and Dar-es-Salaam, and thence across the Mozambique Channel.

A Rotating Floodlight Beacon

The efficient lighting of air ports used by night air services is of great importance. The illustration on this page shows the powerful rotating beacon that is used for flood lighting the National Air Port at Madrid, Spain. It is equipped with an automatic lamp changer that instantly places a second lamp in operation in the event of the first one failing. The beacon is part of an extensive lighting installation, supplied by the International General Electric Company of New York, that includes landing projectors and boundary and obstruction lights. A master control panel enables the operator to light or extinguish any part of the installation as required.



A rotating floodlight beacon that is a conspicuous feature of the lighting equipment at the National Air Port at Madrid, Spain. Photograph by courtesy of the International General Electric Company of New York.

Deutsche Luft Hansa Summer Services

The Deutsche Luft Hansa are making important developments in their summer services this year. On the Hamburg-Berlin route there will be four daily flights each way, instead of only two as last summer, and three of them will cover the distance of 158 miles in five minutes under the hour.

London and Hamburg will be connected by a service covering the distance just under 3½ hrs. A machine will leave London at 11.15 a.m., and reach Hamburg at 2.35 p.m. In the reverse direction a machine will depart from Hamburg at 10.40 a.m. and will be due at Croydon at 2.5 p.m.

Another service will enable passengers to travel from London to Oslo in 8½ hrs.

British Civil Aircraft

There is ample evidence of the steady growth in the popularity of civil aviation, but the considerable extent that it has already attained is not generally realised. The Air Ministry have published an analysis of all aircraft carrying British registration letters, exclusive of those of the Dominions and Colonies, and a study of this report reveals some very interesting facts. A total of 937 machines possessed the Ministry's certificate of airworthiness at the end of last year, and of these 478 are owned by private persons, 153 are in use at flying schools, 95 are owned by aeroplane clubs, 80 are employed on regular air transport, and 190 are used for taxi work, joy riding and miscellaneous air tasks. The 937 machines consist of 101 different types. De Havilland machines are very numerous and include "Moths," "Fox Moths," "Tiger Moths," "Puss Moths" and "Leopard Moths." Many types of Avro machines are also mentioned.

An International Air Race

The success of the MacRobertson Air Races last autumn has already given rise to two proposed races round the world, one British and one French, as mentioned in our February "Air News" pages. According to "*Flight*," America is now following the fashion, with a proposal to organise an international air race from Washington to Buenos Aires and back, in October or November next. The route suggested for this 18,000 mile race is down the Atlantic coast of North America and the Pacific coast of South America, and across the Andes to Buenos Aires. The return flight to Washington would be made by way of Rio de Janeiro, Mexico and Los Angeles.

Extending Heston Air Port

Important extensions, including the erection of a larger hangar, are being carried out at Heston, the busy London airport owned by Airwork Ltd. The new hangar will be on the west side of the existing premises and will have an entrance 200 ft. in width, the floor space available for aircraft totalling 31,500 sq. ft. Two floodlights each of 1,250,000 c.p. are to be erected on the boundaries of the aerodrome.

Heston Airport is used by three regular air lines. These are Jersey Airways Ltd., who run trips daily to the Channel Islands; the Portsmouth, Southsea and Isle of Wight Aviation Co. Ltd., operating daily between the places named, and the British Aerial Navigation Co., who last summer maintained a daily service to Le Touquet and Deauville.

New Manchester Aerodrome

The sanction of the Air Ministry has been obtained to the Manchester City Council's scheme for constructing an aerodrome at Ringway to replace the present one at Barton. The scheme will cost about £180,000, and involves the purchase of 660 acres of land. It is anticipated that by the spring of next year sufficient progress will have been made with the work for machines of the principal air lines operating in this country to use the landing ground.

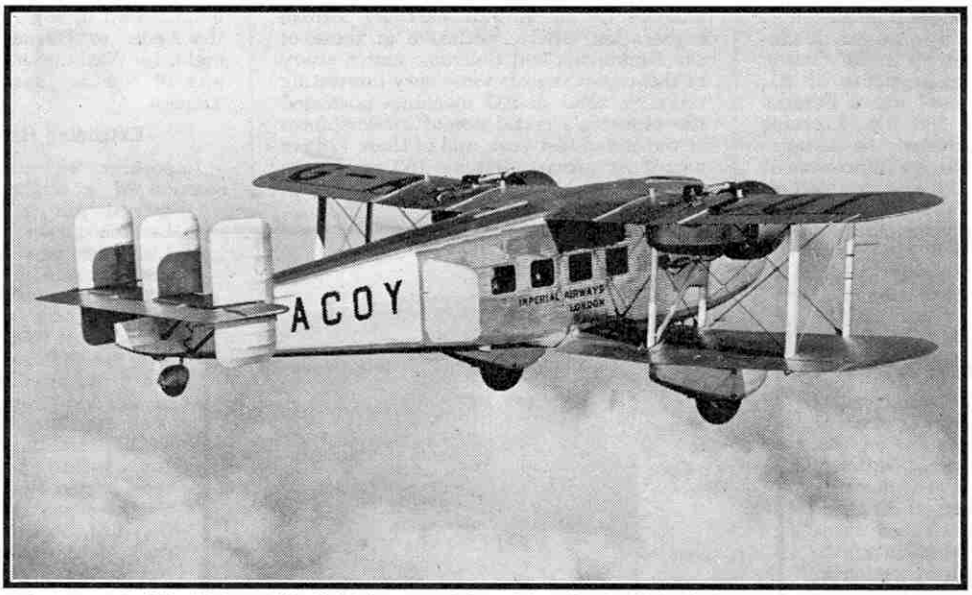
"Scimitars" for Norway

After a series of trials during which various types of American and European aircraft were tested, the Royal Norwegian Air Force have decided in favour of the Armstrong Whitworth "Scimitar" single-seater fighter, and several of these machines have been ordered. Each machine will be equipped with a "Panther VII" supercharged air-cooled engine, developing 640 h.p. at 2,500 r.p.m. at 14,000 ft. It will have two fixed Vickers guns.

New Machines of Imperial Airways

High-Speed Special Charter Air Liners

IT is now 11 years since Imperial Airways was formed by the union of the four British air lines then in existence. The new organisation provided services to six European countries. As the speed and convenience of air travel became more appreciated, the services to the Continent were extended, and Empire air routes to South Africa and India were developed. One of the great romances of modern transport has been the extension, link by link, of these trunk air lines, that now stretch for thousands of miles across the Empire. In July 1933 the India service was carried to Calcutta, and by the end of that year to Singapore; and in December last it was further extended to Brisbane, thus enabling a total distance of 13,000 miles to be operated regularly between England and Australia.



This photograph of the "Britomart" in flight gives a good view of the tail unit with its fixed centre fin flanked by balanced rudders. The illustrations to this article are reproduced by courtesy of "Flight."

In addition, Imperial Airways machines are often called upon for what is known as special charter work, to distinguish it from the operation of timed services. Business men who wish to visit overseas countries, invalids who are unable to travel by train, and people who are in need of speedy means of travel in emergencies are carried on flights of this type. The company's 39-seater air liner "*Syrinx*," for instance, was chartered by the Iraq Petroleum Company in January last to convey a party of directors and officials from Europe to Kirkuk, Damascus, Tripoli, Haifa and Amman, for the ceremonies at these places in connection with the opening of the Iraq pipe-line, and to bring the party back home.

The chartering of a large liner for a private flight of such great extent is not yet a common occurrence, but the hiring of smaller machines by single individuals or small parties now takes place so frequently that Imperial Airways have added to their fleet two new machines intended primarily for this work. They will be used also for services auxiliary to the company's main trunk routes in various parts of the world. The new aeroplanes have been produced by Boulton Paul Aircraft Ltd., of Norwich, to Imperial Airways' specification. They are the first two machines of a new type known as P.71A, designed to meet the demand for a passenger-carrying aeroplane of moderate capacity with a high cruising speed and long range, and possessing a standard of comfort equal to that of a much larger but usually slower aeroplane. They have been named "*Boadicea*" and "*Britomart*."

Our photographs show that the P.71A is a twin-engined biplane with wings of equal span. It has a span of 54 ft., a length of 44 ft. 2 in. and a height of 15 ft. $2\frac{1}{4}$ in. It is of standard Boulton and Paul all-metal construction, except in respect of the covering of the planes and rear portion of the fuselage, for which doped fabric is employed. Light alloys are used extensively, but the parts that have to bear the heavier stresses are made of high tensile steel. The planes are constructed of built-up spars and girder type ribs, and have a total area, including the ailerons, of $718\frac{1}{2}$ sq. ft.

The structural work of the front part of the fuselage is of steel longerons braced by duralumin tubes flattened at their joints to facilitate riveting, or secured by machined fittings. It carries a secondary framework, of light spruce, covered with plywood. The centre portion of the fuselage is built up of duralumin channel section girders and is braced across the top by tubes made of the same material; and the whole is covered with corrugated light alloy sheeting riveted in position. The rear portion of the fuselage differs structurally from the front part only in being covered with fabric.

The tail unit of the P.71A is of the monoplane type, with a fixed central fin flanked on each side by a balanced rudder situated near the end of the tail plane spar. The rudders extend above and below this horizontal spar. A castoring wheel fitted beneath the tail unit facilitates the handling of the machine on the ground and helps to reduce wear on the aerodrome surface. Dunlop wheels and brakes are employed in the undercarriage, and each wheel is sprung by Boulton and Paul oleo-pneumatic shock absorbers.

The forward baggage compartment has $28\frac{1}{2}$ cu. ft. of space and is in the nose of the machine. Immediately aft of it, but at a higher level, is the pilots' cockpit, to

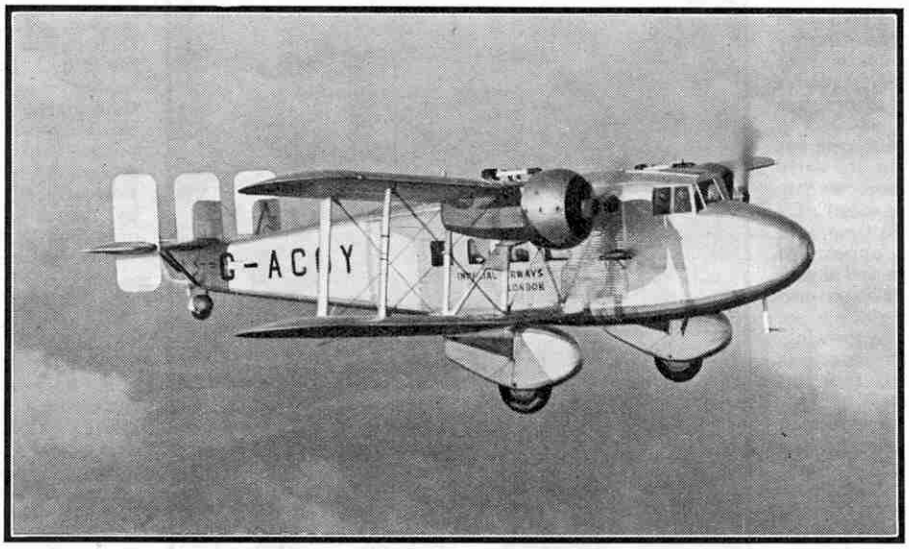
which access is gained through a large door in the starboard side of the fuselage. The cockpit is totally enclosed, but is equipped with a "sunshine" or sliding roof. The two pilots sit side by side, and of course dual control apparatus is provided. The passenger cabin is in the centre part of the fuselage, and is equipped with seats for seven passengers, arranged in three staggered pairs with the odd seat centred at the rear of the third pair. The cabin is entered at the back through a door in the port side of the fuselage. Behind the passenger accommodation is a second baggage compartment, of 55 cu. ft. capacity.

The machine has been built primarily for the transport of passengers, and in its design close attention has been paid to the provision of accommodation of the most comfortable character. The position of the fuselage is evidence of the care and thought that has been expended in this direction, for it is situated behind the plane of the airscrews in order to reduce the disturbance to passengers caused by the noise of the engines. Another device adopted that helps to reduce noise in the cabin is the padding with sound insulating material of the space between the exterior wall and the interior decorations.

The efficiency of the ventilation of the passenger accommodation is also a feature of the new machine. The cabin is normally warmed by hot air drawn from the engine exhaust muffs. Before reaching the cabin it passes through a regulator or mixing chamber in which cold air drawn in through a scoop may be added in order to attain any desired temperature. The mixed air enters the cabin through an aperture in the rear wall, and the used air is drawn away at the front.

Two Armstrong Siddeley "Jaguar V1A" engines, each of which develops 490 h.p., are housed in nacelles close to the fuselage and attached to the underside of the upper plane. It will be seen from the illustrations that they are equipped with Boulton and Paul Townend rings.

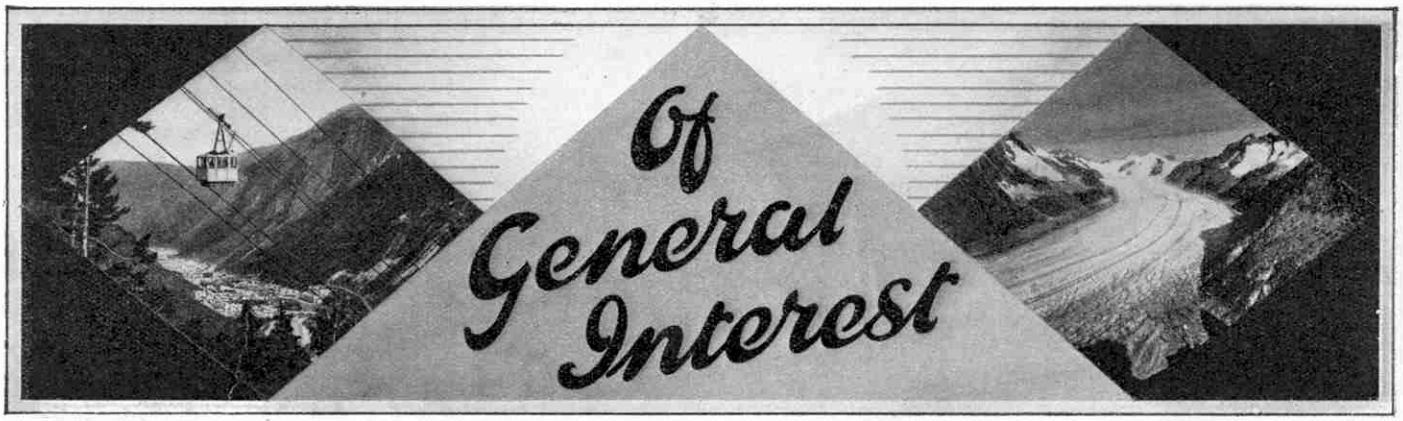
The fuel is carried in four tanks, two of 65 gall. capacity and two of 28 gall. capacity, fitted in the upper plane. The larger pair of tanks are situated one on each side of the fuselage in the centre section of the wing, and the smaller tanks are placed farther apart, in the top wing section outside the engines. The lubricating oil is carried in tanks fitted inside the leading edge of the upper plane, between the engines.



In the top photograph the clean lines of the "Britomart" are very noticeable. The lower photograph shows the machine in the air, It will be seen that the pilot has an excellent outlook ahead.

The paying load is 1,510 lb. and the all-up weight 9,500 lb. The cruising speed is 150 m.p.h. at 4,500 ft. and the machine can maintain this high rate of travel for a considerable distance. At sea level the rate of climb is 1,400 ft. per min., and the service ceiling is 21,000 ft. The landing and take-off runs are each 200 yards, and the stalling speed with full load is 62 m.p.h. Even on only one engine the machine will fly fully loaded at a height of 4,500 ft.

The constructors of the P.71A have produced two alternative schemes. In one of these the passenger accommodation can be increased to 14 persons by dispensing with the rear baggage compartment. In the other scheme the passenger accommodation is eliminated, and the whole space, totalling 410 cu. ft., made available for freight, a loading hatch being provided on the top of the rear portion of the fuselage.

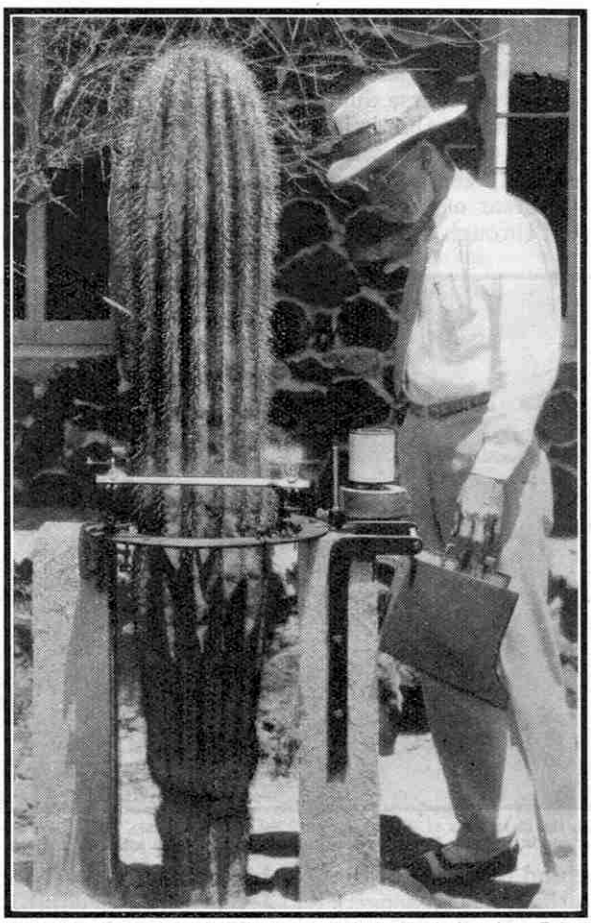


Travelling Three Miles in 82 Years

How quickly does a glacier move? The first effort to answer this question was made nearly 100 years ago when Agassiz, a famous geologist, and several of his friends carved their names on a huge block of schist standing on one of these rivers of ice in the Alps, and determined to revisit the scene at intervals. In 1844, four years after it was marked, the block was found to have been split into two pieces, owing partly to changes in the level of the glacier as it moved slowly downward. It was then lost for many years, and when it was rediscovered yet another fragment had broken away from it. By 1922 it had been broken into eight pieces, all of which could be recognised by the names carved on them, and in the 82 years since its journey was first checked it had moved nearly three miles. Those of my readers who remember Mark Twain's determination to return from his mountain climbing expedition by glacier will realise why he had to abandon his plan. A glacier moves slowly, even if its downward progress is very sure.

A curious feature of the movement of this stone was that in its early days it had travelled more swiftly than in recent years. The speed of a glacier varies from time to time, and the glaciers themselves appear to push down into the valleys and shrink back alternately. From 1920 onward many of the famous glaciers of Switzerland appeared to be growing, but gradually the movement was changed to one of retreat. It seems likely that in some quarters at least the reverse change is now taking place, and that the snouts of the glaciers are again creeping forward into the Swiss valleys. One of them, the lower Grindelweld glacier, receded about nine yards in 1930, but in the two following years regained practically the whole of the lost ground.

Measurements of ice movements in the Alps are of value as well as interest. More than once the waters of lakes dammed by glaciers have been suddenly released, to cause appalling destruction and loss of life in the valleys below them as they rushed away. In certain cases continuous ice observation has given warning of impending catastrophes of this kind, and these have been avoided by constructing trenches and clearing obstructions in order to allow the accumulated water to flow away harmlessly.



Measuring the growth of a giant cactus of the North American Desert. Photograph reproduced by courtesy of the Carnegie Institution of Washington.

Freezing Metals in Engineering Work

Most of my readers know that a metal tyre is fitted on the wheel of a locomotive or railway coach by heating it until it has expanded sufficiently to be slipped over the rim. Cooling by quenching then causes the tyre to contract and to grip the wheel firmly. Similar operations are fairly common in engineering work. It is not always convenient to heat the outer part of such an assembly, however, and instead the inner constituent can now be shrunk by cooling by a new process. The chemist has provided the necessary cooling bath by producing Drikold, or solid carbon dioxide, the temperature of which is about 110 deg. F. below zero. This is placed in special compartments in a tank containing a liquid that does not freeze at the low temperature to which it is exposed. Slots in the partitions enable the liquid to circulate through the compartments and the metal parts to be shrunk are simply immersed in it until they have cooled sufficiently.

Cooling metals to the low temperatures of the Drikold bath does not alter their temper and the new process is suitable for such purposes as fitting cylinder linings to internal combustion engines and the assembly of ball races on spindles and in their housings. The G.W.R. employ it in their works at Swindon for fitting locomotive cylinder and steamchest bushes, which are reduced nearly a thousandth of an inch in diameter in about 10 min. and can then be pushed into position, to fit tightly on returning to normal temperature. Formerly the cylinders were heated by means of internal gas jets, an operation that required several hours and caused inconvenience.

Horses of Prehistoric Englishmen

Discoveries in regard to the history of the horse, one of Man's two greatest friends in the animal world, are always of interest. The wonderful development from the tiny five-toed horse, no larger than a hare, of prehistoric times to the handsome and powerful creature that we now know, is one of the greatest romances in the story told to us by fossils. It is not necessary to go very far back to trace changes, however, for we have excellent evidence of the manner in which the horses of our ancestors of 2,000 years ago differed from the present type of English racehorse. This was revealed by the recent discovery in a tumulus on the Berkshire Downs of the skeletons of two horses that were buried about 200 B.C. These creatures were stumpy in build, with large heads but short necks and legs. They were typical of the horses of the early Iron Age and resembled the horses brought into the Mediterranean area from Central Asia more than 4,000 years ago by the Hyksos, or shepherd kings who overran Egypt. These were the first horses known in Europe and the countries round the Mediterranean Sea. They must have spread to Great Britain at a later period, and the modern representatives of this ancient and long-enduring race are the New Forest and Exmoor ponies. The modern English racehorse is derived from an Arab strain.

Aluminium Linings for Sun Helmets

The average human being when at rest gives out every hour sufficient heat to bring a quart of cold water to boiling point. If this rate of production were kept up throughout a lifetime of 70 years, the total quantity of heat generated would boil no less than 153,300 gallons of water, but much more actually is produced, for the rate is increased four-fold or even six-fold when hard muscular work is performed.

The heat generated by the body must be dissipated if an even temperature is to be maintained. In temperate climates nearly half of it is lost by radiation, but relief cannot be obtained in this manner in the tropics, where the surroundings are at a higher temperature than the skin, and discomfort is increased by radiant heat from the Sun or from the walls of buildings heated by the Sun's rays. The use of bright metals has been found to give protection against the Sun's attack. Galvanised iron huts with linings of plywood are as much as 12 deg. F. cooler when aluminium foil mounted on asbestos or some other fabric is placed in the space between the inner and outer walls, for the outer surface of the foil reflects radiant heat beating upon it and radiates very little into the interior of the hut.

Sun helmets lined with bright metallic foil are more comfortable than those with fabric linings, for less heat is radiated to the head of the wearer, and the temperature just above the crown is 5 deg. F. to 6 deg. F. lower, when a metallic lining is inserted.

The Rytecraft Scoota-car in London traffic. This miniature motor car has a maximum speed of 15 m.p.h.

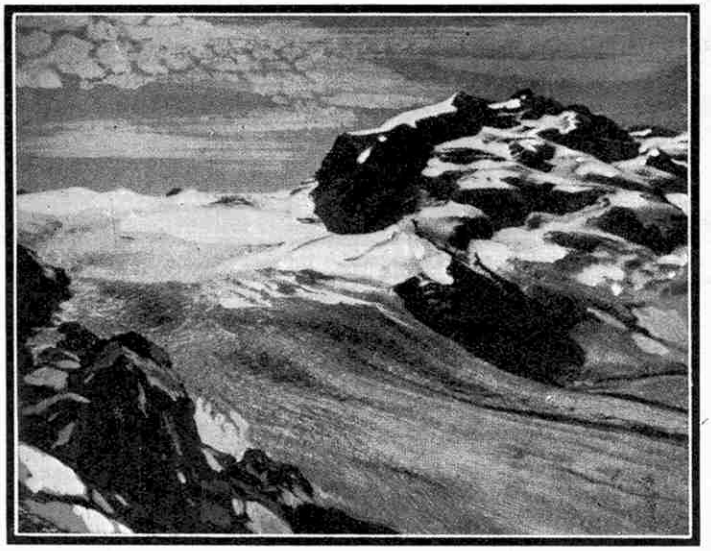
A Successful Miniature Motor Car

The upper photograph on this page illustrates a successful attempt to produce a miniature motor car capable of carrying a single passenger. The first impression on seeing it alongside a London omnibus is one of amusement, but this would scarcely be deserved, for the tiny motor car is a thoroughly practical vehicle. It is known as the "Rytecraft Scoota-car," and has been designed and produced by two British engineers. Its maximum speed is about 15 m.p.h. and it can easily be handled by the most inexperienced of drivers, to whom its low build, coupled with fairly high engine speed, gives the thrills of real motoring.

The Scoota-car is simple in design. Its chassis consists of two parallel tubular members, and the engine and the transmission form a complete unit just behind the driving seat, and together with the rear wheels and axle can be removed in a few minutes. A one h.p. air cooled "Villiers" engine is used. Access is given to it by removing a casing just behind the driver's seat, and it is coupled to the transmission by means of a clutch that comes into operation when the engine speed exceeds 800 r.p.m. The wheels of the car are only 12 in. in diameter and are fitted with balloon tyres.

A single pedal is the only control fitted to this remarkable miniature vehicle. The brakes are released when it is depressed to the extent of about $\frac{1}{2}$ in., and the engine is speeded up when it is pushed farther down. The drive is then taken up smoothly and easily. The throttle is closed and the brakes applied by simply removing the foot from the control pedal, and allowing it to spring back to its original position. Thus driving is very simple.

The car is safe to drive, for there is no risk of capsizing even when the steering wheel is pulled hard over when running at full speed, and this, with its simplicity and ease of control make it ideal for children, although in their hands it can only be used on private roads. It also can be fitted with a hopper body, to convert it into an efficient substitute for a wheelbarrow, and many commercial applications no doubt could be found for it. It would be useful for advertising purposes, and one of the ideas behind its production is that it can be provided with bodywork reproducing in miniature the characteristics of well-known motor cars, and employed by car manufacturers and agents to draw attention to the full-sized originals.



The birth place of great glaciers. The Monte Rosa, between Switzerland and Italy, and near Zermatt, an Alpine mountain mass with a height of 15,217 ft.

What Little Drops of Water Can Do

Most schoolboys know that a tremendous explosion ensues if a light is applied to a mixture of hydrogen and oxygen in the proportion of two volumes of the former gas to one of the latter, and will be surprised to learn that nothing of the kind happens if the gases are dry. Somehow a few drops of water distributed in the form of invisible vapour confer upon the constituents of the mixture the power of combining with each other rapidly enough to cause the tremendous disturbance that follows ignition.

Many other examples can be given of the far-reaching effects of traces of impurities. For instance, it is a commonplace that iron left in moist air rusts, but iron that is pure in the chemical sense absolutely refuses to rust, however much air and moisture is supplied to it. Similarly, red hot carbon ordinarily burns very well in air or oxygen. We depend largely for warmth and comfort upon this chemical change, for coal is mostly carbon, but if we filled our fire grates with pure carbon made red hot by some means, and supplied this with dry air or oxygen, we should simply cool the carbon instead of warming ourselves. It would be necessary to introduce a little moisture to keep the carbon burning or, as one writer has put it, we must get up steam literally in order to put vigour and life into the chemical action.

In these and similar cases the impurity, whether it is moisture or some other chemical, speeds up the chemical change involved. It is scarcely true to say that dry hydrogen will not combine with dry oxygen, but the change is so slow that it is scarcely perceptible. Somehow or other this is connected with the curious properties of absolutely pure substances. We often insist on the need for pure water for human use, but one taste of chemically pure water would be sufficient for most people, for it lacks the sweetness and refreshing sparkle that dissolved air and small proportions of other chemicals give to good drinking water. A more startling example is prussic acid. Everybody knows that ordinary prussic acid produces sudden death, but it is said that chemically pure prussic acid has no such effect. This of course is a matter for experiment only by experts, and in any case there is a great difference between the standards of purity of ordinary people and those set by chemists in their experiments on the influence of traces of foreign materials on the properties of the substances with which they deal.

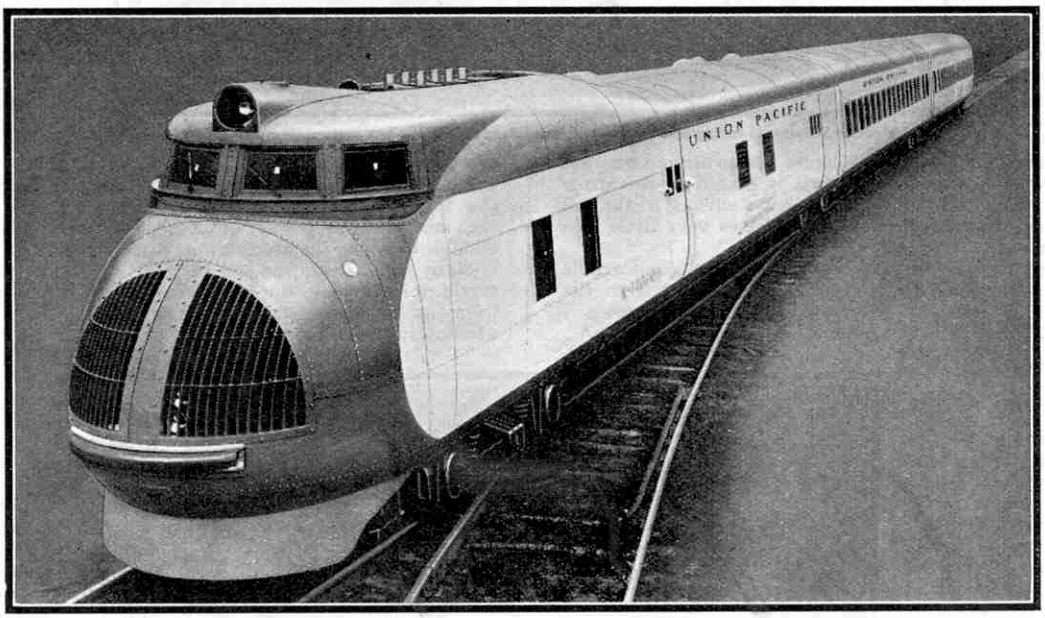
Streamlined Trains in the United States

Some Remarkable Developments

By Edward T. Myers

FOR many years railway vehicles as a class have followed the same outline, with necessary alterations from time to time due to increases in size and other developments. In recent times, however, in order to compete effectively with road and air transport, there have been evolved light self-contained, high-speed railway units. These are more mobile than the conventional train with its separate components and locomotive. They have high-efficiency power plants, and incorporate special methods of reducing air resistance at high speeds, for railway engineers have turned their attention to the streamlined forms already familiar to motor car and aeronautical designers. Proposals are also on foot to provide streamlining for steam locomotives, as far as their design renders this possible.

The most notable example so far in Europe of this new form of railway train is the *"Flying Hamburger"* of the German State Railways. This is a two-car streamlined train with Diesel-electric propulsion, and it operates a service over the 178.1 miles between Berlin and Hamburg at an average speed of 77.4 m.p.h. As a result of the performance of this remarkable unit interest in similar trains has quickly shown itself in other countries. In the United States two systems, the Union Pacific, and the Chicago, Burlington and Quincy Railroads, have each had built a special articulated train of three streamlined coaches with oil-electric drive. These differ from present standard equipment to a great extent, not only in their external appearance and technical details, but also in their internal convenience and appointments.



The Union Pacific three-coach articulated oil-electric train "M.10000." This photograph, reproduced by courtesy of the Union Pacific Railroad, shows the bulbous front end of the train with the driver's compartment above the engine room.

The Union Pacific train known as *"M.10000"* has been developed as a result of the opinion of the executive officers of that line that a new type of passenger equipment, radically different from existing standards, was necessary to enable rail transport to meet competition by air and by road. The saving of time on the transcontinental run from Chicago to the Pacific coast will, it is anticipated, meet competition by air. The reduced cost of operation together with increased comfort is expected to meet rivalry by road. Actually between 23rd and 25th October last, this train traversed the 3,334 miles across the American continent in the record time of 56 hours 55 minutes, as compared with the usual 84 hours. From Los Angeles to Chicago, a distance of 2,364 miles, the average speed was 60.6 m.p.h. this including the crossing of the Rocky Mountains. For over 500 miles the average speed was 84 m.p.h. and for two miles a top speed of 120 m.p.h. was registered.

In the construction of the cars duralumin, a copper-aluminium alloy, has been used exclusively, except for the castings and for the bogie trucks, for which steel is employed. The use of duralumin in place of stainless steel was decided upon because extruded metal shapes can be used to take the place of ordinary rolled shapes and pressings. These extruded shapes are highly accurate in dimensions, thus permitting the designer to interlock various sections to produce cars of minimum weight yet maximum strength. The three cars composing *"M.10000"* weigh only 85 tons together, or approximately the weight of a single ordinary Pullman car. A 10-car American train of the conventional steam type has a weight of approximately 1,000 tons.

The train has an overall length of 204 ft. 5 in., and is 8 in. narrower and 3 ft. less in height than standard rolling stock. Its design is such that the train "hugs the rails," the bottoms of the cars being only 9½ in. above the rails and their total height only 11 ft. The low centre of gravity, which is situated only 38 in. above the rails, together with the articulation of the cars, gives smooth riding at high speeds.

In place of the underframe and body of conventional design, each car is tubular and forms a stiff rigid beam that resists shocks. A minimum of material is thus required for a given strength. The space between the outer and inner sheathing is filled with a layer of fireproof insulation that is light in weight and also assists in deadening sound. The streamlined form of the train was determined by a series of scientific tests carried out with models in wind tunnels at the University of Michigan. These models were made with detachable front and rear ends in order to determine the best shape for these parts. The parts indicated the desirability of closing up or eliminating the gaps between the cars, but the accomplishment of this was a difficult task, as will be realised when the relative movement between individual cars on curves is remembered.

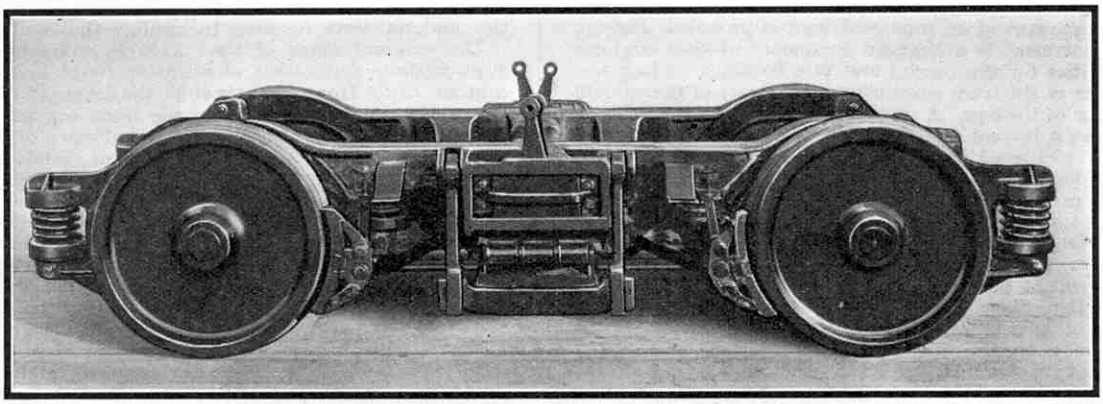
The problem was solved by the use of an aluminium shield extending from the rear of one car towards the front end of the next, forming in effect a prolongation of the contour of the car. The extent of this projection depends on the minimum radius of curve that the train has to negotiate. A rubber sheet stretches from the following car to the inside of the projection and is held against this by spring-actuated arms, which allow it to accommodate itself to the motion of the train.

The tests just referred to indicated that this new train travelling at a speed of 90 m.p.h. requires less horse-power for its propulsion than any other form of transportation, carrying a similar load of passengers and luggage at the same speed. It was shown that 500 h.p. only is necessary to propel the train at 90 m.p.h. with a load of 116 passengers and 25,000 lb. of luggage and mails. A three-coach train of conventional design would require 1,700 h.p. at the same speed, and 15 transport aeroplanes similarly loaded would need 5,000 h.p. to operate under the same conditions.

In order to provide the necessary power a 600 h.p. Winton engine using distillate as fuel is employed. Distillate is a non-explosive oil that is left as a residue after petrol has been extracted from coal. The entire rated horse-power is available for driving the train as the engine can deliver sufficient excess power to operate

the cooling fans, air-conditioning apparatus and lighting plant.

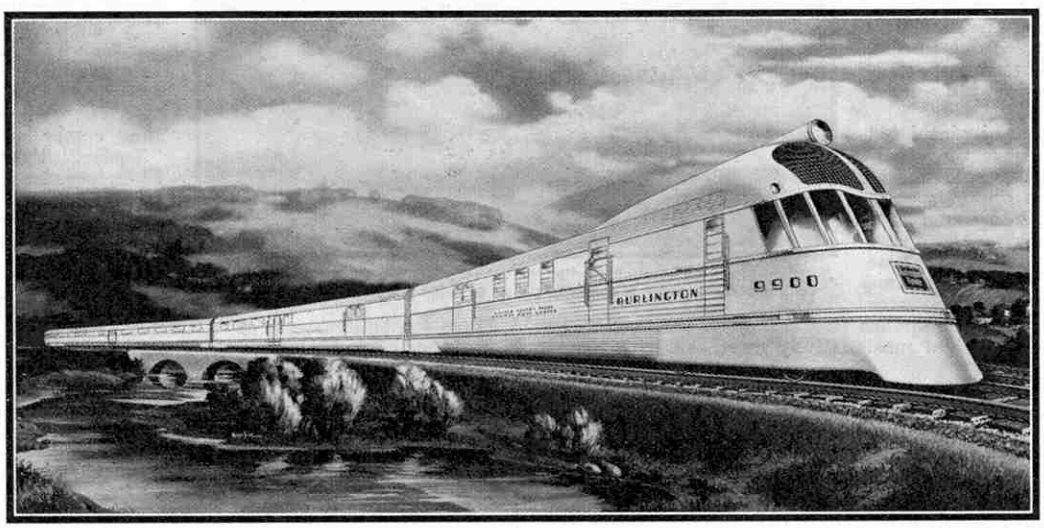
The V-type engine has 12 cylinders, and their water jackets and the crankcases are made of welded wrought steel. The crankshaft is of chrome molybdenum steel. The cylinders have a bore and stroke of 7½ in. and 8½ in. respectively, and the pistons are of aluminium alloy. Each cylinder has two inlet and two exhaust valves and four sparking plugs. The exhaust connections have an individual pipe for each cylinder and are led away vertically between the two banks of cylinders. The front end of the engine is connected by flexible couplings to a Westinghouse generator, the current from which passes to two G.E.C. traction motors, each of 300 h.p., one mounted on each axle of the front bogie truck.



A close-up view of one of the trailing bogie trucks of the Union Pacific "M.10000." Photograph by courtesy of the Pullman Car and Mfg. Corp., Chicago, Illinois.

This bogie truck runs on wheels 3 ft. in diameter, the axles being accommodated in roller-bearing journals placed outside the wheels in order to provide space for the motors. The other three bogie trucks of the unit have rolled steel wheels 2 ft. 9 in. in diameter, and have inside roller-bearing journals in order to reduce width. A metal apron covers the bogies and tends to reduce air resistance. There is no actual metallic contact between the axle-boxes and the bogie frames, rubber "doughnuts" or buffers being used, which take up dynamic rather than static loads, the major portion of the latter being borne by coiled springs.

While it was desired by the Union Pacific Company to use some form of shock-absorbing or resilient wheels, it was considered that the development of these had not advanced to a sufficient point to warrant their use on an essentially high-speed train. A new two-car train of the Texas Pacific Railroad running between Fort Worth and Texarkana has two 8-wheeled bogies with pneumatic tyres on the passenger vehicle only; but this train is only moderately streamlined, and is not designed for operation at a higher speed than 78 m.p.h.



An impression of the "Zephyr," the high-speed train of the "Burlington route," the front of which differs markedly from that of "M.10000." Photograph by courtesy of the builders, the Edward G. Budd Mfg. Co. of Philadelphia, Pa.

The problem of the satisfactory braking of *"M.10000"* was solved by a device called a decelerometer. This consists of a movable 100-lb. weight mounted on ball-bearing rollers and arranged to move in the line of motion of the train. The momentum of this operates a pneumatic valve, which in turn controls air pressure in the control line in order to obtain the maximum braking effort without allowing the wheels to lock and slide on the rails. The decelerometer brings the new train to a stop from a speed of 100 m.p.h. in a shorter distance than a standard steam train can be brought to rest from a speed of 60 m.p.h.

From the driver's control handles three parallel sections run to the brake equipment of each car. One of these, known as the supervisory line, operates the air reservoirs under each car, charged to maximum pressure even while the brakes are being applied. Another, called the control line, operates the valves that admit air to individual brake cylinders. Each axle has its own brake cylinder mounted directly on the bogie, thus eliminating any rigging between the two axles. The third section, a parallel electric control line, synchronises and speeds up the operation of these valves. If the electrically controlled system were to fail, the brakes would operate pneumatically; if either or both air lines should be ruptured, the brakes would be applied at once. This braking system ensures the maximum braking effect with the utmost ease of control and absolute safety.

The driver or motorman is located in an elevated cab above the rounded nose of the front car. He has a visual range far greater than that of any engineer of a steam train, and is removed from the noise of the engine room.

The main operating controls in the cab consist of first, the throttle that governs the speed of the engine itself; second, the controller by which the motorman increases or decreases the speed of the traction motors that drive the train, this controller being somewhat similar to that on an ordinary tram car; and third, a brake valve to slow or stop the train. This brake is equipped with a "dead-man's" control, requiring the motorman to keep either his hand or foot on the brake control. Removal of this pressure closes the throttle and applies the brakes. There are duplicate controls on the left side of the cab. On the instrument board is a multitude of interesting gauges, including a highly sensitive speedometer, and electric, oil, air, water, and signal light gauges.

On certain divisions the train is operated by train control, that is the aspects of lineside signals are automatically displayed in the cab. In addition to this visible indication, an audible signal is provided in the form of an air whistle that starts to blow when the cab signal changes from green to red-over-yellow, and continues to blow until the engineman acknowledges it. The train control receivers are mounted behind the protective apron ahead of the front wheels and come just over the rails.

What would happen if the light, speedy *"M.10000"* should hit a heavy road vehicle? Experienced railway men accustomed to steam locomotives weighing 150 tons or more naturally ask this question. They wonder how a whole train that weighs only 80 tons can meet obstacles in its path with safety. The designers of *"M.10000"* gave special consideration to this problem. In the first place, they concentrated nearly half the weight on the front or power bogie. Most of this weight comes from the power plant and its massive supports. Another point is that the nose of the driving coach is well ribbed, and has a large vertical girder in the centre. Additional strength is afforded by the unusually solid floor supporting the engine, and this floor forms the centre of the front end.

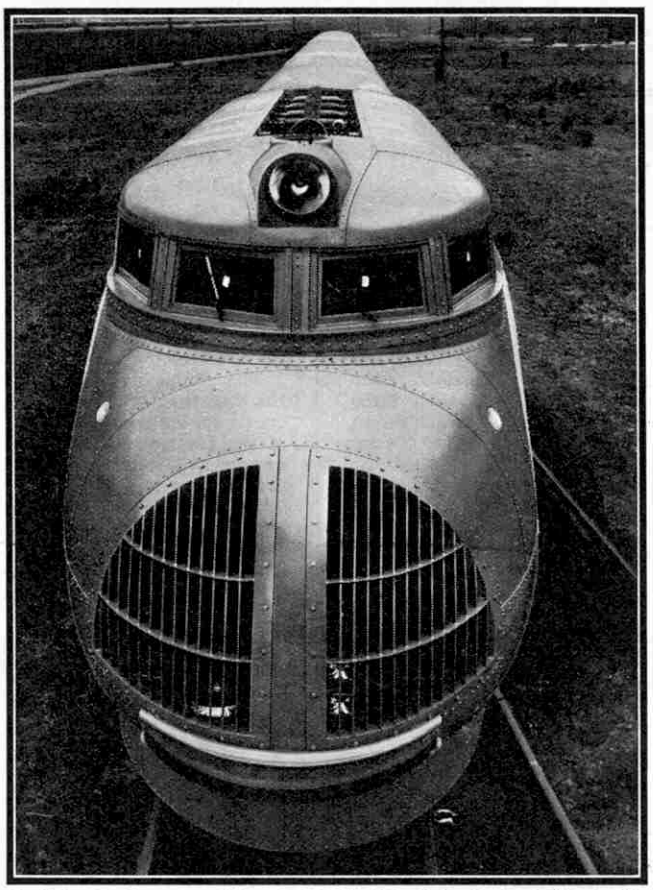
All the structural members converge to form a strong parabolic arch that should resist the shock of a collision satisfactorily. The heavy weight on the front bogie truck, together with the bulbous nose, will tend to push any obstruction off the track and so save the train from derailment.

Mail and baggage compartments are situated behind the engine room. The mail compartment is fitted with the latest devices of the United States railroad mail service and is 33 ft. in length. Mail bag pick-up apparatus of an improved kind is provided. Beyond the mail compartment is a baggage compartment that contains the usual facilities for the careful and safe handling of baggage.

All side doors of the train when closed form part of the smooth exterior contour of the cars. A special device opening the baggage door first moves it inward and then slides it lengthwise along the inside of the car. Even the steps fold up as the doors are closed, so that the train in motion forms a long, smooth, glistening tube. There are no tie bars under the cars, and as the bogie trucks are entirely shrouded as part of the streamlined design, there can be no possibility of any stowaways making a journey on this train.

The interior of this train strikes the traveller as ingenious and modern, as modern in fact as the long, rounded, streamlined exterior would lead him to expect. Diffused light spreads from a white central overhead duct across the light blue metallic ceiling down to dark blue panels below the window sills. In summer, clean cool air is supplied from this central duct, while warm air is removed by two floor ducts. The air-cooling system has a refrigeration capacity equivalent to the production of 7½ tons of ice in 24 hours. The degree of heat or cold in the cars is thermostatically controlled. In winter circulation is reversed and the warm air is supplied from the floor ventilators. The windows are permanently rubber-sealed to keep out all dirt, while special shatterproof glass excludes the glaring ultra-violet rays of the Sun.

Carpets laid on heavily insulated cork-tiled floor relieve the otherwise cold metallic appearance of the car, and this effect is completed by fabric Venetian blinds and the upholstery on the chairs flanking the central aisle. These chairs are extremely luxurious and can be adjusted to three positions. The small buffet kitchen that is built in the rear of the train in order to serve light meals is fully fitted out with space-saving devices.



A striking head-on view of the "M.10000" of the Union Pacific Railroad. The central vertical girder is specially strong to resist possible collision shocks.

The Chicago, Burlington and Quincy train known as the *"Zephyr"* although built for similar reasons differs from the Union Pacific *"M.10000."* It may be described as a silvery shaft of stainless steel 196 ft. long and weighing 95 tons, and it is composed of three cars, of which the first, as in *"M.10000,"* contains the motive power and accommodates mails and baggage. The second car incorporates a baggage compartment, a buffet, and limited accommodation for passengers. The third car is exclusively for passengers, and a special parlour compartment is situated at the tail end.

The material used is practically all cold-rolled stainless steel containing 18 per cent. of chromium and 8 per cent. of nickel. This steel is characterised by its light weight, rugged character, high tensile strength and great resistance to fatigue, and its non-corrosive qualities make it possible to dispense with painting. Although the weight of the entire train is about equal to the weight of an ordinary Pullman car, yet the ratio of strength to weight is greater than with any other type of construction. The framework or skeleton of the train embodies the latest scientific latticed method of construction with the parts secured by electric welding instead of by riveting. The new "Shotweld" process was employed, in which each "shot" of electric current is precisely timed. This results in absolute uniformity in the welds, which appear as close together as the stitches in a seam, effectively uniting the various sections without breaking down the atomic qualities of the metal. In addition to effecting a reduction in weight as compared with riveting, the use of welding obviates any fatiguing play at the corners or joints.

The insulation between the exterior and interior sheathing is a metal foil almost as thin as tissue paper. It is slightly crumpled before being placed in position, and its surface is characterised by millions of tiny angular and irregular-shaped facets, insulation being accomplished by reflection. It is interesting that only 100 lb. of this material were required to insulate the complete train.

The external shape of the *"Zephyr"* takes advantage of the most modern application of scientific streamlining in which the contours of the front and rear ends, the design of the wheel guards, the concave fluted sheathing of the sides, top and under surface, are important factors as also are the absence of rivet heads and the flush window frames. The front of the *"Zephyr"* is different in shape from that of *"M.10000."* Instead of having the rounded nose of the latter, its front slopes gradually in an unbroken line from the top of the train down to within a few inches of the rails. The centre of gravity is situated 51 in. above the rails, or approximately 20 per cent. lower than in equipment of the usual type. This assists the train to cling to the rails and gives it the necessary balance, and tends to the avoidance of any swaying action when rounding curves.

Power is obtained in the first instance from an 8-cylinder two-cycle heavy oil engine of 600 h.p. This engine was developed specially for this train, and is the first of its type to be used in rail transportation in the United States. It is of the compression-ignition type, so that no sparking plugs or ignition system of the kind used in petrol engines is required. The G.E.C. electrical equipment consists of a generator driven by this engine, and motors that are supplied with power from the generator. The air ducts are above the motorman in the *"Zephyr,"* whereas in *"M.10000"* they come beneath him. In the *"Zephyr,"* therefore, he is in a lower position with more exposed windows.

From the point of view of safety in a collision, the sloping front of the *"Zephyr"* seems more likely to push any larger object clear of the track than does the bulbous nose of *"M.10000,"* which might allow wreckage to become lodged between the rails and the underside of the train.

In other respects the *"Zephyr"* is similar to *"M.10000."* It is equipped with electro-pneumatic brakes and runs on roller bearings, and the windows are equipped with shatterproof glass. An overhead tubular duct houses the lights for the indirect illumination of the passenger compartments, all of which are equipped for radio reception. All windows are sealed, but the passenger compartments are air-conditioned and the temperature is thermostatically controlled.

This train was built for service between Kansas City, Omaha, and Lincoln, Nebraska, but was exhibited during last summer in the Exposition in Chicago. During its initial runs a speed of over 100 m.p.h. was attained on several occasions. The non-stop run of 1,015 miles from Denver to Chicago was made in 13 hr. 5 min., an average of 77.6 m.p.h. The maximum speed attained was 112.5 m.p.h. On this exceptionally long and fast run, only 500 gallons of crude oil, costing twopence a gallon, were consumed.

The success of the *"Zephyr"* has led to the adoption of the type for a high-speed service between Chicago and St. Paul. Test runs were made with the original *"Zephyr"* and showed that no fundamental changes would be necessary in either track design or maintenance. Owing to the light curvature of the line and the lower centre of gravity of the new trains, no increase in elevation has been necessary on many of the curves.

108 m.p.h. on the L.N.E.R.

New World's Record by "Pacific" Locomotive

By "Observer"

ALL previous speed records for steam-driven trains were decisively smashed on Tuesday, 5th March, when a special, travelling on the L.N.E.R. from Newcastle to London (King's Cross), attained a maximum rate of 108 m.p.h. This notable feat was achieved on the glorious stretch of racing ground that begins several miles south of Grantham. Over the 12.3 miles from Corby to Tallington an average speed of 100.6 m.p.h. was maintained, and for the 3.6 miles between Little Bytham and Essendine the average was 104.5 m.p.h. The wonderful maximum of 108 m.p.h. was reached on the last mile of the falling grade of 1 in 200 a little distance north of Essendine.

This marvellous running was done in the course of experimental runs on the L.N.E.R. from London to Newcastle and back to test further the capabilities for high-speed running of the steam locomotive in comparison with the Diesel electric rail-cars of the German "*Flying Hamburger*" train. In each direction the train consisted of three first-class corridor coaches, a restaurant car, a brake van and a dynamometer car. Its empty weight was 213 tons, and it had a seating capacity of 204. The locomotive employed was the Gresley "Super-Pacific" No. 2750, "*Papyrus*," which was taken out of ordinary express passenger work and had not been specially prepared for the test runs. In the down direction Driver H. Gutteridge and Fireman A. Wightman formed the engine crew, while for the return journey, Driver W. Sparshatt and Fireman R. Webster had charge. The special schedule that had been drawn up allowed four hours for the journey of 268.2 miles in each direction, requiring an average of 67.05 m.p.h.

The L.N.E.R. "Super-Pacific" locomotive No. 2750, "Papyrus," that was used on the record-breaking runs described on this page. It is here shown in ordinary service on the down "Flying Scotsman" express. Photograph by Real Photographs Co., Liverpool.

On the down journey King's Cross was left at 9.8 a.m. and although the running was highly creditable, no records were broken, the highest speed being 88.6 m.p.h. between Hitchin and Huntingdon. An unfortunate delay was caused by the derailment of some coal trucks near Doncaster, which entailed single line working and occasioned not only slow running for some distance, but an actual stop for 19 sec. In all, about 7 min. were lost through this check.

After York had been passed at reduced speed, some excellent running was done and over the slightly adverse grades an average of 80 m.p.h. was kept up for almost 40 miles, with the result that all losses were recovered and Darlington was passed before schedule time.

The arrival at Newcastle was 3 min. early, the overall time from King's Cross having been only 3 hr. 57 min. The average speed was 67½ m.p.h. Never before had Newcastle been reached by rail in so short a time from London. The gain on the usual time of "*The Flying Scotsman*," which of course is a heavier train, was no less than 1 hr. 11 min.

The return journey from Newcastle to London was started at 3.47 p.m. and in the earlier stages schedule times were adhered to fairly closely. But from Doncaster onwards time was gained steadily and the average speed for the 156 miles from Doncaster to King's Cross was all but 75 m.p.h., the time for that distance being 125 min. 8 sec. The 105.4 miles from Grantham were covered in 83 min. 6 sec., as against a schedule allowance of 91 min., giving an average of 76.2 m.p.h. The 76.3 miles from Peterborough, including a cautious run into the terminus, occupied only 62 min. 5 sec. Over the 27 miles between Huntingdon and Hitchin, where the gradients are against the engine, the average was only a trifle under 80 m.p.h.

King's Cross was reached more than 8 min. early, 3 hr. 51 min. 48 sec. after leaving Newcastle, and the average speed had been just under 70 m.p.h., notwithstanding the special slack for the derailment near Doncaster and the usual service slacks that were carefully observed. Travellers in the train declared that the running was at all points delightfully smooth, and never more so than when speeding at 100 m.p.h. and over.

Driver Sparshatt and his mate were cheered heartily by the big crowd awaiting the train at King's Cross and many enthusiasts looked with admiration on the giant locomotive "*Papyrus*" that had done its part so well. In the course of the day it had covered nearly 540 miles and travelled at unprecedented speeds, but on examination every bearing was found to be perfectly cool and every part in good order.

It should be added that the purpose of the L.N.E.R. in making these test runs was not to break records, but to gain data on the basis of which new accelerated schedules can be drawn up for operating a service of super-expresses between London and various important provincial centres. These will supplement the ordinary services. Many factors such as coal consumption, the effect of high speeds upon the permanent way and the locomotive and rolling stock, the possibilities of streamlining, and the disturbance caused to ordinary services have to be carefully considered before they can be introduced, but a super-express service between London and Newcastle may be provided next autumn.

The record-making runs described in this article, together with those made between London and Leeds on 30th November last, have certainly demonstrated that modern steam locomotives are capable of maintaining high speeds over long distances and inspire the hope that in the near future considerable speeding-up will be done to the existing express services.

It is interesting to see how Great Britain now compares with the rest of the world in regard to railway speeds. It is necessary to distinguish carefully between experimental or test runs and those regularly made in actual service, and also between average speeds and maximum speeds. The fastest regular steam train in the world is the G.W.R. "*Cheltenham Flyer*," which is required to average 71.3 m.p.h. over the journey of 77¼ miles from Swindon to London. Great Britain therefore not only holds the record for the highest speed yet reached by a steam locomotive, but also claims the fastest regular run made by a steam train. (*Continued on page 264*)

A Modern "Ghost Train" on the L.M.S.R.

A modern "ghost train" that speeds silently over the metals at 70 m.p.h. on 16 pneumatic-tyred wheels has appeared on the L.M.S.R. It is the Coventry Pneumatic Railcar, a self-contained, petrol-driven unit that is being tried out by the L.M.S.R. in conjunction with Armstrong Siddeley Motors Limited, Coventry.

The Railcar is of streamlined appearance and a distinctive feature is the control cabin, which outwardly resembles the conning tower of a submarine, projecting from the roof of the car at the motor end and giving the driver a clear view in both directions along the track. The engine is a 12-cylinder petrol engine of 240 b.h.p. There is accommodation for 56 passengers and a luggage compartment also is fitted.

The remarkable capabilities of the Railcar were demonstrated in a recent run from Euston to Leighton Buzzard and back. On the outward journey, with a full complement of passengers, stops were made at both Willesden and Watford in order to demonstrate its accelerative and braking capabilities. Leaving Euston, the climb to the first mile-post up the Camden Bank, mostly at 1 in 70, was accomplished in 2 minutes 16 seconds, and the stop at Willesden Junction, 5½ miles from the start, was effected in 7¼ minutes. Leaving Willesden, a speed of 62 m.p.h. was attained within little more than a mile of the start and the 12 miles to Watford were covered in 13¼ minutes. At Watford, the car was stopped dead in nine seconds from a speed of more than 55 m.p.h.

Proceeding to Leighton Buzzard, the 22¾ miles were covered in 25 minutes start-to-stop, at an average speed of more than 54 m.p.h., the highest speed attained being 67 m.p.h. The return journey was made without stop, the 40¼ miles being covered in 42½ minutes, giving a speed of 57.8 m.p.h., in spite of a strong head-wind and a slack for permanent way operations near Leighton. The highest speed attained on the return journey was 65 m.p.h.

L.M.S.R. Locomotive News

The first of a batch of 20 new two-cylinder 2–6–2 superheated tank engines has been completed at Derby works to the designs of Mr. W. A. Stanier, the chief mechanical engineer of the L.M.S.R. The 20 engines are to be numbered 71–90 inclusive. The Company already possessed 70 tank engines, numbered 1 to 70, having the 2–6–2 wheel arrangement. The new engines have been designed as a development and improvement of the earlier type, and will be described in an illustrated article in next month's issue.

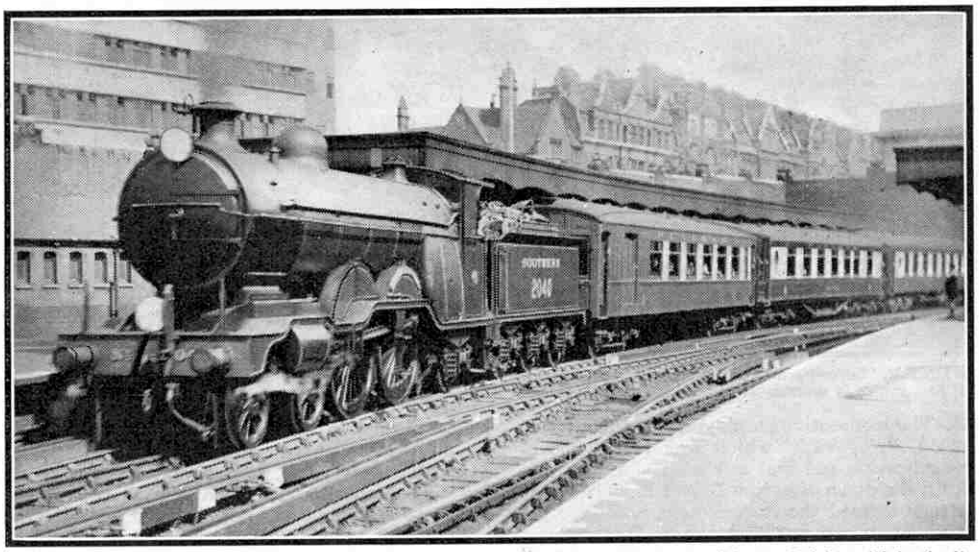
Crewe works are busy with the order for 20 of the new two-cylinder mixed-traffic 4–6–0 locomotives and the first three, Nos. 5000 to 5002, have already been completed. They have tenders of the new type with a water capacity of 4,000 gallons and side-sheets curved in at the top. The North British Locomotive Co. Ltd. have delivered further improved "Baby Scots" down to No. 5599.

It is of interest to note that the rebuilt "Claughton" No. 5999, "*Vindictive*," has been to Crewe for general repairs in spite of the rumour that these large-boilered "Claughtons" were to be broken up when in need of general repairs. No. 5999 was formerly at Northampton and is now stationed at Crewe.

The engine concerned in the Duffield Branch derailment in the last week of February was No. 4402, a Class "4" engine of the 0–6–0 type. The 0–6–4 tank engine No. 2023 was in a similar accident at Ashton-under-Hill, near Evesham, a few days later.

Work is proceeding with the installation of a new locomotive turntable of 60 ft. diameter at the south end of the Bedford Motive Power Depot.

The new signal box at Rugby No. 7, containing over 130 levers, was brought into use on 3rd March. It is on the down side of the line, replacing the existing box on the up side.



A down Pullman express leaving Victoria for Eastbourne. The locomotive is one of the well-known Brighton "Atlantics," now S.R. No. 2040, "St. Catherine's Point." Photograph by J. M. Craig, Farnborough, Kent.

New "Castles" and "Halls" from Swindon

The latest batch of 30 tank engines of the 0–6–0 type, numbered 9720 to 9749, were completed at Swindon and sent into traffic before the end of February. Work is now well forward on the 10 new 4–6–0 locomotives of the "Hall" class, and the first two, No. 5941, "*Campion Hall*," and No. 5942, "*Doldowlad Hall*," are already finished. The others will be turned out in quick succession. Further 0–4–2 tank engines of the "48" class to the number of 10 also are in hand at Swindon and work has just been commenced on the new batch of 10 "Castles."

Railway Camping Coaches

There will be a greatly increased number of camping coaches on the railways of Britain during the coming holiday season. So popular did they prove last year that many more coaches have been adapted in readiness for use this summer. The S.R. have now come into line with the other three "groups" in providing these facilities for holiday makers, with the result that railway campers now have the choice of a great variety of sites.

Every coach has sleeping and living rooms and a kitchen, and is fully equipped with crockery, bed and table linen, table ware, kitchen equipment and a cooking stove. The coaches have been aptly styled "bungalows on wheels."

Good Running by "Stanier" Locomotives

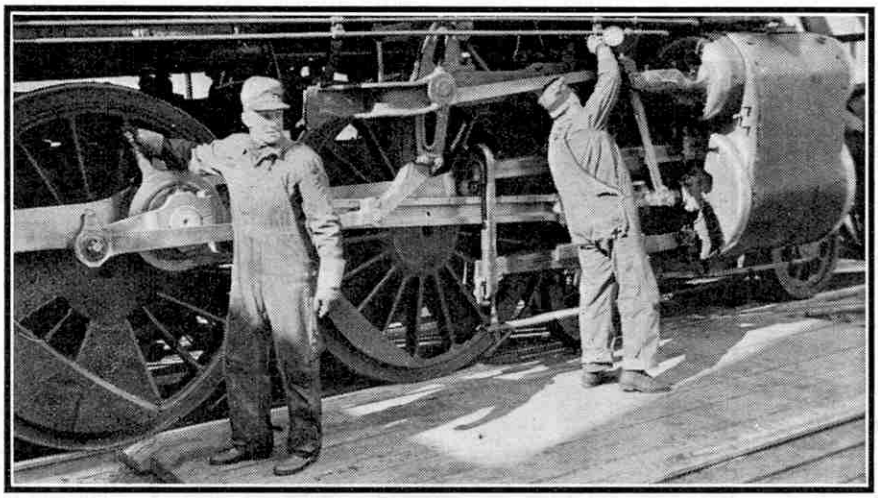
Stanier 4–6–0 taper-boilered engines of Classes "5X" ("Baby Scot") and "5P5F" (mixed-traffic) are now generally at work on Midland Division expresses. No. 5662, of the Derby-built series, is stationed at Bristol. The "5P5F" engines are frequently to be seen on the "25's" from St. Pancras, also between Derby and Manchester, and show a surprising turn of speed for engines with 6 ft. driving-wheels.

No. 5615, of the "5X" Class, made a very fine run from St. Pancras to Nottingham recently with the "*Thames-Forth Express.*" With a load of seven vehicles, 212 tons tare, the 123.5 miles were covered in 125 min. 45 sec. start-to-stop, the net time, after allowing for delays, being 120 min., as compared with a schedule of 129 min. Luton, 30¼ miles from the start, was passed in 32 min. exactly, the minimum speeds at Elstree and Sandridge summits being 55 and 58.4 m.p.h. respectively. Although the engine was run under easy steam down most of the long gradients, a maximum of 85.4 m.p.h. was attained at Plumtree before shutting off steam for Nottingham.

On the favourably-graded Manchester and Liverpool (Western Division) line, No. 5644 of the same class with a light train of four coaches ran from Manchester (Exchange) to Edge Hill, a distance of 30 miles, in 32 min. start-to-stop, inclusive of a severe permanent way slack at Glazebury, while the engine was eased after Rainhill. The maximum speeds were 80 m.p.h. beyond Barton Moss Junction, and 79 m.p.h. near St. Helens.

"Prairie" Locomotives for L.N.E.R.

The appearance of the new 2–6–2 "Prairie" locomotives that are to be built for the L.N.E.R. will be awaited with unusual interest, for although engines having that wheel arrangement have been built in large numbers for railways on the Continent of Europe and in America, hitherto no British railway has had any of that type. It is characteristic of Mr. H. N. Gresley, the Chief Mechanical Engineer of the L.N.E.R., that he should introduce features that are new to British practice. As yet the new locomotives are only in the drawing office stage and many details of the design remain to be settled, but it is definite that they will have three cylinders and wide fireboxes.



The upper illustration shows the all-steel Pullman "Queen of Scots" express hauled by the booster-fitted L.N.E.R. 4-4-2 locomotive No. 4419. Photograph by courtesy of the Pullman Car Company Ltd. The lower photograph shows a typical American locomotive crew lubricating their engine during a stop of the "Empire Builder" express of the Great Northern Railroad. Photograph by A. Hobart of Minneapolis, Minn.

Five more three-cylinder 4–4–0 locomotives of the "Hunt," or "D49" class have been completed at Darlington works. They are No. 363, "*The Grafton*"; No. 364, "*The Grove*"; No. 365, "*The Morpeth*"; No. 366, "*The Oakley*"; and No. 368, "*The Puckeridge.*" Additional 0–6–0 freight engines of the "J39" class also have been turned out at Darlington and are numbered 1475 to 1479, 1488 and 1490. During the present year 39 engines of the "J39" class are to be built at Darlington, together with five further engines of the "Hunt" class and five of the 4–6–0 "Sandringham" class.

Mixed-traffic 2–6–0 engines of the "K3" class, numbered 1307, 1322, 2738 and 2739, have been delivered by Messrs. Robert Stephenson and Co. and sent to work in Scotland, and 20 locomotives of this class have recently been ordered from the North British Locomotive Co. Ltd.

Doncaster works have completed the order for seven express locomotives of the "Pacific" class and are now engaged on a batch of 16 three-cylinder 2–6–2 tank engines, the first of which has been sent into service.

"Southern" Electrification Extensions

Such good progress has been made with the Southern Railway's Eastbourne electrification scheme that on Sunday, 17th February, trial electric trains began running between Brighton and Hampden Park Station at Eastbourne.

Some of the most difficult works in connection with the scheme are being carried out at Lewes, where men are working night and day. Lewes tunnel is being widened. At present it is not wide enough to permit the rolling stock of the new electric services to pass through, and its width is being increased to the extent of 3 ft. for a distance of 230 ft. to make this possible. The station also is being enlarged, and a new road bridge is being provided.

Just south of Lewes Station runs the River Ouse, which is spanned by a bridge carrying the railway. As the passage of certain vessels necessitates the raising of the central span, in somewhat similar fashion to that employed on the Tower Bridge, London, the high tension cables that will supply the current for the third rail cannot be carried over it. They are now being laid under the river bed.

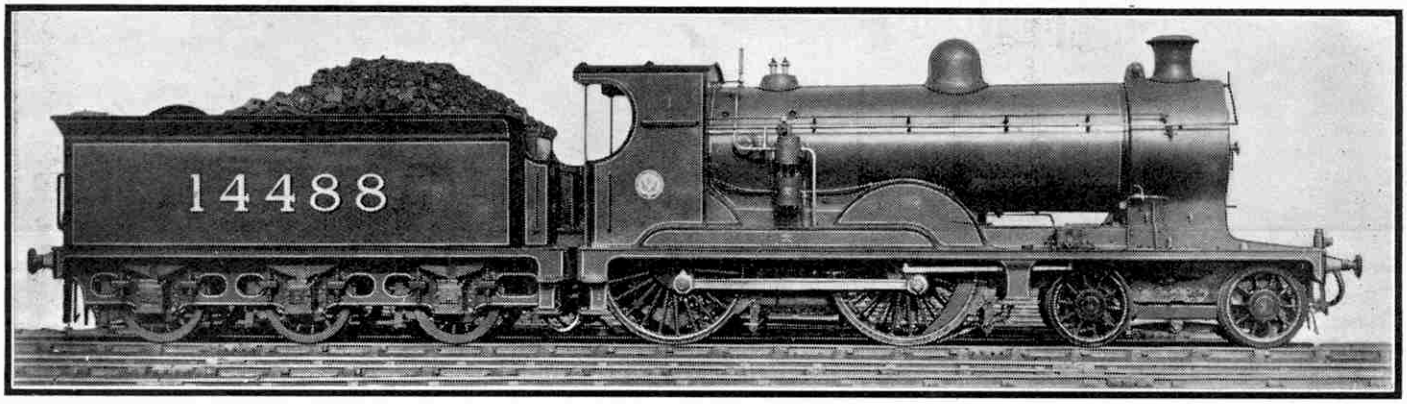
Warm Welcome for Ocean Travellers

The S.R. are to construct a special "Train Warming" and Cleaning Shed behind the huge Passenger and Cargo Sheds 103 and 104 in their new docks at Southampton. In the new shed boat trains will be heated to the same temperature as that of the liners from which passengers will disembark. It will be 759 ft. long and 98 ft. wide, and will accommodate six boat trains, each consisting of 12 bogie coaches. The necessary train cleaning also will be carried out in it.

On the Footplate of "The Granite City"

Splendid Driving of 4-4-0 Engines

By a Railway Engineer

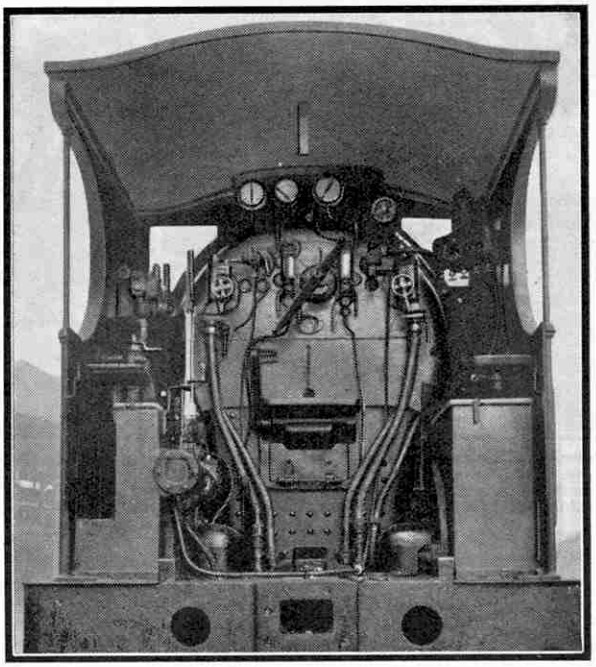


THE express train service of the L.M.S.R. between Glasgow and Aberdeen is unlike any other main line service in Great Britain. There are no runs longer than about 40 miles made non-stop, but the intermediate timings are extremely fast. Engines of the 4–4–0 type are almost exclusively used and the running is some of the fastest and hardest still entrusted to such comparatively small engines.

I was recently privileged to make the return trip from Glasgow to Aberdeen on the footplate of the best-known train on the service, "*The Granite City*," which leaves Glasgow at 10 a.m. and returns to Aberdeen at 5.35 p.m. In these days of "Pacifics," "Mikados," and huge 4–6–0 engines, it was deeply interesting to see the different methods of driving necessary with the older smaller machines.

My journey was made at the very height of the summer service, and in the down direction, after we had made an excellent start, passing Stirling three minutes early, we suffered badly from signal checks for the rest of the run to Perth, and it was not until after this point that the running became of real interest. Our load was one of nine corridor coaches, 259 tons empty, and 275 tons with passengers and luggage. The engine was a Caledonian 4–4–0 of the Pickersgill type, No. 14494, in charge of Driver Cooper and Fireman McKechnie of Perth. This type, in common with standard practice on the old Caledonian Railway, is driven from the left-hand side of the cab. The reversing gear is of the older pattern consisting of a long lever working through a notched quadrant. It is from this type of gear that the enginemen's term "notching up," to denote the process of changing from long to short cut-off working, is derived. The cab is roomy and comfortable, and as the boiler is not very big, there is a good look-out ahead from either of the glasses. No. 14494 was a very steady riding engine; I noticed particularly how smoothly she took the curving stretches of line.

We got away in fine style. This type of engine is fitted with the pattern of valve gear almost universal on all British locomotives until comparatively recently. On such engines it is not possible to work at a shorter cut-off than about 30 per cent., as the big ends tend to run hot. With such a long cut-off it is not possible to open the regulator to its fullest extent because the blast would be so fierce as to draw a large proportion of the coal straight through the chimney. For all the hard work on this run from Perth to Aberdeen, Driver Cooper worked at 40 per cent. cut-off with the regulator between one-half and five-eighths open. This method of driving produced very good results on all the steep rising gradients, but on the level the engine was distinctly sluggish. This was only to be expected, because such a large volume of steam in the cylinder at each stroke has a decidedly choking effect, and does not permit of very free running.



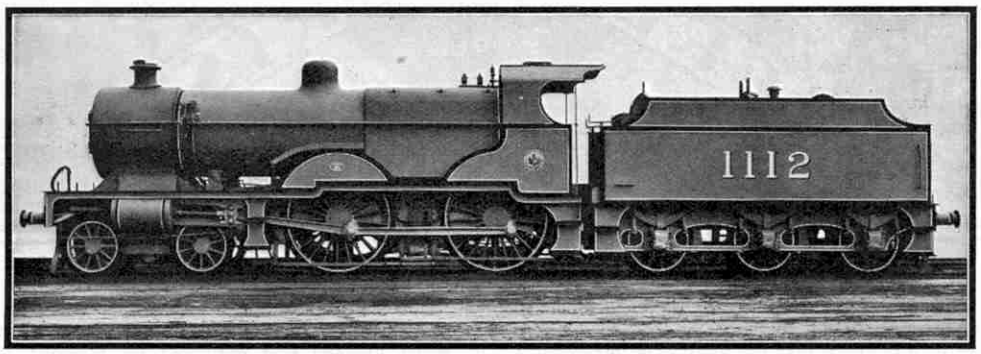
The upper illustration on this page shows a Caledonian 4-4-0 of Pickersgill design. Below is a cab view of one of these engines. The illustrations to this article are reproduced by courtesy of the L.M.S.R.

Starting away from Perth the line rises steadily up to Stanley Junction where the Highland main line to Inverness goes off. The steepest grade is 1 in 125, and here the speed fell to 39 m.p.h. On the level grades that follow, the speed rose to 60 m.p.h., but just as Cargill was passed the damper slipped out of adjustment. In less time than it takes to describe, the boiler pressure had dropped from its rated maximum, 175 lb. per sq. in., to 125, and although the damper was quickly re-set, it was some considerable time before the boiler pressure was fully restored. Travelling in the train the sudden easing up from 60 to under 50 miles an hour would have seemed rather strange, and as it was it caused a loss of fully a minute. The 15.8 miles from Perth to Coupar Angus took 22½ minutes, against 21 minutes scheduled time.

The next section to Forfar is timed extremely fast, the 16.7 miles being booked in 18 minutes start to stop. It is here that the limitations of the engine were clearly marked, as the speed did not go above 58 miles an hour on this level stretch, and two minutes were dropped on booked time, although for about half the distance the pressure had not fully recovered from the damper episode.

Beyond Forfar the line begins to rise and fall just like a switchback, and here No. 14494 showed up to considerably better advantage. We got away in excellent style, reaching 60 m.p.h. 6 miles after starting, and covering the 15.3 miles to Bridge of Dun in 18½ minutes start to stop. The speed down the Farnell Road bank rose to 67 m.p.h., and here was revealed again another curious difference between the method of working this type of engine and the ultra-modern high-pressure engines. Down the bank the driver increased the cut-off to no less than 70 per cent., that is very nearly full forward gear, and closed the regulator to only about one-fifth open. At high speed, even though working on so long a cut-off as 40 per

cent., there was a very decided "bump" at each stroke, and this became more pronounced as the speed rose. By lengthening the cut-off the "bump" was almost entirely eliminated when the engine was running at high speed down the bank, but at the same time a large volume of steam in the cylinder had a still more pronounced choking effect. What a contrast this makes to the working of modern high-pressure engines fitted with long-travel valves! In such a case the cut-off would probably have been reduced to 10 or 12 per cent., and with the regulator about half open at most, the speed probably would have got well into the eighties on so favourable a stretch of road without the slightest danger of any heating troubles in the rods and motion.



L.M.S.R. Standard Compound No. 1112. This is one of the engines with left-hand drive for service on the Western, Central and Scottish Sections, where such driving practice has long been usual.

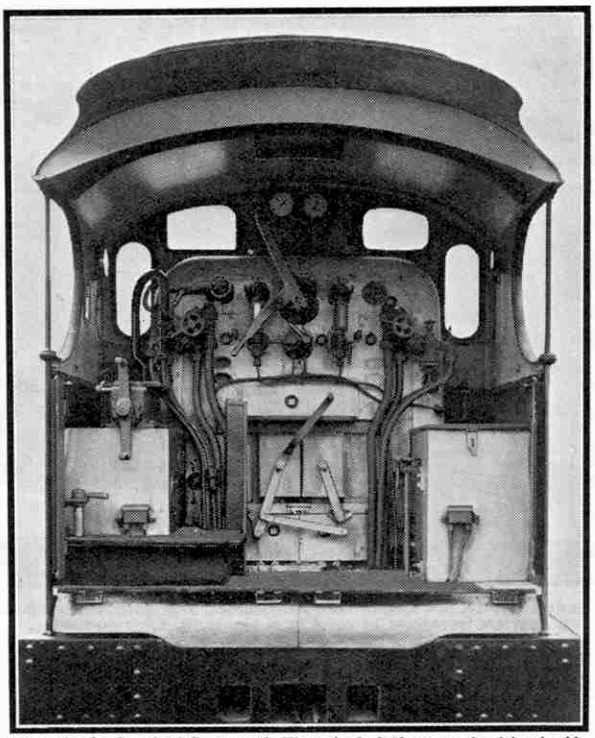
The next section from Bridge of Dun to Laurencekirk involved some hard climbing, and here the work of the engine was excellent. On the 1 in 100 past Kinnaber Junction the minimum was 37 miles an hour, while on the steep ascent past Marykirk, again at 1 in 100, the speed was sustained at 36 m.p.h. The 11.3 miles from Bridge of Dun to Laurencekirk were covered in 17¾ minutes. Further good work was done up to Stonehaven, keeping exact time, and the final stretch to Aberdeen, a wonderful stretch of line, where the railway is carried high up on the cliffs by the wild Kincardineshire coast, the running was the finest of all. From Stonehaven station, in 2½ miles, rising at 1 in 100, the speed had risen to 32 m.p.h., and the 16.2 miles from Stonehaven to Aberdeen would have been covered in 21 minutes but for signals against us at Ferryhill Junction. By good running over the concluding sections of the journey, the time lost between Perth and Forfar was entirely recovered, and we kept exact time from Perth to Aberdeen, but all the same the run clearly shows the limitations of the type concerned.

The return trip on the 5.35 p.m. up was a truly thrilling experience from start to finish. The load was very much heavier, 10 corridor coaches and a Pullman Dining Car, weighing 332 tons empty, and 355 tons with passengers and luggage. Our engine throughout to Glasgow was No. 1127, a Standard Compound, very ably driven by J. Grassie of St. Rollox shed.

With this very heavy load for a 4–4–0 engine it was necessary to take a pilot engine over the steep grades between Aberdeen and Forfar, as the starts from Aberdeen and Stonehaven are up very steep gradients, and rather than risk losing time such assistance is fully justified. The pilot engine was one of the famous "*Dunalastair*" class, built as long ago as 1896. This graceful, elegant little engine looked quite an infant alongside the sturdy Compound, and still more so against a big North British "Atlantic" that was standing near by. Yet in 1896 the "*Dunalastairs*" were considered enormous engines and, incredible though it may seem to-day, set the fashion in this country for big boilers! I was talking to her driver and recalling this when, on the next set of metals, an L.N.E.R. Pacific, No. 2566, "*Ladas*," backed down to take the 5.45 p.m. East Coast express. Big boilers indeed! How would "*Ladas*" have been described in 1896?

It was now nearly starting time, and I climbed up on the footplate of the Compound. The original engines of this type, as used on the Midland Railway, were driven from the right-hand side, but when the type was standardised by the L.M.S.R., all the new engines were given left-hand drive to suit the practice of the London and North Western, Caledonian and Glasgow and South Western railways, on which lines they were to be used. The reversing gear is of the modern screw type. The look-out from the right-hand side, where I was, is not so extensive as on the Pickersgill 4–4–0s, as you have to look past the vertical side of the Belpaire fire-box, but the driver has a raised platform on his side of the cab so that he can use the second glass, which looks right over the top of the fire-box. Thus he gets an excellent view.

We started away in great style, and on the 1 in 100 ascent out of Aberdeen the two engines sustained 38 m.p.h. Then comes the descent to Muchalls, a thrilling piece of line right on top of the cliffs, where from one point it looks from the footplate as if you are going straight into the sea. Here the speed rose to 69 m.p.h., and we reached Stonehaven in the excellent time of 22 minutes. Re-starting from Stonehaven there is a tremendous ascent past Dunnottar at 1 in 90, easing later in the climb to 1 in 100. Here we accelerated to no less than 40 m.p.h., and despite the pilot engine in front, the compound was being driven at nearly three-quarters full power. Once over the top both engines were very markedly eased for the descent to Laurencekirk, in fact the driver of the pilot engine shut off steam altogether; and the compound, running also under quite easy steam, pushing the pilot, and hauling the train, worked up to 65 m.p.h.



The cab of a Standard Compound. The raised platform on the driver's side will be noticed, also the convenient arrangement of the fittings generally.

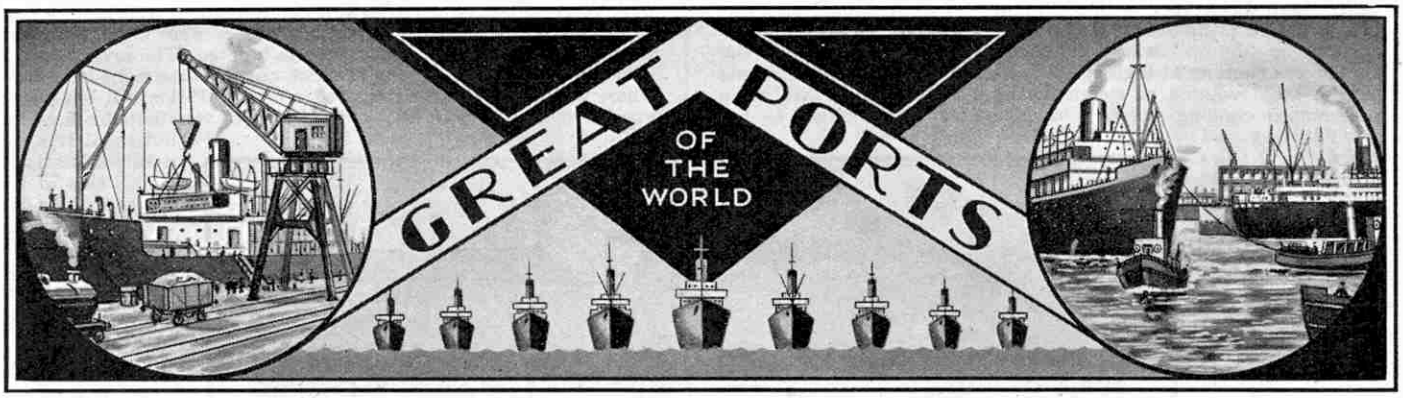
We had passed the summit of the bank at Mile Post 220¼, 4½ miles from Stonehaven, in the splendid time of 9¼ minutes, and reached Laurencekirk, 14½ miles in 19¾ minutes, only 15 seconds less than booked time. The next run, on to Dubton Junction, is typical of the short, sharp spurts demanded on this route. Only 11 minutes are allowed to cover the 8½ miles, start to stop, and to do so means getting "off the mark" like lightning. We were soon flying down the Marykirk bank at 73 m.p.h. and kept time exactly, speed being moderated as usual to 55 m.p.h. over the curve at Kinnaber Junction.

This lonely signal box will be for ever famous in British railway history as the goal of the great Railway Race in 1895. Here the East and West Coast routes from London to Aberdeen converge, and during that stirring time the 8 p.m. sleeping car expresses from King's Cross and Euston raced for this junction. It was a case of "first come, first served," and on one of the most exciting nights the Caledonian train beat the North British by less than one minute!

Over the remainder of the distance to Forfar there was no running of exceptional note, as the grades are rather easier from this point onward, and with two engines no very great effort was demanded.

Now the real thrills began. No. 1127 set out to haul this really big train unassisted over the remainder of the distance to Glasgow, and put up some magnificent running. First of all comes the run from Forfar to Perth, 32½ miles booked in 35 minutes. On getting away from the start the regulator was first of all moved to about one-quarter open; this gives single expansion working, and is used to get the train under way. After about 100 yards the regulator was pushed fully open, and compound working began. The cut-off was 67 per cent. in the high-pressure cylinder and 55 per cent. in the low-pressure. Although this at first seems very

(*Continued on page 252*)



XIV.—QUEBEC

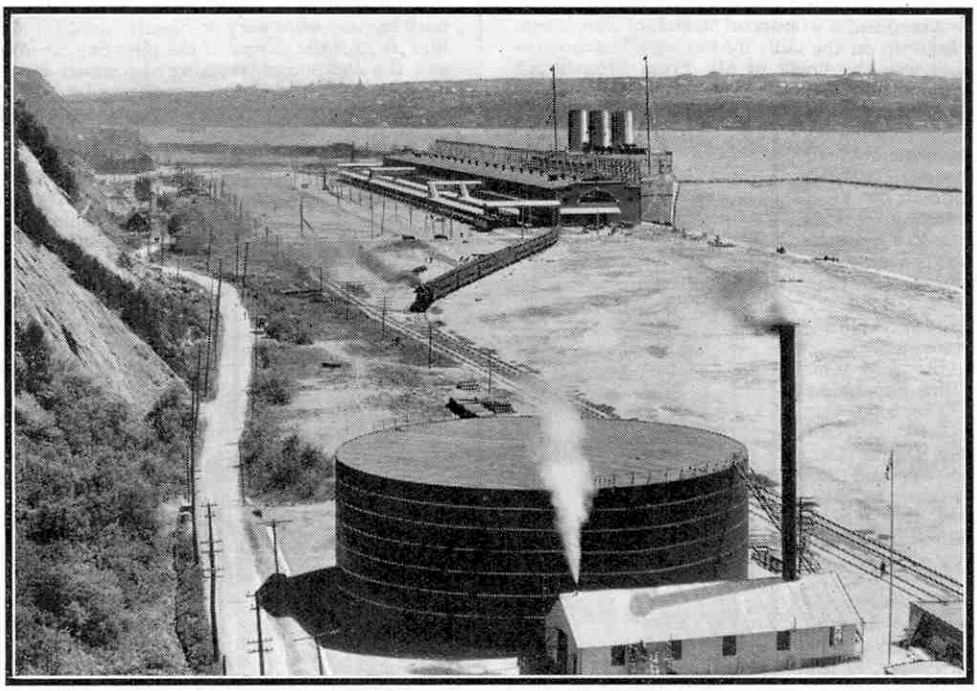
THE history of Quebec dates back to the days when the hardy adventurers of the 16th century first navigated the mysterious Atlantic Ocean in their frail ships in search of new empires. The locality and extent of the New World, as the American Continent was called, was very imperfectly understood by those navigators, and it is not surprising therefore that although explorers of various nations were seeking the same destination they drifted widely apart. The Spaniards, for instance, reached the fertile regions of Florida, and French adventurers led by Jacques Cartier entered the bays and rivers of what is now Canada. Cartier, in *"La Grande Hermine"* of 120 tons, and accompanied by two smaller ships, *"Le Petite Hermine"* of 60 tons and the *"L'Emerillon"* of 40 tons, sailed from St. Malo, Brittany, in the summer of 1535, and landed at the Indian village of Stadacona, where Quebec now stands, on 14th September, 43 years after the discovery of America by Columbus.

Sir James M. LeMoine, in his *"Annals of the Port of Quebec,"* describes the arrival of Cartier's expedition. "Great had been the surprise and the alarm in the Indian village on the heights," he says, "not less the anxiety of the Chief Donnacona on contemplating the white sails and black hulls, and the 'foreign devils,' 110 all told, crowding on the decks of the unwelcome craft. Still greater their terror when Cartier's big guns roared out a salute which echo repeated from hill to dale along the St. Lawrence. The occasion required the convocation of an Indian Council. Donnacona called together his braves; an address and offerings were tendered by the Great Chief, with 500 followers. This brought back a reply and presents for the Red Skins."

After spending the long, dreary winter months at Hare Point, on the St. Charles River, Cartier sailed for home on 6th May, 1536, taking with him six of the Indians to present to his royal master as living proof of his discovery. He returned to Canada six years later with a squadron of five vessels.

From 1541 France was engaged in almost continuous warfare in Europe, and did not make any serious attempt to organise any permanent establishments in Canada until the arrival there of Samuel de Champlain, who founded Quebec, the "Walled City of the North," on 3rd July 1608. The colony established by Champlain and those who accompanied him was held by France until 1759, when Quebec was captured by General Wolfe at the famous battle of the Plains of Abraham, and Canada passed from French to British rule.

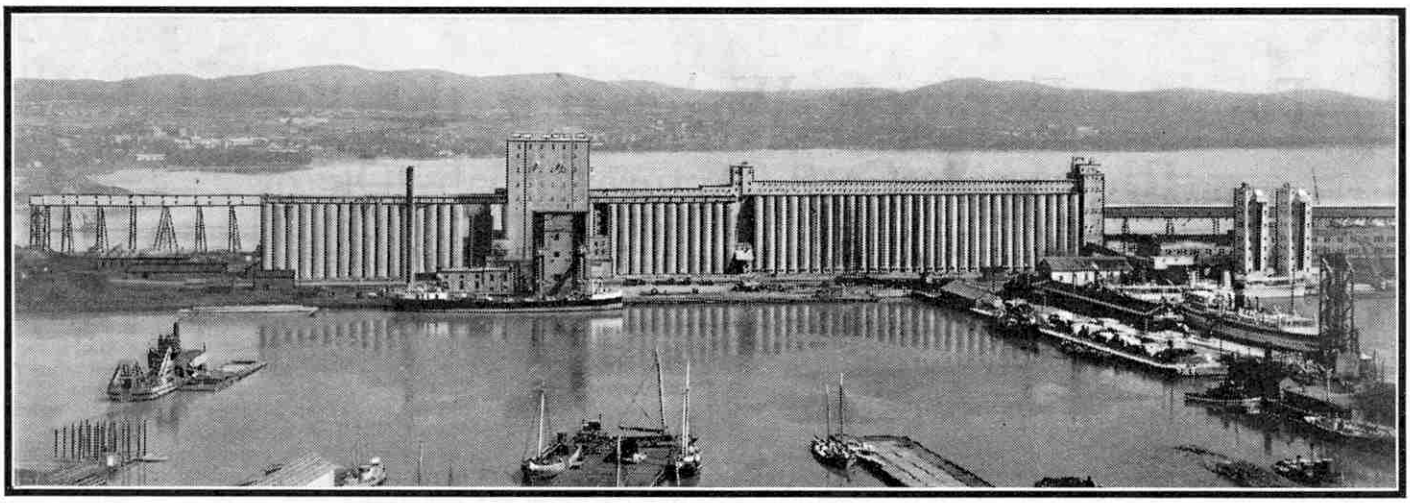
Quebec is situated on the St. Lawrence River at the point where it is joined by the River St. Charles, 166 miles below Montreal by the river, and 180 miles above the entrance to the Gulf of St. Lawrence at Father Point. The development of Quebec as a port was begun by the French, who improved what had been the Indians' principal landing place so that vessels of deeper draught could be accommodated. This landing place was at the foot of Canoterie Hill, so named because the coast led to the place where the Indian canoes were stationed. As the commerce of the town increased private interests built wharves and piers, without any general plan, along the St. Charles and St. Lawrence rivers, on both sides of the point still known as Pointe-à-Carey.



Wolfe's Cove Terminal, the first section of new harbour facilities at Quebec. This illustration and the lower one on the opposite page are reproduced by courtesy of Mr. W. B. Edwards, Quebec.

In 1805 an Act of Parliament established Trinity House, the first authority vested with power to administer the port of Quebec, and gave them jurisdiction over the pilots. Just over 50 years later the Board of Harbour Commissioners was formed. These two bodies functioned simultaneously until 1876, when the powers that still belonged to the Trinity House were transferred to the other body, who were renamed the Quebec Harbour Commissioners. The first big development of the port began a few years before the disappearance of the old Trinity House, when an extensive programme of improvements, including practically all the wharves of that time and providing for considerable enlargements, was prepared and put into execution. Subsequent Commissions have gradually added to these early facilities.

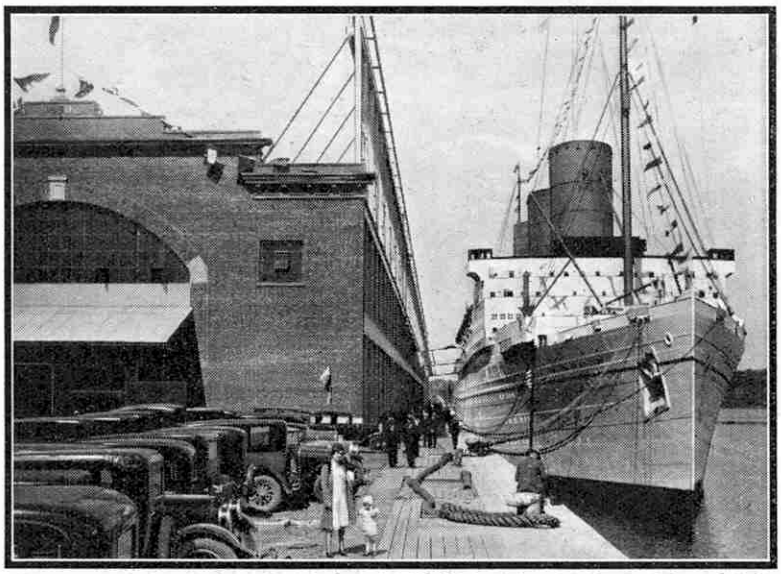
The construction of the first section of new and extensive harbour terminal facilities at the port was begun in 1925 and completed in May, 1931. This terminal is at Wolfe's Cove on the north shore of the St. Lawrence River, and covers the development of that shore from Cape Diamond to Point Pizeau. It is being built in sections, a new one being added when made necessary by the increasing trade of the port. The first section includes 4,352 ft. of quay wall, of which 3,776 ft. is parallel with the



shoreline; and the remaining 576 ft., forming the south-western extremity of the wall, projects at an angle with the shore.

Up to low water level the quay wall is constructed of timber cribs, and the portion above that level is of concrete. The cribs are of 1 ft. by 1 ft. British Columbian fir, and are 60 ft. wide at the base and stepped to 20 ft. wide at the top. The main cribs are 202 ft. long. Anchor cribs 150 ft. deep are placed at every fourth main crib to give improved anchorage and alignment. The concrete portion consists of pre-cast reinforced concrete sections, which were first placed in position on top of the timber cribs and then filled with concrete. It is 26 ft. high and is 19 ft. wide at the base and stepped to 6 ft. wide at the top. The front of the wall is faced with pre-cast concrete blocks. The shore enclosed by the wall was filled up to the required level with about 6,000,000 cu. yd. of material, part of a huge quantity dredged from the river bed in the approach channel and in front of the quay wall. This dredging was necessary in order to provide a depth of 40 ft. at low water in the channel and at the various berths.

A two-storey steel-framed concrete shed 1,380 ft. long and 100 ft. wide was erected on the completed section of the terminal. It is used for the passenger traffic of the Canadian Pacific Steamship Company's "Empress" and other liners. The shed is fireproof and is equipped for the rapid handling of passengers and cargo. Baggage and freight are efficiently dealt with by cargo beams above the shed roof, operated by electric winches from the upper storey. These winches also handle the gangways run out from both floors of the shed. A passenger railway station adjoins the shed and connects with the line of the Canadian National Railways running from Quebec Bridge, and also with the tracks of the Canadian Pacific Railway Company leading to their tunnel through Cape Diamond and to their Quebec-Montreal line.



(Above) The Quebec Harbour Commissioners' 4,000,000 bushel grain elevator. Photograph by courtesy of the Commissioners. (Below) A closer view of the quay at Wolfe's Cove Terminal, and of the C.P.S. liner "Empress of Britain."

The port possesses 33 berths for ocean ships, with a depth of water ranging from 25 ft. to 40 ft. at low tide. The extensive wharfage available totals 30,000 ft., half of which is controlled by the Harbour Commissioners and the remainder belongs to private companies. The docks equipment includes a 50-ton floating crane, five locomotive cranes with a lifting capacity up to 38 tons, and wagons and barges for the removal of ballast from ships. The warehouses on the various wharves have a combined floor space of 750,000 sq. ft. Warehouse No. 27, on Pier No. 1, is equipped as a cattle resting, feeding and loading station, and can accommodate 2,000 head of cattle. The dock railway operated by the Commissioners has a total of 32 miles of line, and connects the Canadian Pacific, Canadian National and Quebec Central Railway systems with all berths and warehouses.

There is ample provision for the bunkering of oil-burning ships using the port. The Commissioners have a fuel oil pipeline running from storage tanks at the Louise Docks to various berths, and a similar pipeline runs from a private company's tank at Wolfe's Cove to all ships' berths. Ships requiring repair are provided for by two excellent graving docks, one of which is 1,150 ft. long and 120 ft. wide at the entrance and can accommodate the largest ships afloat. The other graving dock is 600 ft. long and 62 ft. wide at the entrance.

Quebec is not an all-year-round port, but is open from the beginning of April until the end of December. During that period a great volume of trade passes through the port, and in 1933 imports totalled 960,700 tons of various commodities and 4,385,416 superficial feet of lumber and timber, while exports totalled 618,364 tons of merchandise and 6,667,300 superficial feet of lumber and timber.

The principal imports are coal, iron and steel manufactures, raw cotton, grain and fuel oil. Powerful cranes are used to unload the cargoes of coal and load the material into railway wagons, and for the bunkering of ships. The coal companies using the port have five towers for discharging and loading coal. Large quantities of grain are dealt with at the Commissioners' grain handling plant. The elevator is of fireproof construction and has a storage capacity of 4,000,000 bushels. The cargoes brought by the Great Lakes boats are discharged by three mechanical unloaders at the rate of 40,000 bushels per hour, and grain received by rail is unloaded at the rate of 120 wagons per day.

The chief exports are paper of all kinds, wood pulp, grain, cheese, apples and fish. The grain exported from the Commissioners' elevator during 1933 totalled 16,716,535 bushels, of which 15,193,713 bushels were loaded on to ocean steamers. The immense volume of dairy products made in the districts tributary to the port, and the products of the fisheries of the St. Lawrence River and Gulf, which are among the most extensive and richest fisheries in the world, are catered for by a modern cold storage warehouse and fish house at the port. The traffic through this plant during 1933 included 870,342 lb. of fish; 7,609,454 lb. of cheese, and 1,135,381 lb. of butter.

Quebec is also an important passenger port, and has a considerable transatlantic passenger traffic.

We are indebted to the courtesy of the Quebec Harbour Commissioners for the information contained in this article.

Famous Explorer Writes for the "M.M."

III.—Attilio Gatti Captures a Baby Okapi

THE story of *Toto* is not an everyday story. It is, in fact, the first time that such events have happened in the dark and humid depths of the equatorial forest, as it is the first time that it has happened to me to be transformed from an explorer into a nurse.

How the affair began I was not able to see with my own eyes, for the entanglement of trees and vines and bushes of every kind in which *Toto* and his mother were safely hidden that morning was absolutely sight-proof. But I had already spent five months in that part of the Ituri Forest—where man had never been before—for the sole purpose of finding out one by one the secrets of the life of the okapi. So it is not difficult for me to reconstruct the first events of that day with the eyes of the imagination, as exactly as if I had actually witnessed them myself.

That morning very, very early, when the hot sun of the equator had just begun to warm up the infinite expanse of the forest, mother okapi got lazily up from the bed of perfumed leaves on which she had passed the night with her small one. "Small" is a figure of speech, by the way, for although only four odd weeks of age, *Toto* already was three feet high at the shoulder and four at the head. But near that mother of his, taller, stronger and heavier than a big horse, he looked like a ball of beautiful shining hair, red and black, white and brown.

Toto, too, got up after a little while, drowsy from the abundant breakfast he had just finished, and, as every morning, he made a few steps towards the tortuous exit of that cavern of vegetation, as if he would precede his mother. But she, also as every morning, said to him sharply; "No." How she said this, or anything else, to him, I frankly do not know; for the okapis are similar to the giraffes, not only in the form of the head, but also in the peculiarity of being unable to emit a vocal sound of any kind. Still, in spite of this, they know how to talk among themselves.

Commander Gatti trying to persuade Toto to eat a leaf of lettuce.

Once more, as I was saying, *Toto* heard that "No." One couldn't go out until one had become big and strong enough to gallop with his mother; because there was the *tshewi*, the big leopard so ferocious, and the *mboko*, the little red buffalo so nasty—and beware if they found a young one out by himself!

With her blue tongue, a foot-and-a-half long, mother had meanwhile given a last licking to *Toto*, for fastidious cleanliness is the most characteristic peculiarity of the okapi. First of all she licked his small giraffe-like head, where already two tiny horns covered with skin are appearing, and which is crowned by two enormous red ears bordered in black. Then the stiff short mane, which ends in a little tail, full of importance. Then the black back, the red sides, and the silverish belly that resembles that of an antelope. Finally the plump thighs, striped in glossy black and snowy white as are those of a zebra, and the big woodenish legs that look as if they were wearing immaculate white stockings and an anklet of jet.

At this point the ears of mother okapi, which are as big as a loud speaker and even more sensitive, must have picked up some infinitesimal, unpleasant noise, for suddenly they began to point at attention towards every direction. Her big eyes revolved, each one on its own account, as the eyes of a chameleon, in order to try to find out the cause of that noise.

A few seconds of silence, of absolute immobility, followed, during which *Toto* concentrated all his energies in trying his best to imitate those interesting gymnastics of eyes and ears. Then the noise became distinct. A slow cracking of wood—an even slower and continuous rustling of leaves. A great mahogany or a monumental palisander, mined by old age, was about to fall. And this is the only danger that the okapi really fears, for instinct tells him that when those giants fall they break and smash everything in their path, and neither the obstinacy nor the determination of any animal can accomplish anything against them.

A snort as of a horse came from the long patrician nose of mother, a noise which, in such an emergency, signifies something like: "Let's get out of here." And at once the beautiful animal started towards the exit with that funny slow-motion-picture gallop of hers. *Toto*, happy at the chance at last of getting out from that hiding place where he had been so bored for so many days, started to gallop too. But this method of proceeding was so new to him that his gallop was uncertain, and all those big vines and those thorny branches embarrassed him a lot. So when, at the end of the dark green corridor, he came to a place where the vegetation is a little less thick and some rays of the sun can penetrate, *Toto* stopped suddenly, looking all around, full of curiosity. His mother had already disappeared as if she had been swallowed by the vegetation. Something he didn't understand, but which must be quite terrible to have frightened away his brave mother, hadn't happened yet, although the noise that had provoked such a panic still continued near at hand.

Toto, for the first time in the open and by himself, realised that in his short life an important moment had come in which, to be on top of the situation, he must comport himself as a grown-up, strong okapi. First of all, one had to snort as one's mother had done a little before. But the result of this effort wasn't very brilliant, reducing itself to a sort of melancholy sneeze that wouldn't have frightened either an *mboko* or a *tshewi*. Undaunted at this poor success, *Toto* thought of those acrobatics of eyes and ears. These, after the rehearsal a little while before, went much better. Not only that, but one ear told him that the noise of leaves and cracking wood came from the right. There his right eye in one of its quick circumvolutions surprised some black things moving in the green, and on them fixed itself, very interested.

Of course *Toto* didn't know that those round black things were heads of the pygmies who the night before had followed the footprints of his mother to the impenetrable hiding place. Neither could he imagine that all that movement of leaves and crackling of branches was a trick that the observations made in the forest had taught me, and which in my turn I had taught to the pygmies in the hope of scaring away the mother and so avoiding the useless cruelty of having to kill her if she had charged my little group of men.

However, *Toto* saw that one of those small black forms was silently advancing towards him, and his eyes, beginning to revolve again, discovered all around him other forms coming from the left,

from the front and from behind. Then abruptly he raised his head, and stamped peremptorily with a stiff foreleg. This was intended as a gesture of impatience such as to frighten anybody, but it had all the appearance of a delicious little movement of those tiny trained ponies one sees in the circus.

Then events were precipitated in such a way that *Toto* couldn't make very much out of them. Something—he didn't know what—descended over him, enveloping him and impeding every movement. The first voices he had ever heard—and strange voices are those of the pygmies—spoke around him, while he felt himself lifted up from the ground. Then something even stranger began that he took some time to appreciate. The trees passed, one after the other, quickly, as when he had made those few paces of gallop, but now they were all upside down, with the roots in the place where the leaves should be, and vice versa. The earth was up on high and the sky was below, and he was running without touching the ground, without even being able to move his legs.

Toto wandering in the base camp garden. This photograph shows well his beautiful leg markings.

This continued for quite a while, a strange rather than an unpleasant experience, until the trees suddenly stopped and some unknown things appeared, big, light green, quite funny, especially seen from his angle. *Toto* didn't have very much time to think it over, for in the midst of those strange things he again took contact with the ground—his back first, then his head, and finally, with a half spin, his legs.

In the big clearing we had cut out of the forest to put up our base camp, in the middle of the semi-circle formed by our large green tents, the pygmies had deposited the bag which, attached to a long pole, had transported for more than four hours *Toto*, the first okapi ever captured by a white man!

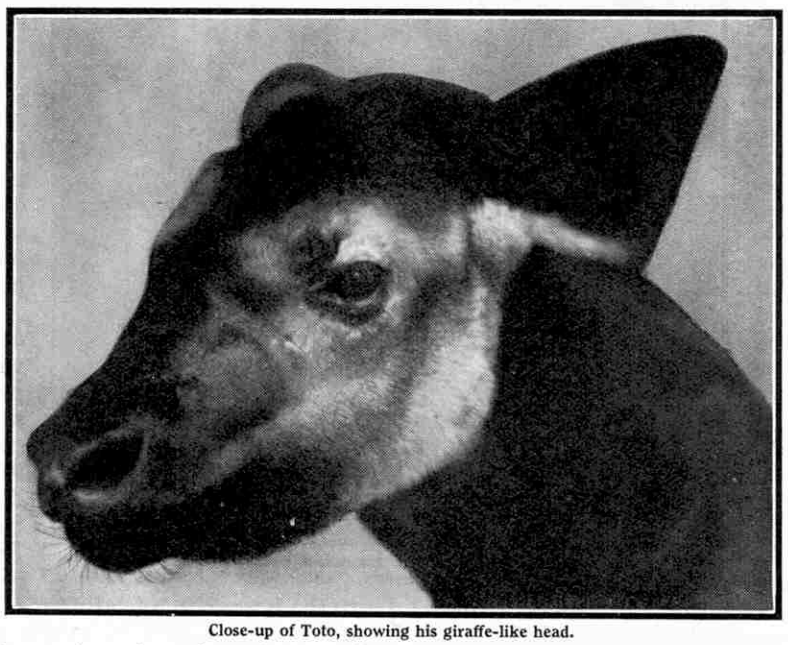
The joy of my companions of the expedition, after so many hardships and the innumerable unsuccessful attempts we had made previously to capture an okapi, at once manifested itself in a hundred little attentions. Between a caress and an affectionate word, they got him out from the bag, extricated one of his legs from a tangle of ropes, and helped him to his feet; while I tried in every way to quiet the natives of our camp who, good devils that they are, seemed to have become mad with excitement at our success, and all around us shouted at the top of their lungs.

Toto, however, if he was alarmed at all by those unusual noises, was too much of a born gentleman to show any emotion; he merely threw at the natives an indifferent glance of his rotating eyes. He projected a good foot of tongue to dismiss a fly from the top of his head; repeated that stamp of impatience, so delightful; and began to walk slowly towards me, one leg at a time. Then, reaching me, he laid his head, full of confidence, on my arm.

This was the beginning of *Toto's* life among civilised people, and the beginning of my career as an okapi nurse.

If there is a person in the world who knows little about the care of a young animal, I must confess it is I. As regards shelter for *Toto*, everything went perfectly, for months ago, in expectation of the so-much-desired capture, I had prepared a palisade about 500 ft. long, which included a piece of forest and a beautiful hut of sticks and leaves. For the most essential part of the food, in some way we managed, improvising a nursing bottle with which to give *Toto* goat's milk. At the beginning he wasn't enthusiastic at all about that system of feeding, but all of us together, with great exchange of suggestions and recommendations, finally succeeded in making him take some milk, and after that the operation became easier and quicker from day to day.

But my great problem was to teach *Toto* all the other things which, had he remained in the forest, he would have learned naturally—to drink, to wash himself, to eat leaves and lick saliferous substances, to jump ditches and trunks, to pass under big lianas and through thick bushes, and many other things. But how to do it? My companions knew as much as I did. The pygmies at all my questions replied only by shouts of laughter; it seemed to them more than funny that a Bwana, a white, could take so much trouble for an animal. But finally I had an idea, and it was two cats who gave it to me—a beautiful black Persian cat and her kitten, a handful of striped velvet, which a missionary going on leave had presented to us a few days before. I had taken *Toto* from his mother, who would have taught him everything, as with infinite patience all day long our cat was teaching her kitten. Therefore I ought to take the place of *Toto's* mother, and with as much patience teach him all the most indispensable things, the basis of the teaching being imitation.



Close-up of Toto, showing his giraffe-like head.

At once I took some leaves of lettuce, and having made sure that nobody was looking at me, I went to sit down near *Toto* in his hut. He smelled me well all over, looked at me from every possible angle, and then, evidently satisfied with the examination, rested his head on my shoulder. Then, trying to eat as noisily and with as bad manners as possible, I began to chew one leaf, letting another protrude from my hand which I kept near my mouth. The manœuvre didn't fail to interest *Toto*. Moving his head to the right and to the left, smelling, revolving his big eyes, sticking out his long tongue, opening and closing his mouth, finally he managed to capture a leaf and slowly began to chew it. One can imagine my satisfaction, and how avidly I began to devour one leaf after the other, even forgetting that all my life I have always hated vegetables. And the more I ate, the more *Toto* ate, each time taking the leaves with more facility.

This experience was enough to upset all my work. Every hour I could spare I passed in the palisade in a succession of performances ridiculous enough to convulse any observer. (*Continued on page 252*)

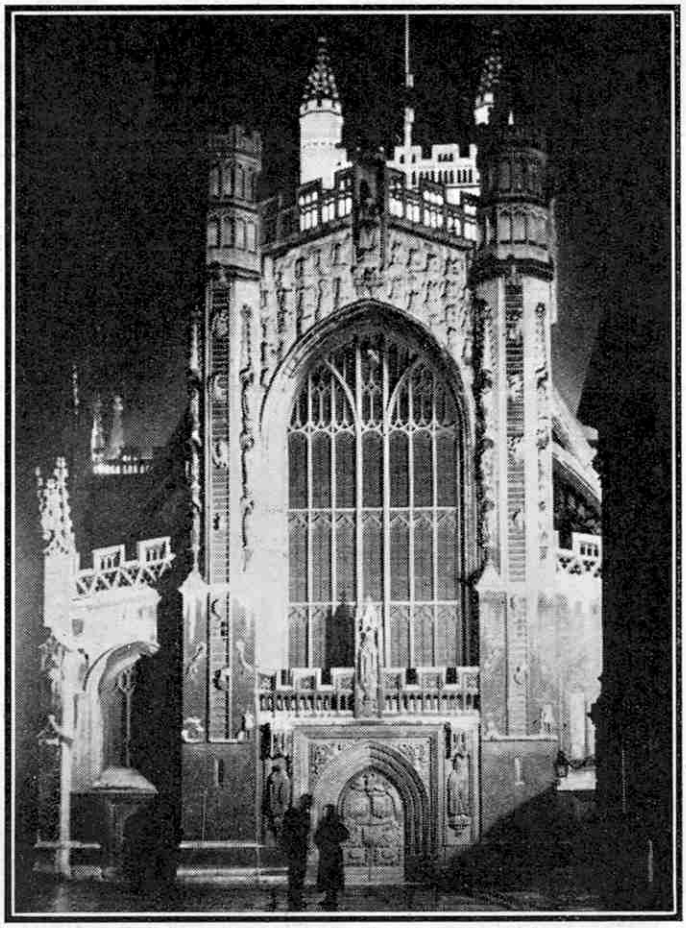
These pages are reserved for articles from our readers. Contributions not exceeding 500 words in length are invited on any subject of general interest. These should be written neatly on one side of the paper only, and they may be accompanied by photographs or sketches for use as illustrations. Articles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

The Descending Angels of Bath Abbey

I wonder how many of those who have stopped to admire Bath Abbey have realised the significance of the carvings on each side of the great window shown in the accompanying photograph. Many no doubt have recognised in them representations of Jacob's Ladder, but there is more in the carvings than a casual inspection reveals.

The Bible story tells us that Jacob saw the angels ascending and descending the ladder. To represent such a scheme is not easy, for there is no clear and obvious distinction between the attitude adopted when climbing a ladder and that in which the descent is made. I can imagine that the mason, or whoever was responsible for this work, spent a few sleepless nights trying to solve this problem. In the end he did the one thing possible to make his intention clear at the merest glance; he showed the descending angels coming down the ladder head first! In our illustration the second figure from the top on the right-hand side of the window is readily seen to be in this strange attitude.

E. H. COLES (Sheffield).



Bath Abbey illuminated by floodlight. This brings into bold relief the representations of Jacob's Ladder on each side of the window. Photograph by E. H. Coles, Sheffield.

The Brown Coalfields of Victoria

The description in the "*M.M.*" for January last of a giant dredger employed in the German brown coalfields is a reminder that similar methods of winning coal are in use at Yallourn, Victoria, a town about 90 miles from Melbourne. Around it is one of the largest brown coal deposits in the world, and when I visited the scene some time ago I was greatly interested in the operations carried on there.

The coal is easily mined, for it is covered by only 30 ft. to 40 ft. of overburden, and the covering material was being removed by electrically-driven revolving excavator dredgers with buckets of 15 cu. ft. capacity. These were at work on a level half way between the surface and the top of the brown coal, and the material they dug out was being taken away in special trucks hauled by electric locomotives. I was interested to see that the locomotives had pantographs at their sides as well as overhead. The overhead pantographs are used for normal running, but at the loading stages those at the side are brought into use.

At the time of my visit the exposed vertical face of the brown coal seam was 120 ft. to 180 ft. thick, and I saw two electric dredgers at work on it. These machines weigh 411 tons and have a guaranteed output of 500 tons per hour. Each has 31 buckets, and is capable of working to a depth of 92 ft. below the level of the track on which it runs. The coal is discharged into trucks running underneath the machines for transport to the power house in which it is used.

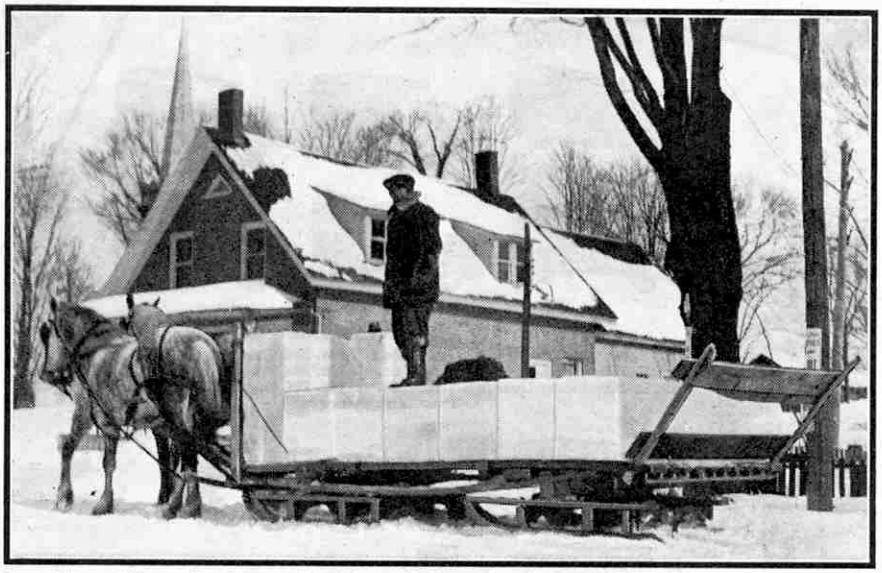
A Ruston electric shovel also was being used for winning the coal. This machine was equipped with a bucket holding six tons of coal. It worked an area of 92 ft. radius, and had no difficulty in cutting coal to the top of the working face 75 ft. high. The coal extracted with its aid was delivered to the hopper of a loading machine, from which it passed into trucks hauled by means of an endless chain. These trucks were automatically disengaged from the cable for discharge.

Part of the brown coal from the remarkable open mine at Yallourn is employed in the generation of electrical power, but some of it is heated in order to drive out a proportion of the moisture it contains and is then converted into briquettes by a pressure of 8 tons to the square inch.

F. BUCKLAND (Melbourne).

Ice for the Canadian Summer

In Canada winters are colder than in Great Britain, but the summers are hotter, and in consequence ice is regarded as a necessity. Small farms and ranch owners regularly provide themselves with a store of ice for summer use. They cut it from frozen rivers or lakes in blocks about 2 ft. square, and the strange harvest is usually gathered in at the end of March. The upper photograph on this page was taken in the province of Quebec and shows blocks of ice loaded on a sleigh for removal to a deep cellar or ice house, in which they are stored and packed tightly with sawdust to preserve them in the heat of summer.

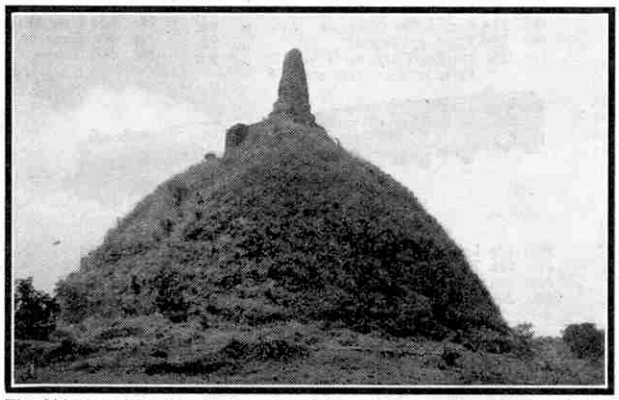


Ice cut from a lake near Dunham, Quebec, being carried away by sleigh, to be stored in sawdust in a cellar or ice house for use in the hot summer months. Photograph by Miss W. H. Cross, Grange-over-Sands.

Various customs no doubt prevail in various parts of Canada, but in the district of Western Alberta with which I am familiar the ice cellar usually is dug in the side of a steep hill at a short distance from the ranch house, and is fitted with double doors in order to provide efficient insulation. Hay is used as an outer protection against the heat of summer if the wood pile has not provided sufficient sawdust to pack and cover the ice properly. The result is that during July and August Canadians in remote districts enjoy as a matter of course what is regarded as a luxury in Great Britain. J. D. U. WARD (Reading).

The Ruins of Anuradhapura

Anuradhapura, the greatest city of the former kingdom of Ceylon, was founded by King Pandukabhaya, and served as the capital of the country for more than 1,400 years. In the days of its greatest splendour, the city was 17 miles long and 16 miles wide. It was surrounded by a high wall, with a gate in the middle of each side, and the temples, palaces, monasteries and other buildings within it, shining in the tropical sun, must have presented a wonderful spectacle.



The Abhayagari Dagoba, in the ruins of Anuradhapura, the ancient capital of Ceylon. Photograph by B. D. H. J. Silva, Ceylon.

Extensive ruins remain to indicate the wonders of the ancient Ceylonese capital. Among them is the Brazen Palace, which housed a college of Buddhist monks. It is said to have been nine storeys in height and to have contained 1,000 rooms. Its roof was covered with brazen tiles, from which it derives its name. The ruins of the building enclosed an area of 232 sq. ft. and there are still to be seen 1,600 monolithic pillars of rock richly ornamented with oriental designs.

The area round the Brazen Palace is known as the Thuparama, and is notable for a huge rock cistern that during the festival season was filled with "Kandha," a stimulating drink made from rice that was served to thousands of pilgrims.

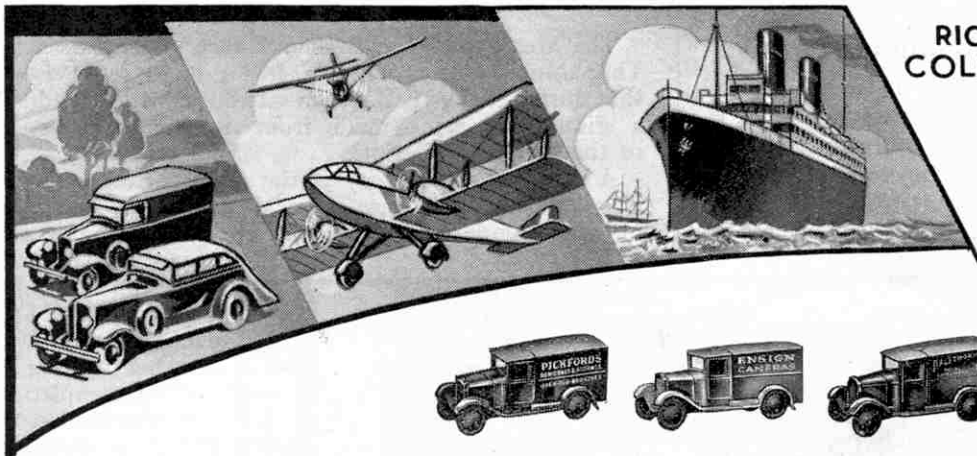
A short distance away is the colossal Ruanweliseya Dagoba. Dagobas were conical buildings presented by the reigning Sovereign to the temples and this gigantic structure was the crowning effort of King Dutugamunu, who did not survive to see its completion. Its foundation is 375 ft. in diameter and its spire towers to a height of 180 ft.

A little farther away is the Abhayagari Dagoba. Its spire looms through the thick jungle with which it is surrounded and the ascent to the top is very difficult because of the dense foliage. It is an awe-inspiring citadel that ages ago was transformed into an impregnable fortress, and it is difficult to understand how this and other great dagobas were built without the aid of the powerful mechanical appliances that are available at the present day. B. D. H. J. SILVA (Colombo).

A Motor Car Ferry in Madagascar

A vessel in which I recently enjoyed a cruise called at Tamatave, the chief port of Madagascar. When my friends and I found that we could spend a few hours on shore there, we decided to visit the botanical gardens about 12 kilometres, or seven miles away. The journey was made by car and the winding road passed through typical countryside of the sub-tropical lowlands until it came to an abrupt stop on the bank of a river. On the opposite bank were a few natives, who slowly began to punt a ferry boat towards us when they heard our shouts.

The boat was a mere platform of timber supported by three canoes lashed together side by side. It was moored to the bank and the car was slowly run on to it. We followed on foot and the crossing began. The unwieldy boat was slowly propelled across the river, the natives chanting in rhythm with the movements of their bodies. Continual practice had made them skilful in manipulating their poles and manœuvring the boat, and they brought us alongside the opposite bank without difficulty. There they jumped off and steadied the boat by means of ropes while the car was driven ashore. R. G. BROOKS (Saltash).



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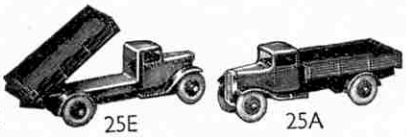

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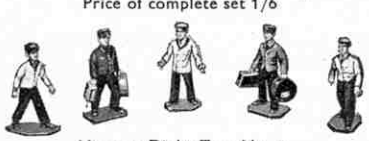

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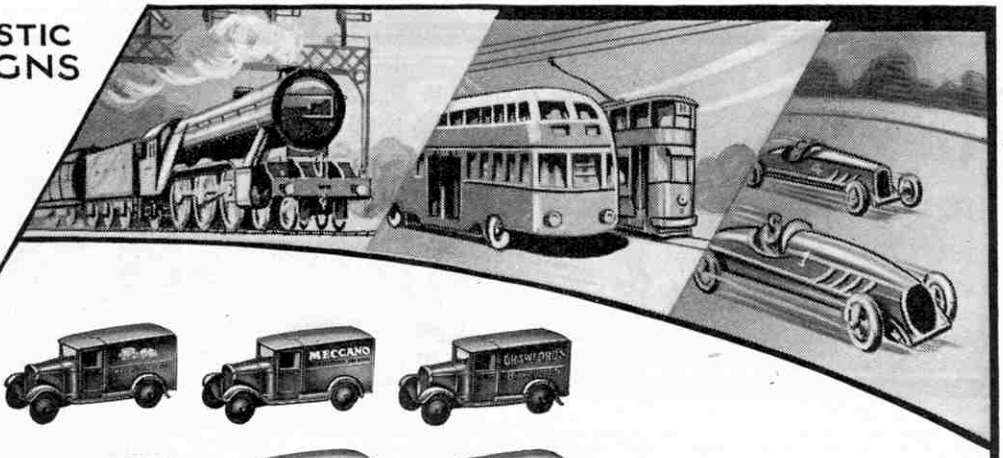

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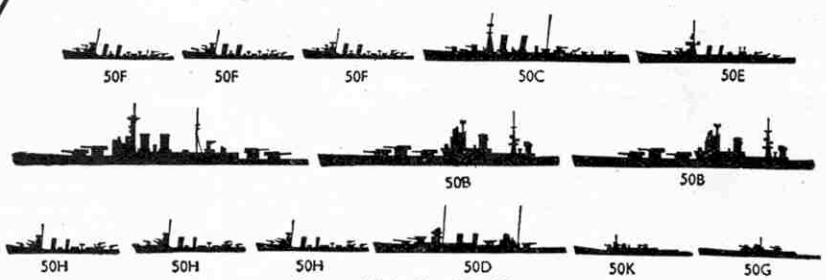

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No. 21b Wagon	,, 4d.
No. 21d Petrol Tank Wagon	,, 6d.
No. 21e Lumber Wagon	,, 5d.

Price of complete set 1/11

Meccano Dinky Toys No. 20

PASSENGER TRAIN SET

No. 21a Tank Locomotive	each 9d.
No. 20a Coaches (2)	,, 7d.
No. 20b Guard's Van	,, 7d.

Price of complete set 2/6

No. 31
RAFT
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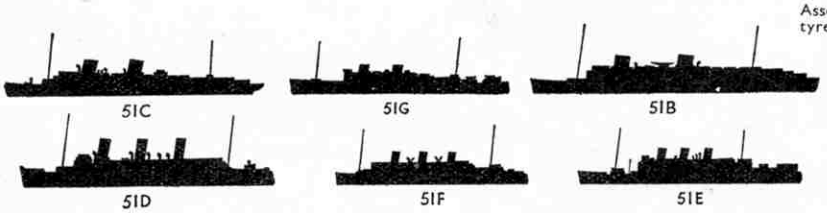
Meccano Dinky Toys No. 32

"AIRFLOW" SALOON

Assorted colours. Fitted with rubber tyres. Silver-plated radiator and bumpers.
Price 9d. each.



Meccano Dinky Toys No. 51

FAMOUS LINERS

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

Price of complete set 3/6

Meccano Dinky Toys No. 27

TRAM CAR

Assorted Colours. Price 6d. each

Meccano Dinky Toys No. 6

SHEPHERD SET

No. 6a Shepherd	each 3d.
No. 6b Dog	,, 2d.
No. 2d Sheep (4)	,, 2d.

Price of complete set 1/–

Meccano Dinky Toys No. 29

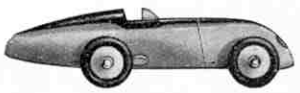
MOTOR BUS

Assorted Colours. Price 6d. each

Meccano Dinky Toys No. 26

G.W.R. RAIL CAR

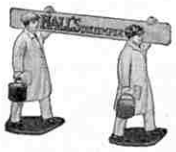
Assorted Colours. Price 6d. each



Meccano Dinky Toys No. 23

RACING CAR

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

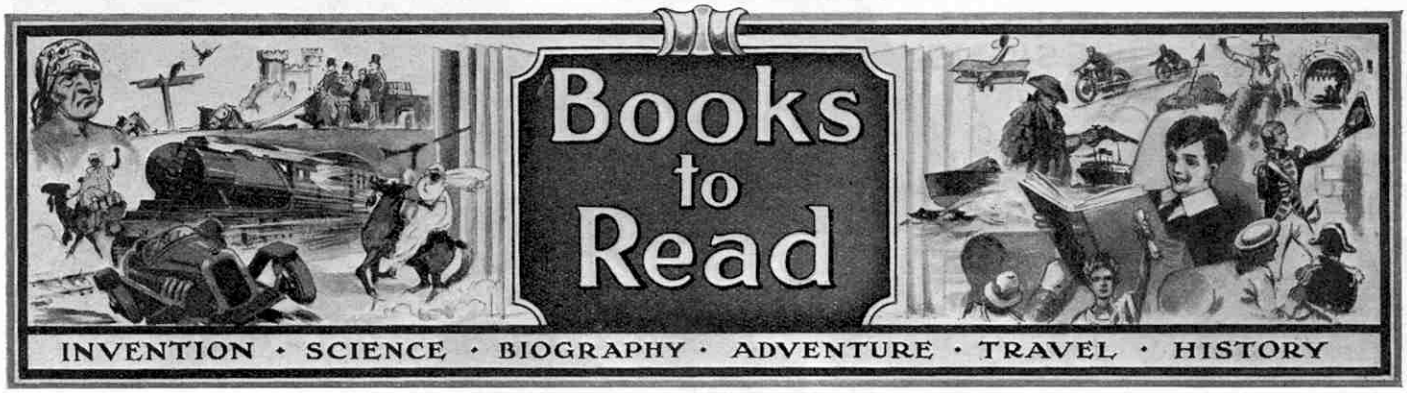


Meccano Dinky Toys No. 13

HALL'S DISTEMPER ADVERTISEMENT

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

ed by MECCANO LTD.
Road, Liverpool 13



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 vary, but any balance remaining will be refunded.

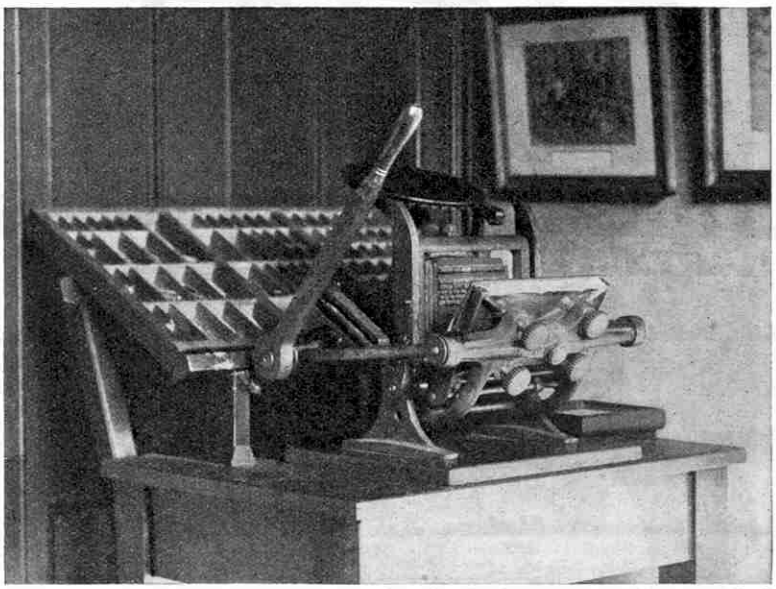
"Robert Louis Stevenson at Davos"

By W. G. Lockett
(Hurst & Blackett. 10/6 net)

Robert Louis Stevenson is familiar to every boy as the author of *"Treasure Island,"* the magnificent romance of the search for a pirate's hidden hoard that has enthralled several generations. It is well known that ill-health drove Stevenson to spend the later years of his life in Samoa in the Southern Pacific Ocean, but the threat of consumption appeared long before he departed for the South Seas, and led to prolonged visits in the winters of 1880-1 and 1881-2 to Davos, the Swiss mountain resort that has since become famous for its dry invigorating air. Mr. Lockett was British Consul in Davos for 30 years, and in this book he tells us what he has learned of Stevenson's life there from records and from the stories of old residents.

Davos is a valley, 5,000 ft. above sea level, that is protected from cold winds by mountains nearly 10,000 ft. in height, and enjoys brilliant sunshine practically throughout the year. In 1880 winter sports had not been greatly developed and were restricted to crude skating and tobogganing. Stevenson took part in these, often with more zeal than wisdom, and also joined in the few indoor pursuits and entertainments then available. For the most part visitors seem to have been thrown on their own resources, however, and most readers of the book will be attracted by the chapters that deal with Stevenson's home life and recreations. Unfortunately his health was not uniformly good, and financial worries often depressed him. In spite of these difficulties he actually finished *"Treasure Island"* which was published during his second winter in Davos and certainly does not betray the troubles and anxieties that oppressed him.

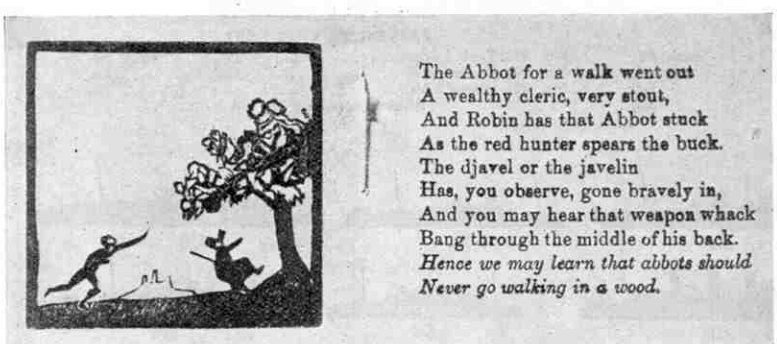
Lloyd Osbourne, Stevenson's stepson, then a boy 12 years of age, was with him in Davos, and the two joined in painting scenery for a model theatre and in the performance of puppet plays that greatly amused their limited audiences. They also waged mimic warfare on a large scale with toy soldiers, but a printing machine gave them even more lasting occupation and enjoyment. The press was incapable of printing anything larger than a postcard, but, as our illustration shows, was strongly and solidly built and turned out remarkably good work. It was soon applied to the production of leaflets containing stories and plays written by the boy and his stepfather, who also cut wooden blocks for the illustrations and helped in the actual printing. In a letter to a friend Stevenson gleefully records the serious business instincts of his partner, who actually compelled him to buy copies of his own works! Davos press productions now command very high prices from collectors, although they are only leaflets and booklets of a few pages.



The Davos Press, a small printing machine used by Robert Louis Stevenson and his stepson, Lloyd Osbourne. (From "Robert Louis Stevenson at Davos," reviewed on this page.)

In other chapters the author gives many interesting pictures of Stevenson in health and in sickness, alone and in company with literary and other friends, some of whom had been driven by illness to the Swiss resort. The dry, invigorating mountain air was beneficial to Stevenson, but the improvement was not permanent, and eventually he was compelled to seek a more genial climate in the islands of the Pacific Ocean. He never returned to Davos, but the memory of his stay was kept alive by people who had known him, and their stories, now gathered together, and amplified by Mr. Lockett, will be of absorbing interest to all Stevenson enthusiasts.

The illustrations in the book include a portrait of Stevenson and reproductions of scenes in Davos and the valley in which it is situated.



A specimen of the work of the Davos Press. (See above.)

"Simple Boat-Building"

By Geoffrey Prout
(Brown, Son & Ferguson. 5/– net)

To the average woodworker the thought of constructing a boat immediately brings with it visions of innumerable difficulties. This idea formerly was not without justification, but during recent years the problems of boat construction have been so thoroughly investigated that it is now little more difficult to construct a small boat than it is to make a bookcase. Mr. Prout is well known in connection with small boat construction, and in this book he explains in simple language every step in the construction of four different types of open boat. The conversion of rowing boats to sailing boats also is fully described, and this undoubtedly will be of interest to a great many readers. The instructions are illustrated by a large number of simple and practical drawings that will help to clear up any constructional difficulties that may be encountered.

"The Wonder Book of Aircraft"

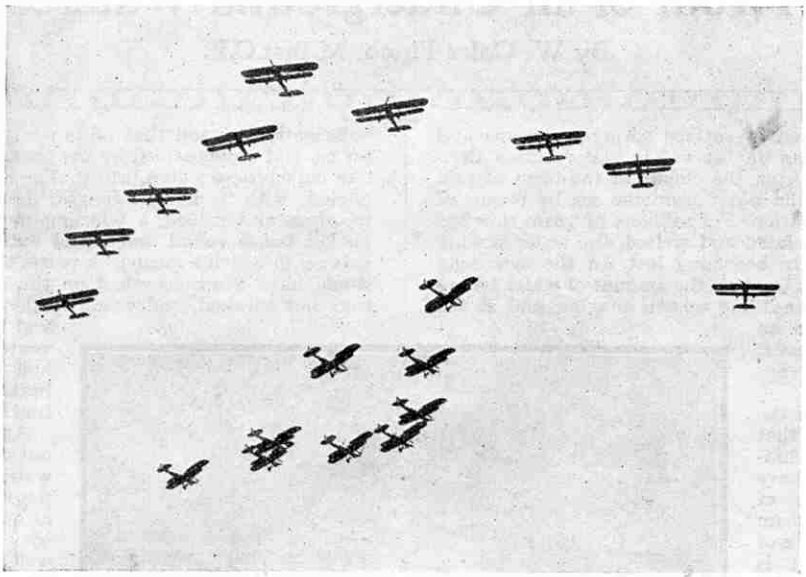
Edited by H. Golding, F.R.G.S.
(Ward, Lock & Co. 5/- net)

The amazing developments in aviation that have taken place since the War, and particularly in the last few years, have added interest to the story of flight, one of the most fascinating of Man's achievements. Young readers will find in this book an adequate account of the Air Age in which we live, and the hundreds of pictures and the interesting articles by well-known experts included in it are a mine of information that will interest and surprise older people, as well as those for whom the book is intended.

The articles cover every phase of aviation. They recount the achievements of the pioneers whose first dangerous experiments with gliders culminated in the triumph of the Wright Brothers in 1903; tell the stories of the great flights, in what now seem to us crude and flimsy contraptions, that proved flying had come to stay; and describe the development of the wonderful machines now used for military work and commercial purposes. Flying boats, airships and strange aircraft such as the Autogiro also are adequately dealt with, and other interesting articles depict scenes at a great airport, describe life in the Royal Air Force, and carry the reader in imagination along the world's airways.

Photography from the air, the use of parachutes, aerobatics and the machines and airways of the future are among other topics that form the subjects of articles, and these are full of sound information expressed in simple language. The book ends with a valuable record of outstanding events in the history of flying.

Pictures of course should play a great part in a book intended chiefly for young readers, who will be delighted with the eight colour plates and the hundreds of half-tone illustrations. These provide a remarkable record of aeroplanes that have made history, machines that were used in the War, and an extensive range of modern air liners, airships and other aircraft of all shapes; and include also attractive scenes from the air in all parts of the world and glimpses of pilots at work and of the Royal Air Force in training.



Wing evolutions. Aeroplane formations coming over and reverse flying. From "The Wonder Book of Aircraft," reviewed on this page.)

"Scott's Book"

By C. W. A. Scott
(Hodder and Stoughton. 7/6 net)

The wonderful flight from Mildenhall to Melbourne accomplished in the De Havilland Comet *"Grosvenor House"* in the MacRobertson Air Race has stimulated interest in aviation generally, and in our Empire airways in particular, to a remarkable extent. The heroes of this great flight were C. W. A. Scott and Campbell Black, who throughout showed remarkable skill, energy and daring; and this story of the life of Scott, the captain, will be greeted eagerly by all who are interested in great adventure. Scott is a true successor of the daring pioneers who have done so much to advance the frontiers of civilisation. He is enterprising and adventurous, but at the same time skilful and so well trained in his job of flying that he can extricate himself from difficulties and take risks that would be fatal to many.

Scott's first act on leaving school was typical of him, for he immediately went to Demerara, in South America, with the intention of becoming a sugar planter. Life on the plantations did not satisfy him, however, and he returned to England. Then came the great day when a friend suggested that he should join the Royal Air Force. Without pausing to think of the future he sent in an application for a short service commission and soon was posted to a training squadron.

An aeroplane pilot with an electrically-driven motion camera. (See above.)

Young Scott had now found his vocation. He proved himself a thorough airman, and was never so much at home as when in a good machine that responded instantly to his touch on the controls. His natural exuberance often led him into trouble, and on one occasion he was court-martialled for joyously indulging in aerobatics too near the ground. In the Air Force he had more than his share of adventure, and enjoyed many humorous moments; and naturally he did not relish a short spell of inactivity that followed his resignation. One day heavy rain drove him into Australia House, and in an amazingly casual manner he found himself agreeing to make his way to Australia to help in the development of aviation there. This was the preliminary to a happy time as a service pilot with *"Quantas,"* the famous Australian air line, and as a flying instructor.

Then came a turning point in Scott's career. He had already worked out a scheme for beating the record for a solo flight from England to Australia set up in 1928 by Hinkler, and his determination to attempt to put it into practice was strengthened by his selection to meet Amy Johnson at Port Darwin, on the conclusion of her famous flight from England, and to escort her to Brisbane. He returned to England, and with great difficulty raised enough money to purchase an aeroplane and to arrange for supplies of fuel and other requirements. After waiting a short time for favourable weather conditions he left Lympne, a comparatively unknown airman, and reached Port Darwin in nearly a day less than the existing record time, to find himself famous. It is typical of the man that his only thought was that his task was over and that he could relax.

Scott was now a national figure, and the successful attack he made on the Australia–England record was followed with keen interest, as was a further flight to Australia in which he set up a third record. Then came a season of joy-riding, travelling round Great Britain with a well-known "flying circus," and the general life of a commercial pilot. In the meantime plans were slowly being matured for his greatest triumph. He met Campbell Black, and the two airmen were so sure of each other's ability, and of their capacity to fit in with one another, that they resolved to take part in the coming MacRobertson Air Race only in each other's company. They were fortunate in being offered the opportunity of flying in one of the three machines specially prepared for the race by De Havilland Company, and although they had little time for testing the capabilities of their "Comet," the day of the race found them firmly established as popular favourites.

The story of their epic flight half round the world is well-known to most people, but seems more amazing in Scott's own vigorous account of their experiences and of their feelings at critical moments. Only once did either of them make a mistake. This was when Scott, tired and half asleep, landed down wind at Singapore; and the quality of the partnership is shown by Black's own comment, in an epilogue he has contributed to his co-pilot's book, that even at such a moment he felt all would be well!

The book is illustrated by 16 plates, which include portraits of Scott and photographs of outstanding events in his career, and in the epoch-making flight from Mildenhall to Melbourne in less than three days. Four maps also are included.

Sinking Deep Wells in the North Downs

I.—A Tour of an Underground Watercourse

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

THE water that can be seen in surface springs, streams and lakes, and the water flowing unobserved in watercourses deep in the ground, is all derived from the clouds in the form of rain or snow. The clouds receive the water from the sea by means of the natural process of evaporation. For millions of years rain has fallen and snows have accumulated and melted, the water sinking into the earth and apparently becoming lost. In the ages long past, particularly in the Great Ice Age, the amount of water falling as snow exceeded in volume anything we can imagine, and at the breaking up of the Ice Age an enormous deluge of water must have rushed down the now apparently dry valleys.

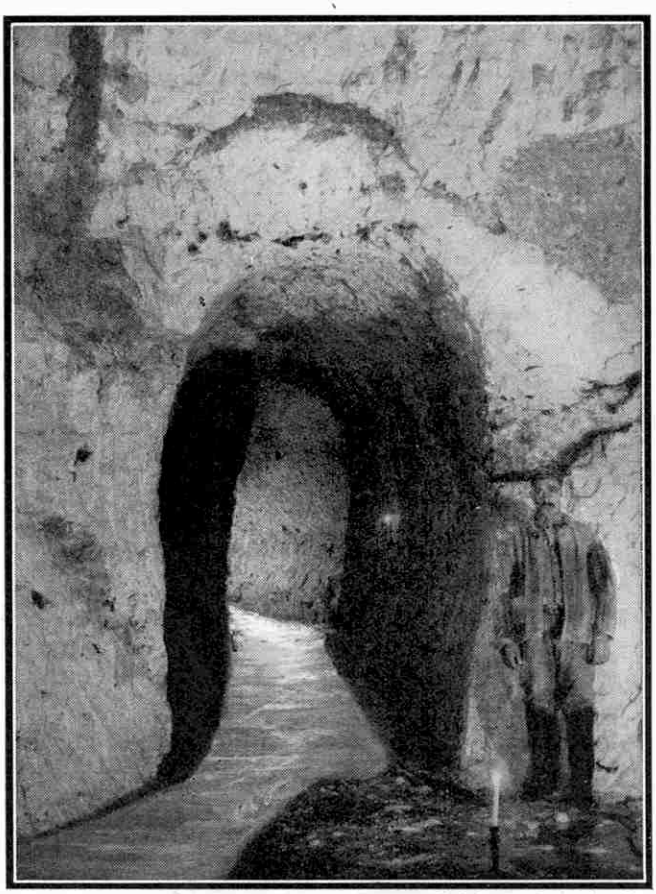
In those remote events lies the secret of springs and streams that exist deep in the earth. These hidden natural watercourses have been flowing for thousands of years, but no water from them has accumulated on the surface of the ground above them. It is obvious, therefore, that the water is still escaping unobserved to the sea. Investigations have revealed that networks of small "veins" extending in all directions collect the percolating rain and supply it to the large underground streams, which in turn feed the submarine springs that burst up in whirlpools all around the adjacent coast. There the pure water issuing from the springs mingles with the salt water of the sea until, under the influence of the Sun, it is again evaporated and later precipitated upon the earth.

The data available to the modern geologist enable him to locate these secret watercourses. Except for a slight seasonal variation, the line of saturation, or level in the earth at which the water stands before it overflows to the sea, is definite. The ancient watercourses will therefore be found at this level, as below it the earth is water-logged.

Underground watercourses are a very profitable source from which to augment the water supply of large towns, and the intercepting or tapping of them is an important branch of water engineering. London obtains many millions of gallons of water daily from artesian wells sunk several hundreds of feet to tap the chalk formation that stretches for miles beneath the city. Chatham, in Kent, obtains a good deal of its water supply from wells that penetrate the chalk formation of the North Downs, and in this article I will take you on a tour of one of the wonderful underground streams there. You will be able to note the sharp contrast between the watercourses formed by Nature, and the artificial passages, called "adits," cut by the water engineer.

This tapped stream is reached by descending a deep vertical shaft in which a large bucket serves as the lift. An examination of the workings below ground is made possible by powerful pumps which, working day and night, draw off the water. The subterranean photographs accompanying this and later articles in the series could not have been taken if the pumps had not outpaced the underground springs feeding the stream.

We prepare for our tour by donning some old clothes and knee-boots, and provide ourselves with a lantern. At the well top we await a signal from below that the water has been pumped sufficiently low and that all is ready. The huge bucket comes up for us, and accompanied by the chargeman, who is suitably attired like ourselves, we step into it. The steam winch revolves and the bucket, with its human freight, descends. With a habit peculiar to ropes and cables, a whirling motion is set up in which the bucket twists round and round with great speed, similar to the manner in which a meat-jack twists the roasting joint. This motion would have a serious effect on the occupants of the bucket if it were not checked, and would render the descent both unpleasant and dangerous. It is easily prevented, however, and we notice how the chargeman dexterously brakes the spin of the bucket by touching the sides of the well.



View along a natural underground watercourse tunnelled by the increasing flow of the water during many centuries.

At the foot of the well we step out of the bucket into a stream of water two or three feet deep, and pause a few minutes to take stock of our surroundings. We find that we have descended the "draw well," that is the one not occupied by machinery, but constructed solely for convenient access to the adits and for the removal of the material hewn out during their frequent extension. For obvious reasons it is sunk at the junction of numerous adits, which radiate in all directions to the various sources of the water and to the various powerful pumps. These pumps are of vital importance in keeping the water soiled by men at work extending certain adits separate from the remainder of the supply. The soiled water is conducted to certain wells and pumped to waste, while the clean water coming down other adits is diverted to pumps set apart for the purpose of maintaining the town water supply.

Thanks to the effective work of the pumps it is possible for us to walk to the adit where the men are working, and also to travel some distance up the partly filled adits of the clean water system by means of a shallow raft constructed on copper cylinders. In anticipation of our visit both the clean and the soiled water adits have been illuminated somewhat feebly by candles suspended at frequent intervals from the sides of the adits.

We first traverse the clean water adits, where the water is about 4 ft. deep and clear as crystal, making little eddies as it winds its course to the pumps. The candle-light is reflected on the surface of the water with a weird and fascinating effect. Seated on our raft we look around, astonished at the vast underground workings that have been driven in the search for water. We soon come to a junction with adits conducting other streams of water to the pumps, and turning our frail craft into one of these we are able to see the ponderous iron suction pipes that are greedily sucking up the water to deliver it at the surface.

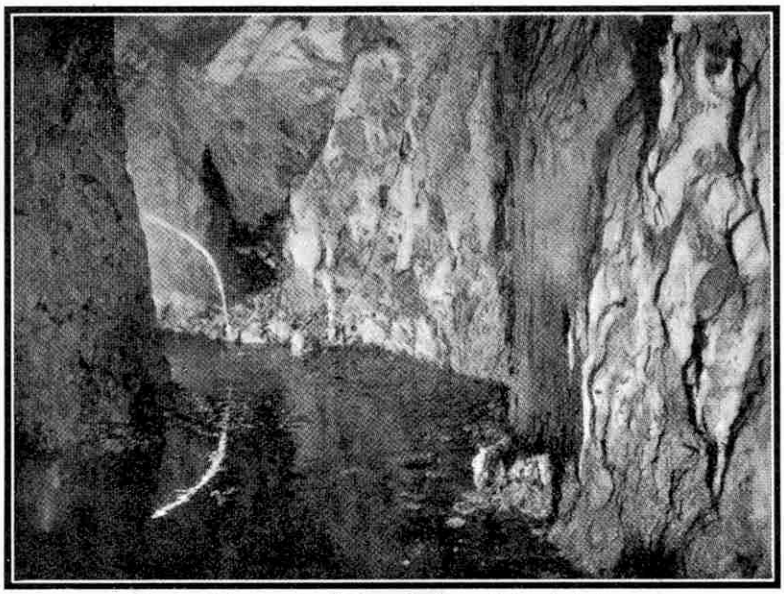
Passing on, we note with interest how huge pieces of chalk rock at faulty places have been underpinned with timber to prevent them from falling into the adit, perhaps at the very moment when workmen are passing the spot. We see, for instance, a treacherous five-ton piece ready to slip out, for it lies on a seam of slippery clay only $\frac{1}{8}$ in. thick, but having great water pressure behind it. A lifetime of experience is necessary to carry out effectively this work of timbering, as one has to decide where and how it should

be done. In passing these timbered parts of the adit it is often necessary for us to lie flat on the raft in order to pass beneath the timber struts supporting the fault.

We come to a place where small jets under pressure are spurting energetically in all directions. These jets will be opened out later, when the adit is further developed, and the water will then be freed to increase the yield.

Farther on we reach a severed artery where the water is pouring and roaring into the adit. After remaining several minutes and revelling in the enchanting scene we return along the adit, collecting and extinguishing the candles on the way. As we journey along, the roaring of the water behind us becomes less distinct, but we know that day and night, year after year, the water continues to flow through the long dark tunnels of white, unsullied chalk, to minister to our needs.

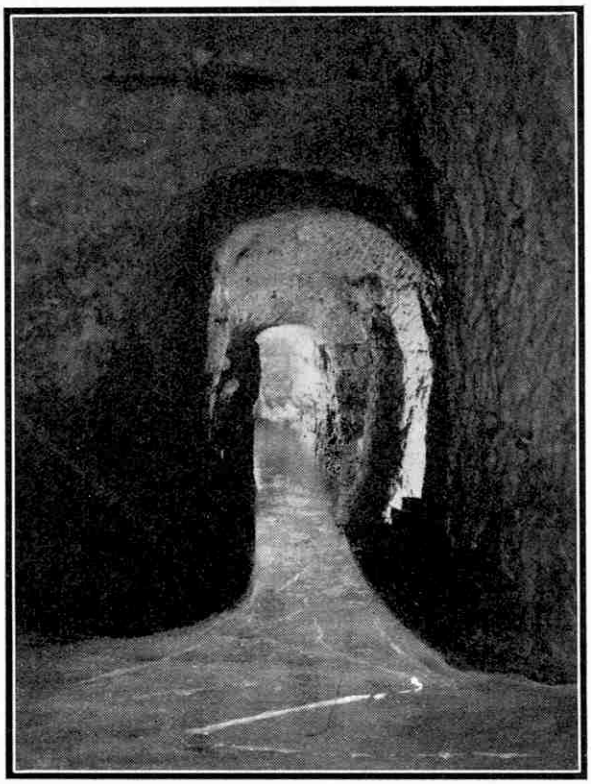
Back again at the draw well we step from the raft and prepare to walk along the adit in which the men are working. Here a different state of things presents itself. The floor is slippery with clay and chalk slurry, resembling a creamy paste, and over this is running a stream of cloudy-white water. This stream is the result of the men working at the adit face and of the tramping of the trolley runners as they push the huge buckets of hewn chalk along the narrow gauge track leading to the draw well.



A natural chamber deep in the earth, from which water is drawn.

Our progress through the slippery adit is slow, but eventually we come to a large natural chamber over 17 ft. in height, about 60 ft. in length, and of considerable and irregular width. We notice that a long natural tunnel, untouched by human hands, leads into this great cavity. It is possible by stooping to travel a long way up this remarkable tunnel, and even when one has progressed as far as possible the end of it is still out of sight. A considerable stream of clear, cool water is flowing down the tunnel and passing through the great chamber on its way to the pumps. This large watercourse is part of Nature's system of drainage, and under prehistoric conditions, when rain and melting of the ice were at the most active period of their operation, it doubtless carried off a flood of water, delivering it as a submarine spring into river or sea. Waterworn fissures now dry are frequently being severed high above the present line of saturation, thus proving that this variable level was much higher in remote ages than it is to-day.

We leave the chamber, and as we approach the end of the adit we hear increasingly loud the heavy thud! thud! of the workmen's picks and the echo of voices. The rumbling of trolley wheels warns us of the approach of loaded buckets, and we step aside to allow them to pass; soon afterwards reaching the face of the workings. Day by day little jets of water have been cut, spurting from the roof and sides of the adit and giving the workmen a familiar indication that success is near to hand. On the floor of the adit bubbling eddies of clear water are playing through the chalk-soiled stream, while the men, in sodden clothes, work on expectantly, anticipating a breaking through of the imprisoned water, pent up at this low pumping level.



Another interesting view of a natural underground watercourse.

Our visit has been well timed, as soon after our arrival a workman on the ledge at the face strikes a heavy blow in the crown of the adit, and the water gushes out with violence and in great volume. Large pieces of rock are bowled across the floor by the force of the water, which carries with it the clay lying in the seams of the chalk. At first the water is dark brown, owing to the presence of the clay, but it soon becomes clear, and then discharges as a crystal spring, glorious to behold.

We receive the signal to withdraw from the well as the water is rising owing to the yield of this new spring overpowering the pumps. We pause just long enough to photograph the scene by the aid of a magnesium flash-lamp, and then, in company with the workmen, hasten back to the draw well. It is not easy to hurry, for the floor is slippery, the water increasing, and our knee-boots, now full of water, are very heavy and impede rather than help us. At last we reach the foot of the well, however, and in parties are hauled up to the surface and to safety.

The tour just made will not readily be forgotten, for it has revealed one of nature's sweetest miracles, and has shown us how she absorbs and holds in the secret recesses of the rocks the gracious gift of rain. After refreshing the earth, and "making it very plenteous," this passes down to feed the secret springs, and eventually joins the tidal rivers and the mighty ocean. We may also recall that these marvellous operations, now so necessary to our well-being, were in progress millions of years ago, long before Man appeared upon the earth, but nature has no need to hurry, for has she not an eternity in which to accomplish even her simplest wonders?

In these natural and artificial underground streams we see a typical instance of the manner in which Man controls and utilises the bounteous supplies of pure water that nature has so carefully stored in the wonderfully formed chalk rocks, miraculously upheaved from the ocean bed. The most superficial study of a piece of chalk will tell a fascinating story, for this substance is composed almost entirely of perfect shells of microscopic creatures that are known as foraminifera and are so small that many thousands of them could be put into a walnut shell or a thimble. Each of these shells consists of carbonate of lime, built into a beautiful and fascinating shape.

Water, more than anything else, fixes the abode of Man, and in the early stages of civilisation, when the conditions of his life were simple, he lived near springs and streams. Now, in these days of scientific engineering, he has traced the geological conditions that have made it possible to obtain a supply of pure water from deep wells, of the existence of which there is no indication on the surface. With the knowledge thus acquired he is able to delve into the bowels of the earth, discover the precious liquid and raise it to the surface. It would be well if every consumer could fully grasp the work involved, the difficulties and dangers of the task of thus providing him with a supply of water, for it might then be possible to impress upon the careless user that nature's gift should be fully appreciated, and at least not wasted.

To be continued.)

MAKING MINIATURE DIVING BELLS

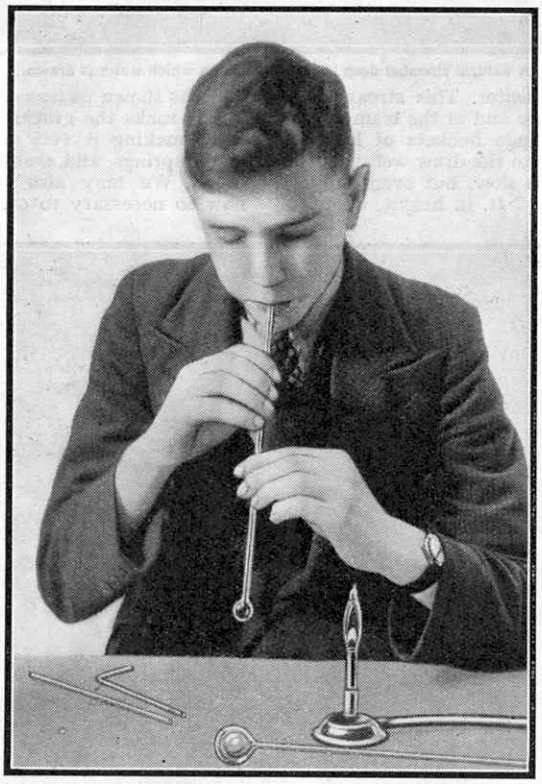
OWNERS of a Kemex Bunsen burner can make good use of it in manipulating glass and in blowing bulbs. The Kemex spirit lamp also can be used for many fascinating experiments in the bending of glass tubing, but the flame of the Bunsen burner is hotter, and glass working with its aid is speedier and more convenient. Those who possess only a spirit lamp can carry out all the experiments described in this article, however, if they have access to a small gas stove, or a gas cooker, for the burners of these utensils can be used for operations in which the glass is to be heated to a higher temperature than that of the spirit lamp flame.

The first thing that every glass blower must know is how to cut glass tubing so as to leave no jagged edges that may give rise to cuts. A triangular file is the best cutting instrument, but any form of file having a sharp corner can be used. A good clean cut that passes about half way round the tube is made, preferably in one stroke. The cut must not pass right through the glass, and the weight placed on the file as the stroke is made therefore must be sufficient to produce only a V-shaped notch. The tube is then held firmly but lightly with the notch uppermost, and the outstretched thumbs meeting at their tips just under it, and is bent downward at each end. It breaks with surprisingly little effort, and if an appreciable resistance is encountered, the notch must be deepened before a further attempt is made.

The edges of a cut made in this manner are not jagged, but it is advisable to smooth them by heating in the flame of the Bunsen burner or of the spirit lamp. The heating must be stopped immediately the edges soften, for if it is prolonged the diameter of the opening of the glass tubing is decreased. The appearance of an intense yellow colour in the flame, due to the presence of sodium compounds in the glass, usually is an indication of the correct time to stop heating.

Bending glass tubing to form right angle bends, or delivery tubes of various shapes, also is an interesting task in which skill can quickly be acquired. For this purpose the glass is softened by heating in a flame and is bent to the shape required before being allowed to cool. For practically all bends it is necessary to heat a section of the tubing about 2 in. in length, for if the heating is restricted the bend is not only of poor shape, but the glass on its inner side is kinked and restricts the opening within the tube. The best type of flame to use is that of the old-fashioned "fishtail" or "batswing" gas burner, the shape of which is indicated by its name. This is luminous, and was generally used for lighting purposes before the introduction of the incandescent mantle or of electric light. It gives a sufficiently high temperature to enable ordinary glass tubing to be bent when heated in it.

When making a bend the tubing is held above the flame to warm it gently, and then it is lowered into the flame itself in order to soften the glass, which is rotated continuously, for even heating is necessary in order to give a shapely result. The flame covers the outside of the tubing with soot, which shows a tendency to become red hot and burn off. At this stage the glass is soft enough and the tube is removed from the flame and steadily bent to the required shape. It is held for a moment or two until it is set in its new position, and of course must not be brought into contact with any cold object until it is itself quite cold. The best plan is to lay the hot tube on two thin pieces of wood so that as little glass as possible is in contact with solid material. Those who have a piece of asbestos board can lay the hot glass on it until it has cooled. Any soot remaining on it is then wiped off.



Blowing a bulb at the sealed end of a length of glass tubing after softening the glass in the flame of the Kemex Bunsen burner.

The flames of the Bunsen burner and the spirit lamp can be used quite well for bending if steps are taken to heat a sufficient length of tubing. This can be done by holding the tubing at an angle so that as much as possible is in the flame, and by moving it up and down slightly in addition to rotating it. Otherwise the procedure is exactly the same as when a fishtail burner were used. It is best to restrict the air holes of a Bunsen burner employed in bending glass tubing sufficiently to give a partly luminous flame that is reasonably steady. The flame obtained by closing them altogether usually is too unsteady to give satisfactorily even heating.

For drawing out glass tubing, either to make a jet or to form a narrower tube, or for sealing glass tubes, the non-luminous flame of the Bunsen burner is best, for the length of tubing to be heated is less than in making a bend, and a higher temperature is required. The flame of the spirit lamp also can be used with excellent results.

Whatever the source of heat, a piece of tubing to be drawn out into a jet is warmed by holding it above the flame, and is then slowly lowered until the glass at the position of the required jet is in the hottest part. There it is rotated, care being taken to prevent it from bending as the glass softens, until the part in the flame is red hot. It is taken out of the flame and the ends are steadily pulled apart. The tube must be rotated while this is being done, and the part that was heated is then drawn out to a narrow tube in line with the unaltered section. A jet for use in the ammonia fountain experiment described on page 34 of the 2-3 Kemex Manual, or for the pipette, or dropping tube, illustrated in Figs. 52 and 57 of the same Manual, is made by drawing out a piece of tubing in this manner and cutting it in the narrowest part. The edges of the opening are softened by heating as already explained, and its size can be reduced by further heating to give a finer jet of liquid, or to give good control of drops falling from it.

In order to produce a piece of very fine tubing, or capillary tubing as it is called, the glass is made a little hotter and the two ends are pulled apart rapidly and to a greater distance. Sealing a glass tube is a similar operation, but in this case the tube is not removed from the flame as one end is sharply drawn away. The section remaining in the flame is then sealed owing to the complete fusion of the very narrow capillary tube produced by the movement, and is removed from the flame immediately this takes place. In all these manipulations the tubing must be kept rotating as far as

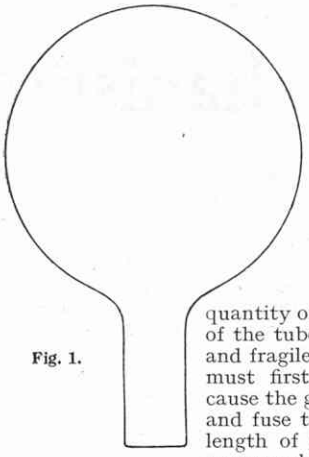


Fig. 1.

possible in order to prevent kinks in the glass and ugly shapes.

Blowing a bulb on the end of a piece of glass tubing is a very fascinating occupation. It is by no means as difficult as is generally supposed, but a little practice is required in order to judge the correct moment to blow and to gauge the pressure to be applied in order to give a bulb of the required size.

The first thing to realise in bulb blowing is that unless a good quantity of molten glass is collected at the end of the tube the bulb to be blown will be thin and fragile. For this reason the end of the tube must first be heated strongly in order to cause the glass walls to fall towards each other and fuse together. Alternatively the end of a length of glass tubing can be sealed in the manner already described. The heating is then continued. It is best to hold the tubing nearly horizontally, with the closed end in the hottest part of the flame and slightly higher than the open end, and the tube is rotated continuously. When the glass is thoroughly softened, the tube is taken from the flame and the bulb is blown, as shown in the illustration on the opposite page. The blowing must commence immediately, before the glass has had time to cool, and the rotation must continue in order to give a bulb that is symmetrically placed at the end of the tube.

If too small a quantity of glass has been softened, and too much zeal is shown in blowing, the glass suddenly flares out into a large mis-shapen bulb with walls of exceedingly thin glass that break almost immediately. It is better to blow gently in order to form a small bulb and to soften this again by reheating, followed by a further blowing. Sometimes two reheatings are necessary in order to get a bulb of the size required, and each time a little more softened glass is collected in order to make sure that the walls of the bulb will be thick enough to be serviceable.

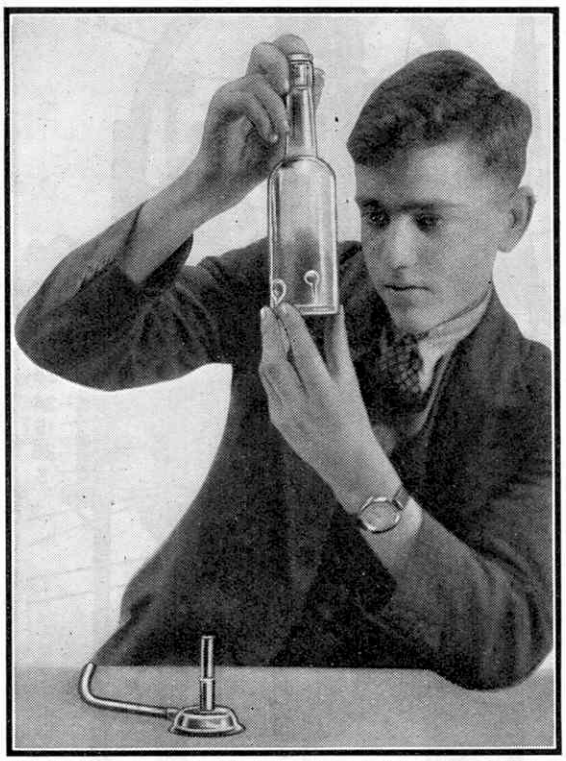
When the experimenter has had sufficient practice to be able to blow a good bulb, it is interesting to make a Cartesian diver, a figure that will rise and fall in a bottle of water in a very amusing manner in obedience to variations in the pressure of a finger on the cork. A simple form of diver consists of a small bulb at the end of a short length of tube, as shown in Fig. 1, in the upper left hand corner of this page. It is made by blowing a small bulb and cutting off the tube in the usual manner to leave the required length. The bulb is partially filled with water, and then floats upright, in the position illustrated. The quantity of water introduced must be such that the bulb floats just submerged. It then forms a kind of diving bell, and the density of the bulb and its contents is very slightly below that of water.

A bottle with a good cork is the scene of the operations of this interesting diver. The bottle is filled to overflowing with water and the diver is transferred to it from the vessel in which it is tried by closing the end with the finger and opening it only when it is under the water in the bottle. The cork is then inserted and the pressure of the finger on it causes the diver to descend to the bottom, while releasing the pressure or pulling the cork upward brings it to the surface once more.

If the diver refuses to descend it is necessary to introduce a little more water into the bulb, and by adjustment a bulb that responds instantly to slight pressure of the finger on the cork in the neck of the bottle can be obtained. A sauce bottle is shown in use in the central illustration on this page. In this a glass stopper passes through a cork lining in the neck and can be used as a plunger that is pushed down or pulled up in order to cause the diver to sink or ascend to the surface. Another good plan is to stretch a piece of thin rubber over the neck of the bottle and to tie it firmly in position. The diver is despatched to the bottom with great speed when the rubber is depressed by means of the thumb or finger, and as quickly springs to the surface when the pressure is released.

The cause of these movements is the variation in pressure. When this is increased more water enters the bulb and its density becomes greater than that of the water itself, causing it to sink. The release of the pressure is followed by expansion of the air within the bulb, and this drives out the water previously forced in. The diver then is light enough to rise to the surface again.

Interesting antics are performed by Cartesian divers of irregular shape. A suitable form is shown in Fig. 2, in the lower right-hand corner of this page, and is made by drawing out the glass tubing a short distance from the bulb and bending the narrower section to the shape indicated. It is a little more difficult to introduce the water into this bulb, and the simplest way is to suck out some of the air and to close the end with the finger immediately, releasing it only when under water. A diver of this shape gives a sharp kick when the pressure of the finger on the cork or indiarubber at the top of the bottle is suddenly changed as it is rising or falling. It may even turn completely round or perform a somersault, and its antics in these circumstances will give rise to much amusement. Other shapes can be tried, but of course care always must be taken to keep the diver small enough to pass through the neck of the bottle used. There is more scope for variation in this respect if a wide-necked bottle is used, and in that case it is advisable to stretch a piece of indiarubber over the top instead of relying upon a cork.



Watching the movements of Cartesian divers made from glass tubing, as explained on this page. Two simple and effective forms of this amusing toy are illustrated separately on this page.

This amusing device can be made more attractive by introducing several Cartesian divers into one bottle. It is scarcely likely that any two will be of exactly the same density, and it is great fun to watch the differences in behaviour that they show when the pressure is altered. Some will be livelier than others, and the pressure on the cork or rubber cover can be so adjusted that one or two remain undisturbed when the rest sink.

Variations in the direction of the side tubes of divers similar in general form to that shown in the lower right hand corner of this page also lead to astonishingly irregular movements, for these are caused by the passage of water into or out of the tube as the cover of the bottle is pushed in or released.

The movements of the divers are more easily followed when they are brightly coloured. Enamels or oil paints of course are necessary, for water colours would be washed off; and half the outer surface of the bottle should be painted white, or covered with white paper, in order to give a background against which the colours show up well.

Joining two glass tubes of the same diameter is another fascinating glass blowing task. The ends of the tubes of course must be cut square and the two sections to be joined are then held, one in each hand, with their ends in the flame of the Bunsen burner or spirit lamp, and about $\frac{1}{8}$ in. apart. They are rotated as usual in order to give even heating, and as only one hand is available for each tube, this is best accomplished by simply rolling them backward and forward between the fingers and thumb. When their ends have been thoroughly softened, the tubes are removed from the flame and brought together with just sufficient force to cause them to adhere to each other. Further heating for a few seconds usually suffices to cause the ends of the glass tubes to melt thoroughly into each other, and if the walls of the joint approach too near each other the tube is opened out by gently blowing into one of the two open ends, while the other is closed with the finger.

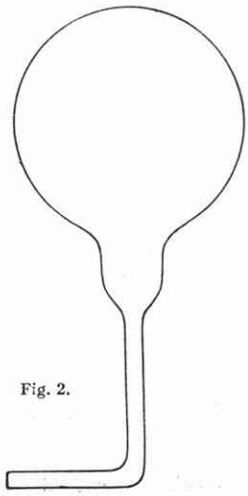


Fig. 2.

New Meccano Electric Clock Mechanism

Interesting "Waiting-Train" Movement

ONE of the most serious difficulties encountered in the past in the construction of electric turret clocks has been that of ensuring good time-keeping in all weather conditions. It was possible to protect the dials from wind, snow and sleet by covering them with glass, but this introduced the further difficulty that the glass often reflected the sunlight, so that glare made it impossible to read the dials. A solution to this problem is provided by the "waiting-train" movement. Hands driven by this are unaffected by weather conditions, so that the clocks, unlike weight-driven mechanical clocks, always maintain their time-keeping qualities. The "moving fingers" are unaffected by snow or sleet that would stop any mechanically-driven exposed turret clock.

The "Pul-syn-etic" waiting-train turret clock movement designed by Gent and Co. Ltd., of Leicester, provides practically unlimited power for driving the exposed hands of large clocks, and is under the constant control of the time-transmitter, which may be fixed in the base of a building or in any other suitable position. The "power factor" of the waiting-train movement is an electrically-driven pendulum, known as a motor pendulum, the function of which is not to keep time, but to drive by means of a pawl, a ratchet wheel, tooth by tooth, at each vibration. The ratchet wheel, in turn, by means of worm gearing, drives the hands of the clock. By a simple device the motor pendulum is re-energised by an electro-magnet, when its oscillations fall below a pre-determined arc. Under normal working conditions re-energisation takes place about once per minute, but when heavy work is thrown on to the movement as the result of resistance and wind pressure on the hands, the motor pendulum becomes energised more often—at each complete vibration if necessary. When it is energised at each complete vibration, the motor pendulum develops 30 times its normal power, and it is impossible to stop the movement by hand, even when exerting one's full power on the worm wheel.

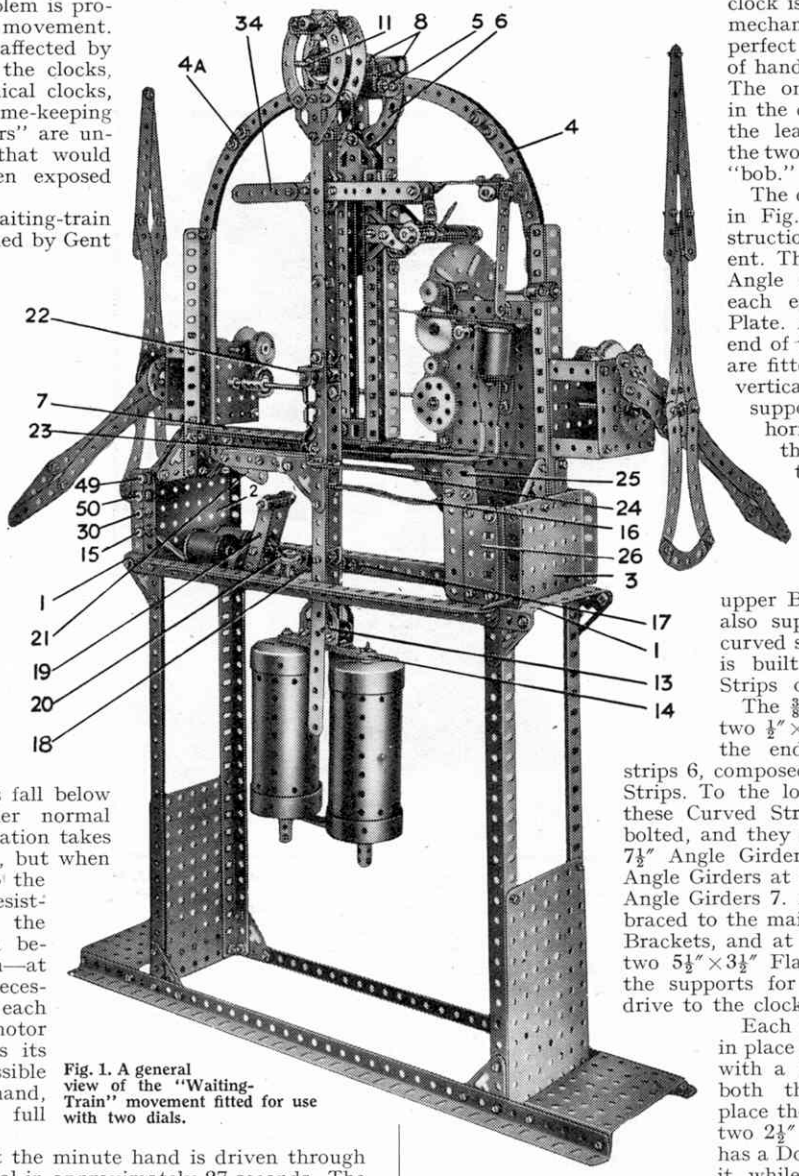


Fig. 1. A general view of the "Waiting-Train" movement fitted for use with two dials.

The gear ratio is such that the minute hand is driven through a half-minute space on the dial in approximately 27 seconds. The pawl of the motor pendulum is then automatically lifted out of engagement, so that, although the motor pendulum maintains its action, the hands remain stationary for two or three seconds, locked by the worm wheel. A current impulse from the transmitter, dead on the half-minute, releases the pawl, and the hands are driven forward for another half-minute on the dial. As a rest of two or three seconds is inappreciable, the hands appear to move with absolutely regular progression, and do not move in half-minute jumps, as is the case in impulse movement.

Among the many famous clocks operated by the "Pul-syn-etic" waiting-train movement of Gent and Co. Ltd., is the Royal Liver Clock at Liverpool. This fine clock, which has four faces measuring 25 ft. in diameter, is one of the most conspicuous features of Merseyside. Another fine clock is the Singer Clock at Clydebank, Glasgow. This is the largest electrically-operated true turret clock in the British Empire, and has four faces each 26 ft. in diameter.

The Meccano model described here is a splendid reproduction of a standard "waiting-train" mechanism, and if an accurate master clock is used for operating the delay mechanism it will keep almost perfect time and will drive two pairs of hands for dials of 12-in. diameter. The only non-Meccano parts used in the construction of the model are the lead weights concealed within the two Boilers forming the pendulum "bob."

The complete mechanism is shown in Fig. 1, and from this the construction of the frame will be apparent. The base consists of two 18½" Angle Girders secured together at each end by a 3½"×2½" Flanged Plate. At a position 3½" from each end of the base two Corner Brackets are fitted, forming supports for two vertical 12½" Angle Girders. These support, at their upper ends, two horizontal 12½" Angle Girders that are braced by means of two further Corner Brackets. The two 7½" Angle Girders are connected together at their round holes by ⅜" Bolts, and are spaced apart by four 7½" Strips. The upper Bolts of the compound girder also support the lower end of two curved strips 4 and 4a, each of which is built up from two 4½" Curved Strips overlapping two holes.

The ⅜" Bolts 5 each hold in place two ½"×½" Angle Brackets, and also the ends of two built-up curved strips 6, composed of 2½" small radius Curved Strips. To the lowest point in the centre of these Curved Strips two Flat Trunnions are bolted, and they carry the upper ends of four 7½" Angle Girders secured by means of 1½" Angle Girders at their lower ends to two 12½" Angle Girders 7. At one end these Girders are braced to the main frame by two large Corner Brackets, and at the other they are bolted to two 5½"×3½" Flat Plates. These Plates form the supports for the gears transmitting the drive to the clock hands.

Each pair of Angle Brackets held in place by one of the Bolts 5 is fitted with a 1½" Angle Girder, and when both these short Girders are in place they are connected together by two 2½" Angle Girders. One of these has a Double Arm Crank 9 secured to it, while the corresponding Crank 10 is not bolted to its respective Girder. A 3" Rod 11 is secured in the bosses of the two Double Arm Cranks, forming a support for two ½" Pinions, in the uppermost teeth of which rock two Centre Forks. As shown in Fig. 2, these Centre Forks are prevented from sliding laterally by the 1" loose Pulleys 12, and they are attached to the top of the pendulum by two Couplings. A short Rod, on which these Couplings are locked in place, is gripped in the bosses of two Double Arm Cranks carrying at each end a 2½" small radius Curved Strip. Each pair of these Curved Strips is bolted to a Flat Trunnion that in turn is bolted to one of the top Strips of the pendulum.

Each side of the pendulum is built up from one 9½" Strip and one 12½" Strip, and the two compound strips are connected together by

Double Brackets. At a point 4 in. from the bottom of the pendulum two Flat Trunnions 13 are fitted, and these carry a channel section girder composed of two 1½" Angle Girders. Four 3½" Strips 14 are now fitted, and the outer holes of these carry two 6" Threaded Rods locked in place by nuts. Boilers, filled with lead, are passed on to the Threaded Rods, and then are held in place by means of a 3½" Strip and two Threaded Couplings. The total weight of the lead in the pendulum "bob" must be about 8 lb.

The next portion of the model to be built is the impulse motor and contacts. The impulse motor consists of two Elektron Magnet Coils and two Cores, the latter parts being secured to a 1½" Angle Girder bolted to one of the Plates 1. The Magnet Coils are connected in series, and one of the two unoccupied terminals, one being on each coil, is connected to the Terminal 15. The other coil terminal is joined up by a long length of insulated wire to the insulated Strip 16, the purpose of which will be described later. A Rod 18, secured in the boss of a Double Arm Crank 17, carries a rocker arm 19 and a Coupling 20. The Coupling, which is locked by one of its Grub Screws to the Rod, carries a thick rubber band or band of paper, against which the impulse arm rests when not energising the pendulum. This arrangement reduces the noise of the clock mechanism considerably when it is in operation. The impulse arm is built up from two 1½" Angle Girders, bolted together to form a short channel section girder, and fitted with two 2½" Strips. The 1½" Angle Girders also carry an armature built up from a number of 1½" Flat Girders held in place by a ½" Bolt.

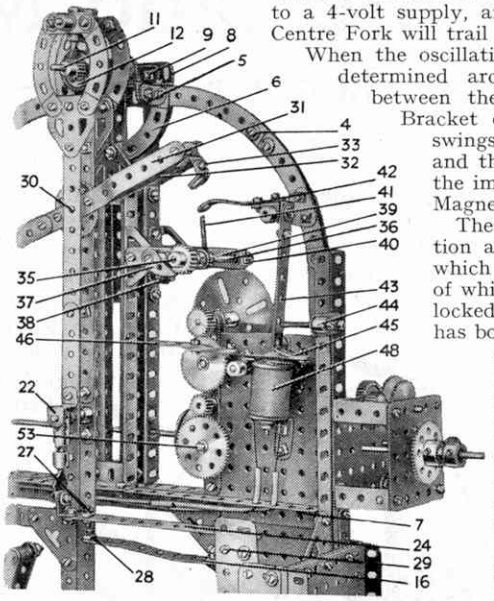


Fig. 2. Each pair of hands is controlled by a stage of gearing similar to the gear-train shown in this illustration.

The top holes of the 2½" Strips form the bearings for a 1½" Rod on which a number of Washers are free to rotate. The Rod is prevented from sliding sideways by means of two Collars, and the Washers roll against the 2½" Strip 21 when the impulse motor is excited. This short Strip is bolted to a 4½" Strip that is braced to the outer member of the pendulum by a large Corner Bracket. It will be seen from Fig. 1 that the 4½" Strip is bent slightly in order to allow the Strip 21 to make proper contact with the Washers. This part of the model will need a little careful adjustment in order to allow it to work efficiently.

A ½" Reversed Angle Bracket 22 is now bolted to the pendulum, and it supports the outer end of a short Rod mounted as shown in Fig. 2. This part carries a freely moving Threaded Crank in the threaded hole of which is fitted the screwed portion of a Rod Socket, a nut being used for locking purposes. A Centre Fork, carried in this latter part, brushes across the checking clip 23 that is carried on one end of a 5½" Strip 24. The checking clip consists essentially of a ½"×½" Angle Bracket, the two lugs of which are bent until they are at an angle of 45 degrees to each other. The part is then bolted to a second ½"×½" Angle Bracket by means of its slotted hole, a small slot being formed between the Bracket and a Washer carried on the securing bolt.

The 5½" Strip 24 is attached to a ½"×½" Angle Bracket that is bolted near the top of a 3½" Flat Girder 25. This Girder is attached to the frame of the model by means of a second shorter Flat Girder 26. By making use of the slots in these two Girders it is possible to adjust the position of the checking clip in relation to the Centre Fork already mentioned.

A Silver Tipped Contact Screw 27, fitted by means of two 6 B.A. Nuts to the 5½" Strip, is so arranged that it almost touches a second similar Screw 28 on the end of the 4½" Strip 16. This Strip is secured to, but insulated from, a ½"×½" Angle Bracket that is attached to the Flat Girder 25 by means of the Bolt 29, Fig. 2.

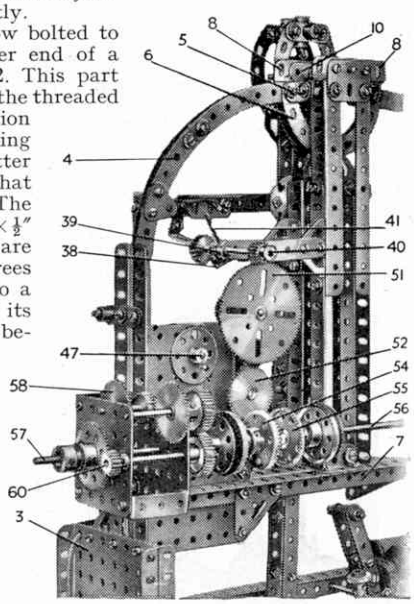


Fig. 3. The delay mechanism by which means the clock is controlled.

If the Terminal 15 and earth Terminal 30 are now connected to a 4-volt supply, and the pendulum is set in motion, the Centre Fork will trail backward and forward over the clip 23. When the oscillations of the pendulum fall below a predetermined arc, however, the Centre Fork catches between the Washer and the bent ½"×½" Angle Bracket of the clip 23. As the pendulum now swings from right to left the Strip 24 is depressed and the contacts 27 and 28 meet. This causes the impulse arm to be drawn towards the two Magnet Coils, and thus re-energise the pendulum.

The next parts of the model to receive attention are the ratchet and timing mechanisms, which are shown in Fig. 2. A Pivot Bolt, part of which is shown at 30, carries a Bush Wheel locked on its plain section. This Bush Wheel has bolted to it two 5½" Strips 31 and 32, bent as shown. The Strip 32 carries a 1½" Angle Girder, the use of which will be described later. The Strip 31 is fitted at its end with a Corner Angle Bracket to which is bolted a ½"×½" Angle Bracket 33. In order to counter-balance the weight of the built-up pawl 33, two 2½" Strips 34 are carried at the opposite end of the two 5½" Strips.

The Angle Bracket 33 is used in conjunction with a Ratchet Wheel 35, one tooth of this Wheel being picked up for every complete movement of the pendulum. It is mounted on a Rod 36, journalled in bearings as shown in Fig. 3, and is prevented from moving backward by means of a Pawl, without boss, 37. This Pawl is carried loosely on a ¾" Bolt and spaced away from its supporting Strip by two Collars. A short length of Spring Cord 38 keeps the Pawl in engagement with the Ratchet Wheel. The Rod 36 carries a Collar 39 and a ½" Pinion 40, the Collar having a 1" Threaded Rod 41 locked in one of its threaded holes as shown in Fig. 3.

When the pendulum is working the Threaded Rod makes one complete revolution in approximately 26 seconds and, as the Pawl is moved round one tooth at the end of one complete revolution, the Threaded Rod strikes the end of the 2½" Strip 42. This Strip, which is bent as shown in Fig. 3, is attached to a 3½" Strip 43 by means of a 1"×1" Angle Bracket; and the unit so formed is pivotally mounted on a short Rod by means of a Double Bracket. This Rod is mounted in two 1" Triangular Plates secured to the Strips 4. The downward movement of the Strip 42 is limited by an adjustable stop 44 consisting of a Threaded Crank and ¾" Bolt. As the Strip 42 is raised by the Rod 41, it lifts the 1½" Angle Girder secured to the Strip 32, thereby disengaging the pawl 33 from its Ratchet Wheel 35 and allowing the pendulum to swing idly. The pawl is kept in this position in the following manner.

The action of the Threaded Rod 41 causes the Strip 43, Fig. 2, to move across an Obtuse Angle Bracket 45, bolted to a pivotally mounted 3½" Strip counterbalanced by two 2½" Strips 46. The 3½" Strip is locked on a Collar by a nut and bolt, the Collar being free on a 1½" Rod locked in the boss of a Bush Wheel 47, Fig. 3. It will now be seen that until the Flat Bracket 45 is depressed the pendulum will not transmit any movement to the driving Pinion 40. A Magnet Coil 48, excited at half-minute intervals from a master-clock, draws the Flat Bracket out of engagement with the Strip 43, thereby resetting the impulse mechanism of the clock. This arrangement allows the pendulum to vary its speed within a limit of four seconds slow or fast, without in any way impairing (*Continued on page 264*)

Parts Required to Build the Model:

2 of No. 1	2 of No. 9b	1 of No. 16	6 of No. 27	8 of No. 53	2 of No. 79a	14 of No. 111c	2 of No. 162
8 " " 1b	2 " " 9d	3 " " 16a	2 " " 27a	1" " " 58	2 " " 82	1 " " 125	3 " " 171
12 " " 2	10 " " 9f	1 " " 16b	1 " " 27c	19 " " 59	8 " " 89	2 " " 126	1 " " 179
4 " " 2a	6 " " 11	6 " " 17	2 " " 28	1 " " 62	12 " " 89b	6 " " 126a	6 " " 182
9 " " 3	8 " " 12	4 " " 18a	4 " " 31	1 " " 62a	4 " " 90	15 " " 133	3 " " 1538
14 " " 5	2 " " 12a	2 " " 18b	230 " " 37	5 " " 62b	10 " " 90a	4 " " 133a	3 " " 1539
5 " " 6a	1 " " 12c	2 " " 21	20 " " 37a	6 " " 63	1 " " 103d	2 " " 142c	3 " " 1561
2 " " 7a	1 " " 13a	3 " " 22	134 " " 38	3 " " 63c	1 " " 103f	1 " " 147b	4 " " 1563
8 " " 8	1 " " 14	8 " " 24	6 " " 48	3 " " 65	8 " " 103h	1 " " 147c	2 " " 1569
8 " " 8b	1 " " 15	7 " " 25	1 " " 48b	4 " " 72	1 " " 111	1 " " 148	5 " " 1573
2 " " 9	2 " " 15b	6 " " 26	4 " " 52a	2 " " 77	8 " " 111a	1 " " 154a	11 " " 1583

New Meccano Models

Sailing Ship—Drop Hammer—Crane—Telpher Span, etc.

THERE is an almost unlimited variety of subjects for new Meccano models and the enthusiastic constructor need never be short of ideas. It sometimes happens, however, that difficulty is experienced in deciding what to build, and the purpose of these articles is to provide new ideas for constructional work. The models that are illustrated from time to time include a varied selection of subjects built with different Outfits, so that constructors with small Outfits are provided for as well as those who are more fortunate and have a larger range of parts.

Possessors of the larger Outfits will be able to build most of the models exactly as shown, and in many cases a number of parts will be left over. These parts may sometimes be used for improving the model, or alternatively the entire range of parts may be used for building a model of the same subject to the constructor's own ideas. Where more parts are available, a larger and more elaborate model can be built. Model-builders who have insufficient parts to build a particular model may find that they can build it by making modifications to the design. An entirely new model could be built on a smaller scale and with less detail work to enable it to be constructed with the parts available.

It often happens that one model suggests other subjects for models. For instance, the Sailing Ship on this page shows how such a subject can be treated and suggests other different types of sailing vessels. The Drop Hammer brings to mind different stamping and punching machines and the Mortar Mill (Fig. 5) is suggestive of building operations and the various equipment that is necessary for such work.

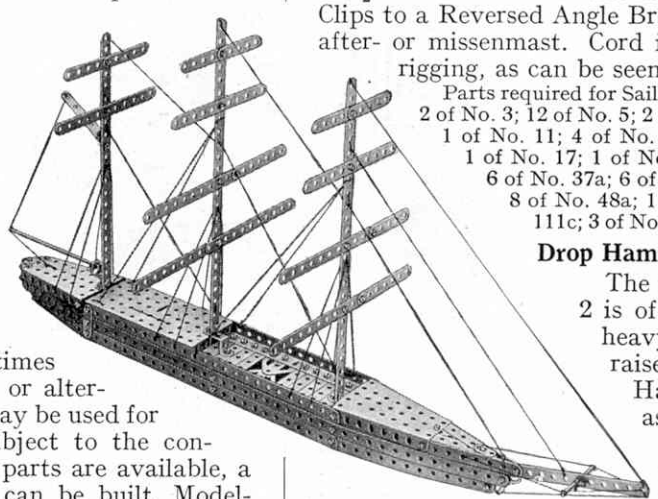


Fig. 1. Full-rigged Ship.

Full-Rigged Ship

Sailing ships have now been almost entirely replaced by power-driven vessels, and the few ships that remain always create much interest when they visit any of the large ports. A full-rigged ship under sail is a most impressive and fascinating sight and forms a striking contrast to the present day motor vessels.

The model sailing ship illustrated on this page is an excellent reproduction of a full-rigged ship, and its appearance can be further enhanced by making sails from white paper and fitting them in position after they have been curved to she shape of the actual sails when before the wind.

The hull of the model is made up of 12½" Strips and Angle Girders and the deck is filled in by means of a 5½" × 2½" Flanged Plate and two Sector Plates. The well-deck is filled in with 2½" Strips and Flat Trunnions. Strips are used for the masts, and the various yards are represented by further Strips bolted at right-angles. A 5½" Strip is used for the bowsprit, and a 2" Axle Rod is passed through this and retained in place by Spring Clips. A 4½" Rod is used for the boom and is fixed by Spring Clips to a Reversed Angle Bracket that is secured to the after- or missenmast. Cord is used extensively for the rigging, as can be seen in the illustration.

Parts required for Sailing Ship: 10 of No. 1; 13 of No. 2; 2 of No. 3; 12 of No. 5; 2 of No. 6a; 4 of No. 8; 7 of No. 10; 1 of No. 11; 4 of No. 12; 2 of No. 12a; 1 of No. 15a; 1 of No. 17; 1 of No. 24; 4 of No. 35; 60 of No. 37; 6 of No. 37a; 6 of No. 38; 2 of No. 40; 1 of No. 45; 8 of No. 48a; 1 of No. 52; 2 of No. 54; 6 of No. 111c; 3 of No. 125; 2 of No. 126; 2 of No. 126a.

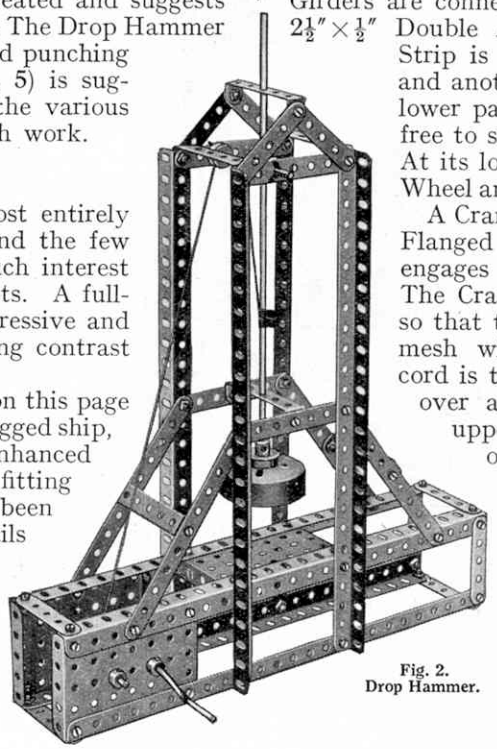


Fig. 2. Drop Hammer.

Drop Hammer

The model drop hammer in Fig. 2 is of the type used for making heavy forgings. The hammer is raised by means of a Crank Handle and drops as soon as the Gears are disengaged.

The base is made from four 12½" Angle Girders that are bolted at one end to two 3½" × 2½" Flanged Plates and 2½" Strips, and at the other end to 2½" Strips. A further 3½" × 2½" Flanged Plate is bolted at the centre of the upper pair of Angle Girders. Four 12½" Angle Girders are secured vertically to the base, the side Girders being spaced apart 3½". Two 3½" Strips are bolted between the Angle Girders at each side, and the two pairs of Girders are connected together at their upper ends by 2½" × ½" Double Angle Strips. A third Double Angle Strip is attached to two pairs of 2½" Strips, and another similar part is bolted between the lower pair of 3½" Strips. An 11½" Axle Rod is free to slide in these two Double Angle Strips. At its lower end the Rod carries a ¾" Flanged Wheel and a Boiler End that forms the hammer.

A Crank Handle is journalled in the 3½" × 2½" Flanged Plates and carries a ½" Pinion that engages a 57-teeth Gear on a 3½" Axle Rod. The Crank Handle is slideable in its bearings so that the Pinion can be thrown in or out of mesh with the 57-teeth Gear. A length of cord is tied to the secondary shaft and passes over a ½" Pulley on an Axle Rod at the upper end of the vertical frame. The other end of the cord is attached by Spring Clips to the sliding 11½" Axle Rod carrying the hammer.

When the Crank Handle is pushed in, the Pinion engages the Gear, and on turning the Handle the hammer is raised. To release the hammer the Crank Handle is pulled forward so that the Pinion is thrown out of mesh with the Gear which is then free to revolve, thus letting the hammer descend.

Parts required for Drop Hammer: 4 of No. 2; 4 of No. 3; 10 of No. 5; 8 of No. 8; 1 of No. 13; 2 of No. 16; 1 of No. 19s; 1 of No. 20a; 1 of No. 20b; 1 of No. 23; 1 of No. 26; 1 of No. 27a; 4 of No. 35; 53 of No. 37; 1 of No. 40; 6 of No. 48a; 3 of No. 53; 4 of No. 59; 1 of No. 162a.

Swivelling Crane

For the model crane shown in Fig. 3, a Bush Wheel is bolted beneath a 5½" × 2½" Flanged Plate and carries a 3½" Axle Rod. A 1" Pulley is fitted on the Rod and a 2½" × ½" Double Angle Strip is placed above this, the Rod passing through its centre hole. A second Pulley retains the Double Angle Strip in position. Two 2½" Strips are bolted beneath the Double Angle Strip and each carries a Trunnion. The two Strips are spaced apart at their outer ends by a 2½" Curved Strip. The Trunnions form journals for a Crank Handle carrying the hoisting cord.

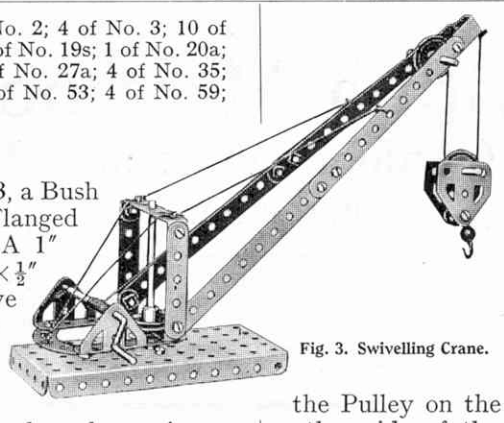


Fig. 3. Swivelling Crane.

Vertical 2½" Strips are bolted to each end of the Double Angle Strip, and the securing bolts carry also the 5½" Strips that form the jib. The latter Strips are extended by further similar Strips that are connected across the ends by a Cranked Bent Strip. A 2" Axle Rod at the upper end of the jib carries a 1" Pulley over which the hoisting cord passes before being passed round the Pulley in the pulley block and being tied to the jib head. The pulley block is made from two Flat Trunnions that are held together by a Double Bracket. A 2" Axle Rod is journalled between the Trunnions and carries a 1" Pulley Wheel, and a small Loaded Hook is bolted to the Double Bracket.

Parts required for Crane: 4 of No. 2; 4 of No. 5; 1 of No. 11; 1 of No. 16; 2 of No. 17; 1 of No. 19s; 4 of No. 22; 1 of No. 24; 5 of No. 35; 17 of No. 37; 1 of No. 40; 1 of No. 44; 2 of No. 48a; 1 of No. 52; 1 of No. 57c; 1 of No. 90a; 2 of No. 126; 2 of No. 126a.

Telpher Span

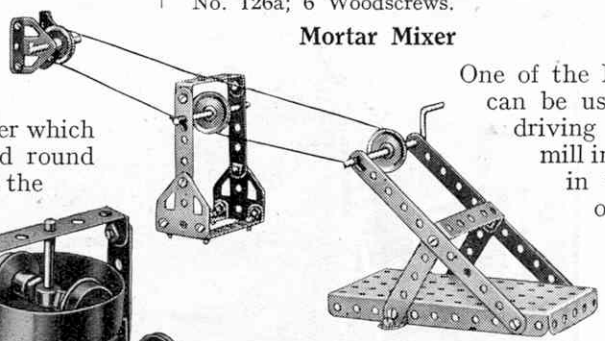
Although this model is only small and of simple construction much fun can be had from its operation. In Fig. 4 only a short length of cord is shown, for compactness of the illustration, but any convenient length of cord can be used. The free Pulley can be arranged on a suitable support at one end of the table and the windlass placed at the other end of the table. By operating the handle small loads can be taken from one end to the other.

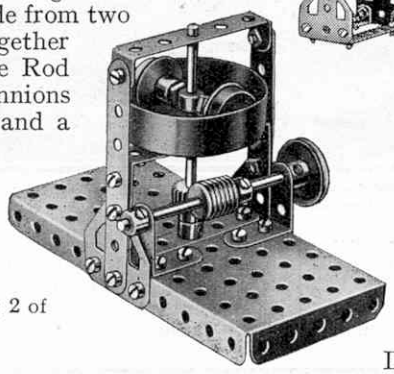
The windlass is made by bolting 5½" and 2½" Strips to a 5½" × 2½" Flanged Plate. A 2½" × ½" Double Angle Strip is bolted between the Strips and the upper ends of the 5½" Strips carry a Crank Handle. The Flanged Plate is provided with Angle Brackets that should be screwed down to a suitable baseboard, but if a board is not available a weight should be placed on the Plate. The free Pulley on the left of the illustration is carried on a 2" Axle Rod that is journalled in two Trunnions. The latter must be screwed down to some rigid support such as a wooden post, or they may be screwed to a block of wood that is weighted to prevent it sliding or toppling over.

The travelling telpher is made of two 2½" Strips bolted to a 2½" × ½" Double Angle Strip and carrying a 3½" Axle Rod on which a 1" Pulley is secured. The lower ends of the Strips carry Flat Trunnions that are connected together by 2½" Strips and Angle Brackets.

A single length of cord is used to form both the carrying cord and the hauling cord. One end is tied to the Double Angle Strip on the telpher and is passed round the 1" Pulley on the Crank Handle. It then passes beneath the Pulley on the telpher and round the Pulley on the wall bracket before being tied to the other side of the Double Angle Strip. By turning the Crank Handle the telpher is hauled to and fro, the Pulley being supported by the lower cord.

Parts required for Telpher Span: 2 of No. 2; 6 of No. 5; 6 of No. 12; 1 of No. 16; 1 of No. 17; 1 of No. 19s; 3 of No. 22; 5 of No. 35; 18 of No. 37; 2 of No. 48a; 1 of No. 52; 2 of No. 126; 2 of No. 126a; 6 Woodscrews.





(Above) Fig. 4. Telpher Span.
(Left) Fig. 5. Mortar Mixer.

Mortar Mixer

One of the Meccano power units can be used to advantage for driving the model mortar mill in Fig. 5. When driven in this way the model operates in a most realistic manner and it could be used in a model such as a builder's yard in which a small saw bench, concrete mixer, and other machines of this type could be used and driven from the same source of power.

A 5½" × 2½" Flanged Plate is used for the base and carries two Flat Trunnions to which 3½" Strips are bolted vertically to the Plate. Two 2½" × ½" Double Angle Strips are bolted between the Vertical Strips, and the lower one carries a Boiler End that is secured by two bolts and nuts. A 3½" Axle Rod is journalled in the Double Angle Strips and in the Flanged Plate and carries at its lower end a Collar and a ½" Pinion, and also a further Collar inside the Boiler End. A Threaded Pin is screwed into each tapped bore in this Collar and each carries a ¾" Flanged Wheel. Two 1" × 1" Angle Brackets are attached to the base Plate and form journals for a 3½" Axle Rod carrying a 1" Pulley, a Worm and a Collar. The Worm engages the Pinion on the vertical shaft, and as the 1" Pulley is rotating, the Flanged Wheels are caused to roll round inside the Boiler End, thus mixing up the contents.

Parts required for Mortar Mixer: 2 of No. 3; 1 of No. 5; 2 of No. 12a; 2 of No. 16; 2 of No. 20b; 1 of No. 22; 1 of No. 26; 1 of No. 32; 20 of No. 37; 4 of No. 38; 1 of No. 46; 1 of No. 48a; 1 of No. 52; 3 of No. 59; 2 of No. 115; 2 of No. 126a; 1 of No. 162a.

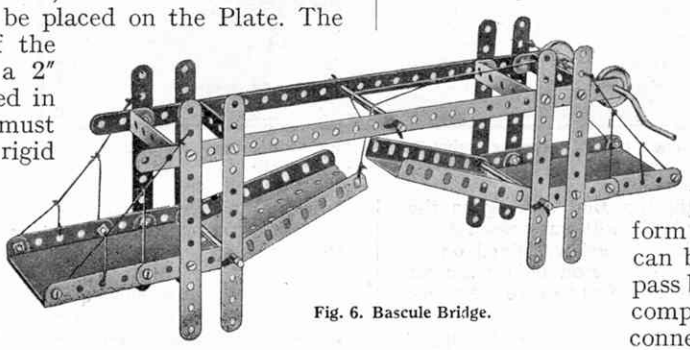


Fig. 6. Bascule Bridge.

Bascule Bridge

The centre section of the bridge in Fig. 6 is hinged in the form of two leaves, or bascules, that can be raised to allow river traffic to pass beneath. The end towers are each composed of four 5½" Strips, and are connected together

(Continued on page 252)

Surveying with a Meccano Theodolite

Fascinating Outdoor Work at a Boys' School

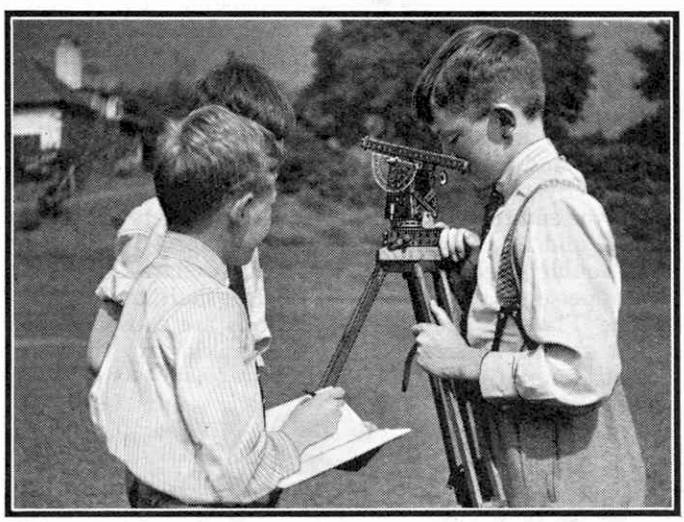
By H. E. G. Read

TOWARDS the end of the summer term three years ago, the top form at our school decided that they would like to put into practice some of the work they had done for their examinations. They had all done a little trigonometry, and surveying seemed an excellent excuse for getting out of doors. We started by fixing a board to a rickety tripod, and with this apparatus, which we referred to magnificently as our plane-table, we made a map of the playing field.

At the time the Headmaster was thinking of using a new fertiliser, and was delighted when we were able to tell him the area of the field. He immediately commissioned us to survey another field that he wished to level. With this job before us, we bent some glass tubing, filled it with water, and fixed it on some sort of sighting arrangement to form a "level." We started operations with this, but it was not good enough, so we set to work to design a theodolite. No metal-working shops were available, but several boys were very keen on their Meccano outfits, and a proposal to make a theodolite from Meccano parts was carried unanimously.

Mapping a field with the aid of a Meccano theodolite. The instrument is being sighted on the staff held upright on the edge of the field.

To give us some idea of what we wanted, we consulted the description of the Meccano Theodolite illustrated in the 5–7 Manual, 1932-3 Edition, together with various scientific catalogues. The idea in the Meccano model of using a plumb line for the vertical reading appealed to us immediately, and in practice this seems to make the setting up of the instrument quite easy. The weak point in the design appeared to be the bearing for the horizontal movement, and our first problem was to think of something more substantial. Eventually we decided on a 3" ball bearing. For reasons of cost this was built up from two 3" Pulleys and 21 Steel Balls of $\frac{3}{8}$" diameter. The lower Pulley Wheel was bolted to a $3\frac{1}{2}$"×$2\frac{1}{2}$" Plate, and four Strips 1" wide completed a box in which the 57-teeth Gear Wheel and Worm for the slow motion drive were housed. Between the Pulley Wheel and the $3\frac{1}{2}$"×$3\frac{1}{2}$" Plate two celluloid protractors were clamped, but these were not accurately positioned until the instrument was ready for test.



Taking a theodolite reading during the field survey work shown in progress in the upper illustration on this page.

Since the drive is from underneath, the Rod serving as the spindle is clamped to the upper Pulley Wheel. It was passed down the lower Pulley Wheel before the Gear Wheel was fixed on it, and spring washers were threaded on to the Rod before the set screw of the Gear Wheel was tightened up, so as to give a smooth but tight action with the minimum of backlash.

The turning part of the instrument was bolted to the upper Pulley Wheel at four points and its construction is quite evident from the photographs. The pointer can be seen on the right hand side of the photograph of the instrument itself; this is of the aperture type, and carries a piece of celluloid with a fine ink line on it. The drive from an old wireless condenser provided the material.

The sighting tube consists of two $9\frac{1}{2}$" Girders bolted together with Angle Brackets, the open ends being filled in also with Angle Brackets bolted through the slotted hole. At one end was fixed a piece of card with a pin hole punched in the centre, and at the other end two strands from a piece of electric light flex were secured in position by means of Seccotine to form the cross wires. Two $2\frac{1}{2}$" Girders, carrying Cranks, are bolted below the centre of the tube, and the horizontal Axle Rod on which this turns is secured in the bosses of these Cranks. One end of the Axle Rod carries the protractor scale and forms the pivot for the plumb line pointer; and to the other end is fixed a 57-teeth Gear that is driven through a Worm by turning the handle seen on the left of the photograph of the instrument.

A point in the design not evident in the photographs is the use of brass bushes at every bearing point. These consist of Cranks with the Set Screws removed. They were not fitted until after the first trials, when it was found that the holes in a Plate or Strip allowed too much play. Vertical movement is damped with spring washers, as already explained.

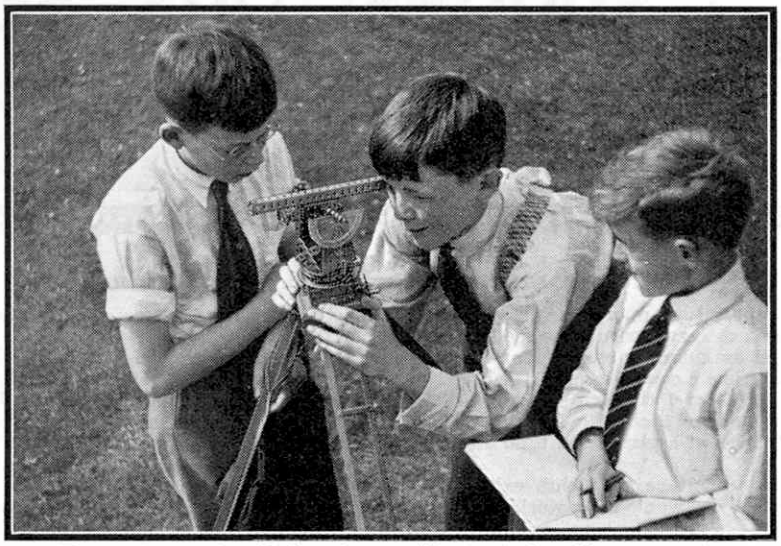
When the instrument had been bolted to its oak base, it was found that the ball bearing did not keep in the same plane when rotated. This was probably due to our fit of economy in not buying the proper cage type Ball Race, and though the trouble has been compensated to a certain extent by inserting wedges between the metal box and the wood base, it will never be quite overcome with the present materials.

Before putting the instrument into use, various adjustments were necessary. First, the theodolite was set up to sight an object known to be at the same level. A small spirit level was placed on the sighting tube, and the pin hole accurately positioned in line with the object and with the cross wires. At the same time the protractor was clamped to the axle in the position that gave a zero reading with the plumb line.

The next adjustment was to ensure that the two axles were at right angles. In this case the tripod was first accurately levelled, the spirit level being placed on it in two positions at right angles

to each other when testing. The theodolite was then fixed on with a bolt and wing nut, and the Bolts at the bottom of the Sector Plates were slackened off. By a rather laborious system of trial and error, these Bolts were finally tightened in such a position that the upper part of the instrument could be rotated through a complete revolution without disturbing the bubble in the level. Finally the theodolite was set up on the line between two points at the same level, and the horizontal protractors set so that a reading of 180 deg. was obtained for the swing from one point to the other for different positions of the tripod.

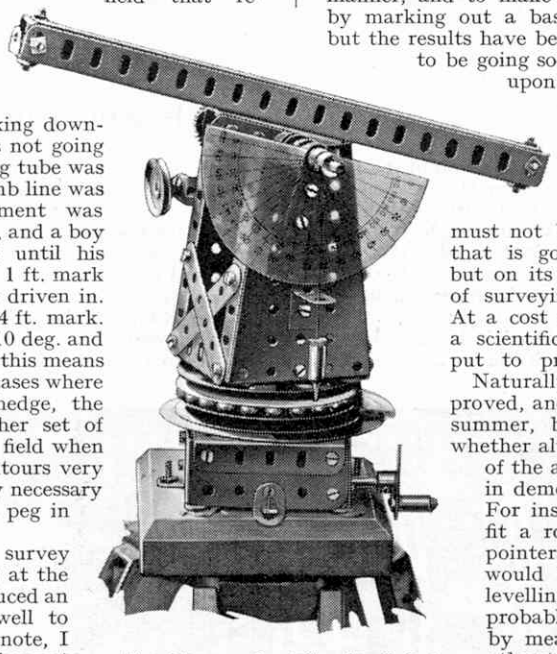
An ordinary half-plate camera tripod of the rule-joint type is always used. This pattern has a considerable advantage over other types, because each leg is attached to the head at two points, and levelling is easily carried out by moving one leg only. No level is permanently fitted, so the position of the instrument is checked by setting the vertical scale at zero, and rotating horizontally through a right angle. With this arrangement a spirit level on the sighting tube will show at once in which direction the theodolite is canting, and corrections can be made.



The surveyor at work, with his assistants waiting to note down his measurements.

Refinements like surveyor's poles are not indulged in. Instead we use the corner flagstaffs from the football field. These are painted white and are about 4 ft. 6 in. high, and the theodolite is very convenient for working when it is set to the same height as their tops. Sometimes a higher pole is required, and then one of the laths from the high jump apparatus is pressed into service.

We were now prepared to map the field that required levelling. The theodolite was set up in the lowest corner, with the sighting tube at the same height as the top of the flagstaff we were going to use. This had been marked clearly in feet, starting from the top and working downward. Since the vertical movement was not going to be used, the spirit level on the sighting tube was retained, as the zero reading on the plumb line was not sufficiently accurate. The instrument was sighted along a line parallel to one hedge, and a boy walked down this line with the flag until his companion at the theodolite found the 1 ft. mark on his cross wires, and there a peg was driven in. The process was repeated down to the 4 ft. mark. The theodolite was then swung through 10 deg. and a new set of pegs were driven in; and by this means the whole field was covered fanwise. In cases where the "4 ft. peg" did not "find" the hedge, the theodolite was moved up and a further set of points made in the same direction. The field when viewed from above now showed the contours very clearly, and to draw the map it was only necessary to measure the distances between each peg in each direction.



The Meccano theodolite described in the accompanying article.

The two boys who carried out this survey were convalescing from German measles at the time, and in two days they not only produced an excellent map, but were sufficiently well to come back into school again! As a footnote, I may add that the result of their labours has not yet been used, as levelling fields costs money.

We always use the theodolite now for marking out the running track for the sports. The playing field is not long enough for the usual shape of the 220-yds. track, but is of considerable width, especially towards one end. The track we use therefore is shaped rather like an egg, and consists of about five-eighths of the circumference of a big circle and three-eights of the circumference of a smaller circle, with the free ends joined by straights. It is a simple matter to set this out with the theodolite, because we have only to set up the angles subtended at the centres by those parts of the circles that we wish to use, and then to describe the circles with a tennis marker.

Work with the vertical scale is apt to be very inaccurate unless certain precautions are taken, but even then the results are not too good. Last year three boys who thought they knew all about it took their own measurements and found the height of a certain hill to be 40 ft. On the Ordnance Survey maps the height is given as 1,600 ft., and we are 700 ft. above sea-level! And yet their calculations were perfectly right. They were working from two positions in the same vertical plane as their objective, and taking angles of elevation from each point, afterwards calculating the height on the lines of the kind of question in the trigonometry books that runs: "A man observes the angle of elevation of a tower to be 30 deg. and on approaching 100 yds. nearer finds it to be 50 deg.; find the height of the tower."

The astonishing inaccuracy of this result was due to two causes. In the first place they had gaily assumed their points to be on the same level; and secondly the distance between the points was very small in comparison with the other distances involved. The fall of the ground between the two points showed an angle of depression of 1 deg. only, and the elevation angles were both less than 10 deg., but even so it was possible to get consistent results with an error of less than five per cent. when the height was redetermined from the same positions. With fairly large elevation angles, and a measured distance comparable in size to the other distances, much more accurate results than this are quite easily obtained.

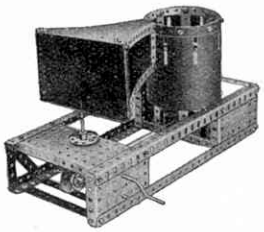
We have tried several times to use the theodolite in the orthodox manner, and to make a complete survey of the school grounds by marking out a base and working from it by triangulation, but the results have been far from satisfactory. Everything seems to be going so well until a check reading is taken, whereupon all the readings are thrown away in disgust. The reason is quite simple—no accurate work can be done in this way with an instrument with which angles of less than one deg. cannot be read on each scale.

Our working model of a theodolite must not be judged on its accuracy, though even that is good provided one realises its limitations, but on its value in teaching the principles not only of surveying, but also of mechanical construction. At a cost of well below 10 shillings we have made a scientific instrument that we have been able to put to practical use.

Naturally an instrument of this type can be improved, and we have various schemes in view for next summer, but it is necessary to consider carefully whether alterations will tend to destroy the simplicity of the apparatus, and thus make it of less value in demonstrating the principle of the theodolite. For instance, it is certainly not worth while to fit a rotating horizontal scale with 'A' and 'B' pointers in order to eliminate scale errors, but it would be an advantage to be able to carry out levelling without altering the tripod legs. We shall probably fit the instrument to a new base plate by means of three supports, one fixed and the other two adjustable for height, and at the same time provide two levelling tubes on the instrument. This will enable us to dispense with the rather inaccurate plumb line on the vertical scale, and to fit a hair-line pointer.

Another refinement would be to arrange for the worm drives to be thrown out of action, so that big swings could be carried out quickly. Some arrangement of slotted holes and springs would probably serve for this purpose.

I cannot help drawing a comparison between our home-made theodolite and a sextant that has been lent to me. With its telescopes and verniers, the latter is a marvel of scientific precision, and as such is a delight to handle. But the certainty of its results takes away half the charm in its use, and I and the boys far prefer our red and green Meccano theodolite.



Suggestions Section

Edited by "Spanner"

(324)—Counting Machine (J. R. Williams, Cardiff)

Counting machines can be applied to many useful purposes, and in actual practice their uses are very varied. The model illustrated on this page was designed for counting the number of coins inserted in a slot machine. Each time a coin is inserted an Electric Motor is started up to rotate the Gear 1 through one revolution, and in this manner a record is kept of each coin inserted in the machine, so that it is possible to tell at a glance the total amount inserted.

The model could be used to advantage at a club exhibition, where the insertion of a penny in a slot would set a working model in operation. The counting machine would add interest to the model and would serve also as an encouragement for visitors to increase the club funds.

Fig. 324 shows a rear view of the inverted model with the back and bottom Plates removed. It will be seen that the outer framework is made up of Angle Girders, the sides being filled in with Flat Plates. Four openings are left in the front to expose the figures, and are formed by means of Strips, as shown in the upper illustration. Four 1″ Corner Brackets are bolted at the corners of the openings.

In the rear view of the model the figures are not shown, so that the construction can be seen more clearly. The figures are marked on strips of paper that are bolted round the rims of four of the Hub Discs. A separate framework is built up to carry the mechanism, and is supported on three 11½″ Screwed Rods arranged longitudinally in the outer framework. Strips are attached to the Screwed Rods by means of nuts and are bolted to Face Plates as shown. At the front of the model the Strips are bolted to Angle Brackets. In arranging the Face Plates in position care should be taken to ensure that the bosses are in proper alignment, and to make quite sure that they are correctly placed it is advisable to insert temporarily an 11½″ Axle Rod through the bosses of all the Face Plates, before tightening up the bolts. An additional Face Plate is bolted to the end Plate, and can be seen on the left of the illustration in Fig. 324. This Face Plate carries the Axle Rod on which are journalled the four Hub Discs carrying the figures. A separate Rod carries the Gear 1 and the Hub Disc 2.

The Hub Disc 2 carries a Bush Wheel by which it is secured to the Rod of the Gear 1. A Threaded Pin 3 is carried on the Hub Disc, so that for each revolution of the Disc the Threaded Pin strikes one of the Threaded Pins 4 that are mounted in a "spider" removed from a Swivel Bearing or a Universal Coupling. The spider is carried on a 2″ Axle Rod journalled in two 3½″ Strips as shown. The other end of the Rod is fitted with a ½″ Pinion 5, and three Washers are carried on the Rod between the spider and the Strip. A 1½″ Rod is journalled immediately above the 2″ Rod and carries a ½″ Pinion that engages with the Pinion 5. The second Pinion meshes with the 2½″ Gear 6 secured to the Hub Disc that carries the units figures. At the other side of the Hub Disc a Bush Wheel is fitted.

For each revolution of the Hub Disc 2, the Pinion 5 is moved through a quarter of a turn, and as it is geared through a 5 : 1 reduction ratio to the second Hub Disc, it follows that the second Disc must rotate through 1/20th of a turn. In arranging the figures on the discs, two complete sets are fixed to each, numbering from 1 to 9, 0, and then 1 to 9 and 0 again. Thus each time the Gear 1 is given a complete turn the units figure is raised or lowered one according to the direction of rotation.

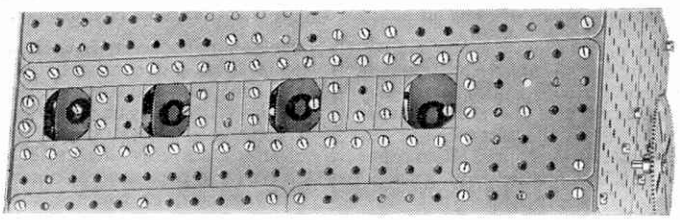


Fig. 324a.

Three of the Hub Discs that carry the figures are each fitted with two Threaded Pins, and these are arranged in such a manner in relation to the figures that as the 9 appears behind the opening at the front of the model one of the Threaded Pins is ready to strike one of the Threaded Pins in the respective spider. In this case the next Hub Disc is rotated through 1/10th of a revolution in two impulses for a com plete revolution of the preceding Hub Disc.

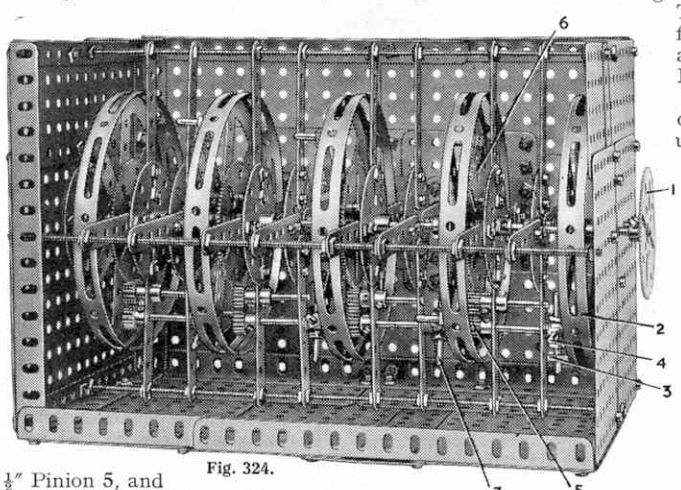


Fig. 324.

(325)—Automatic Brake for Winding Gear

(L. Cowley, Coventry)

The device (not illustrated) is intended for use in model cranes for automatically applying the brake to the hoisting or luffing barrels as soon as they are thrown out of gear with the power unit. The hoisting and luffing barrels are mounted end to end and the Rod of each carries a Gear Wheel. The driving Rod is placed parallel to these two short Rods and carries two Pinions opposite each Gear. One of the Pinions in each pair is not secured to the Rod, and is prevented from rotating by means of a ¾″ Bolt screwed into its boss and held in a Strip. The Strip is connected to the lever controlling the sliding movement of the Rod. The two remaining Pinions are fixed to the Rod and two Washers are placed between the two Pinions in each pair.

For the luffing operation the driving Rod is slid in its bearings until the respective rotating Pinion engages the gear on the luffing barrel, and the fixed Pinion at the other end of the Rod engages the Gear on the hoisting barrel, which is thus prevented from unwinding. To throw the luffing barrel out of gear, the driving Rod is slid in the opposite direction, and thus the luffing barrel is held by its fixed Pinion and the drive is transmitted to the hoisting barrel.

By means of this simple arrangement the hoisting and luffing operations are fully controlled by one lever only, separate brakes being unnecessary. It will be clear, however, that the lowering of the load or jib must be effected under power and cannot be carried out under the influence of a brake.

(326)—Gearless Reduction Drive

When spur gearing is operated at high speed, vibrations are set up and a considerable amount of noise is produced by the teeth. A very ingenious form of drive that eliminates all noise and vibration is produced by Burn Silent Gears Ltd. The essential features of this form of drive are reproduced in the model in Fig. 326. The model can be used as a reducing or increasing gear and gives a ratio of 2 : 1 between two shafts that are arranged ½" out of line.

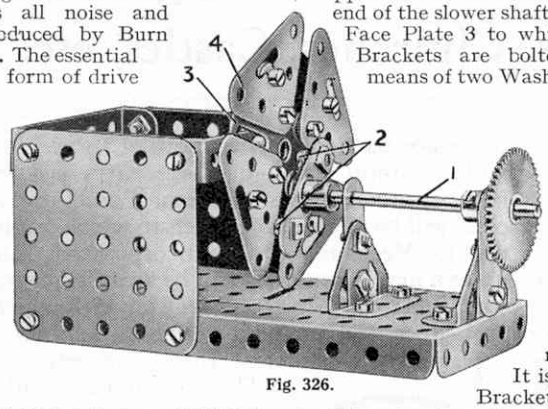


Fig. 326.

The lower shaft 1 is journalled in 1½" Strips that are bolted to Trunnions, and the upper shaft is journalled in two Double Angle Strips attached to the 2½" × 2½" Flat Plates. Any suitable bearings can be used, but it is important that the Rods should be parallel and mounted ½" apart.

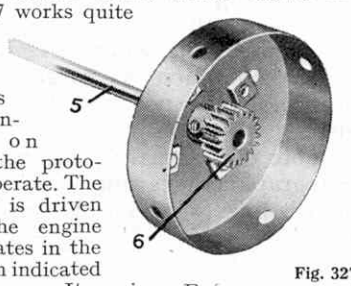
A Double Arm Crank carries two bolts 2 that are each secured by two nuts, and when the Crank takes up the vertical position the upper bolt should be directly opposite the end of the slower shaft. The latter carries a Face Plate 3 to which four 1½" Corner Brackets are bolted but spaced by means of two Washers on each securing bolt. It will be seen that the Corner Brackets are spaced apart to allow the heads of the bolts 2 to slide freely in the slots so formed, but they should be carefully positioned so that play is reduced to a minimum.

It is important that the Brackets should be accurately placed, and when the device is assembled it should work perfectly freely if all the parts are correctly positioned. It gives a silent drive and operates equally well when used as a reduction gear or a step-up gear. A little grease on the bolt heads 2 will improve the operation of the device.

(327)—Traffic Clutch (J. Morris, Newcastle)

Modern motor cars incorporate many ingenious devices that are intended to reduce the effort required of the driver to control the vehicle. There is a growing popularity for forms of drive transmission that minimise gear changing, and several ingenious mechanisms known as traffic clutches have been evolved by various makers so that the car can be started up from a standstill without the driver manipulating controls except the accelerator. These clutches rely upon centrifugal force to bring into engagement the clutch members, which somewhat resemble the shoes of an internal expanding brake. Notable examples of clutches of this type are fitted to Alvis and Talbot cars.

The Meccano traffic clutch shown in Fig. 327 works quite well and demonstrates the principle on which the prototypes operate. The shaft 1 is driven from the engine and rotates in the direction indicated by the arrow. It carries a Face Plate to which two Pivot Bolts 2 are each attached by two nuts. A Collar is free on each bolt and is spaced away from the Face Plate by three Washers. The shoes of the clutch are formed by bending 2½" × ½" Double Angle Strips as shown, and are attached to opposite Collars on the Pivot Bolts 2. Each shoe is secured by a bolt that is screwed into the tapped bore of the Collar, and a Washer is placed on each side of the Double Angle Strip to prevent the bolt from gripping the Pivot Bolt. The shoes are free to pivot on the Bolts 2 but are kept together by lengths of Spring Cord attached to bolts on the Face Plate.



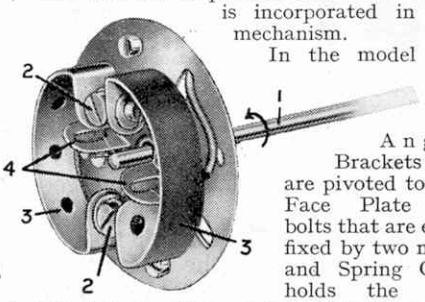


Fig. 327.

As the driving member of the clutch rotates, centrifugal force causes the shoes 3 to fly outward, and they are thus brought to bear against the inner surface of the Boiler End that is attached by a Bush Wheel to the driven Rod 5. The shoes should be lined with some friction material such as leather or fibre to ensure a grip on the Boiler End.

As the engine starts up, the shoes are not in contact with the inside of the drum, but as the speed increases the shoes tend to grip the drum and to turn it round, and the faster the driven member rotates the greater is the grip of the shoes. Eventually a speed is reached when the driving and driven members rotate solid.

With this arrangement it will be clear that there is no means of preventing the car from overrunning the engine, and in order to provide this a free wheel is incorporated in the mechanism.

In the model the Angle Brackets 4 are pivoted to the Face Plate by bolts that are each fixed by two nuts, and Spring Cord holds the two Brackets together. A Pinion 6 is carried on the end of the driven Rod, and when the clutch is assembled the outer end of the Pinion fits over the end of the Rod 1, and the Brackets 4 engage the teeth of the Pinion. When the shaft 1 is driving, the Angle Brackets trail over the Pinion teeth, but when the Rod 5 tends to drive faster than the Rod 1, the Brackets 4 engage the Pinion and the two Rods rotate as one.

The purpose of the free wheel in actual practice is to enable the engine to be used as a brake, so that when the throttle is closed the slowing up of the engine reduces the speed of the car. Also when a car is descending a hill, control can be maintained by means of the accelerator.

Miscellaneous Suggestions

Under this heading "Spanner" replies to readers who submit interesting suggestions regarding new Meccano models or movements that he is unable to deal with more fully elsewhere. On occasion he offers comments and technical criticisms that, he trusts, will be accepted in the same spirit of mutual help in which they are advanced.

(M.177.) Lock and Key.—A simple lock is suggested by F. Jepson (Heysham). The catch at the rear of the door consists of a Crank carried on a Screwed Rod passing through the door and screwed into a Threaded Boss on the front. It is firmly locked in the Boss by a nut. A Chimney Adaptor is placed over the Threaded Boss and is retained in position by means of a 5½" Strip, the centre hole of which coincides with the hole in the Chimney Adaptor, both ends being bolted to the door. The fixing bolts are lock-nutted to prevent them from being unscrewed when the door is locked.

A spring is attached to the catch to prevent the door from being opened, but when a Screwed Rod with a suitable handle is passed through the Chimney Adaptor and screwed into the Threaded Boss, it locks against the Rod of the Crank, which can thus be forced back against the action of the spring. The purpose of the Chimney Adaptor is to prevent the Threaded Boss from being turned without a key.

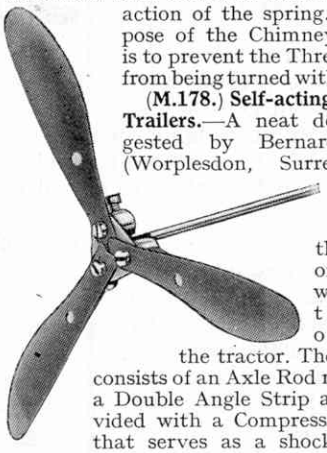


Fig. 328.

(M.178.) Self-acting Brake for Trailers.—A neat device suggested by Bernard Harms (Worplesdon, Surrey) automatically applies the brake on a trailer when it tends to overrun the tractor. The draw-bar consists of an Axle Rod mounted in a Double Angle Strip and is provided with a Compression Spring that serves as a shock absorber when the tractor is hauling. A 1½" Strip is pivoted on a bolt passed through its centre hole and attached to the trailer frame. The upper end of the Strip is pivoted to a Collar on the sliding Axle Rod, and a length of cord or wire is connected from the lower end to the trailer brakes. When the trailer tends to overrun the tractor the Collar on the drawbar forces back the upper end of the 1½" Strip, which thus applies the brakes to the trailer.

(328)—Three-Bladed Propeller (J. A. Rodiguez, Montreal)

The type of propeller in most common use on aircraft has two blades, but on some machines the design will not permit the use of this type of airscrew owing to the length of the blades that would be necessary. In such cases a four-bladed propeller is usually employed, although during recent years three-bladed propellers have increased in popularity. Meccano parts do not readily lend themselves to the construction of a three-bladed propeller, but the usual difficulties have been overcome in a most efficient manner in the three-bladed propeller illustrated in Fig. 328.

The three Propeller Blades are secured to a 1" Triangular Plate by means of bolts that are inserted in Threaded Bosses on the other side of the Plate. A ⅜" Bolt is passed through the transverse bore of each Boss, and the bolts are arranged radially about the centre of the Triangular Plate to grip the Rod.

"Architectural" Model-Building Contest

Prizes for Model Houses, Churches, Castles, etc.

IN this competition competitors are asked to submit models of houses, castles, monuments, or any other architectural structures. Previous competitions of this kind proved very popular, and numerous readers have written asking us to organise further similar contests. The building of architectural models provides an interesting change from the construction of mechanical models, and the Meccano parts are just as well suited for making churches, houses, etc., as they are for building bridges, cranes, motor cars, ships and other engineering structures. In deciding the prizewinners in the present contest the new system of judging, which was announced last month and which is fully explained on this page, will be adopted.

A collection of prize-winning Meccano architectural models. These show the varied and realistic effects that can be produced with standard Meccano parts.

Several fine examples of the kind of models suitable for entry in the present contest are illustrated on this page, but it must not be thought that because the models shown here are large and complicated that a big Outfit is necessary for success in the contest. This is not the case, and small well-built models will have just as good a chance as the most elaborate structures submitted. Illustrations of suitable architectural subjects for models are quite easy to obtain, and photographs of many fine buildings that would be excellent for reproduction have appeared from time to time in the *"M.M."*

Entries will be divided into two sections: A for competitors of all ages living in the British Isles; B for competitors of all ages living overseas.

In deciding the prizewinners the competition judges will allot points to each model according to its merits when considered under the following headings: *Sound Construction:* Models should be built on correct architectural principles and should be strong and cleanly designed. If possible, Meccano parts only should be used throughout the construction of models, and the parts should not be mutilated or altered in any way unless this is absolutely unavoidable. Maximum points obtainable under this heading 50. *Originality:* Some of the Meccano parts are particularly well suited to architectural work, and a careful study of these parts will soon reveal a number of novel uses for them. Points up to a maximum of 25 will be allotted to models in which original and novel uses for Meccano parts are incorporated. *Realism:* Points up to a maximum of 25 will be awarded to models according to the degree of realism with which they reproduce the appearance of the actual architectural subject they represent.

The maximum number of points under all headings that it is possible to obtain is 100.

Meccano or Hornby goods value £8 will be shared by the competitors in each Section who obtain 75 or more points, in strict proportion to the number of points obtained. Goods value £4 will be shared in proportion by competitors who obtain between 65 and 74 points. Prizewinners will have an opportunity of selecting from current price lists the Meccano or Hornby goods they desire to the value of the prize awarded to them.

Competitors should choose their subject very carefully. If only a small Outfit is available the best selection will be a monument of simple type, or a small building such as a bandstand or club house. Any size of Outfit may be used in building models, but models built from small Outfits, providing they are neat and well built, will receive just the same consideration as large models. Mere size alone is not enough to ensure success for a model.

Competitors should note that actual models must not be sent. A good photograph or drawing is all that is necessary. If possible it is best to send a photograph, as this will give the judges a better idea of the appearance of the model than is obtainable from a drawing, unless the latter is very well prepared.

Competitors should write their age, name and full address on the back of each photograph or drawing submitted, and should address their entries to "Architectural" Model-Building Contest, Meccano Ltd., Binns Road, Liverpool 13. The closing dates of the competition are as follows: Section A, 29th June, 1935. Section B, 31st August, 1935.

Photographs of prizewinning models become the property of Meccano Ltd., but unsuccessful entries will be returned if a stamped addressed envelope is enclosed.

"Architectural" Model-Building Contest

The Prizes

Meccano or Hornby goods value £8 will be divided among competitors obtaining 75 points or over in proportion to the number of points that they obtain. Prizewinners will be allowed to make their own choice of goods from current Meccano catalogues.

Meccano or Hornby goods value £4 will be divided in proportion among competitors who obtain between 65 and 74 points.

Certificates of Merit will be awarded to competitors who obtain between 55 and 64 points.

Separate sets of prizes will be awarded in the Home and Overseas Sections.

Model-Building Competition Results

By Frank Hornby

"September" Contest (Overseas Section)

The judges of this competition had a difficult task in deciding the principal prizewinners owing to the fact that several entries appeared of equal merit. Three competitors tied for First Prize and four competitors for the Second and Third Prizes. In order to treat each of these competitors as fairly as possible it was decided to divide the First Prize equally between the three tying competitors, and to combine the Second and Third Prizes and divide the total equally between the four competitors concerned. The full list of awards are as follows:

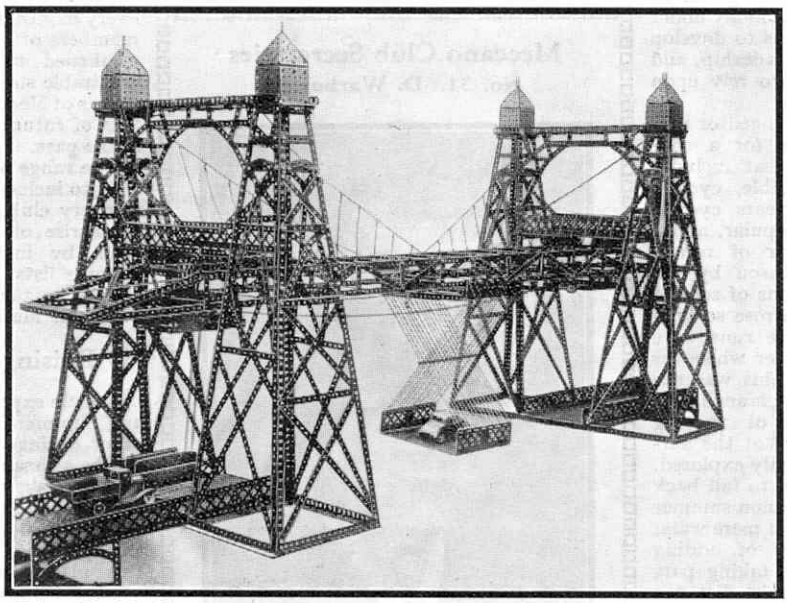
First Prize (£3-3s.) divided equally between three competitors, each receiving Meccano or Hornby goods value 21/–: R. Myburgh, Claremont, S. Africa; H. Shorten, Regina, Sask., Canada; A. Boeke, Baarn, Holland.

Second and Third Prizes combined and the total (£3-3s.) divided equally between four competitors, each receiving Meccano or Hornby goods value 15/9: C. Blackbeard, Johannesburg, S. Africa; R. Harman, Epping, Australia; D'Arcy Graham, Edmonton, Alberta, Canada; A. Camilleri, C. Balzan, Malta.

Goods value 10/6: J. Diehl, Buenos Aires, Argentine; M. de Wilde, Antwerp, Belgium; C. Cæsar, Trinidad, British West Indies; K. Orams, Blenheim, New Zealand; D. Smith, Wanganui, New Zealand.

Goods value 5/–: R. de Wilde, Hoboken, Belgium; J. Capelli, Buenos Aires, Argentine; K. Van Dommelen, Antwerp, Belgium; J. Willems, Hoboken, Belgium; D. Berkin, Kuling, China.

One of the models that tied for First Prize is the transporter bridge illustrated on this page. It is the work of H. G. Shorten, and is a very close copy of the famous transporter bridge that crosses the River Mersey at Runcorn, Cheshire. The total length of the model is 7 ft., and the overall height of the shore towers is 3½ ft. The builder has never seen the actual bridge and in constructing his model he has had to rely on photographs only. The transporter carriage is worked by means of a Meccano 6-volt Electric Motor incorporated in one of the towers, and by means of a simple type of automatic reversing gear the carriage is made to move to and fro across the bridge. As will be seen from the illustration, the addition of two Dinky Toy miniature motor cars adds a striking touch of realism.



This model of the fine transporter bridge that crosses the River Mersey at Runcorn, Cheshire, was built by H. Shorten, Regina, Canada. An illustration of the actual bridge appeared on page 228 of the March, 1929, "M.M."

A. W. Boeke submitted a splendid model of a chiming clock of the "grandfather" type. Unfortunately the photographs are unsuitable for reproduction and therefore I am unable to illustrate this fine piece of work. The clock is fitted with an alarm that can be set to ring at any predetermined time, and also with a complete set of Westminster chimes. It has dials for indicating the days of the week and the phases of the moon, and the case in which the mechanism is fitted is made from polished wood attached to a framework of Meccano Angle Girders. The mechanism is made almost entirely from standard Meccano parts.

A novel motor car driven by an airscrew was submitted by R. Myburgh. The bodywork consists mainly of Plates and Angle Girders, and the bearing for the airscrew is made from a Bush Wheel mounted on Rods in the centre of a Circular Girder. The car is fitted with Dunlop Tyres, headlamps, rear lamps and regulation number plates, and is driven by means of an Electric Motor. The propeller is driven from the road wheels through the medium of a belt, and the road wheels are each provided with internal expanding brakes.

A motor vehicle of a very different kind won a prize for R. R. Harman. This model represents a giant omnibus that travels a distance of 700 miles across the Syrian Desert between Damascus and Baghdad. The vehicle has accommodation for 36 passengers and is 66 ft. in length. The model is 5 ft. 5½ in. long. The motor unit is fitted with a three speed and reverse gear-box, clutch and internal expanding brakes, and the two rear axles are driven. The front springs are journalled in imitation hydraulic shock absorbers, made from Sleeve Pieces, Chimney Adaptors and Compression Springs.

The backrest of the driver's seat swings clear to allow access to the crew's sleeping quarters, and the engine cover and doors also can be opened. The rear wheels of the trailer are fitted on a pivoted bogie, which is provided with roller bearings and also with a self centring device, as in the prototype. Incidentally, in the actual vehicle the rear wheels can be steered from the rear compartment of the trailer, an arrangement that simplifies control of the bus when travelling through crowded traffic.

Another of the prize-winning models was a twin-engined biplane, which is very neatly built. The splendid work put into this model would have justified a bigger prize if the subject of the model had been more original.

C. Blackbeard's effort is a reproduction of a single cylinder overhead-valve motor cycle. It is complete in essential mechanical features, but unfortunately the commonplace nature of the subject, and the fact that several of the parts used had been mutilated, spoilt its chance of winning First Prize. The most ingenious part of the model is the crankcase and underframe, which is represented by means of a Triple Throw Eccentric. The twin-exhausts are made from bent Rods, and two Threaded Couplings joined together by a 1" Screwed Rod provide realistic silencers.

Another beautifully built, but unoriginal entry, is a model of H.M.S. *"Hood."* It is made almost entirely from Strips, and the gun turrets, control tower, and funnel, display particularly fine workmanship. The model was submitted by A. Camilleri, Malta.

The most outstanding of the remaining models is a floating block-setting crane, which was built by Marcel de Wilde. It comprises a large and massively constructed pontoon fitted with an overhead runway on which a crane truck travels. The truck runs on 12 wheels and is provided with hoisting sheaves and tackle, by means of which the blocks are gripped and lifted. A great amount of intricate detail work has been put into this model, among which overhead electric lights, power house fittings and lifeboats are specially interesting.

A model of a rather unusual type was submitted by K. J. Orams. It is a Lewis machine gun, and the butt and barrel are built up from Strips. The ammunition drum is made from two Circular Strips, in conjunction with several 7½" Strips and Flat Girders. The model looks very like the real thing and is complete with all necessary details, sights and stand.

An automatic machine for loading barrels was built by C. H. Cæsar. The barrels are represented by cotton bobbins, and they are lifted one by one by means of a lever and then allowed to roll one at a time down a chute. The chute can be manœuvred so that the barrels can be loaded into trucks or if necessary into the hold of a ship.

D. Smith sent a model of a Chrysler Airflow saloon motor car, fitted with recessed headlamps and bumpers. The bodywork is well shaped, but scrappy constructional work in some portions of the model spoilt its chance of winning a larger prize.

Preparations for the Summer Programme

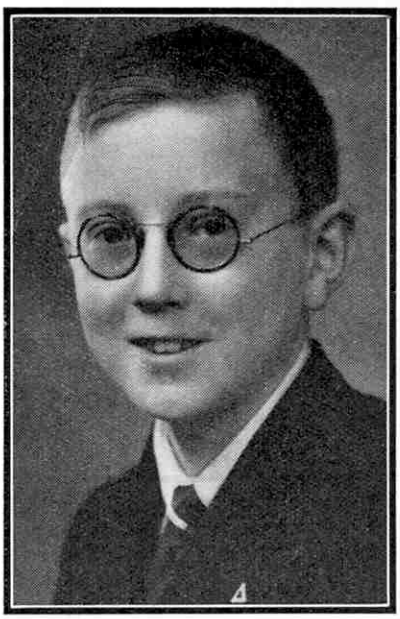
It is now time to look ahead to the summer months in order to decide upon the changes to be made in the programme to adapt it to the outdoor season. To a certain extent the exact form to be taken by summer meetings will be decided by the position of a club and its numerical strength, but I hope that in as many cases as possible arrangements will be made for a summer camp, or a series of week-end camps. Nothing can be more delightful in itself than a holiday under canvas, and in addition it helps to develop the spirit of goodwill and comradeship, and encourages members to learn to rely upon themselves.

Whether a camp can be arranged or not, preparations should be made for a continuous outdoor programme that includes cricket, rambles and, if possible, cycling runs. During the past few years cycling has become more and more popular, and I have been interested to hear of record mileages covered during a season by the members of the Cycling Sections of several clubs. In one case enthusiasm rose so high during last summer that cycle runs were continued throughout the winter whenever the weather was favourable. This was the natural outcome of a carefully-planned programme of interesting runs of varying lengths, in which the by-ways of the surrounding country were thoroughly explored.

In some clubs it is necessary to fall back upon rambles to provide a common summer interest. A ramble need not be a mere walk, for there are countless ways of adding interest. One is to lead those taking part to an open space a reasonable distance away, where games can be played, and an impromptu picnic organised, in order that they may have an enjoyable time in the fresh air before the homeward march begins. Rambles also can be combined with cycle runs so as to bring all the members of the club together. Those who walk make use of footpaths, the cyclists following a more circuitous route and carrying the necessary refreshments and any material required for the games to be played.

Meccano Club Secretaries

No. 31. D. Warburton



D. Warburton is secretary of the Macclesfield Grammar School M.C. Although the club was affiliated as recently as June, 1934, it already has a splendid record, and its first Exhibition was a great success. A party of members recently accompanied Mr. S. R. Jones, Leader, on a tour of the Meccano factory at Liverpool.

Visiting Other Meccano Clubs

The outdoor season provides splendid opportunities for the meetings of neighbouring clubs, who may exchange visits or arrange joint rambles or excursions. The photograph that appears on the opposite page is an interesting memento of an event of this kind. It was taken when a party of members of the Exeter M.C. visited the seaside home of the Sid Vale M.C. The hosts willingly exerted themselves to give their visitors a splendid time, showing them places of interest in Sidmouth and entertaining them royally before speeding them on their way home again. As a result friendly relations were established between the two clubs, and plans have already been made for bringing the members of both together again during the coming summer, and for the inclusion of models built by members of the Exeter M.C. in an Exhibition to be held in August by the Sid Vale club. The example set by these clubs could be followed with advantage by others, and I hope no opportunity of forming new Guild friendships will be lost.

Club Entries in "M.M." Model-Building Contests

The chief interest of members of Meccano clubs is the design and construction of models, and their skill in this direction is shown by their splendid displays at Exhibitions, which in all quarters have earned praise from interested visitors and appreciative notices in the press. Even wider publicity would follow, and greater credit would be reflected on their clubs, if the best of these models were entered in the Model-building Competitions announced every month in the "*M.M.*" The officials and members of one or two clubs have already awakened to this fact and have scored creditable successes, and I hope to see more names of Meccano club members in the prize lists of future Contests than have appeared in the past.

The range of these Contests is sufficiently wide to include the model-building activities of every club, and Leaders can reward the enterprise of members who win prizes in them by including their names in club honours lists. Success in this direction also should be taken into consideration in the award of Merit Medallions.

Raising Funds for Outings

A little expense is inevitable in the Spring and Summer Sessions, when excursions and other outings are arranged, but this need not be a burden. The best course is to open a club bank, into which small weekly sums are paid, and this should be done even when accumulated club funds are employed for this purpose. Members of clubs in which this plan has been followed have been surprised to find how quickly their contributions amount to quite respectable totals, and a bank of this kind should be started as early as possible if the greatest fun is to be obtained from the summer programme.

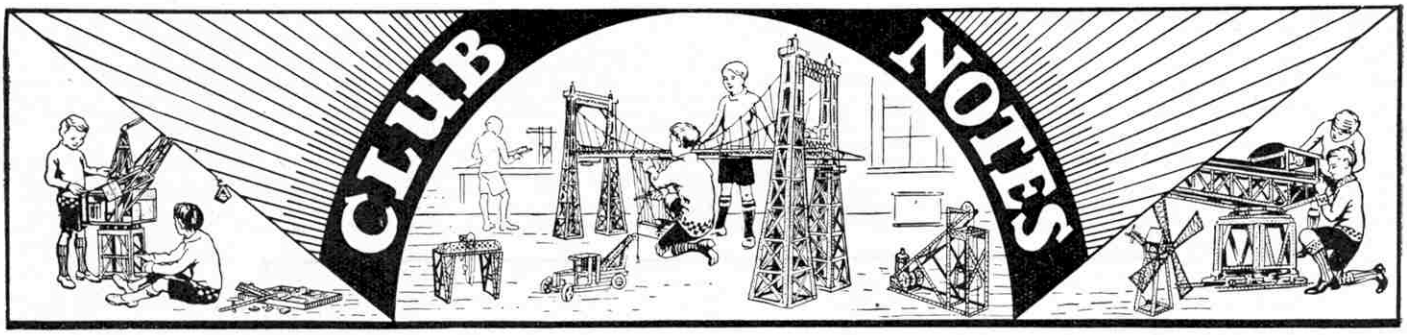
* * * *

The 4th Annual Exhibition of the Old Charlton M.C. will be held on 27th April at the Charlton Assembly Rooms. The Mayor of Greenwich has kindly consented to present the prizes, and the attractions will include a splendid display of Meccano models and an extensive Hornby Railway. The Exhibition will be open from 4.0 p.m. to 9.30 p.m., and the charges for admission to the display are 3d. for adults and 1d. for children.

Visits to Dagenham

I should be glad if Leaders of clubs and others who contemplate visiting the works of the Ford Motor Company Ltd. at Dagenham would note that the visiting days are Mondays, Tuesdays, and Wednesdays—not Thursdays, as stated in my paragraph in the March issue.

The days on which visits to Dagenham can be made by motor boat from Westminster Pier are Tuesdays and Fridays during May, June and July, and Tuesdays only in August and September. The return fare on the boat is 3/6 for adults and half price for children under 14. I wish to draw particular attention to the fact that children under 10 years of age are not permitted to visit the works.



Worcester Y.M.C.A. M.C.—Recent meetings were devoted to games and preparations for the Annual Exhibition. The Exhibition was a remarkable success and a pleasing feature was the large entry of models in the open section, for Meccano enthusiasts who were not members of the club. Model-building Contests also have been held, and an enjoyable Supper and Social Evening has been arranged. Club roll: 10. *Secretary:* R. J. Baker, 49, Lowell Street, Worcester.

Hornsea M.C.—Each section of the club continues to hold attractive meetings frequently, and the usual varied programme of Model-building, Lantern Lectures, Cinematograph entertainments and Games is followed. Special interest was taken in practical demonstrations of the construction of electric cells, and of electric lighting systems. Lantern Lectures have included descriptions of "*A Tour of North Wales*" and "*The Western Highlands of Scotland*," slides for the latter being kindly lent by the L.N.E.R. Hornby Railway Evenings are held regularly. Club roll: 75. *Secretary:* L. Chapman, "Cleveleys," Hull Road, Hornsea.

Tynecastle School M.C.—A Dramatic Section has been formed and members are rehearsing a play for the club's Exhibition. A Games Section also has been formed. Model-building activities continue, and the hum of electric and clockwork motors is continuous at every meeting. A special series of models for use on the club's Hornby Train layout has been completed, and the layout itself has been largely extended and provided with many lineside accessories. Club roll: 35. *Secretary:* R. A. Forsyth, 41, Caledonian Crescent, Edinburgh.

Hele's School (Exeter) M.C.—More ambitious programmes are now being planned and recent meetings have included Lantern Lectures and an Astronomical Evening, at which the sky was examined with the aid of a 2-inch telescope. A very successful Exhibition has been held. A modern train and its locomotive "*Lord Hood*" were inspected at the S.R. Central Station. Interesting meetings are now being planned in which a Cinematograph owned by one of the members and the School Epidiascope are to be used. Club roll: 12. *Secretary:* J. A. Drake, 7, Barton Terrace, St. Thomas, Exeter.

Queen Elizabeth's Grammar School (Barnet) M.C.—Exceptionally interesting meetings have been held. At most of these there has been intense model-building activity in preparation for the School Exhibition, at which the display of the Meccano club was a great attraction to the many visitors. Members were well received on Visits to the Printing Works of Gibbs and Bamforth Ltd., and the works of Standard Telephones and Cables Ltd. Excellent Lantern Lectures have been given, and a special visit of great interest was paid by Mr. S. C. H. Davis, the famous racing motorist and Sports Editor of "*The Autocar*," who gave a very entertaining talk on "*Motor Racing*." Other attractions have included a Lecture by Mr. P. J. Bassett-Lowke on "*The Progress of Transport by Water*," in which waterline models were used as illustrations, and a Lantern Lecture on "*How London Tube Railways are Made*," for which slides were kindly loaned by London Transport. Club roll: 80. *Secretary:* E. J. Mansfield, "Norfield," 25, Hillside Gardens, Barnet, Herts.

Mall School M.C.—Great interest was displayed in an exciting Treasure Hunt. A special feature has recently been made of Lantern Lectures, including "*The History of the London Omnibus*," for which slides were kindly lent by London Transport, and in Cinematograph Displays. Useful General Knowledge Contests are arranged, members being required to answer a series of questions covering a wide range in engineering and science. Model-building and miscellaneous Hobbies Nights also have been held. Club roll: 26. *Secretary:* D. Frost, 1, Broad Lane, Hampton, Middlesex.

Regent Street Central School (Heywood) M.C.—Members recently visited the Cathedral, the Docks and other places of interest in Liverpool, and after a subsequent tour of the Meccano Factory were entertained to tea by Meccano Ltd. At ordinary meetings Lantern Lectures have been given on "*Famous Places*," by Mr. Whitworth, and "*The Geology of the Heywood District*," by Mr. Greenwood, who showed many fossils. Club roll: 120. *Secretary:* T. Wild, 1, Orchard Street, Heywood, Lancs.

Morison Memorial (Clydebank) M.C.—Model-building activities are again in full swing. The club is divided into sections, the members of which are showing keen rivalry in their preparations for the club's Exhibition. Other events have included a Novelty Competition Night and a Lecture and demonstration by D. Muir on "*The Construction of a Motor Chassis*." Club roll: 25. *Secretary:* J. Glassford, 347, Kilbowie Road, Clydebank.

A group of officials and members of the Exeter and Sid Vale Meccano clubs. Our photograph was taken on the occasion of a cycle run by members of the former club, who were entertained at Sidmouth by the Sid Vale M.C. Later models built at meetings of the Exeter M.C. were included in a display organised at Sidmouth and a similar contribution is to be made to the Sid Vale club's Exhibition next August.

Whitgift Middle School M.C.—Most meetings are devoted to model-building. Members have constructed various types of motor vehicles, an excellent Stiff-Leg Derrick and an ingenious Calculating Machine that performs addition and subtraction. A visit of outstanding interest was paid to the works of the Ford Motor Co. at Dagenham, where special interest was displayed in the assembly plant. A further visit was paid to Croydon Gas Works. Club roll: 46. *Secretary:* H. D. Macdonald, 23, Woodvale Avenue, South Norwood.

Gate House School M.C.—Excellent progress has been made with model-building. Equal success has attended the efforts of the Hornby Train Section, and the stations of the club's layout have been fitted with electric light. The Exhibition was very successful. The Hornby railway attracted special notice and the displays of the Meccano and Fretwork Sections also were greatly appreciated. The Meccano Section was remarkable for the futuristic models included and a skilfully constructed miniature of "*The Golden Hind*," the vessel in which Sir Francis Drake made his celebrated voyage round the world, was greatly admired. Members have now pooled their Outfits in order to build a gigantic Eiffel Tower. *Secretary:* F. C. L. Melville, Gate House School, Ingatestone, Essex.

CANADA

St. Clair (Toronto) Y.M.C.A. M.C.—The club has now been affiliated. A large club room has been secured and excellent meetings for Model-building and other pursuits are being held weekly. Visits to factories also have been arranged. Club roll: 14. *Secretary:* G. Bell, 13, Rockvale Avenue, Toronto, Canada.

Edmonton Y.M.C.A. M.C.—Members greatly appreciate the grant of affiliation. Models built at home are brought to each meeting for judging, and this plan arouses keen competition. A mystifying Conjuring Exhibition was given by one member, and Mr. E. Jordan, Leader, contributed an interesting talk on "*Physics*." Visits have been made to engineering and industrial works. Club roll: 14. *Secretary:* J. Hargreaves, 12031-96, Street, Edmonton, Alberta, Canada.

HOLLAND

Maastricht M.C.—Many new members have joined the club and it has been decided to hold two meetings weekly. A better club room also is to be obtained. The programme includes Lectures, Model-building and Hornby Train Evenings. Competitions are frequently arranged, and a special meeting was devoted to photographic talks and demonstrations. Club roll: 10. *Secretary:* F. L. Bingen, Mathias Wyandstr, 18, Wyk/Maastricht, Holland.

SPAIN

Marsa (Tarragona) M.C.—This newly formed club has quickly qualified for affiliation, and the first meeting after the receipt of the Club Certificate was devoted to a talk by Sr. Costa, Leader, on Meccano and the Meccano Guild. Each member displayed a model at a great Exhibition arranged by the club. A Hornby Train layout also was on view and the hall in which the event was held was crowded with interested visitors. Club roll: 7. *Secretary:* J. A. Baig, Plaza de la Libertad num 1, Marsa, Prov. Tarragona, Spain.

Clubs Not Yet Affiliated

Vancouver Y.M.C.A. M.C.—Great enthusiasm prevails among members and interesting meetings have been arranged. These have included Lectures on railway topics, slides for which were kindly loaned by the C.N.R., and Social Evenings in addition to Model-building meetings. A Library has been organised. Model-building Contests and other competitions have added interest to the proceedings. Club roll: 9. *Secretary:* N. Gloag, 2944, Waterloo Road, Vancouver, B.C., Canada.

Peterborough (Ontario) M.C.—Meetings are becoming more successful and enjoyable as experience is gained. An excellent variety of models has been brought to meetings for judging and discussion. The Library is being extended and is greatly appreciated by members. An Exhibition has been planned and careful preparations are being made to ensure success. Club roll: 6. *Secretary:* K. Brown, 763, George Street, Peterborough, Ontario, Canada.

Verdun (Quebec) Y.M.C.A. M.C.—The club has been fortunate in securing the interest of Mr. A. J. Ganter as Leader. Mr. Ganter is a watchmaker, and his Meccano models have a professional precision. Under his guidance members are developing into expert model-builders and excellent meetings are being held. *Leader:* Mr. A. J. Ganter, Jr., Y.M.C.A., Verdun, Quebec, Canada.

St. Catherines (Ontario) Y.M.C.A. M.C.—Mr. F. Ness has been compelled to relinquish Leadership of the club, but will be able to attend some of the meetings. He is succeeded by Mr. R. Fairfield, who has arranged an excellent programme of Model-building Meetings. *Leader:* Mr. R. Fairfield, Y.M.C.A., St. Catherines, Ontario, Canada.

Centennial Church (Victoria, B.C.) M.C.—Programmes of model-building based on the Model-building Contests announced in the "*M.M.*" are being followed, and the best productions are being forwarded as entries in the Magazine Contests. In addition an ambitious railway system is being constructed in the Branch room, and every member is kept extremely busy at all meetings. *Leader:* Mr. F. Hall, Centennial Church M.C., Victoria, B.C., Canada.

Capturing a Baby Okapi—(*Cont. from page 229*)

But in this way *Toto* learned to drink water from a bucket after he had watched me several times bend and suck water directly with the mouth. And to find and eat *moodi* and *matungulu*, *anzarare* and *apopo*, *sangatoto* and *memengano*, plants of which I know the okapis eat the leaves and the flowers, and of which, believe me, during the course of lessons I soon learned to distinguish the taste and the perfume, both, fortunately, delicious. It was in this way also that *Toto* learned to lick the salt that the okapi likes so much and that I like so little, and which after each lesson left me with a terrible thirst for the rest of the day. But *Toto* learned so quickly and so well, and every day grew more fond of me with so much trust and confidence, that nothing was too much for me to do for him.

So day after day passed rapidly both for me and for *Toto*, who between one thing and another never had time for nostalgic thoughts. The only moment when he showed some homesickness was at sundown. That was the moment when, in the hiding place in the forest, he would have been listening impatiently. From far away he would have heard the longed-for gallop approaching. Then his mother, big and strong and beautiful, would have entered the green labryinth, appeared at the opening of the shelter. She would have found him standing waiting for her, ready to throw himself voraciously upon her for his warm, comforting dinner. During this his mother would have licked him all over, giving him meanwhile who knows how much interesting news about the far big river where she had been to bathe, the encounters made, the various events of the forest that nobody knows except the grown-up okapis who see all, hear all, and smell all. Then *Toto* would have laid down, happy and satisfied, near to his mother so as not to have to fear the cold of the night, nor all those mysterious noises, those obscure dangers that the night brings to everybody.

Instead of all this, my bottle of goat's milk, my caresses, my words of sympathy, and the little blanket I tied around him! Small consolation and quite a poor substitute, I am sure *Toto* thought, and he looked at me with his big eyes suddenly sad. During the whole day he had taken on the air of a full grown okapi; but in that moment, if his dignity had permitted, he would certainly have cried something like "Mama!"

It is true that there in that hut, well made and clean and warm, he didn't have to fear either the dripping of the rain nor the fall of great trees, nor the ambush of the leopard nor the poison of the snake, nor all the other dangers and all the other anxieties that embitter the life of his contemporaries in the forest. But so young, how could he know it? If at least I could have given him the company and warmth of another animal during the night, perhaps I could have consoled him a little. One evening I tried. The only animal at my disposal was a goat. I introduced it into the hut, tying it at a certain distance from the place where *Toto* usually slept, so that the goat could move freely and go near to him, but not give him a butt with her horns. *Toto* didn't move an inch, nor did he turn his head from the opposite direction in which he chanced to be looking. A beginning not too encouraging. But perhaps, I thought, in a few hours they will become friends.

When after dinner I came back to the hut I quickly lost every hope. The continuous stupid baaing of the goat must have grated terribly on *Toto's* nerves. Having taken refuge in the farthest corner of the hut, there he was standing, turning his eyes to the sky, exactly like one of us who would say: "Please, please, take away that disgusting, noisy imbecile before I go mad." And not to leave me in any doubt as to his feelings, he lifted his head and stamped incessantly on the ground with his stiff little foreleg—that gesture of his I found so amusing. "Oof! Take her away! Take her away!" Nor did his gesture of impatience cease, nor would he decide to lie down, before the goat and her beastly baa had disappeared far away. Only then he calmed down and rested his head on my arm.

"Believe me, better alone than in bad company," he would have said to me, if it were not for the fact that the okapi leaves the saying of trite things like that to men.

The start of a model yacht race. Model yacht sailing is one of the most interesting of outdoor hobbies and races between evenly matched vessels cause great excitement.

"The Granite City"—(*Continued from page 225*)

strenuous working, the equivalent cut-off for a simple engine would be only about 28 per cent. to 29 per cent. The engine simply romped away. At Glamis 5¾ miles from the start speed had risen to 60 m.p.h., and the 22½ miles from there to Luncarty were run in exactly 21 minutes, speed being maintained at between 63 and 71 m.p.h. the whole way. We should have reached Perth in 34 minutes—a minute early—but for a bad succession of checks outside the station, which actually caused us to take 41¼ minutes.

We were just getting well away again from Perth when we were stopped by signals at Hilton Junction two miles out, and stood for three-quarters of a minute. On re-starting the work of the engine was again magnificent. All up the gradual rise along Strathearn, speed was maintained at 53 to 54 m.p.h., working on the same cut-off as before. Then came the tremendous climb to Gleneagles, nearly six miles, and nearly all up at 1 in 100. Here the cut-off was increased to no less than 75 per cent. in the high pressure, and 67 per cent. in the low, but even this was only equivalent to about 31 per cent. or 32 per cent. on a simple engine.

The minimum speed on the climb was 28 m.p.h., and despite the signal stop at Hilton Junction which cost fully three minutes, only a minute was lost between Perth and Gleneagles, the 15.8 miles being run in 27 minutes. From here we got away in great style, and along the level stretch of line to Kinbuck, speed was mostly sustained from 65 to 66 m.p.h. On the steep descent of Dunblane bank the regulator was brought right back to about three-fifths open, and numerous gentle applications were made of the brake to keep the train running steadily on this winding stretch of line, the 17.2 miles from Gleneagles to Stirling being run in 20¾ minutes.

On the last stage from Stirling to Glasgow the work was perhaps the finest of all. It was getting dark now, and in readiness a tiny oil lamp was lighted in the cab to show the level of the water gauges. Away we went again with 75 per cent. cut-off in the high-pressure and 67 per cent. in the low-pressure. Up the rise past Bannockburn the exhaust was a perfect roar. The speed at the summit was 35 m.p.h., where the grade is 1 in 100. There was a swift dash down past Alloa Junction at 62, a really thrilling run through the maze of junctions at Larbert, and then we tackled the last bit of really hard climbing. From Carmuirs West junction to Cumbernauld we ran the 7¾ miles of really heavy grade in 10¾ minutes, the speed at no time falling below 39 m.p.h. On the last stretch into Glasgow, which is nearly level until within three miles of the terminus, speed was mostly maintained at about 60 m.p.h., but unfortunately a permanent way check just at the finish prevented us from keeping strict time from Stirling, the 30¼ miles being run in 41¾ minutes instead of the 41 minutes allowed.

On this splendid run the driver had gained nearly six minutes on booked time, a fine achievement indeed on a train having so very tight a schedule; and although the engine was being worked really hard throughout, I was astonished at the remarkably low coal consumption. Even on such difficult stretches as Gleneagles bank, and the climb from Carmuirs to Cumbernauld, the work of the fireman was not unduly strenuous. The engine throughout steamed with remarkable freedom and gave altogether a most convincing performance.

It was exhilarating to witness at first hand an engine being worked so tremendously hard. The maximum cut-off at which these engines can be worked is equivalent, in a simple engine, to about 35 or 36 per cent., so that going up to Gleneagles and between Carmuirs and Cumbernauld it was nearly a case of "all-out." Throughout the trip the sense of effort was never absent, the exhaust even at really high speed was full throated and deep, and all the time the response of the engine was wonderful.

Marvels of Nest Building—(*Cont. from page 210*)

an increasing sight in recent years, for this gull, unlike other gulls, nests far inland. Redshanks also nest at these inland gulleries.

In caves along the rocky coasts of Wales, Ireland and western Scotland, we find the seaweed-nests of cormorants on the ledges, and those of jackdaws, rock-doves and choughs, or red-legged daws, in the holes. Caves inland often have nests of swallows and house-martins. On the ledges of the sea-cliffs are the nests of the auks—black and white diving birds like guillemots and razorbills—and the graceful kittiwake gulls in tiered rows up to the top, where nest the herring-gulls and black-backed gulls, and on the ground at top the little puffins or sea-parrots. Farther inland the shearwaters nest in burrows. On the shore we search for the eggs of terns, ringed plovers and oyster-catchers that look so much like the pebbles among which they are laid. Ravens, herons, crossbills and owls often start nesting in January, and thrushes, house-sparrows, robins and blackbirds in February, while nightjars and turtle-doves are not found nesting until May.

New Meccano Models—(*Continued from page 243*)

near their upper ends by means of 12½" Strips. Four 2½" × ½" Double Angle Strips space the 12½" Strips apart. The approaches are formed from 2½" Strips that are spaced apart by Double Angle Strips and carry pieces of cardboard that are used for the roadway. Sector Plates form the bascules and are pivoted on 3½" Axle Rods. A length of cord is tied to each Sector Plate and passed over a 3½" Rod in the centre of the 12½" Strips. The two cords are joined together and wound round a Crank Handle at the end of the bridge. By turning the Crank Handle the cord is wound in, thus raising the bascules. The Motor Cars and Ships in the Meccano Dinky Toy range can be used with this model, and add considerably to its interest.

Parts required for Bascule Bridge: 2 of No. 1; 8 of No. 2; 8 of No. 5; 4 of No. 12; 3 of No. 16; 1 of No. 19s; 2 of No. 22; 6 of No. 35; 20 of No. 37; 2 of No. 38; 1 of No. 40; 6 of No. 48a; 2 of No. 54.

Branch News

WIMBORNE GRAMMAR SCHOOL.—Track meetings are exceptionally popular, and interest in them has increased so much that two sections have been formed in order to give each member good practice in operation. A novelty is the construction of a miniature underground railway with three stations. Special Exhibitions at which realistic operations were carried on aroused great interest among visitors. Secretary: D. V. J. Gibbs, Queen Elizabeth's Grammar School, Wimborne, Dorset.

GULLANE. — Excellent meetings are being held, members attending regularly and interesting themselves keenly in operations on the Branch track. The line is continually being extended and more rolling stock has been introduced to give increased scope for realistic running and shunting operations. Secretary: G. Morran, 23, Hamilton Crescent, Gullane, E. Lothian.

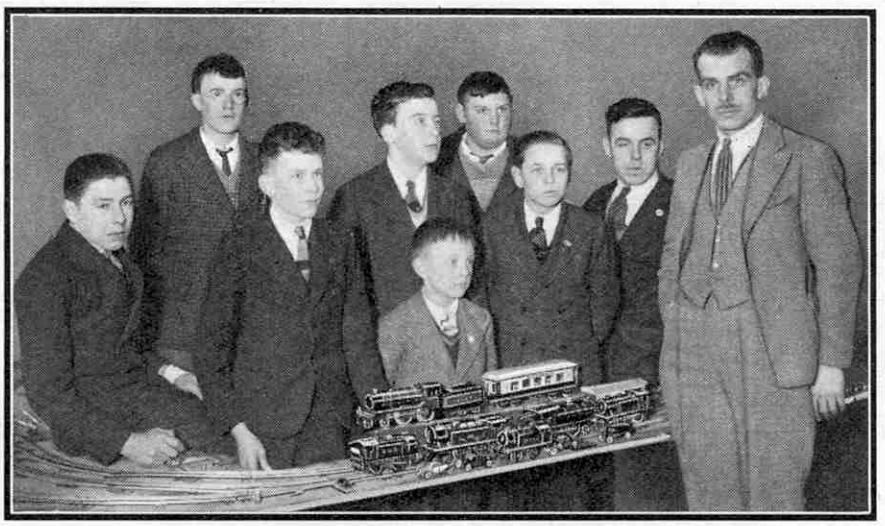
DAGENHAM.—Two successful Exhibitions have been held, and at both a well-planned Hornby layout proved to be a great attraction to visitors. Regular track meetings continue, the running of a Hornby Riviera "Blue" Train creating chief interest. Social Evenings have varied the proceedings and a Concert has been given. The progress of the Branch has made a new Branch room desirable, and efforts are being made to find more convenient quarters. Secretary: P. Bush, 121, Church Elm Lane, Dagenham.

CAMPDEN GRAMMAR SCHOOL.—The Branch track now passes completely round the room and permanent sidings add to the interest of operations. Shunting of "pick-up" goods trains is carried on without interfering with main line service. Miniature fields have been constructed along the lineside, and cuttings and tunnels help to give a very attractive appearance to the track. One of the members intends to film the Branch room during operations. Secretary: R. H. Field, Manor Farm, Kemerton, Glos.

HOLYWELL (OXFORD).—At a special track meeting members were unexpectedly given problems in railway operation to solve, and all showed ability to cope with the difficulties raised. An excellent visitors' meeting was held, one of the attractions being a talk by Mr. Elliot on *"L.N.E.R. Locomotive Classes."* An excellent Lecture was given by Rev. L. A. Garrard on *"Timing Trains,"* and this proved so interesting that it is to be repeated. Track meetings are held regularly and a visit has been paid to the L.N.E.R. locomotive depot at New England, Peterborough. Secretary: J. Spicer, 28, Holywell, Oxford.

STREATHAM PARK.—The timetable to which trains are operated is altered from time to time in order to give a variety of experience in miniature railway operation. The Branch layout now contains more than 140 ft. of track. Automatic colour-light signals are used throughout, and nearly all points are operated by Hornby control from signal boxes. The timetables are worked out in true railway fashion by means of graphs. A talk on *"Types of Valve Gear"* was illustrated by means of working models. A scheme for interlocking points and signals is now being considered. Secretary: J. B. Cass, 161, Ribblesdale Road, Streatham, London, S.W.16.

ST. THOMAS (EXETER).—Games are now played at the beginning and end of each meeting. Ample time is left for track work, and the duties of members taking part in combined operations are re-arranged from time to time in order to give thorough training in all branches of miniature railway working. Every member is given opportunities of making up trains and directing operations. A special display was given, by request, at a local Exhibition in the Buller Hall and this was remarkably successful. A new foundation for the track is being built and a box is to be made for the storage of rolling stock. The wood required was kindly presented to the Branch by a timber merchant. Secretary: H. A. C. Adams, "Westwood," Buckerel Avenue, Exeter.



A group of members of the Hollanders (Spalding) Branch, No. 240, with the Chairman, Mr. F. Keyworth. The Branch was incorporated in December, 1932, and keen interest is displayed in operations on the extensive Branch track, which is double throughout and is equipped with electric signalling.

CANADA

OTTAWA.—This is the first Canadian Branch to be incorporated with the H.R.C. The excellent Branch layout is mounted on boards supported by trestles, and represents the L.M.S.R. main line from Euston to Edinburgh, with a branch to Liverpool. Double track is used throughout and most of the total length of 250 ft. has been electrified. The Branch has recently removed to new quarters and wonderful progress is being made. Chairman: Mr. E. L. Gray, 251, Flora Street, Ottawa, Canada.

Branches in Course of Formation

The following new Branches of the Hornby Railway Company are at present in process of formation and any boys who are interested and desirous of linking up with this unique organisation should communicate with the promoters, whose names and addresses are given below. All owners of Hornby Trains or accessories are eligible for membership and the various secretaries will be pleased to extend a warm welcome to all who apply.

BARNET—F. J. Noble, 58, The Drive, Barnet, Herts.

BARNSLEY—K. Kenworthy, 6, California Garden Houses, Park Road.

BARRY DOCK—J. H. Abbott, 41, Holton Road, Barry Dock.

HARROW—R. A. Vere, 68, Kenton Lane, Kenton, Harrow.

HULL—D. R. Taylor, 1147, Hessle High Road, Hull.

NEWCASTLE—A. R. Needham, 16, Firtree Crescent, Forest Hall, Newcastle.

NEW FERRY—D. Marston, "Avalon," Boulton Avenue, New Ferry.

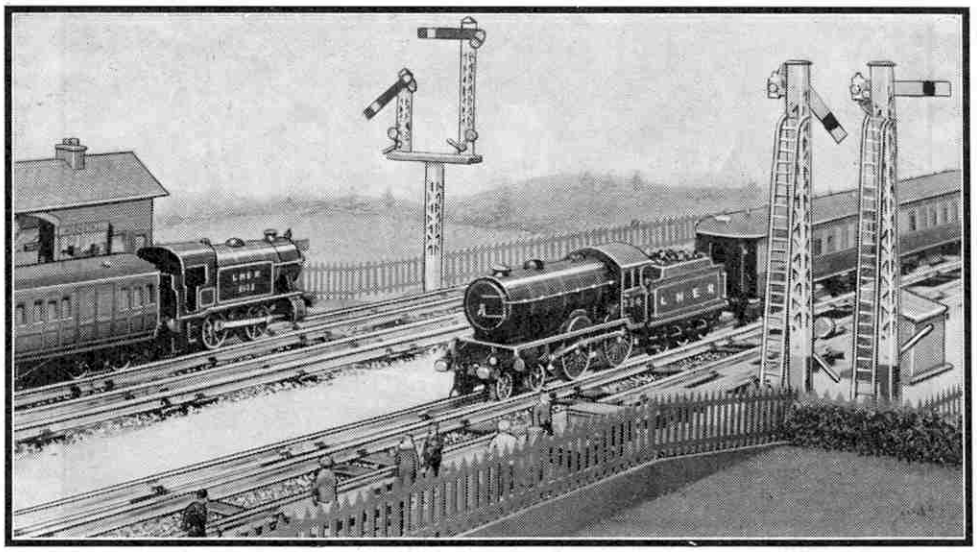
NORTHAMPTON—R. Phillips, 8, Cedar Road, Phippsville, Northampton.

NORTH WEMBLEY—R. Yates, 28, Langham Gardens, N. Wembley.

ORPINGTON—A. I. Somerville, 28, St, John's Road, Orpington.

SIGNALS ON HORNBY RAILWAYS

THE safety of travel on British railways has long been remarkable, and to a great extent this is due to the perfection of the signalling system in use. In order that Hornby Railways may have an equally good safety record, it is necessary that they should be provided with signals in a manner as closely approaching real practice as possible. Apart from the utility in miniature of a signalling system to govern train movements, it is desirable that some signals at least should be included even on a simple layout for the sake of their realistic effect. In this article, therefore, we intend to deal with the various patterns of signals that are available in the Hornby Series, and to make suggestions for their appropriate use.



Two separate signals or the junction type of signal can be used to control the two roads in each direction on a four track section. Here the fast lines are in the centre, the platform lines being formed as long loops connected to them.

All the signals in the Hornby Series are of the type known as "lower-quadrant," that is to say the semaphore arm drops from the horizontal "danger" position in order to indicate "line clear." This is directly opposite to the practice embodied in the "upper-quadrant" signals that have been brought into use within recent years. In these the arm is raised from the horizontal danger position in order to show "line clear." In spite of the introduction of this type of signal and the increasing use of modern colour-light signals, the lower-quadrant pattern is still the most usual and familiar.

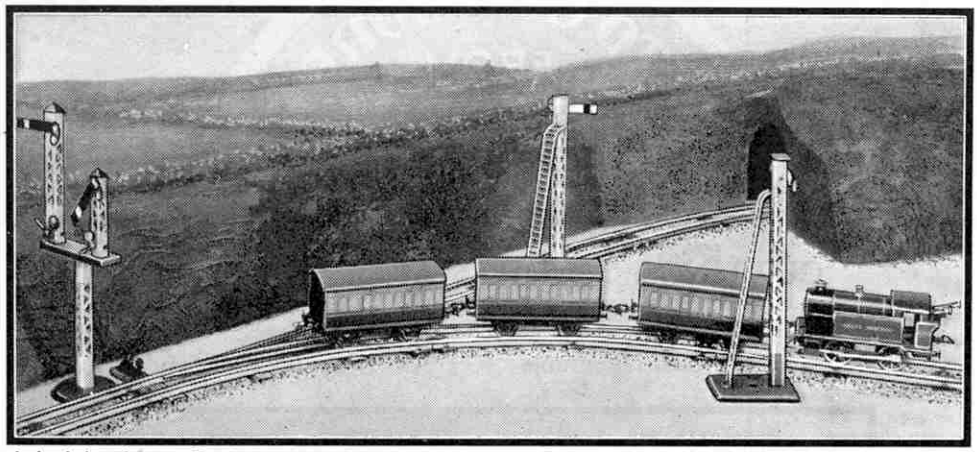
Readers will have noticed that signal arms may be divided broadly into two types. We are not considering for the moment the special types used by different companies for shunting and similar movements, but the normal main line type of semaphore. The first type has a plain outer end and is known as a "home" signal. This in the danger position forms a positive stop signal, and trains must on no account proceed beyond it. The other type of semaphore, the "distant," has a "fish-tail" or notched outer end, but apart from this difference its shape corresponds to that of a home semaphore. The "distant" signal is placed some distance away from the "home" signal, the actual length depending on the conditions of the particular situation, and varying between 600 and 1,000 yards.

The purpose of the "distant" signal is to act as a caution or warning signal, and the position of its arm when viewed by the driver of an approaching train indicates the state of affairs at the next "home" signal. Therefore if the "distant" shows line clear, the "home" arm will also be in that position, and the driver knows that he may continue on his way without any slackening of speed. On the other hand, if the "distant" is at danger he may expect the "home" to be at danger also, so that he is thus given ample warning to reduce speed and be prepared to stop at the "home" signal. Possibly the latter may show line clear by the time he reaches it, owing to the obstruction on the road ahead having been removed; and he may then proceed to work his engine up to normal running speed again.

"Home" signals are placed at all points requiring protection, such as junctions and sidings, crossings, and at the entrance to stations. The corresponding "distant" signals are situated at a suitable distance wherever the situation allows this. Sometimes signals are observed on which both a "home" and a "distant" arm are mounted on the same post. Such a signal is used where there is only a short section ahead, and there would not be sufficient space to place a "distant" signal in the normal position. The distant arm applying to the next "home" signal is therefore placed on the same post as the preceding "home" arm, and is always below the "home" arm on the same post.

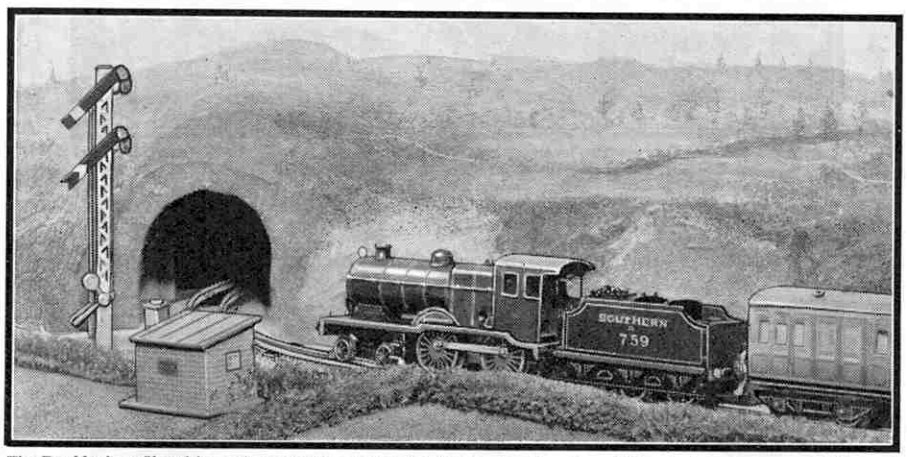
In order to prevent conflicting indications being given by these two arms, an arrangement is incorporated at the

foot of the post whereby it is impossible for the "distant" arm to show line clear unless the "home" one is doing so as well. On the other hand, the "home" arm may be "off"—as the line clear indication is known to railwaymen—when the "distant" is not, showing that the line is clear up to the next "home" signal. In cases where the two together happen to be showing line clear, the return of the "home" to the danger position causes the "distant" to be returned to danger also. This arrangement is known as "slotting."



A simple junction on a Hornby layout, protected in each direction by the appropriate signals. The arm on the smaller post of the Junction Signal is lowered to permit of the passage of the train on to the branch line.

Each of the types of signals so far mentioned, the "home," the "distant" and the combined "home and distant," are reproduced in the Hornby Series. Thus the simplest layout can be provided with at least an elementary form of signalling. Each of these types is available in what we may term three grades. The simplest are the No. 1 Signals, which consist of a lattice post and a semaphore arm with solid printed, not transparent, "spectacles." Operation is by means of a wire connection to the weight lever at the foot of the post, and the latter is arranged so that the arm can be left in either the danger or the clear position as required. The No. 2 grade of Signals, on the other hand, are more complete. The post is similar, but on it is mounted a semaphore having correct transparent spectacles with red and green "glasses." A dummy lamp is secured to the post behind the spectacles, and in order to provide the "lamp man" with access to this, there is a ladder of the correct type reaching from the base to the top of the post. The operating mechanism is similar in design to that provided on the No. 1 grade signals.



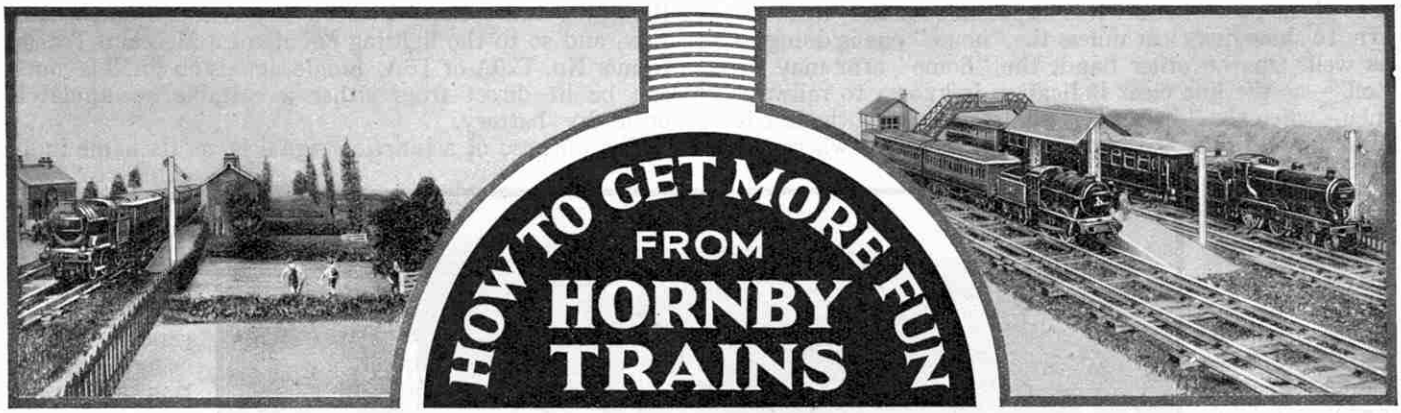
The Double Arm Signal is used where the section ahead is too short to allow of the placing of a separate "distant" signal. In this photograph the lowering of both arms indicates that the road is clear through the tunnel, and that the next home signal also shows "line clear."

The No. 2E signals are the same as the No. 2 type in their mechanical equipment, but are provided with special lamps, the lower part of which is formed as an electric bulb holder, and the upper part, or lamp casing, which is removable, is fitted with correct front and back glasses. Thus when the bulb is illuminated the correct red or green aspect that is seen in actual practice is obtained, according to the position of the arm and its spectacles. For lighting purposes wires are carried from the lamp to the base of the signal where there are two plug fittings. This enables the signals to be connected by the "plug and socket" Flexible Leads to a Distribution Box, and so to the lighting circuit of a Meccano Transformer No. T20A or T6A. Single signals on small layouts can be lit direct from either a suitable accumulator or a dry battery.

The purpose of a junction signal is, as its name indicates, to control the movements of trains where the choice or rather a divergence of routes occurs. Junction signal arms and their arrangement in actual practice vary according to the requirements of the situation, but the Hornby Junction Signals are essentially adapted to controlling the divergence of a single line branch from the main line. They consist of a main post that branches out, as it were, into two smaller posts, on each of which a semaphore is fitted. In actual practice these smaller posts are sometimes made identical in height, but the usual rule is for the higher one to indicate the more important or main track. Therefore the Hornby No. 2 and 2E Junction Signals, which have the higher post on the right, are suitable for a left-hand turnout; while the No. 1 Junction Signals, with the high post on the left, are meant for a right-hand branch turnout. On high-speed routes it is necessary to give the driver an early indication of the state of affairs at the junction. Real junction "home" signals are therefore duplicated by junction "distant" signals, and these also are available in the Hornby Series.

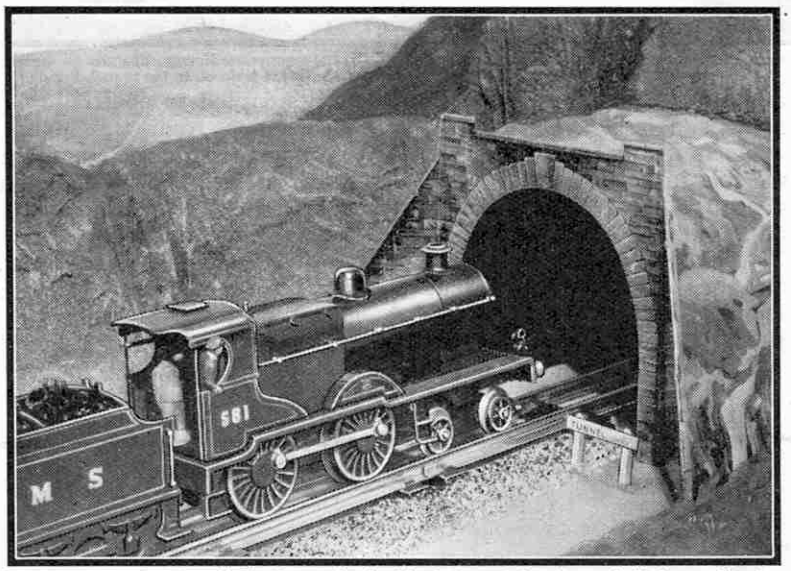
Having passed the "distant" and "home" signals and entered a station, the driver of a train encounters another signal at the head of the platform. This is the starting signal, or "starter," and gives him authority to leave the station. It is provided with a "home" semaphore arm, and therefore corresponds in appearance to the "home" signal.

Where there are several parallel tracks, as on a busy main line, or in the neighbourhood of important stations and junctions, the signals for individual tracks are frequently arranged on what is known as a gantry. This forms, as it were, a bridge of signals across the track. In the Hornby Series the Signal Gantry is available in each of the three grades, No. 1, No. 2 and No. 2E, and will span the standard Hornby Double Track.



CUTTINGS, TUNNELS AND VIADUCTS

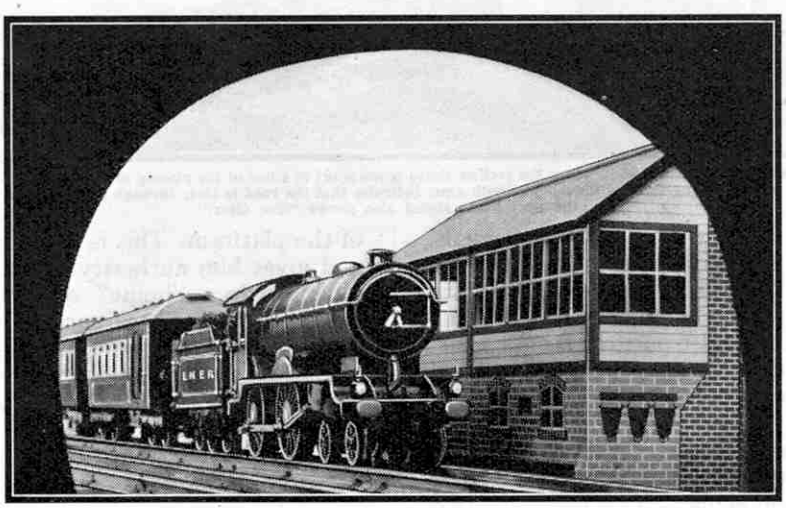
IN the course of the progress of a railway through the country the construction of various earthworks is usually necessary in order to secure the most favourable route. As it is desirable for the line to be as level as possible, depressions have to be filled up in order to bring the ground up to the required level, and where the ground rises above the level of the railway a way has to be cut through the obstructing heights. Circumstances will determine whether the engineer will make a cutting to accommodate the line or whether he will bore through the ridge and carry his line in the tunnel so formed.



Entering a Hornby Tunnel! The locomotive in this photograph has been rebuilt from a Hornby L.M.S.R. No. 2 Special as described in the February, 1933 "M.M."

On miniature railways, particularly those of the portable kind, which have to be put down when required and taken up again when finished with, the inclusion of cuttings was formerly a matter of some difficulty. Since the introduction of the Hornby Cuttings, however, temporary layouts may have such features arranged in as realistic a manner as permanent lines. The Hornby Cutting No. O consists of two sloping "banks" mounted on a base, the railway track being laid over this base in between the banks. This is quite an effective and complete accessory and is suitable for small single-track layouts. The cutting banks of fabric material are formed to a realistic shape, and the natural colours used make the accessory a realistic feature of the layout on which it is used.

An interesting and useful feature of the next Cuttings to be considered is that any number of them may be laid end to end in order to form a continuous cutting. To lead up to the raised banks of Cutting No. 2 there is an appropriate sloping piece known as Cutting No. 1. To make up a complete realistic cutting several No. 2 centre sections are laid down on each side of the track, and each cutting "bank" so formed is approached by the use of the No. 1 Sections. These cuttings are independent of the track, and therefore any number of lines of rails may be laid between them. In working out how many sections are required for a given purpose it is useful to remember that the centre section or Cutting No. 2 measures the same length as a Hornby straight rail.

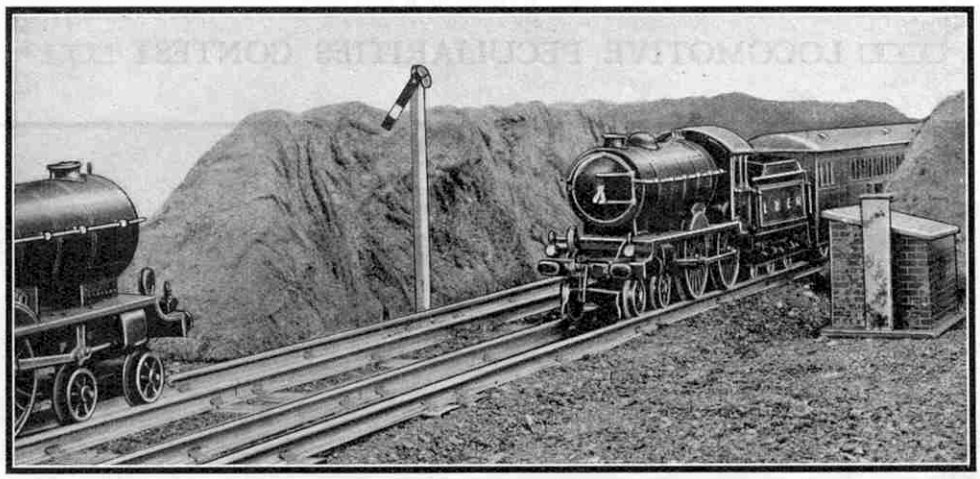


A Pullman express hauled by a Hornby L.N.E.R. "Yorkshire" locomotive approaching a tunnel. The tunnel is constructed of wood and cardboard as suggested in this article.

Cutting No. 3 is similar to Cutting No. 2, and is intended to form cutting banks that are laid alongside curved sections of track. It is therefore suitably curved, and its radius is such that it can be used equally well in conjunction with 1 ft. or 2 ft. radius rails.

In Cutting No. 4 a return is made to the self-contained design of the type exemplified by Cutting No. O, but on a scale large enough to accommodate a double track between its banks.

The cuttings can be employed very effectively to lead up to one or other of the Tunnels of the Hornby Series, for the Hornby Tunnels Nos. O to 6 are all of fabric construction similar to the Cuttings. In actual practice, tunnels are often approached by a length of cutting. The Nos. O, 1 and 2 Tunnels all have straight bores of varying length. The other fabric Tunnels, Nos. 3 to 6, are intended to be used on curved sections of line, and Nos. 4, 5 and 6 are only for use with 2ft. radius curves.



This photograph shows how the banks of a miniature cutting are made up by the use of Hornby Cuttings. The Cuttings No. 1 form the sloping approaches leading up to the main portion composed of Cuttings No. 2.

The remaining Hornby Tunnel is of different construction, being formed of metal representing a tunnel bored through a small hill, with suitable approaches at each end. The hill portion is finished in effective colours and the tunnel mouths represent stone construction, the tunnel lining being faced appropriately and being complete with the usual keystone.

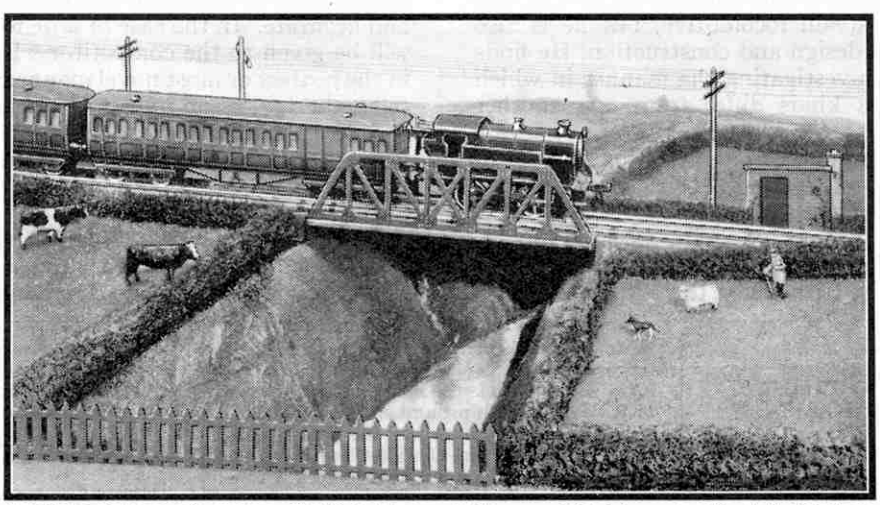
As all the Hornby Tunnels are arranged to accommodate one track only, two separate bores must be provided for double main lines. This situation is found in real practice in several instances. Woodhead Tunnel on the G.C. section of the L.N.E.R. is a notable example, and another tunnel through the Pennines is Standedge, on the L.M.S.R., where there is a "down" and an "up" single line tunnel in addition to a double line bore.

Alternatively a single line tunnel section may be incorporated on layouts consisting otherwise of double track. This will add to the interest of operation, and efficient working will be necessary where a frequent service of trains in both directions is the rule.

Those readers who are keen on the home construction of accessories can easily make up a suitable tunnel to cover double track where such a feature is required. The "body" of the tunnel may be made up quite roughly of wood, or even a strong cardboard box of suitable size may form the basis of construction. Over this may be arranged well crumpled brown paper that has been previously soaked in paste. Any particular contours that are required may be reproduced by stuffing balls of paper, or anything else suitable, underneath the covering surface. When the paste dries and the whole is set, the painting of the tunnel may be undertaken, the colours used varying according to the characteristics of the ground represented. Cardboard can be used very effectively in the reproduction of the tunnel mouth or face. Tunnel mouths in actual practice form quite a study in themselves, and those who are unable to draw up a suitable design will do well to consult the illustrations of tunnels in the 1934/5 "Hornby Book of Trains," where various examples are shown.

In connection with tunnels on a Hornby Railway a point that should not be omitted is the placing of the "Tunnel" Notice Board of Railway Accessories Set No. 8 just outside the entrance. This gives details of the length of the bore and is useful to the engineering staff. Readers can alter the dimensions quoted on the standard board to suit their own particular tunnel, by painting out the printed figures and substituting more appropriate ones in Indian ink.

Where the path of a railway cuts across a waterway an embankment is impossible, and a suitable bridge or viaduct has to be provided. The Hornby Series includes a Viaduct of interesting design that can be used to bridge any real or imaginary waterways that are crossed by the railway. It is difficult on a temporary layout, particularly indoors, to arrange any suitable depression for the Viaduct to cross, so that its design is such that it is higher than the usual rail level. It is therefore led up to by special sloping approaches so that trains cross at a suitable height and look most effective when traversing the Viaduct. As the Viaduct will accommodate single track only, it will be necessary to institute a special system of single line working for controlling the operation of trains over it on a railway that is otherwise double track. Such arrangements are by no means unknown in real practice, and even such a train as the famous "*Cornish Riviera Express*" has to pass over a single track section in the course of its journey, when crossing from Devon into Cornwall by means of Brunel's famous Saltash bridge. This forms the only single track section between Paddington and Penzance.



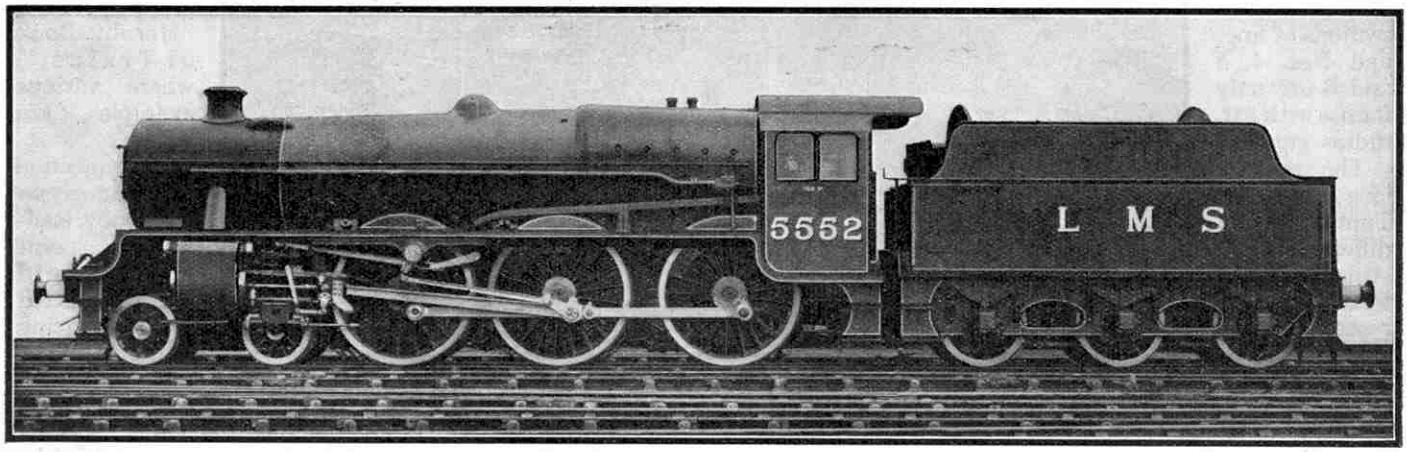
A realistic miniature railway scene. The Viaduct is arranged to span a defile between two "banks" of Cuttings No. 2, the Viaduct approaches and Countryside Sections completing the effect.

Join the Hornby Railway Company and become eligible for the competitions announced on this page.

H.R.C. COMPETITION PAGE

LOCOMOTIVE PECULIARITIES CONTEST

Join the Hornby Railway Company and become eligible for the competitions announced on this page.



The fascination of the steam locomotive, which continues unabated in spite of rival attractions of record breaking rail cars, motor cars and aeroplanes, is due to a variety of causes. First of all there is its immense size, and the impression it gives of enormous power. The electric locomotive hides its giant strength and therefore appears comparatively unimpressive; but the steam locomotive scorns false modesty of this kind, and its exhaust when in motion proclaims its power far and wide.

The keen railway enthusiast appreciates to the full these features of the steam locomotive, but he is also interested in details of design and construction. He finds a great fascination in investigating the manner in which locomotives of various kinds differ from one another in details.

This month we announce a competition that will enable H.R.C. members to test their knowledge of locomotive details. We illustrate on this page an L.M.S.R. three-cylinder 4–6–0 locomotive, with tapered boiler, designed by Mr. Stanier, the Chief Mechanical Engineer. Competitors are required to study the illustration and to state as many features as possible included in this locomotive, but not found as standard features of similar passenger locomotives owned by the other three British groups. For example, there is the rather severe-looking cab which is quite unlike anything of the kind elsewhere.

The contest will be divided as usual into two sections—Home and Overseas. Prizes of Hornby Train goods (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded to the four competitors in each section whose lists are most complete and accurate. In the case of a tie for any prize preference will be given to the competitor whose entry is presented in the neatest or most novel manner. This is a point worth remembering, as on numerous occasions the judges have had to pass over untidy entries which might otherwise have been in the prize winning list.

Envelopes containing entries must be clearly marked in the top left-hand corner *"H.R.C. April Loco Peculiarities Contest"* and posted to reach Headquarters at Meccano Ltd., Binns Road, Liverpool 13, on or before 30th April. The closing date for the Overseas section is 31st July.

Railway Photographic Contest

The month of April may be said to mark for most amateurs the opening of the photographic session. With Easter, the first public holiday of the year, thousands of cameras that have been practically forgotten throughout the winter are remembered, hauled from their hiding places, and prepared for further action. H.R.C. members will naturally turn their thoughts towards the securing of a series of good railway photographs. Railway photography is a splendid hobby, and in order to encourage it we offer this month prizes for the best photograph of *"Any Railway Subject."* Thus members are free to exercise their preference for any particular aspect of railway working.

Competitors may submit as many prints as they desire, but no competitor can win more than one prize in one contest. It is important that every print sent in should have on the back the name, address and H.R.C. membership number of the sender. A description of the scene of the photograph should also be given. This last requirement should not be given at great length, a few words will suffice.

The contest will be divided into two sections, Home and Overseas; and prizes of Hornby Train material (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded to the senders of the best photographs submitted. A similar set of prizes will be reserved for Overseas competitors.

Envelopes containing prints should be clearly marked *"H.R.C. April Railway Photo Contest,"* and posted to reach Headquarters at Meccano Ltd., Binns Road, Liverpool 13, not later than 30th April. The Overseas closing date is 31st July.

Competitors desiring their entries to be returned should enclose a stamped addressed envelope of suitable size. Prizewinning prints become the property of Meccano Ltd.

COMPETITION RESULTS

HOME

January "Missing Links Contest."—1. D. Morley Davies (40035), Maesteg, Glam. 2. E. Beven (35158), Birley Carr, Sheffield. 3. A. J. Powell (32985), Rugby. 4. W. P. E. Beer (34796), Oundle, Northants.

January "Railway Photo Contest."—1. J. C. Button (10335), Crewe. 2. S. Garbutt (30122), Altrincham. 3. K. Gandy (7571), Sheffield, 8. 4. S. A. Davis, Coventry.

January "Voting Contest."—1. C. Brett (5868), Great Coates, Lincs. 2. B. Boyle (9895), Gilford, Co. Down, N. Ireland. 3. T. Scriven (31842), Merthyr Tydfil, Glam. 4. R. Diggins (37104), Colne, Lancs.

OVERSEAS

October "Impossible Tour Contest."—1. I. Brough (9112), Preston, Victoria, Australia. 2. G. Hallack (17578), Capetown, S. Africa. 3. A. A. Tibbitts (24271), S. Rhodesia, S. Africa.

October "Articles Suggestions Contest."—1. D. Murison (37642), Buenos Aires. 2. Marcus De Lima (34925), India. 3. J. A. Rodriguez (3647), Canada.

NOW WE KNOW!

Sonny: "Why does the wind make apples fall, mother?"

Mother: "To save you climbing the tree, risking your life, tearing your trousers, scratching your knees, and being sent to bed without your tea."

* * * *

A small boy who had just started school and could not pronounce letter "r" correctly, was asked by his teacher to repeat the following sentence after her: "Robert gave Richard a rap in the ribs for roasting the rabbit so rare."

The boy thought it over a moment, and then said: "Bobby gave Dick a poke in the side for not cooking the bunny enough."

* * * *

Post Office Clerk: "You don't need a 2d. stamp on your letter, madam."

Old Lady: "Oh, that's all right, my son is in the G.P.O. and it all helps, you know."

* * * *

Maid, answering door: "Sorry, sir, the master's gone out."

Tax Collector: "Huh! I saw his head at the window. Pretty absent-minded, isn't he, to leave it behind like that?"

* * * *

Stout Gentleman (returning to theatre after the interval): "Did I tread on your toes as I went out?"

Seated Man (grimly): "You did, sir."

Stout Gentleman (to his wife): "That's right, Martha; this is our place."

* * * *

Applicant: "Need any men—I don't suppose?"

Foreman: "Start on Monday—I don't think."

* * * *

Mandy: "Must I give Rastus one of dem musta'd plastahs again to-day, doctah?"

Doctor: "Yes, Mandy, I think you had better."

Mandy: "Well, he says to ax yo' kin he have a slice of ham wid it, to kill the taste."

* * * *

"Mother says there was a fly in the cake she bought here yesterday."

"Tell her to bring the fly back, and I'll give her a currant for it."

* * * *

The druggist instructs his new clerk: "See this bottle? This is what we always use for filling prescriptions that we cannot read."

* * * *

ALL HE WANTED!

Steward (to sea-sick passenger): "Pardon me, but is there anything you would like, sir?"

Sea-sick Passenger: "Only an island."

HIS GOOD TURN

"It is the duty of everyone to make at least one person happy during the week," said a Sunday school teacher. "Have you done so, Freddy?"

"Yes, teacher," said Freddy, "I went to see my aunt and she was happy when I went home."

* * * *

"I see you're letting your little boy drive your car."

"Yes, he is rather too young to be trusted as a pedestrian."

* * * *

SHARING THE WORK!

Mother: "What is this supposed to be, my son?"

Son: "Why, a train, mother."

Mother: "But you haven't drawn any carriages."

Son: "Oh no, mother. I've left the engine to draw them!"

* * * *

A rich uncle wrote to his nephew as follows: "Herewith I am sending the £10 you requested, but must draw your attention to a spelling error in your last letter: '10' is written with one nought, not two."

* * * *

First Office boy: "Don't you ever have a day off for your grandmother's funeral?"

Second Office boy: "What? And me working for the Registrar of births and deaths?"

* * * *

"I call my husband Theory."

"Why?"

"Because he so seldom works."

* * * *

Teacher: "Now, Willie, tell me how many ribs you have in your body?"

Willie: "I don't know, teacher, I'm so ticklish I can't bear to count them."

* * * *

Sergeant: "When did you blow in?"

Recruit: "With the last draft."

* * * *

Gardener: "Is this your ball in the garden here?"

Boy: "Are there any windows broken?"

Gardener: "No, sonny."

Boy: "Oh, that'll be my ball, then."

* * * *

The class had been asked to write an essay on hens, and this is how one small boy did it:

"Hens is very curious animals and they don't have no nose, no teeth, and no ears. The outside of hens is generally put into pillars and fether dusters. A hen is a lot smaller than a good many other animals, but it can scratch up more garden in five minutes than anything that isn't a hen. Hens is very useful to lay eggs and eat worms."

ONE FOR UNCLE SAM

American (visiting London): "What is that bridge over there?"

Guide: "That is the famous London Bridge."

American: "In our country we build bridges like that in three days." (Pointing to the Tower of London), "What building is that?"

Guide (fed up): "I don't know—it wasn't there this morning when I passed."

* * * *

Professor (after lecture): "Now does anyone wish to ask a question?"

Student: "Yes, sir. How do you calculate the horse-power of a donkey engine?"

* * * *

"Bejabers! What a night!" said the Irishman at a party. "It's simply pouring."

"You can't go home in that downpour," remarked the host. "You had better stay the night with us."

The Irishman then disappeared, returning in several hours' time, dripping wet.

"Where have you been?" questioned the host.

"Home for my pyjamas," replied the Irishman.

* * * *

Boy to cinema attendant: "What are the prices of the seats, mister?"

Attendant: "Front seats one shilling, back seats sixpence, and programme a penny."

Boy: "I'll sit on a programme, please."

* * * *

Vet: "Well, my lad, what do you want?"

Youth: "Will you come to father at once. He took the medicine you sent for the cow, and we can't stop him eating grass!"

* * * *

"Do you think I shall ever recover, doctor?"

"You have every hope. I have been attending a patient with your complaint for more than ten years!"

* * * *

Plaintiff: "I have two witnesses to prove it."

Defendant: "I have two witnesses to prove that there were no witnesses present."

* * * *

Boss: "Yes, I want an office boy. Do you smoke?"

Boy: "No, thank you, sir, but I don't mind having an ice cream cone!"

* * * *

Teacher: "Tommy, take this sentence, 'I lead the cow to the field!' What mood?"

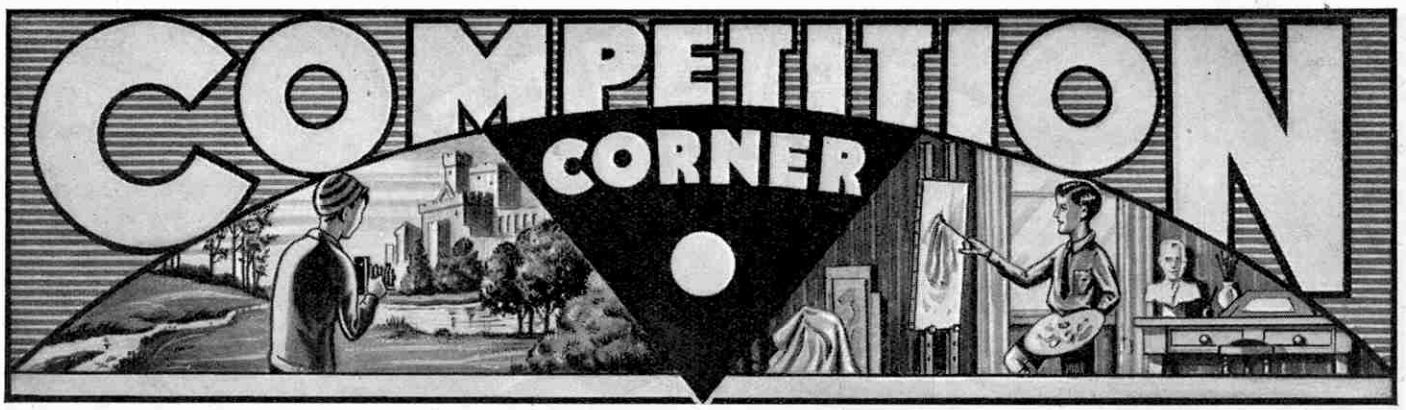
Tommy: "Please, miss, the cow."

* * * *

NEARLY THROUGH!

Jones: "Did your son get through college alright?"

Parkes: "Not quite. He took a chemistry course and only went as far as the roof."



HIDDEN ADVERTISEMENTS

The advertisement Jig-Saw Contest in the December "*M.M.*" proved so extraordinarily popular that it is evident that competitions of this type appeal strongly to most of our readers. Accordingly we propose to start this month a short series of such contests, some based on "*M.M.*" advertisements and others on advertising in general.

In this month's competition readers are set the task of identifying a number of advertisements and advertised articles from clues given in the centre panel on this page. Study of the clues will show that each is a simple direct statement based on a fact given in the advertising pages of this month's "*M.M.*" In certain cases, but not all, the actual fact, as stated in the advertisement, is given in the clue.

To make the idea clear, let us take clue No. 1: "This firm has only one address." Careful search reveals this clue to refer to Hamley Brothers' advertisement on page i. It is based on the note "Only address. No branches."

Prizes of Meccano products—this expression covers all goods listed in our current catalogue—to the value of 21/–, 15/–, 10/6 and 5/– will be awarded to the senders of the four most accurate solutions. In the event of a tie for any of these prizes, preference will be given to the neatest or most novelly prepared entries.

In addition, "consolation" points will be awarded to the remaining entries, and these points will be carried forward to the May and June contests, in which similar consolation points will be awarded. After the close of the June contest, each competitor's total of consolation points will be ascertained, and prizes value 5/– each will be awarded to the 24 competitors gaining the highest totals. A competitor who wins a prize in any of the individual month's contests will automatically be debarred from securing one of these special consolation prizes.

1. **This firm has only one address.**
2. **This scheme offers new articles for old.**
3. **This advertiser quotes a laboratory report.**
4. **These cost just 37 for one penny.**
5. **An aeroplane is fast, but not too fast to be "caught" by this product.**
6. **This "makes cycling easy."**
7. **In 44 years, 4½ millions have passed through this advertiser's hands.**
8. **This is driven by means of a flexible shaft.**
9. **These are illustrated with a series of actual photographs.**
10. **This model is 18¾ inches in span and flies 700 feet.**
11. **This is made specially for fast road work.**
12. **This advertiser never sells less than a hundred.**
13. **This will tell you what service your tyres have given.**
14. **Every stamp collector must have this book.**
15. **This has no solderings or loose pieces to break.**

Entries to this month's contest should be addressed "April Advertisement Contest, Meccano Magazine, Binns Road, Liverpool 13," and must arrive not later than 30th April.

A separate set of prizes including several special consolation prizes will be reserved for Overseas entries, which must arrive not later than 31st July.

The 1935 Photo Contests

Throughout the coming spring and summer we shall offer prizes each month for the best and most interesting photographs submitted by readers. The photographs may be of any subject, and may be made with any make of camera, plate, film or paper. The only conditions will be that each photograph must bear the reader's name, age and address, and a title on its back. The exposure must have been made by the competitor, but the developing and printing may be professionally done. All other points being equal, preference will be given to photographs that are solely the work of the competitor.

Each month's competition will be divided into two groups, Home for those living in Great Britain, Ireland and the Channel Islands, and Overseas for those living outside those areas. Each group will be divided into two sections, A for those aged 16 and over, B for those under 16; and prizes of Meccano Products or Photographic Materials, to be chosen by the winners, to the value of 21/– and 10/6, will be awarded in each section.

Entries sent this month must be addressed "April Photo Contest, Meccano Magazine, Binns Road, Liverpool 13," and must arrive not later than 30th April. April will be ended before this issue reaches many of our Overseas readers, but it will be in order for them to address as for the April Competition all entries that can reach us before the Overseas closing date for that Contest, 31st July.

COMPETITION RESULTS

December Advertisement Jig-Saw Puzzle.—The Overseas section now having closed we give below the solution to the December Advertisement Jig-Saw. The Overseas results will appear in our next issue.

The puzzle contained 47 pieces, which were taken from advertisements as follows: Ever-Ready Company (p. 1036); B.S.A. Guns (p. 1036); Wilson Gumpert & Company (p. 1036); Warneford Flying Aircraft (p. 1018); F. Warne & Co. Ltd. (p. 1018); Aero Toys (p. 1018); Lines Bros. (3 pieces, p. 1040; 2 pieces, p. 1041); Bassett-Lowke Ltd. (3 pieces, p. 1046; 3 pieces, p. 1047); Corinthian Sales Company (3 pieces, p. 1049); Kay (Sports & Games) Ltd. (3 pieces, p. 1050); M'Caw, Stevenson & Orr Ltd. (3 pieces, p. 1052); Insall Andrews & Company (2 pieces, p. 1054); Bond's O' Euston Road (p. 1064); Amalgamated Press (p. 1055); Dolphin & Company (p. 1055); Bowman Models (3 pieces, p. 1056); Lott's Bricks (3 pieces, p. 1058); British Games (2 pieces, p. 1061); Harbutt's Plasticine (p. 1061); Lott's Bricks (p. 1062); Hobbies (3 pieces, p. 1063); E. J. Riley Ltd. (p. 1067); Inventions (Manchester) Ltd. (p. 1065); Aeromodels Ltd. (p. 1065).

HOME

February Drawing Contest.—First Prizes: Section A, L. J. Harwood (Burnley); Section B, E. Buckman (Redhill). Second Prizes: Section A, E. F. Jackson (London, S.E.23); Section B, J. H. Clark (Newcastle-on-Tyne). Consolation Prizes: G. Begbie (Bristol); T. Brown (Rothbury); J. R. Clegg (Doncaster); D. V. Gibbs (Dundee); L. Smith (Nottingham); G. Staples (Batley); P. Walmsley (London, S.E.12).

Doublets Contest.—1. R. V. G. Carrall (Oakham); 2. E. Murray (Dublin); 3. G. C. Hanson (London, N.W.2); 4. R. D. Wells (Pitsea).

OVERSEAS

November Drawing Contest.—First Prizes: Section A, W. Figgins (Timaru, N.Z.); Section B, G. F. Emmerson (Greymouth, N.Z.); Second Prizes: Section A, Myra Morgan (Cremorne, N.S.W.); Section B, E. Newland (Auckland, N.Z.). Special Prize: Section A, S. D. Kurlawala (Bombay). Consolation Prizes: Nils Soderberg (Falun, Sweden); Bengt Soderberg (Falun, Sweden).

November Crossword Puzzle.—1. C. Keekok (Singapore); 2. R. B. Latimer (Burma); 3. A. T. Arnold (Melbourne); 4. R. Burbery (Lyttelton, N.Z.).

AFRICAN Stamp Stories

IN many *"M.M."* stamp articles attention has been directed to the considerable amount of enjoyment and interest to be derived from compiling collections of stamps illustrating one particular subject. Readers who are interested in African life have a series of fascinating subjects ready made for them. Such topics as African Native Life and Industries, Wild Beasts of Africa, the Development of Transport in Africa, are three that come readily to mind. The stamps of the Union itself, South West Africa, Bechuanaland, the Rhodesias, Tanganyika and the Belgian Congo, provide a wealth of material, as the several illustrations on this page show very clearly.

Turning first to Native Life and Industries, the bulk of our material will be found among the stamps of the Belgian Congo, although excellent illustrations of Kaffir huts are to be found on the 4d. stamp of the Union's 1927 issue and the 5/– value of South West Africa's 1931 issue. Among the Belgian Congo issues there are splendid illustrations of native huts on the 3F. value of the 1910 issue, on the 1F. of 1920, the 15F. of 1930 and the 15c. of 1931. The 1923 issue of the Belgian Congo might almost have been made for our purpose, for it includes no less than 14 stamps, none of them costly, that can be used in our story. These include portraits of distinctive types of natives, such as Ubangi men and women, illustrations of native industries such as weaving, basket making, wood carving, pottery making, rubber work, rubber and palm oil workers, while the 50c. value of the issue shows a native archer in search of game. The 40c. value of the 1931 issue shows two native musicians.

An important feature of native life in recent years has been the valuable service rendered by Medical Missions, and the 1930 issue that was sold at a premium to provide funds to help the work of the Congo Natives Protection Fund provides four interesting illustrations of medical missionary work. The 10c. and 20c. values show nurses at work among native children, the 35c. a missionary in attendance at a temporary surgery, and the 60c. a view of a local hospital.

The wild life of Africa is even more comprehensively illustrated in our story, and most of the countries in our list can provide interesting specimens. Starting north at the Belgian Congo and working south, our first illustration is a splendid view of an elephant hunt in progress, shown on the 1F. value of the Belgian Congo issue of 1894. The Congo 1923 issue, 10F. value, gives us a very striking portrait of an elephant's head, which in our opinion is one of the finest animal pictures to be found anywhere among stamps. A more simple view of an elephant is given on the Northern Rhodesian stamps issued in 1925 and 1929, and as this is the only British design represented, it certainly should be included in the collection. This stamp features also the giraffe, the head of which is the central feature of Tanganyika's 1922 issue.

Buffaloes and wildebeeste are found on the Bechuanaland 1932 issue, on the 2/6 South-West African issue of 1921, where they are shown in company with zebras, but the most striking illustration in this group, however, is to be found among Belgian Congo issues, on the 45c. and 60c. values in the 1926 issue. This is a very striking illustration.

The South West African 1931 issue provides other interesting wild life specimens in addition to the wildebeeste and zebra illustrations already mentioned. There is the gom-pauw bird on the ½d value and elands on the 1/3 value. The current ½d. stamp of the Union uses a very striking eland head as the central feature of its design, while the 1/– value shows a herd of gnus stampeding.

The story of transport in Africa probably will prove the most fascinating study of all. We start with the 30F. value of the 1930 Belgian Congo air issue, for this symbolises the great strides that transport has made since the development of the aeroplane. The design shows a train of native porters and overhead an aeroplane.

The native canoe is featured in several illustrations, notably the 40c. of the Belgian Congo issues of 1896 and 1910, and the stern wheel steamer used in more navigable stretches of water is to be found on the 10F. stamps of the 1898 and 1910 issues.

The ox-wagon, so common a feature of early transport in South Africa, is to be found on the 2/6 and 5/– values of the Union's current series, and also on the 1d. value of the 1933 Voortrekker Memorial Fund issue. This illustration is one of the most striking in our transport story, for it illustrates very graphically the difficulties that were encountered by the early pioneers.

The aeroplane necessarily figures prominently in our story, and good illustrations are to be found on the 4d. and 1/– Union issues of 1929, the current South-West African air issues, and in profusion among the Congo issues. The first Congo air stamp appeared as far back as 1920, and several of the stamps illustrating native life will be found to include an air machine as part of the design.

Collections such as we have outlined briefly here are well within the compass of any young collector, and if accompanied by neatly written, briefly stated facts, they would prove a source of interest to many friends who do not know already the fascination of stamp collecting.

Next to good display, nothing adds so much to the value and interest of a stamp collection as good writing up. In the ordinary course of writing up it is usual to include brief details of the issue, including the date of its appearance, its watermark and perforation, in addition to notes explaining the design, but for collections such as we have outlined here the one essential is the description of the design, so that its place in the collection may be clearly known.

Neatness in the actual writing and in the arrangement of the notes is just as important to the ultimate interest of the collection as the degree of completeness of the data provided, and except for the heading of the pages, which may be in a decorative lettering, we recommend the adoption of simple straightforward lettering. Colours should be used very sparingly, and as a general rule we would exclude them from the descriptive data.

Finally, before a single word is committed to the album the actual wording of the complete writing up should be decided upon. It is very disappointing after taking great pains to achieve neatness, to discover that the placing and sequence of data leaves something to be desired.

Stamp Gossip

and Notes on New Issues

Austrian Architects Issue

Austrian charity and commemorative stamp issues can always be relied upon to provide a theme of great interest as well as beauty of production. The recent "Architects" set well maintains the standard. It comes as a companion series to the earlier Composers, Poets and Artists sets in the annual winter charity series.

The series contains six stamps ranging from 12gr. to 64gr. in denomination, each of them featuring a famous Austrian architect of bygone days. The list is as follows: 12gr., Anton Pilgrim, creator of the famous chancel, pulpit and organ loft in the Cathedral of St. Stephen. Pilgrim lived in the 16th century and the stamp portrait is based on a statue standing beneath the stairs of the pulpit in St. Stephen's. 24gr., Fischer von Erlach (1656-1723), designer of St. Charles' Church, Vienna; 30gr., Jacob Prandtauer, who rebuilt the monasteries at St. Florian and at Meek; 40gr., A. von Siccardsburg (1812-1868) and E. van der Noll (1813-1868) who were jointly responsible for the design of the Vienna Opera House; 60gr., H. von Ferstel (1828-1883) architect of the Vienna University; 64gr., Otto Wagner (1841-1918) a town-planning expert and architect of the Steinhofer Memorial Church.

An Underseas Stamp Design

A new Bahamas series is to offer stamp collectors something new in stamp designs—a view of the famous undersea gardens of the Bahamas reproduced from under-water photographs made by Mr. J. Williamson, who has specialised in submarine photography. The design will include also the King's portrait. No definite news as to the purpose of the series is available yet. One report has it that it is to be for air mail use. Another—let us hope it is unsoundly based—is that the stamps will be used on "the first despatch of letters from the Williamson photosphere at the bottom of the Bahamas Sea." British Postal administrators do not usually lend their approval to stunts of this nature.

A Half-Cent Stamp

The lowest value stamp ever issued by the United States, a half-cent value—equal to about half a farthing—is shortly to be put in use in St. Thomas and the other Virgin Islands acquired by the United States in 1917 by purchase from Denmark. The engraving and printing of a stamp is a costly matter, and as 400 of this variety will be needed to make $1, it rather looks as though the actual postal service given for this stamp will involve a loss. Sales to collectors will provide some recoupment, of course.

The Tin Can Mail

By courtesy of a Wallasey reader, G. Riley, we reproduce an interesting souvenir cover from what is now universally known as the "Tin Can Mail."

This mail is one of the high spots of life on the island of Niuafoou in the Tongas. In the ordinary way, mail boats are not scheduled to call at Niuafoou, but by courtesy of the skippers of the liners mails are picked up and delivered overside in metal canisters. As the mail boat approaches, a canoe is paddled off from the island to pick up the inward and deposit the outward mail, and it is now almost standard practice for passing mailboats to slow down for this exchange.

During the cruising season at least, the inward mail consists largely of souvenir covers sent ashore by passengers. This mail is franked and "cacheted" ashore—the reverse side of the envelope illustrated bears two cachets and a Samoan back stamp—and sent on by the next passing mailboat, possibly a month later.

Jagged Perforations

Several readers have sent to us recently specimens of Great Britain stamps with badly jagged perforations top and bottom. In one case the jagged separation was actually across the centres of two stamps, which were divided at the usual point by normal perforations.

These freaks are not of great philatelic interest. In all cases they will be found to have come from the coils of stamps used in automatic slot machines. These machines are fitted with teeth that fit into the perforations and hold the remainder of the coil firmly as delivered stamps are detached. The jagged perforation is created when these teeth fail to do their work cleanly.

We thank Stanley Gibbons Ltd. for their courtesy in loaning the stamps from which the illustrations on this page have been made.

Jubilee Stamps

In celebration of the Royal Jubilee a special issue of stamps will appear in all the Crown Colonies on 6th May, the date of the King's Jubilee, and will remain on sale in place of the existing stamps until the end of the year. A common design will be used, in two colours. Of oblong format, it bears the King's head, crowned, on the right, with the dates 1910-1935, and on the left a view of Windsor Castle from the river. The sceptres and orb are incorporated in the framework, and the name of the Colony will appear at the top of the stamp.

The following colonies and protectorates will use this design in the values stated: Antigua, 1d., 1½d., 2½d., 1/–; Ascension, 1½d., 2d., 5d., 1/–; Bahamas, 1½d., 2½d., 6d., 1/–; Barbados, 1d., 1½d., 2½d., 1/–; Basutoland, 1d., 2d., 3d., 6d.; Bechuanaland Protectorate, 1d., 2d., 3d., 6d.; Bermuda, 1d., 1½d., 2½d., 1/–; British Guiana, 2c., 6c., 12c., 24c.; British Honduras, 3c., 4c., 5c., 25c.; Cayman Islands, ½d., 2½d., 6d., 1/–; Ceylon, 6c., 9c., 20c., 50c.; Cyprus, ¾ pi, 1½ pi, 2½ pi, 9 pi; Dominica, 1d., 1½d., 2½d., 1/–; Falkland Islands, 1d., 2½d., 4d., 1/–; Fiji, 1½d., 2d., 3d., 1/–.

Gambia, 1½d., 3d., 6d., 1/–; Gibraltar, 2d., 3d., 6d., 1/–; Gilbert and Ellice Islands, 1d., 1½d., 3d., 1/–; Gold Coast, 2d., 3d., 6d., 1/–; Grenada, ½d., 1d., 1½d., 1/–; Hong Kong, 3c., 5c., 10c., 20c.; Jamaica, 1d., 1½d., 6d., 1/–; Kenya, Uganda and Tanganyika, 20c., 30c., 65c., 1/–; Leeward Islands, 1d., 1½d., 2½d., 1/–; Malta, ½d., 2½d., 6d., 1/–; Mauritius, 5c., 12c., 20c., 1r.; Montserrat, 1d., 1½d., 2½d., 1/–; Nigeria, 1½d., 2d., 3d., 1/–; Northern Rhodesia, 1d., 2d., 3d., 6d.; Nyasaland Protectorate, 1d., 2d., 3d., 1/–.

St. Kitts-Nevis, 1d., 1½d., 2½d., 1/–; St. Helena, 1½d., 2d., 6d., 1/–; St. Lucia, ½d., 2d., 2½d., 1/–; St. Vincent, 1d., 1½d., 2½d., 1/–; Seychelles, 6c., 12c., 20c., 1r.; Sierra Leone, 1d., 3d., 6d., 1/–; Solomon Islands Protectorate, 1½d., 3d., 6d., 1/–; Somaliland Protectorate, 1a., 2a., 3a., 1r.; Straits Settlements, 5c., 8c., 12c., 25c.; Swaziland, 1d., 2d., 3d., 6d.; Trinidad, 2c., 3c., 6c., 24c.; Turks and Caicos Islands, ½d., 3d., 6d., 1/–; Virgin Islands, 1d., 1½d., 2½d., 1/–.

In addition to this issue, there will be special sets issued by the Dominions and by Great Britain itself.

* * * *

The 20th anniversary of the opening of the Panama Canal has been celebrated by the issue of a special Canal Zone commemorative stamp, 3c. value, bearing a portrait of General Goethals in tropical kit. The first printing order was for 3,000,000 stamps.

Scheldt Tunnels— (*Continued from page 203*)

prevent drivers from being dazzled when they emerge from the tunnel into daylight, the intensity of the lighting is increased at each end by arranging the lamps at 13 ft. intervals.

The problem of ventilating the tunnel has been solved by sinking on each bank of the river a ventilation shaft rectangular in shape and measuring 50 ft. by 53 ft. These shafts have been made right over the tunnel and are 92 ft. in depth. In order to sink them through the water-bearing strata with which difficulty had already been experienced, a novel freezing method was employed which previously has only been used for shafts of small diameter and depth. Tubes completely enclosing the area to be excavated were first sunk and a special freezing mixture was circulated through them so that all water and shifting sand in the locality was frozen. It was then possible to sink the shaft without difficulty.

When the shafts had been sunk, underground airways were made to connect them with the ventilation stations. There are 12 fans in each station, six being used to exhaust foul air from the tunnel and the remaining six to pump air to a duct or conduit arranged below the roadway. From this duct it is allowed to escape into the tunnel through slots on each side of the road. Impure air naturally rises to the roof of the tunnel, and is drawn off through special ventilators and eventually discharged into the atmosphere.

The vehicular tunnel is perfectly straight for a distance of just over a mile from the entrance on the left bank of the river, but from there to the right bank there are two slight curves. The pedestrian tunnel, on the other hand, is quite straight for its whole length of 630 yds. It was driven with the aid of a shield and has an internal diameter of 14 ft. It is lined with cast iron segments bolted and caulked with lead, and is filled with concrete as is the vehicular tunnel. The lift and escalator shafts at each end were sunk by freezing the ground. The tunnel has a paved walk 12 ft. 5 in. in width. An interesting feature is that no artificial ventilating system has been installed, sufficient air being obtained naturally through air shafts at each end of the tunnel.

Meccano Electric Clock— (*Continued from p. 241*)

the time-keeping qualities of the mechanism. It is essential, of course, to use a very accurate master-clock for controlling the magnet 48.

In order to prevent the Strip, carrying the Flat Bracket 45, from sticking to the core of the magnet, a piece of thin paper should be gummed across the top of the Magnet Coil. The two terminals on the Magnet Coil are connected as shown in Fig. 1 to two Terminals 49 and 50, which are connected in series with the contacts on the master clock and also with a 2-volt supply.

The gearing must next be considered. The drive is taken from the ½" Pinion 40 to a 2½" Gear 51 mounted on a 1½" Rod carrying a ¾" Pinion. This Pinion meshes with a 50-teeth Gear that in turn drives a second ¾" Pinion and 50-teeth Gear 52. On the opposite end of the Rod carrying this latter Gear a ½" Pinion is secured that drives a second similar part through a 57-teeth Gear 53. This second ½" Pinion is in constant mesh with two 1½" Contrates 54 and 55, the Rods 56 and 57 for these being journalled at their inner ends in a Coupling, through the centre plain hole of which passes the Rod carrying the Gear 53. A Collar is used to hold the Coupling in place as shown in Fig. 2.

Each 1½" Contrate is free to rotate on its respective Rod, and is connected by a Socket Coupling to a 1½" Pulley, forming one side of the slip clutch. A 1" Dunlop Tyre is pressed against the 1½" Pulley by a Bush Wheel locked on the Rod by its Set-Screw. As both minute and hour hand gear trains are similar, only that shown in Fig. 3 will be described. A ¾" Pinion on the Rod 57 meshes with a 50-teeth Gear 58. The drive to the 57-teeth Gear 59 is then taken through a 2 : 1 and 1 : 1 gear ratio, and also a ½" Pinion 60. The Gear 59 is connected to the hour hand by a Socket Coupling as shown in Fig. 1. The framework for the minute and hour hand gearing consists of two 2½" × 2½" Flat Plates joined together by three 1½" × ½" Double Angle Strips. The method of securing the complete gear train to the frame of the clock is shown in the three illustrations on pages 240 and 241.

Either a master clock or synchronous motor may be employed for transmitting half minute correcting impulses to the delay mechanism of the model. A synchronous motor can only be worked from alternating current, and suitable gearing must be incorporated between the armature shaft and transmitting mechanism. This system is fairly simple, and accurate to within about 3 or 4 seconds a day.

A master clock is a far more complicated arrangement but, if properly constructed, will be a remarkably accurate impulse transmitter and time keeper. A master clock suitable for use with this waiting train movement will be described in an early issue of the "*Meccano Magazine*."

L.N.E.R. Speed Record— (*Continued from p. 221*)

In the United States a steam locomotive of the Chicago, Milwaukee, St. Paul and Pacific Railroad recently covered the 85.7 miles between Chicago and Milwaukee in 67 min. 35 secs., thus maintaining an average of 76.07 m.p.h. over that distance, and the highest speed recorded on the speedometer was 103.5 m.p.h. The average speed on the fastest regular steam-operated run in the United States is the 63.8 m.p.h. of a train between Chicago and Adams, a distance of 209.5 miles, on the same system. The oil-electric streamlined "*Zephyr*" of the Chicago, Burlington and Quincy Railroad on test covered a total of 1,015 miles at an average of 77.6 m.p.h., and a maximum speed of 112.5 m.p.h. was recorded, but in making comparisons it must be remembered that the steam engines concerned in the record runs in Great Britain and the United States did not have the advantage of streamlining, which is important at the high speeds attained, and also that they hauled greater loads.

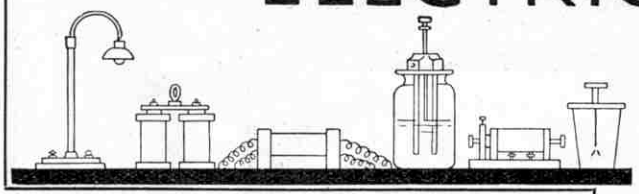
In Germany, where particular attention has been given to the subject in recent years, the fastest regular run is that of the Diesel-electric "*Flying Hamburger*," which covers the 178 miles between Berlin and Hamburg in 138 minutes at an average speed of 77.4 m.p.h. This is the fastest regular railway service in the world. The two-coach unit of this express actually has reached a maximum of 110 m.p.h., and an experimental car running on rails, but fitted with an air screw, has averaged 109 m.p.h., with a maximum of 143 m.p.h., over the 170 miles from Hamburg to Spandau.

Skybird League's Annual Rally

The second annual rally of the Skybird League will be held at Hamley Bros. Ltd., Regent Street, London, W.1, from 11th to 20th April. In addition to the annual Club model competition for the usual Challenge Cups, there will be an open contest for both Club and Associate members. The latest date for despatch of the models will be 5th April, and full particulars of the competitions are given in the "*Skybird Magazine*," February and April issues. The winning models will be exhibited at Hamley Bros. Ltd. throughout the period of the rally. The presentation of trophies and prizes will take place at the Polytechnic, Regent Street, on Tuesday, 16th April, at 3 p.m. Admission will be by ticket, to be obtained on application to Skybird League Headquarters, 3, Aldermanbury Avenue, London, E.C.2.

SEE ALSO PAGE XV

MECCANO ELEKTRON ELECTRICAL OUTFITS



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

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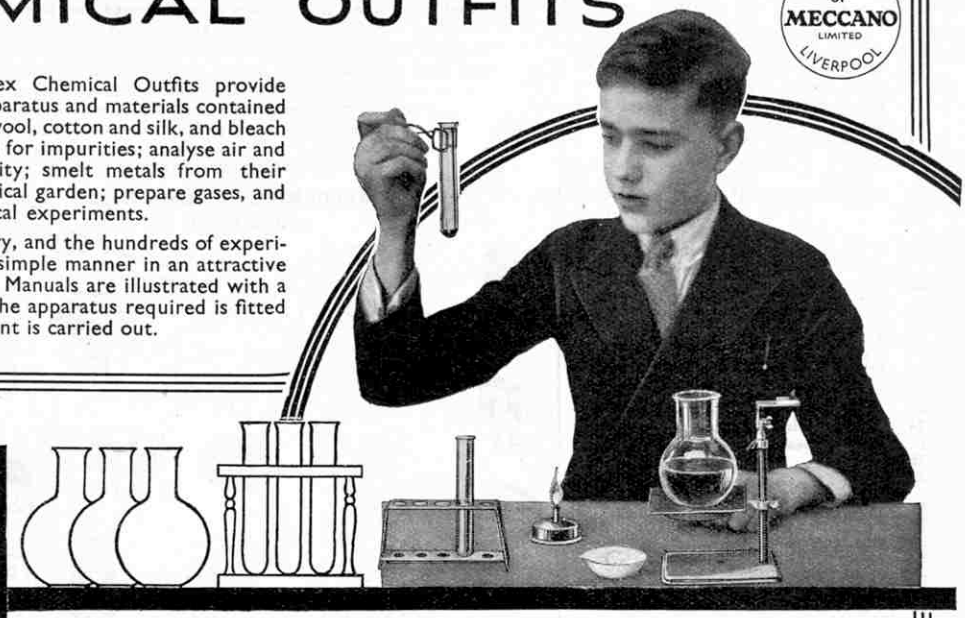
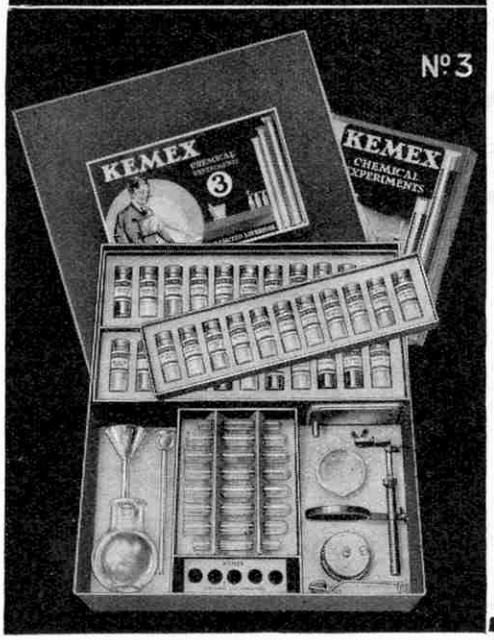
The Outfits include everything necessary, and the hundreds of experiments that can be made are described in a simple manner in an attractive Manual that is included in each Outfit. The Manuals are illustrated with a series of actual photographs showing how the apparatus required is fitted up, and the manner in which each experiment is carried out.





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20b.	,, ,, ¾" ,,	,, 0 3
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19c.	6" dia. with centre boss and set screw	each 1 9
20a.	2" ,, ,, ,,	,, 0 4
21.	1½" ,, ,, ,,	,, 0 4
22.	1" ,, ,, ,,	,, 0 3
23a.	½" dia. with centre boss and grub screw	,, 0 3
22a.	1" dia. without centre boss and grub screw	,, 0 2
23.	½" ,, ,, ,,	,, 0 2
24.	Bush Wheels	,, 0 4
26.	Pinion Wheels, ½" dia., ½" face	,, 0 4
26a.	,, ,, ¾" ,, ¾" ,,	,, 0 5
26b.	,, ,, 1" ,, ¾" ,,	,, 0 6
	Gear Wheels	
27.	50 teeth to gear with ¾" pinion	each 0 5
27a.	57 ,, ,, 1" ,,	,, 0 6
28.	Contrate Wheels, 1½" diam.	,, 0 9
29.	,, ,, ¾" ,,	,, 0 6
30.	Bevel Gears, ¾", 26 teeth ...	,, 0 7
30a.	,, ,, ¾", 16 ,, ...	,, 0 6
30c.	,, ,, 1½", 48 ,, ...	,, 1 6
	(30a and 30c can only be used together)	
31.	Gear Wheels, 1", 38 teeth	each 0 10
32.	Worms	,, 0 4
44.	Cranked Bent Strips	,, 0 1
45.	Double ,, ,, ...	,, 0 1
46.	,, Angle Strips, 2½" x 1"	½ doz. 0 6
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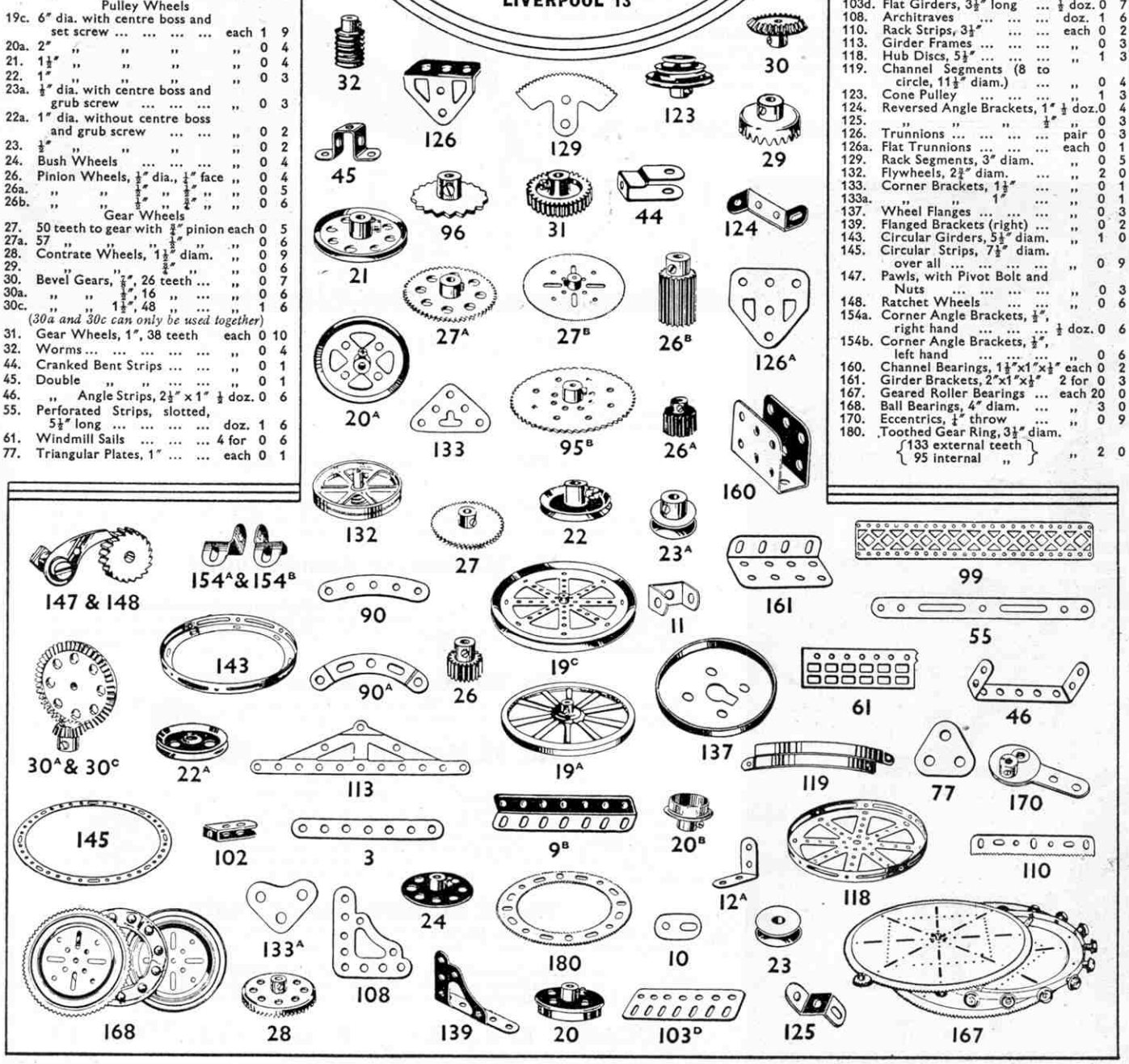
102.	Single Bent Strips	each 0 1
103d.	Flat Girders, 3½" long ...	½ doz. 0 7
108.	Architraves	doz. 1 6
110.	Rack Strips, 3½"	each 0 2
113.	Girder Frames	,, 0 3
118.	Hub Discs, 5½"	,, 1 3
119.	Channel Segments (8 to circle, 11½" diam.) ...	,, 0 4
123.	Cone Pulley	,, 1 3
124.	Reversed Angle Brackets, 1"	½ doz. 0 4
125.	,, ,, ½"	,, 0 3
126.	Trunnions	pair 0 3
126a.	Flat Trunnions	each 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 3
139.	Flanged Brackets (right) ...	,, 0 2
143.	Circular Girders, 5½" diam.	,, 1 0
145.	Circular Strips, 7½" diam. over all	,, 0 9
147.	Pawls, with Pivot Bolt and Nuts	,, 0 3
148.	Ratchet Wheels	,, 0 6
154a.	Corner Angle Brackets, ½", right hand	½ doz. 0 6
154b.	Corner Angle Brackets, ½", left hand	,, 0 6
160.	Channel Bearings, 1½"x1"x½"	each 0 2
161.	Girder Brackets, 2"x1"x½"	2 for 0 3
167.	Geared Roller Bearings ...	each 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 ,,}	,, 2 0



I'M BUILDING A CRANE NEXT!

Every boy is happiest when he is inventing, creating and building. That is the reason for the everlasting popularity of Meccano. It is the most wonderful and the most fascinating hobby in the world, because it enables full scope to be given to all the inclinations and desires that are the natural heritage of boys.

The Meccano system is composed of approximately 250 different parts, each of which serves a definite mechanical purpose. These perfectly finished parts combine to form a complete miniature engineering system with which practically any mechanical movement may be reproduced in model form. More can be accomplished with Meccano than with any other constructional toy, for no other system has such possibilities. The genius is in the parts and the youngest boy can begin to build Models as soon as he gets his Outfit home.

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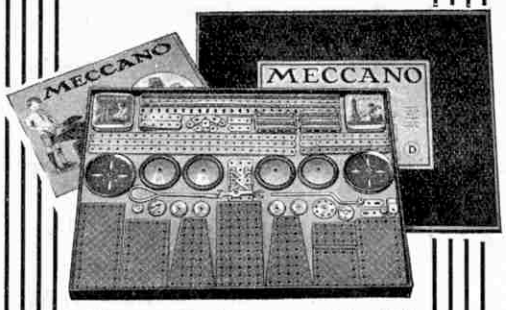
B Meccano Outfit Price 7/6



D Meccano Outfit Price 15/–

H Meccano Outfit Price 72/6

PRICES OF MECCANO OUTFITS

COMPLETE OUTFITS

A	Outfit	each	5/–
B	,, ...	,,	7/6
C	,, ...	,,	10/–
D	,, ...	,,	15/–
E	,, ...	,,	20/–
F	,, ...	,,	30/–
G	,, ...	,,	55/–
H	,, (Carton)	,,	72/6
Hw	,, (Cabinet)	,,	97/6
K	,, (Carton)	,,	132/6
Kw	,, (Cabinet)	,,	157/6
L	,, (,,)	,,	410/–

ACCESSORY OUTFITS

The purpose of Meccano Accessory Outfits is to connect the main Outfits from A to L. They are best described as the stepping stones to bigger and better models. A B Outfit may be converted into a C by adding to it a Ba Accessory Outfit, and a Ca would then convert it into a D. Thus, no matter how small the Outfit you commence with, you may build it up by degrees until you possess all the parts contained in the largest Outfit.

Aa	converts	A	Outfit	into	B	... each	2/6
Ba	,,	B	,,	,,	C	... ,,	3/–
Ca	,,	C	,,	,,	D	... ,,	5/6
Da	,,	D	,,	,,	E	... ,,	5/6
Ea	,,	E	,,	,,	F	... ,,	11/–
Fa	,,	F	,,	,,	G	... ,,	26/6
Ga	,,	G	,,	,,	H	... ,,	17/6
Ha	,,	H	,,	,,	K	... ,,	60/–
Ka	,,	K	,,	,,	L	... ,,	225/–

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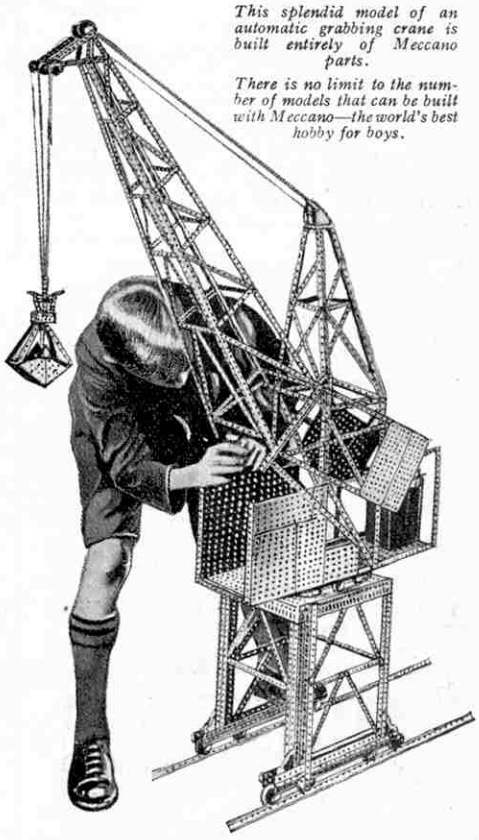
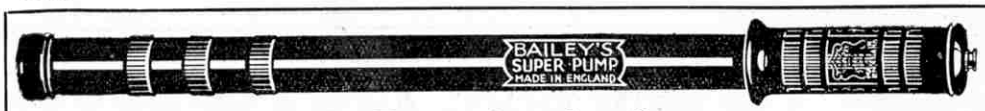
BINNS ROAD
LIVERPOOL 13



This splendid model of an automatic grabbing crane is built entirely of Meccano parts.

There is no limit to the number of models that can be built with Meccano—the world's best hobby for boys.

MECCANO



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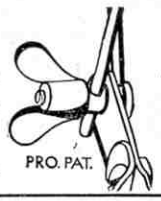

The Patent Fittings allow of 1″ Adjustments

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Extra Thick Celluloid
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ALL Steel parts are Electro Zinced before enamelling. VERY LIGHT, STRONG & RIGID. In 26″ and 28″ sizes for Round or "D" Stay or for Brazed Lugs.

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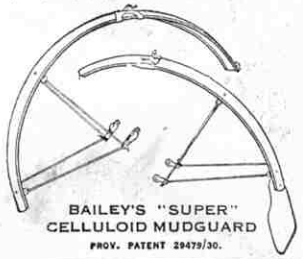
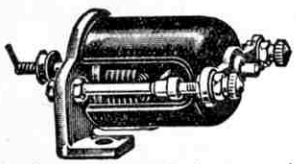


BAILEY'S "SUPER" CELLULOID MUDGUARD
PROV. PATENT 29479/30.

FIT A "WILCO" MOTODYNE IN YOUR SPEED BOAT



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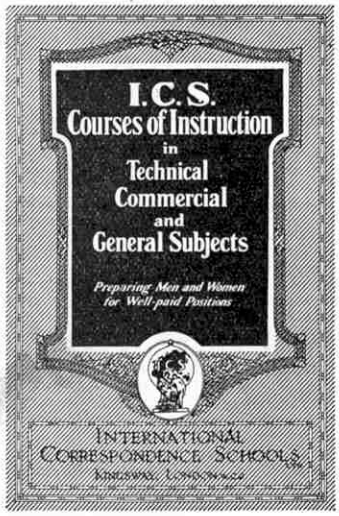

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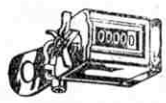

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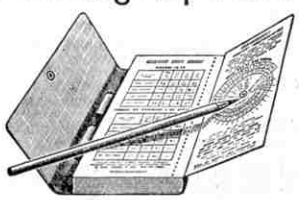

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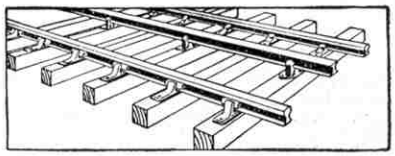

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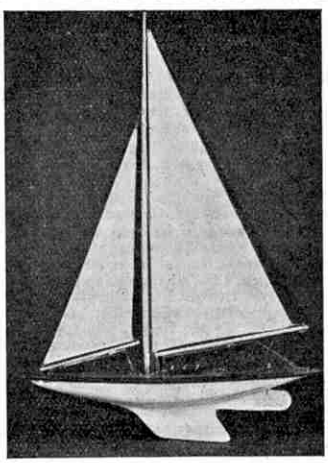

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Sale. "M.M.'s," 1927-1932 inclusive. Perfect condition. Offers by 15th.—Myles, 52, Frederick Road, Wylde Green, Birmingham.

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Sale. Model Cars, Aeroplanes, heaps of new Soldiers, Britain's Toys. Excellent value. Stamp for list.—Sutch, Stymbridge, Gloucester.

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Sale. 5 Vols. Meccano Magazine 1930–1934, Complete, Excellent Condition, 12/6.—Copleston, Chester Road, Flint.

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Stamps. Collector has duplicates for sale in variety.—Drewett, "Avenida," Forest Drive, Kingswood, Surrey.

This Month's Special Articles

Stamp Advertisements cont. from p. 264

MECCANO MAGAZINE

Registered at G.P.O., London, for transmission by Canadian Magazine Post.

EDITORIAL AND ADVERTISING OFFICE:—

LIVERPOOL 13, ENGLAND.

Telegrams: "Meccano, Liverpool."

Publication Date. The "*M.M.*" is published on the 1st of each month and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price 6d. per copy. It will be mailed direct from this office, 4/– for six issues and 8/– for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

Readers' Sales and Wants. Private advertisements (i.e., not trade) are charged 1d. per word, minimum 1/–. Cash with order. Editorial and Advertising matters should not be dealt with on the same sheet of paper.

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Press Day, etc. Copy should be sent as early in the month as possible for insertion in following issue. We usually close for press on or before 6th of each month for following issue. Half-tone blocks up to 100 screen.

Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher copies. Sent free to advertisers booking one inch or over. Other advertisers desiring vouchers should add 8d. to their remittance and should order voucher copy at same time.

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MOTOR CAR CONSTRUCTOR OUTFITS

MECCAUTO 538189

No. 1 Motor Car Constructor Outfit

One of the most fascinating of all boys hobbies, either indoor or outdoor, is model car operation with cars built from Meccano Motor Car Constructor Outfits. Perfect miniature reproductions of many different types of car can be built with these splendid Outfits, including sports four-seaters, speed cars, sports coupés and others.

Now is the time to get a Meccano Motor Car Outfit. You will never grow tired of building and running the superb models that you will be able to build.

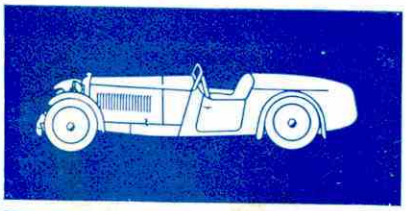
No. 2 Motor Car Constructor Outfit

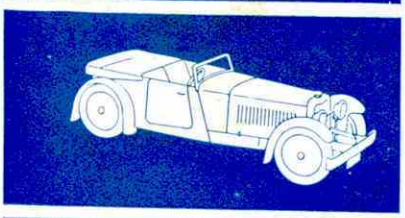
No. 1 Meccano Motor Car Constructor Outfit

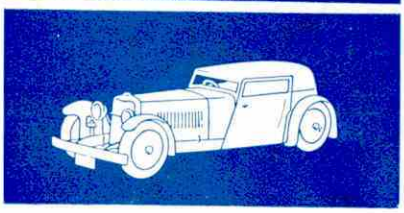
The motor car models that can be built with this Outfit are the finest you ever saw. Look at the examples illustrated at the left-hand side of this page and think of the fun you could have building these and other types equally graceful and realistic.

No. 1 Outfit is available in four different colour combinations and is supplied complete with powerful Clockwork Motor.

Price **13/6**







No. 2 Meccano Motor Car Constructor Outfit

Larger models of a superior type can be built with No. 2 Outfit. Their handsome and realistic appearance may be judged from the illustrations at the right-hand side of this page.

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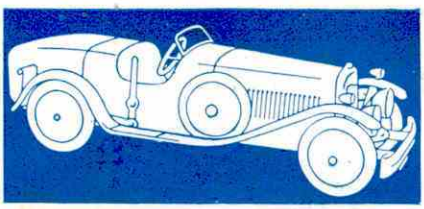

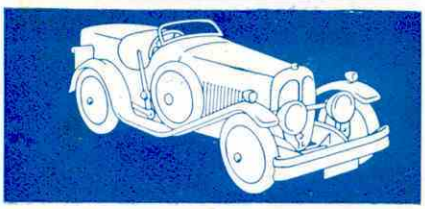

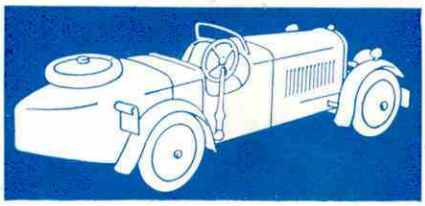

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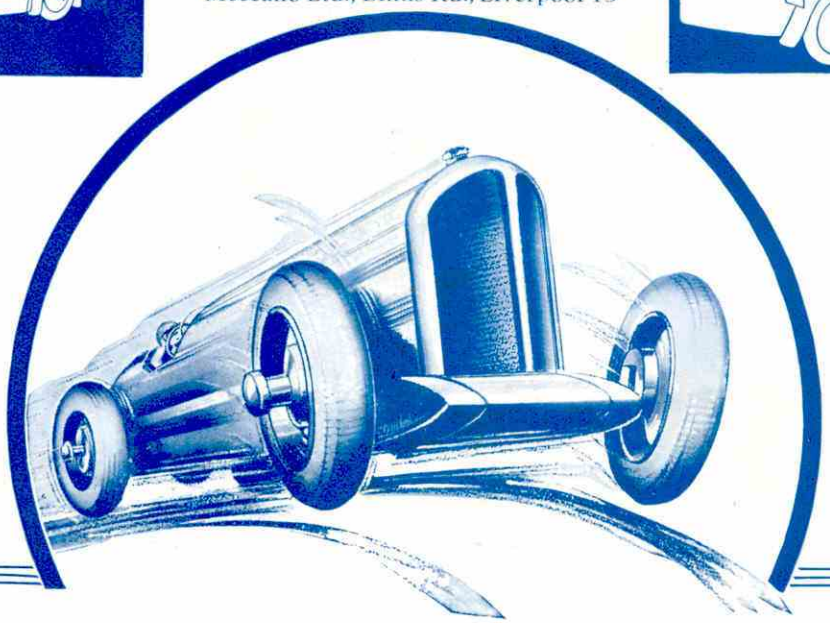
Meccano Ltd., Binns Rd., Liverpool 13

Motor Car Lighting Set

This Lighting Set enables the headlamps of Motor Car models built with the No. 2 Motor Car Outfit to be electrically lighted. Price **2/6**

PRODUCT of MECCANO LIMITED LIVERPOOL



Motor Car Garage

The Meccano Motor Car Garage provides accommodation for any Meccano model motor car or other car of suitable size. It is strongly built, with imitation rough-cast finish. Inside dimensions: Height 5 in. Length 13 in. Width 7¾ in. Price **5/6**

HORNBY

SPEED BOATS

Boys, Get one of these fine Boats for Easter!

Hornby Speed Boats and Racing Boats are the finest examples of model craftsmanship ever produced. Exceptional performance, graceful lines and beautiful finish are the outstanding characteristics of these splendid boats. They introduce a new standard of excellence in British toys. They are superb! Every boy will be proud to possess one of them.

HORNBY SPEED BOATS

When other boats are slowing up, the Hornby Speed Boats are still going strong. The special design of the propeller and the unique methods employed in the construction of the hull give each model exceptional speed and length of run. Every line and every feature of the Hornby Speed Boats emphasises their excellent qualities, speed and reliability. Each model is available in three different colour combinations.

HORNBY RACING BOATS

The Hornby Racing Boats have been introduced to meet a widespread demand for faster boats to be used for racing. They are specially constructed to travel at a high speed, and their remarkable performance, perfect design and beautiful appearance have gained for them a unique popularity amongst boys.

ASK YOUR DEALER TO SHOW YOU THE COMPLETE RANGE

This is the Hornby Speed Boat Club Badge, which may be purchased from your dealer, price 6d., or direct from us, price 5d., post free.

Manufactured by
MECCANO LIMITED
BINNS ROAD
LIVERPOOL 13

HORNBY SPEED BOAT No. 1. "HAWK." Price **2/11**
Travels over 100 ft. on one winding. Dimensions: Length 9¼ in. Beam 3 in.

HORNBY RACING BOAT No. 2. "RACER II." Price **8/6**
Travels over 200 ft. at high speed on one winding. Finished in Blue and Cream. Dimensions: Length 12½ in. Beam 3 in.

HORNBY SPEED BOAT No. 3. "CURLEW." Price **12/6**
Travels over 500 ft. on one winding. Dimensions: Length 16½ in. Beam 3½ in.

HORNBY RACING BOAT No. 3. "RACER III." Price **14/6**
Travels over 300 ft. at high speed on one winding. Finished in Red and Cream. Dimensions: Length 16½ in. Beam 3½ in.

HORNBY CABIN CRUISER No. 5. "VIKING." Price **16/6**
Travels over 500 ft. on one winding. Dimensions: Length 16½ in. Beam 3½ in.

COMPLETE PRICE LIST

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