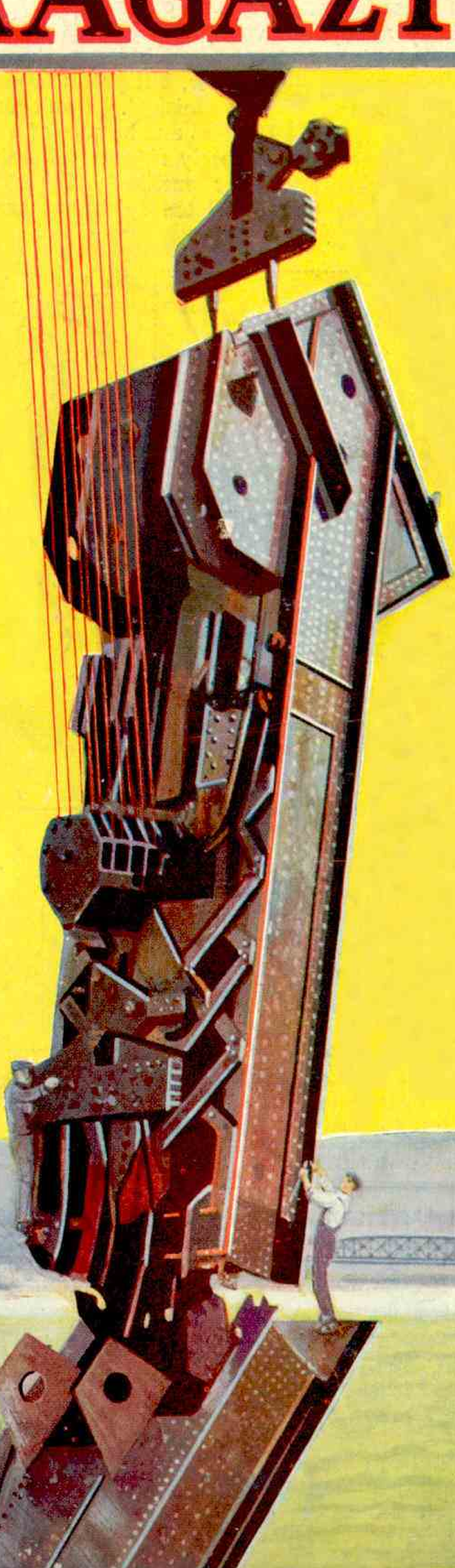
VOL. XII. No. 8 AUGUST 1927

MECCANO MAGAZINE

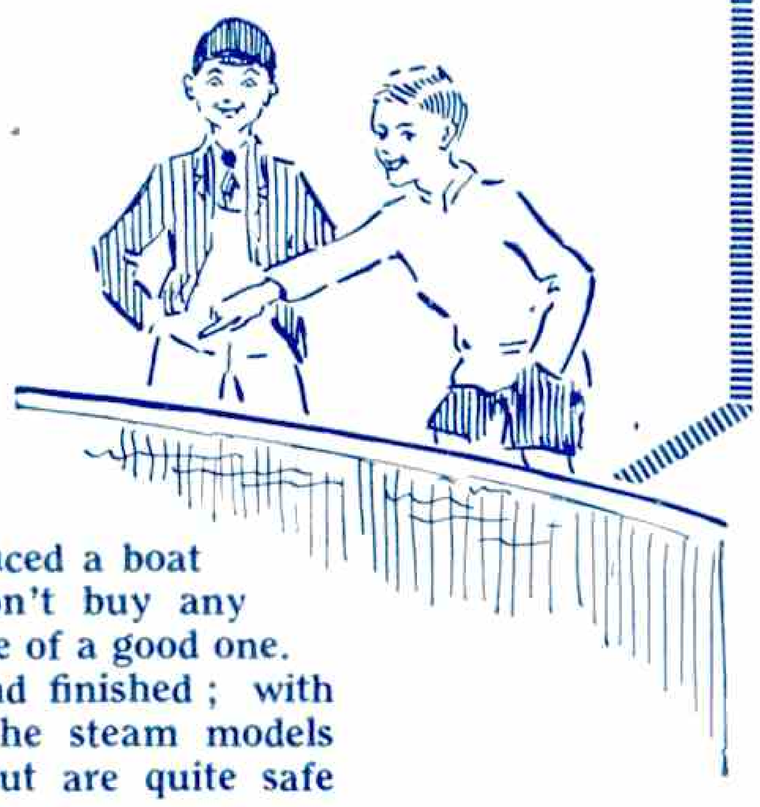


BUILDING A GREAT BRIDGE
(See page 708)

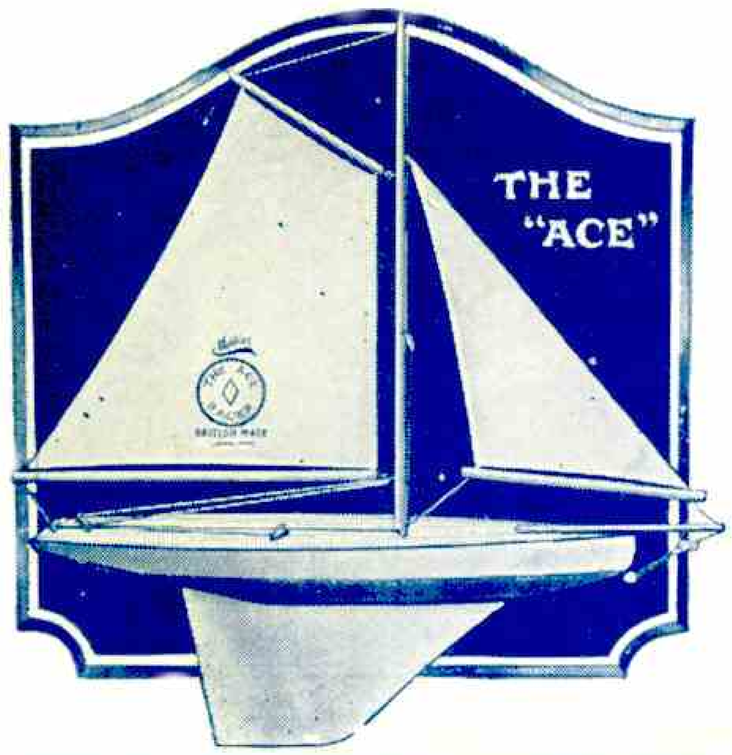
6D

HOBBIES

SAILING BOATS and STEAM LAUNCHES



Such great sport you'll get with one of these boats. See them on any pond—have them at home or on holiday and you'll vote them just top-hole. There's really nothing like them for good value—Hobbies have kept the price low, but produced a boat well built and well finished. Don't buy any old boat—get a Hobbies and be sure of a good one. The yachts are properly rigged and finished; with detachable masts for packing; the steam models are driven by methylated spirit but are quite safe and strong.



The "ACE" Sailer

Really wonderful value. Nothing to compare with it at the price. 14½ ins. deck with hull finished two colours enamel. Collapsible mast, white linen sails, water cord running lines. Shapely and well balanced.

3/6
Post 6d.

The "Seagull" Yacht

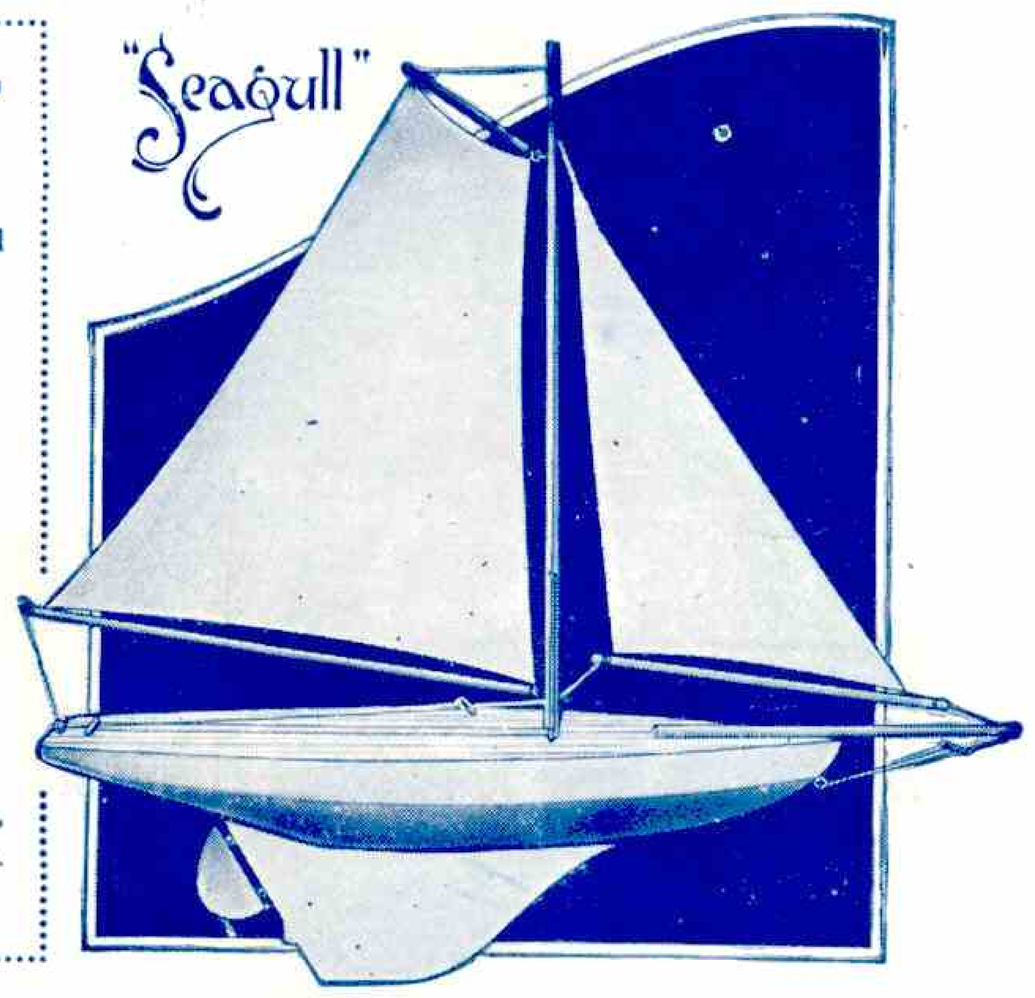
23 ins. long. 26 ins. tall

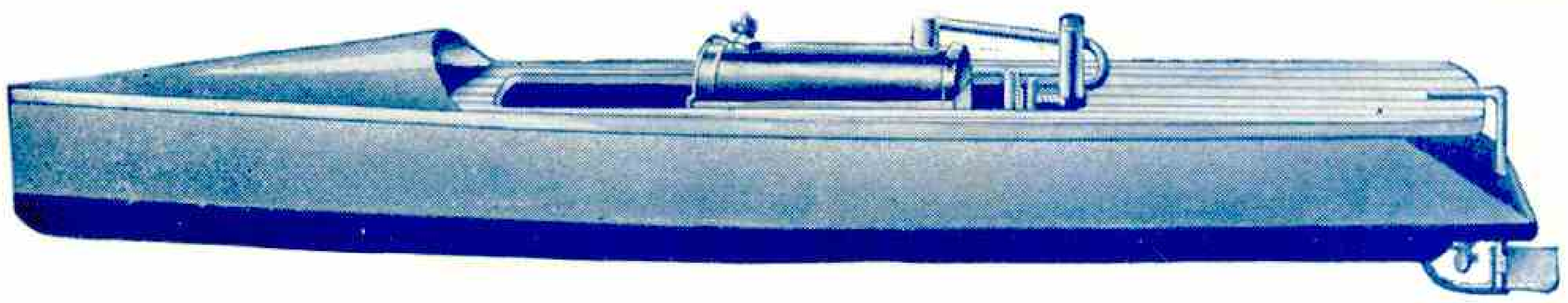
A real racer for any wind. Built with hollow hull, weighted keel and running rudder. Beautifully finished in two colours with planking deck and varnished spars. Clean white canvas strongly lashed. All running lines good water cord (not cheap string) and fitted with bowsies for correct sailing.

In strong box

15/-
Post 9d.

Also the "WHITEWINGS" with hollow hull and 20¼in. deck.
Price 8/6 or 9/3 post free.





These boats are popular everywhere. They are strong and well built, finished in two colour hulls with spray hood. Fitted with brass engine and boiler capable of driving the boats for a long period. The boiler has a safety valve and the lamp cannot leak or turn over. Twin-bladed brass propeller. Supplied in box with lamp, filler and full instructions.

"PEGGY" (as illustrated) **17/6** Post 9d.

"Miss America" (LONG MODEL) **12/6** Post 9d.

DON'T BE PUT OFF WITH ANY OTHER BOAT. THESE ARE REAL VALUE FOR MONEY AND IF YOUR OWN TOYSHOP OR STORE HASN'T THEM IN STOCK, ASK THEM TO GET ONE FOR YOU.

A Free List of Boats, Engines and Yachts is obtainable on application at any Hobbies Branch or from Dereham as below.

Obtainable from :—Gamages, Harrods, Whiteleys, Selfridges, Hamleys, and Barkers ; C. Lucas and Bunneys (Liverpool), Beales (Bournemouth), Bateson (Blackpool), Dixon (Dublin), Pantoys (Cheltenham), Hobbies Branches at 65, New Oxford St., W.C. ; 147, Bishopsgate, E.C. ; 79, Walworth Rd., S.E. ; 326, Argyle St., Glasgow ; 10a, Piccadilly, Manchester ; 9a, High St., Birmingham ; 214, West St., Sheffield ; 89a, Woodhouse Lane, Leeds ; 25, Bernard St., Southampton ; 68, London Rd., Brighton. Or direct, post extra, from

HOBBIES LTD. (Dept. 96), DEREHAM, NORFOLK

CANADIAN DEPOT : 385½, YONGE STREET, TORONTO

NEXT MONTH: A RED INDIAN SUN DANCE. *PUBLISHED: 1st SEPTEMBER (PRICE 6d.)*

MECCANO MAGAZINE

Editorial Office
Binns Road
Liverpool

Vol. XII. No. 8
August, 1927

With the Editor

Common Beliefs that are Not Fact

Is is strange how some popular beliefs continue to persist even after they are supposed to have been "killed." An incident connected with James Watt—whose life story is now appearing in our pages—affords an outstanding example of this. The popular belief is that Watt, as a boy, watched steam lifting the lid of a boiling kettle and from this conceived the idea of the steam engine. This imaginary incident was utilised by an artist in a famous picture showing young James watching the kettle, and after this picture was reproduced as an engraving and widely distributed, almost everybody came to believe the story.

As readers of the *"M.M."* know, as early as 130 B.C. Hero of Alexandria had produced motion from steam with his turbine and steam engines of a kind had been used in mines for some years before the time of Watt. He probably had very little thought for steam engines before he was called upon to repair a model of Newcomen's engine belonging to the Glasgow University. The model would not work and it was in investigating its principles that Watt was led to take up the study of the steam-engine in general, resulting in his epoch-making inventions. The kettle played no part in the scheme of things, as far as he was concerned.

"Accidental" Discoveries are Not Always So

Another commonly accepted belief is that many discoveries are the result of accidents. Watt's discovery of the separate condenser was no accident, but really was the result of his wide experience as an instrument maker and repairer for the Glasgow University, in addition to his close application to the problem of improving Newcomen's engine.

Then again, we all know that the illustrious Sir Isaac Newton made some of his greatest discoveries by means of soap bubbles. It is a common belief that such discoveries were made "by accident" when the great man was playing with a child's toy. The fact is, however, that Newton's experiments with soap bubbles were the outcome of years of deep study, and the knowledge he gained during those years enabled him to draw his important conclusions from such apparently trivial phenomena. Many of his discoveries relating to light, for instance, were worked out in great detail at the expense of much time and thought, involving mathematical deductions of high order. It was not until this work had been done that his theoretical results were verified by studying the behaviour of bubbles.

The Story of Frogs' Legs

According to the popular idea, the theory of gravitation was suggested to Newton by the fall of an apple, whereas nothing of the kind was the fact. The story no doubt originated in the fact that Newton realised it was the same universal force of gravity that caused an apple to fall to the ground as kept the Moon in its orbit and prevented the earth falling into the Sun.

Neither did Galileo invent the pendulum as a direct result of watching a swinging chandelier in the Cathedral at Pisa. He had been studying falling bodies for many years, and had proved the regularity of their movements long before he suggested that the pendulum might be used to measure time.

Everyone has heard the story of how Galvani is supposed to have made his great electrical discovery through noticing the twitching of frogs' legs. The story, which has persisted through many generations and seems likely to go down to posterity, was invented by Alibert, an Italian writer. The fact of the matter is that Galvani, as a trained anatomist, had studied frogs for many years previous to the day on which he made the electrical discovery that made him famous.

The point I want to make in connection with these matters is that there is no "short cut" to success. Nearly every discovery of merit has been made as the result of a definite plan, which in most cases has taken years of hard work—perhaps a life time—to realise. *Labor omnia vincit*, says the Latin proverb, and anyone who wants to "get on" in life must remember this, coupled with George Stephenson's watchword "Persevere."

How to Become a Millionaire

I see that an infallible recipe for becoming a millionaire has recently been given by someone from Australia. Apparently it is only necessary for the aspirant to a fortune to invent a portable freezing plant and travel with it through the farming and grazing lands of Australia. He will become a millionaire in a couple of years or so—if he is lucky!

Rabbits are such a pest in Australia that although ten millions are frozen and exported every year; and the skins of another sixty millions are exported to make fur coats and necklets; and countless other millions are shot, poisoned, buried and drowned, it is impossible to keep them down. Millions of new rabbits spring up in place of those destroyed. They harass the landowner; nibble his wide acres as bare as a board; starve his cattle; and ruin his crops. Although there are thousands of miles of 8 ft. wire-netting fencing—4 ft. above and 4 ft. below the ground—the burrows make the countryside resemble a huge piece of gruyere cheese.

It is said that if each person in Australia ate a rabbit a day every day in the year, there would be as many rabbits remaining at the end of the year as there were at the beginning. It has also been stated that a single pair of rabbits may have over 700 descendants in a year. As there are supposed to be about 50 million rabbits in Australia you can work out for yourselves how many new tails there will be—according to the mathematicians—frisking round at the end of every twelve months!

Naturally, they don't love the rabbits in Australia. Poison carts are sent out by all farmers, and from a single farmhouse as many as 20,000 rabbits may be killed in a night and their carcases burned. Thousands of men are at work everywhere, trapping, shooting and burning out the rabbits. Boys spend their weekends in shooting and skinning them. They invest sixpence in 50 cartridges for their light shot guns and not only have good hunting but turn their sixpence into two or three pounds by the sale of the skins, and with the money buy motor-cycles, canoes and the many other things that ordinarily take months to save-up for!

The millions of carcases of all these slain rabbits are unusable and are burned as soon as they have been skinned. It is said that anyone who could invent a method of quickly preserving them for food and exporting the meat, would very soon be a millionaire. An even better reward would come to anyone who will tell our Australian cousins of a means of exterminating the rabbits. Now then bright Meccano boys (and your fathers and uncles, too!) here is a chance to make your fortunes!

FAMOUS CANALS OF THE WORLD.

II.—MANCHESTER SHIP CANAL

LAST month we described how the scheme for a ship canal to give direct access from the Mersey to Manchester originated and developed, and outlined the course of the canal and the methods of excavation adopted. We now come to the locks, which play such an important part in the operation of a canal.

The locks were built up of cement and faced with blue brick with the exception of the copings, quoins and fender course, which were of granite, brought from Cornwall. The greatest care was exercised to ensure that all the cement used for this purpose was of the highest quality. A sample of every 30 tons of cement received was taken after the material had been stored for a fortnight. Each sample was passed through a fine sieve having a mesh of 2,000 holes per square inch, and if more than 10 per cent. of the material remained in the sieve after the test the bulk load from which the sample had been drawn was rejected. Samples passed as satisfactory were then made up into small briquettes and were immersed in water for eight days. At the conclusion of this period each briquette was removed and tested for resistance to tensile strain and was required to withstand, without showing any sign of weakness, a pull of at least 300 lb. per square in. In those days cement was only about half as strong as it is to-day, and this rigorous test was necessary.

Photo courtesy [*Manchester Ship Canal Co. Ltd.*

Aerial View of No. 9 Dock

Entrance Locks at Eastham

At Eastham, where the Ship Canal joins the Mersey, three terminal locks were built side by side. The largest or landward lock was the most extensive constructed on the canal, being 600 ft. in length by 80 ft. in width. The central lock was made 350 ft. in length and 50 ft. in width, while the riverside and smallest lock was only 150 ft. in length and 30 ft. in width.

There was considerable discussion as to whether the gates for the locks on the canal should be of steel or very hard timber. Finally a decision was made in favour of Greenheart, which is a very heavy hardwood and has a long life in water. A huge shed was therefore erected close to the canal at Eastham and there the massive gates for the entrance locks were built of best Greenheart timber from Demerara. The pairs of gates for the largest lock each weighed 540 tons.

Single locks were erected on the Mersey side of the canal at Weston Point and Runcorn, for the purpose of providing continued access to the Mersey for certain traffic proceeding in that direction. The former lock was built 600 ft. in length and the latter 400 ft., each being 45 ft. in width.

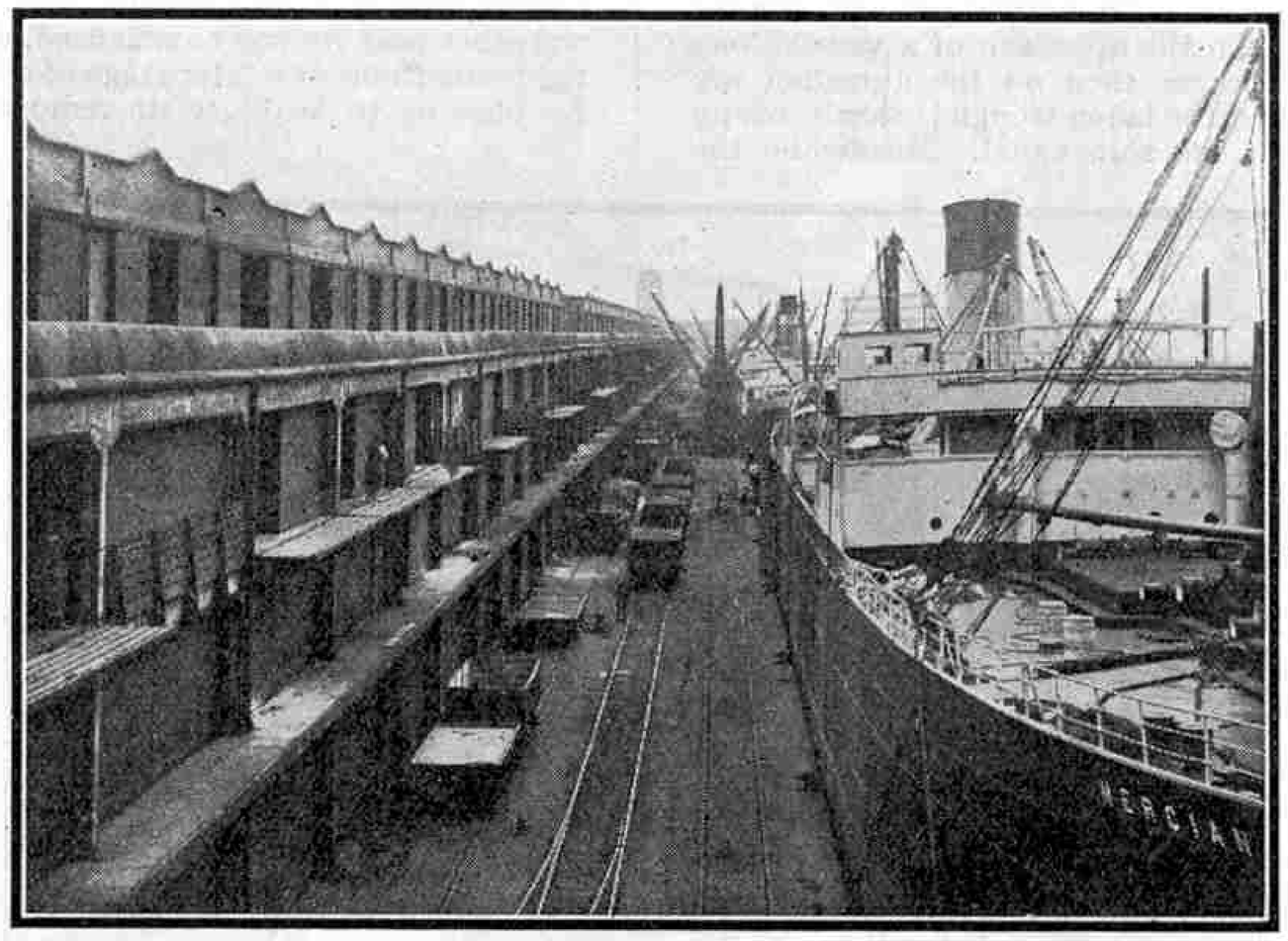
At Runcorn the Mersey narrows considerably for a short distance, and beyond the seaward end of Runcorn lock a massive concrete wall was built up in lieu of a clay embankment as generally adopted where the canal and river ran alongside each other. The wall was erected on a natural foundation varying from gravel to red sandstone rock and was constructed for a distance of 4,300 ft. to a height of roughly 40 ft. from the foundation. From a thickness of 16 ft. at the base the wall was tapered to 2½ ft. at the top, the slope being confined to the Mersey side of the structure. Timber fenders were erected later over the vertical facing of the canal side of the wall for protective purposes.

The canal was constructed as a tidal waterway from Eastham to Latchford, 15 miles from Manchester, and at Latchford the level was raised 14 ft. 6 in. by lock. When the incoming tide of the Mersey equals the level of the water in the canal at Eastham, the lock gates there are opened and an open passage for shipping exists up to Latchford.

At Latchford two locks were built, one being 600 ft. in length and 65 ft. in width—almost as large as the principal Eastham lock—and the other 350 ft. in length and 45 ft. in width. Both locks were equipped with intermediate gates to facilitate the passing of small

vessels and to minimise the wastage of water on such occasions. The inner gates of the large lock divide it into two compartments 450 ft. and 150 ft. in length respectively, while the smaller lock is similarly divided into two compartments respectively 230 ft. and 120 ft. in length. Both the intermediate and the end gates were constructed of best Greenheart timber.

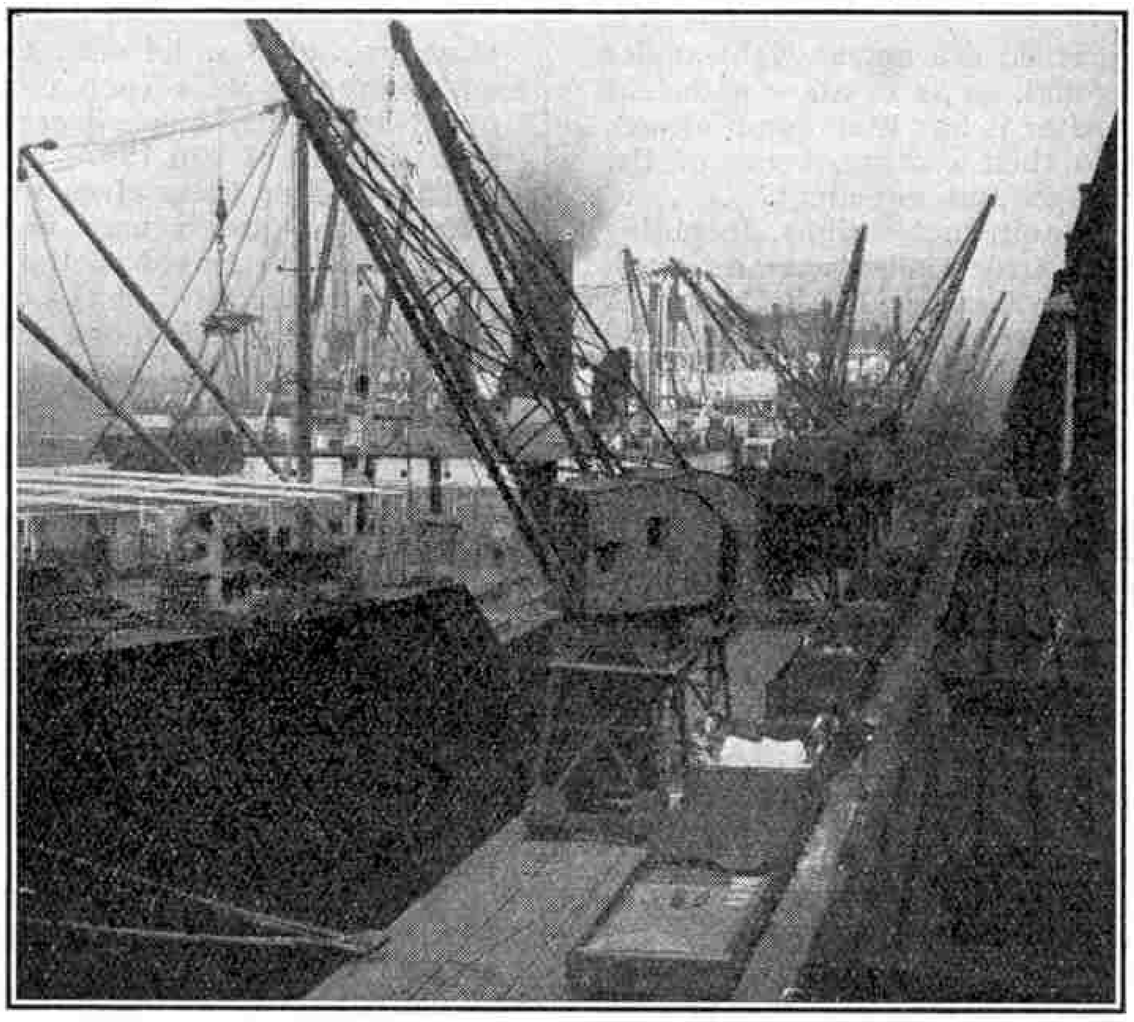
Large culverts were made in the lock walls to enable the locks to be filled or emptied in a very short time. Three "Stoney" pattern 30 ft. sluices, similar to those installed at the Weaver Junction, were erected in a weir situated between the southern bank of the canal and the smaller lock, to receive and pass any surplus water.



A Quayside scene. On the left is one of the 4-storey warehouses

A mishap that might have been attended by more serious consequences occurred on the site during the building of the Latchford Locks. This was a collision between a goods train conveying bricks and a train laden with granite. At the time when the respective drivers realised that a crash was almost certain, both trains were travelling at a good speed. The drivers leaped from their engines into the canal cutting alongside the railway and landed without serious injury on the canal bed 35 ft. below. Much damage was done to the two trains as a result of the impact.

The twin locks constructed at Latchford were duplicated at Irlam, Barton and Mode Wheel, $7\frac{1}{2}$, $5\frac{1}{2}$ and two miles respectively from Manchester. At the Irlam locks the canal was elevated a further 16 ft., at Barton 15 ft., and at Mode Wheel a final rise of 13 ft. was made. The task of excavating for the Irlam locks proved slow and difficult owing to the soil being badly waterlogged, and in making the subsequent solid foundation for the locks as much as 10,000 tons of cement was used. Five sluices were constructed at the Irlam locks and the Barton locks, while four similar sluices were erected at Mode Wheel.



Photos courtesy] [*Manchester Ship Canal Co. Ltd.*

Electric Cranes at work

Brindley's Aqueduct Superseded

When Brindley built the first Barton Aqueduct in 1760 he did not anticipate that the river Irwell flowing beneath would one day become part of a great ship canal and that ocean-going steamers would sail thereon to and from Manchester. His structure carried the Bridgewater Canal over the river, but left very little headroom for traffic using the latter. Thus the ship canal scheme sealed the fate of Brindley's Aqueduct.

To connect the upper canal with the ship canal by means of a short flight of locks was deemed impracticable, as the wastage of water in manipulating the locks was anticipated to be more than the limited supply of the Bridgewater Canal could make good. It was decided, therefore, to substitute for the low stone viaduct built by Brindley an aqueduct that would carry the upper canal over the lower waterway as hitherto, but which could be closed at the ends—the canal "ends" being similarly closed, of course—and swung to one side to let tall-masted steamers pass by on the ship canal. This scheme was as bold and original as had been Brindley's a century-and-a-half previous.

The new Barton Aqueduct was erected close by the old one, new approach channels being made into which the canal was later diverted from its course over Brindley's structure. During clearance operations for the new aqueduct and diversion of the canal an old corn mill situated near the original aqueduct was demolished. This mill had been a familiar landmark for many years.

A narrow island pier of concrete was built up in the ship canal near to one side and a control tower was erected in the centre of the pier, which extends lengthways of the canal. The pier structure was substantially built with granite and brickwork in the part that would have to take the weight of the aqueduct. The total length of the aqueduct is 1,335 ft., comprising the swinging portion of 234 ft., and an approach at each end of roughly 550 ft.

The new aqueduct consists of a large steel trough carried by a pair of side girders each 234 ft. in length and 22 ft. 3 in. apart from the centre of the girders. They are 33 ft. in height in the centre, but taper off

to 28 ft. 9 in. at the ends. The sides of the trough extend to 1 ft. above the water level. The waterway along the aqueduct is 18 ft. in width and 6 ft. in depth, while the side towpath is elevated 10 ft. 6 in. above the level of the water and is carried on a gallery.

At the ends of the trough and at the two shore ends of the Bridgewater canal hydraulically-operated watertight iron swing doors have been fitted. When the trough is in line with the shore lengths of the canal and all gates are open, normal passage over the bridge is available to barges. On the approach of a vessel along the ship canal beneath, any barges then on the aqueduct are detained, all gates are closed, and the laden trough is slowly swung round until it is parallel with the ship canal. Meanwhile the closed shore gates of the Bridgewater canal above hold back the water therein. When the vessel on the ship canal has passed by, the trough is swung back into place and locked as described below. The gates are then re-opened and free passage along the Bridgewater canal is restored once more.

In a paper relating to the new Barton Aqueduct, given before the Institution of Civil Engineers in 1897 or 1898, the designer of the Aqueduct states :—

"At each end of the trough a watertight joint is made by an iron wedge-piece of the shape of the cross section at the end of the trough, both ends and bottom being faced with india-rubber. The fixed and movable ends of the aqueduct are slightly tapered, and about 1 ft. apart; this vacancy is filled by the wedge-piece, which weighs about twelve tons, and is lifted by four hydraulic rams sufficiently to allow the trough to be moved, the water between the gates being passed off into the ship canal. The junctions just described are not at right-angles to the trough, but are slightly diagonal, so as to allow sufficient clearance for moving the trough. After it has been again closed, the wedge-pieces are dropped on to their seating, being of the same taper as the ends of the trough and aqueduct. . . ."

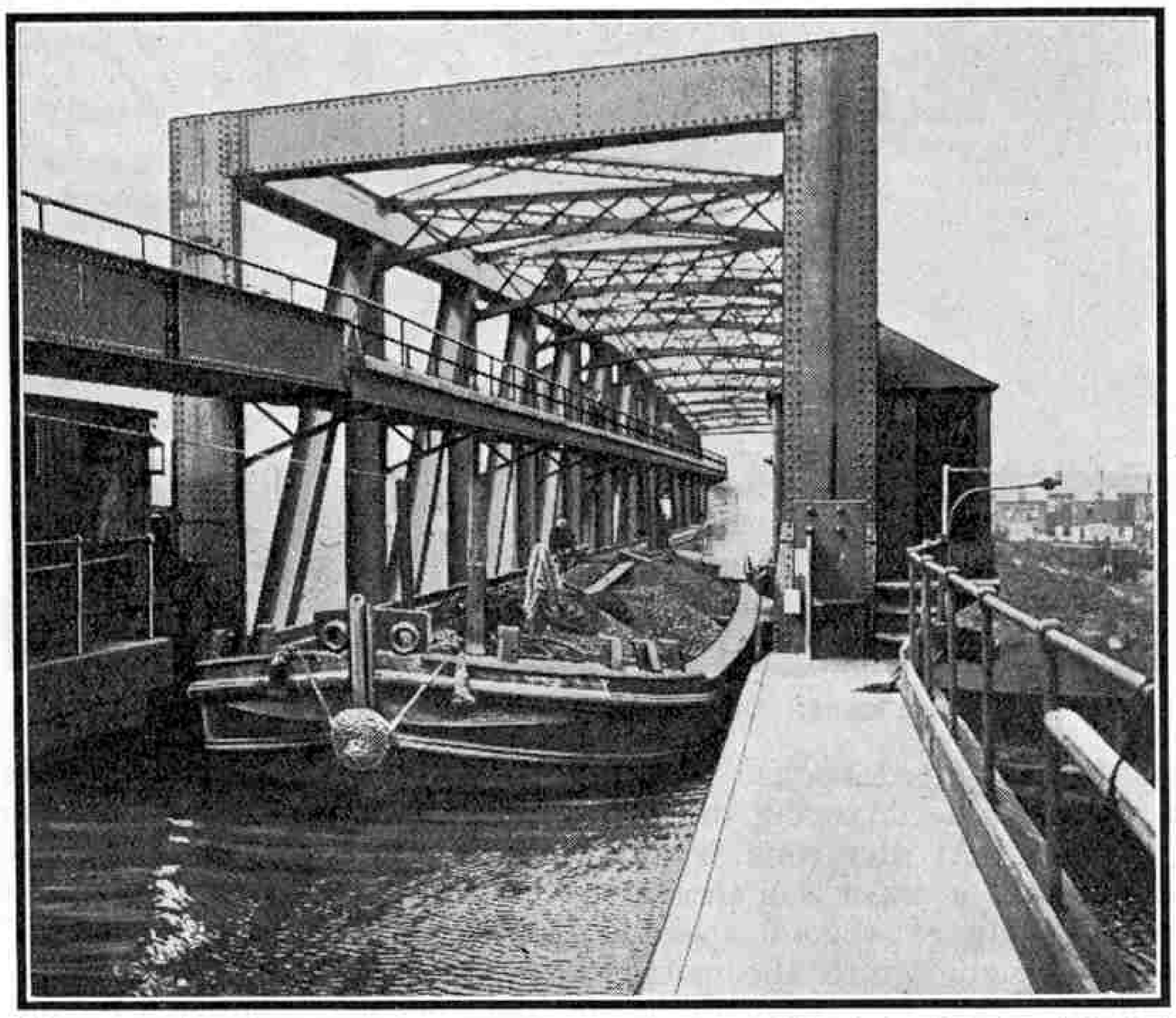


Photo courtesy] [*Manchester Ship Canal Co. Ltd.*

Barge passing through the new Barton Aqueduct

The movable portion of the new aqueduct weighs, including water, 1,600 tons, about half of which burden is borne by a central hydraulic press that functions as a pivot and is free to turn. A hydraulic buffer and locking bolts are also provided.

The island platform was extended far enough along the ship canal to enable a similar swing bridge, continuing the Barton road, to be built up on the other side of the central tower. This was temporarily opened for traffic on 26th January, 1893. The movable portion of the bridge is 195 ft. in length, 27 ft. 6 in. in width and is turned on 64 steel rollers operated hydraulically from the control tower. The hydraulic power for both the aqueduct and the swing road bridge is derived from an engine house erected adjacent to the two canals.

By May 1893, the new Barton Aqueduct was ready to receive the Bridgewater Canal, and on the day appointed for the diversion of the upper waterway to its new passage over the Irwell—or Ship Canal—many people gathered at Barton to witness the event. The approach lengths at each end of the new aqueduct had been completed, but at the points where they branched off from the old route the canal bank had been left intact to serve as a dam. It was the piercing of the dam at each end of the new section that now permitted the water of the Bridgewater Canal to change its course. The arrival of the water was greeted by prolonged cheering from the waiting crowds.

When the new section of the canal was about half-full an untoward incident put an end to celebrations for the time being. Suddenly most of the bed of the approach on the Barton side of the aqueduct gave way, and with a roar the increasing volume of water poured through the gap. Luckily the deluge found an outlet into the ship canal. The dams were hastily closed up again and the official opening of the aqueduct to traffic was postponed indefinitely. A fortnight later the damage had been repaired and on 14th June the filling of the new channel and aqueduct was recommenced, this time by the more cautious method of pumping the water in.

About a month later the New Barton Aqueduct was available to traffic and the first barge passed across on 21st August. This was the "Ann" of Lymm, carrying a cargo of vitriol for Hapton, near Accrington. As soon as the aqueduct and the swing road bridge were put into regular use, the demolition of Brindley's aqueduct near by was commenced, a cofferdam being built around the foundations at a later stage of operations and the rock loosened by blasting to facilitate its removal.

Four Railways Diverted

The route followed by the Ship Canal intercepted four important railways, and it was decided that these should be carried over the canal. When the railway companies learned, however, that the canal authorities proposed to effect these crossings by high level bridges up to which the railways were to be led by long inclined embankments, consternation reigned, and with one accord they vigorously opposed the proposal. Parliament had never sanctioned such extensive alterations to established rail routes, and hesitated to do so now in the face of the railway companies hostility to such a measure. But the canal promoters were equally determined, and eventually Parliament decided in the latter's favour and the work was then quickly commenced.

Material from the canal excavations was utilised as much as possible in constructing the sloping embankments, which were built close to and parallel with the railway track then in use. The embankments were each commenced about 1¼ miles from the canal and when finished carried the railways up to the bridges at a gradient of 1 in 135.

The bridges themselves were not all of the same length, the longitudinal girders used varying from 150 ft. to 300 ft., but in every case the height of the underside of the viaduct above the ordinary water level of the canal was 75 ft. These deviations of railway were carried out near Warrington, at Latchford, near Cadishead and at Irlam, and cost the canal company a total of over £875,000.

Extensive Docks Built at Salford

Facilities had to be provided also for the continuance over the canal of close upon a dozen highroads, and in the majority of cases this was done by the erection of small swing bridges built to a general pattern. The bridge revolves upon a stone pillar erected in the canal and close to one side. Upon the top of the pillar are two circular roller paths mounted upon each other and separated by a ring of conical rollers, acting on the roller-bearing principle. A square frame of short cross-girders is attached to the upper ring path and carries the main steel girders of the bridge. As in the case of the Barton aqueduct, the swing bridges are hydraulically operated.

In addition to the swing bridges two fixed road bridges were erected, one at Latchford and the other at Warburton. The height of the road bridges over the canal was fixed at 75 ft. 6 in.

The canal was made 26 ft. in depth throughout, which has since been increased to 28 ft. and for some miles at the lower end is now 30 ft. in depth. These depths are maintained by the Company's fleet of dredgers. The standard width of the bottom of the canal is 120 ft. but at the approach to locks this figure is exceeded, while in the rock cuttings the course of the canal is somewhat narrower.

From the Mode Wheel locks to the Salford terminus of the canal, two miles further on, the land on each side of the water-way became the scene of docks and warehouses, and these have now

assumed such dimensions as to make Manchester one of the foremost ports of the United Kingdom. The erection of quays, loading wharves, transit sheds and a network of railway sidings transformed peaceful fields and rural areas into centres of industrial activity. Where was once the Manchester racecourse are now docks and warehouses.

The Dock Estate covers an area of over 400 acres, which includes a water space of 120 acres and more than 5½ miles of quay. The height of the quay walls throughout is about 8 ft. above ordinary water level of the canal.

There are eight wet docks, numbered one to four, and six to nine, the last-mentioned being opened in 1905. This dock is of imposing size and capacity, being 2,700 ft. in length by 250 ft. in width, and 10 large vessels can be berthed here at the same time, discharging or loading their cargoes by means of quick-working electric cranes. Under the quays of this dock are subways containing electrically driven endless belts for carrying grain in bulk at a great pace to the grain elevator that stands at the head of the dock and can accommodate 40,000 tons of wheat, or other cereals, in 341 separate storage bins. By means of these conveyors six vessels in this dock can automatically discharge their cargoes of bulk grain into the grain elevator simultaneously at the rate of 900 tons per hour. While they are doing this the vessels can also discharge their general cargo into the ferro-concrete sheds, four floors in height which run in a half-mile series along the quay. Another grain elevator comprising 268 separate storage bins is situated on the Trafford Wharf, the opposite side of the Canal to No. 9 Dock.

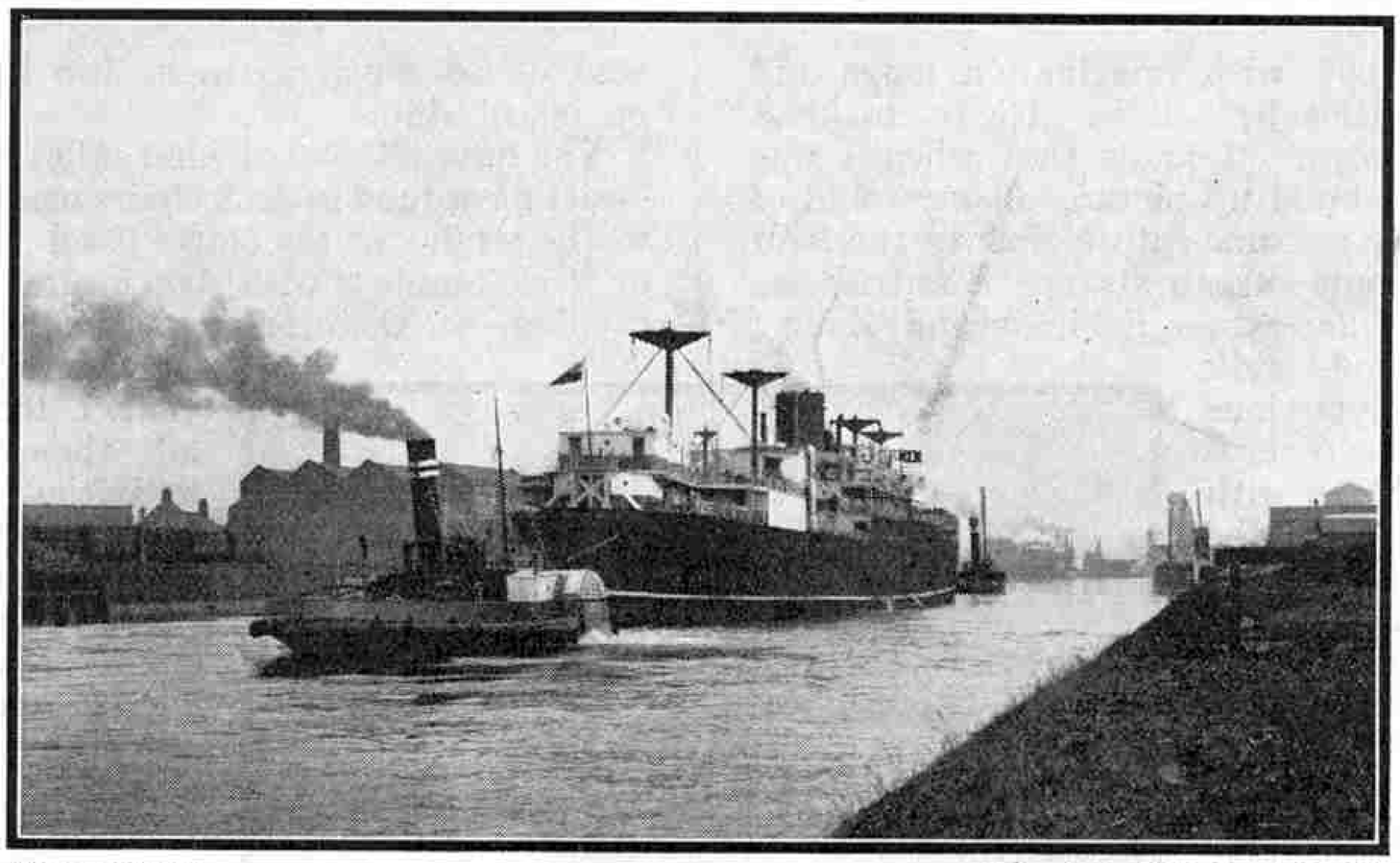


Photo courtesy] [*Manchester Ship Canal Co. Ltd.*

Large Steamship navigating the Ship Canal

The floating plant at the Manchester Docks includes two pneumatic grain elevators, each capable of discharging at the rate of 250 tons per hour; a pontoon sheers capable of dealing with weights up to 250 tons, with a lift of 21 ft.; six pontoons each of 800 tons capacity, and numerous lighters.

An Army of Cranes

There are cranes of all descriptions here, including some 150 electric cranes for dealing with general cargo and numerous portable steam cranes for heavier lifts. There is a floating and self-propelling crane that can draw up alongside a vessel and lift a locomotive or Pullman coach on to it, or hoist anything up to 60 tons in weight. In addition, there are six electric grab cranes with Priestman grabs, for taking ore out of a vessel by great bites of five tons at a time; and a hydraulic coaling crane capable of manipulating 12-ton wagons. In the 29 warehouses are movable overhead gantry cranes, while on the roofs of the 38 transit sheds are roof cranes and, inside these spacious buildings, "jiggers" innumerable.

Eighty-five miles of permanent way are laid down within the dock area. Several railway lines run alongside every ship's berth, transit shed and warehouse, to facilitate quick despatch of goods from any point on the docks to any part of the United Kingdom. Within a short distance of the docks are three junctions with the main line railways, and long trains, representing many hundreds of railway wagons, are exchanged nightly at these junctions by the railway companies and the Ship Canal Company. Sixty locomotives are used at the docks to carry out the vast amount of shunting, and close upon 2,500 wagons are kept busy on transfer of goods within the dock area.

The development of oil importing has led to several extensive oil storage depots being erected in the neighbourhood of Mode Wheel, and 89 tanks, representing more than 43 million gallons capacity, enable Manchester to rank to-day as one of the foremost ports of the United Kingdom for the import of this important product.

The docks also possess a cattle lairage, and considerable cold storage. Quays, sheds, warehouses and the dock area are lighted by electricity. The extension of facilities is still going on and two new reinforced concrete transit sheds, each 450 ft. in length by 110 ft. in width, are in course of construction at No. 9 Dock. Land is available close by for building No. 10 dock when the trade of the Port justifies taking this further step.

Completion of the Ship Canal

The building of the first docks, warehouses, etc., for the Ship Canal was carried on simultaneously with the work elsewhere along the route. The canal was filled section by section as it became ready, a task that was not always accomplished without mishap. During the filling up of the first Eastham section, after completion of the locks, the rush of water that occurred made a bad break in the embankment on two occasions and it was not until this weak place in the defences had been built up with concrete instead of clay, and a third filling of the section carried out, that all was satisfactory and the water held.

Profiting by their initial experience, the engineers adopted more gentle methods of filling up subsequent sections. When the Eastham to Ince section was ready water was fed into it by way of a pipe, 90 ft. in length and 4 ft. in width, that led from the neighbouring full section, through the dam built across the canal channel, and so into the empty portion. In five days the section was filled to the desired level, and the pipe and intervening dam removed. Water was admitted to the last section to be completed, on the 2nd November, 1893, six years after the cutting of the canal was commenced.

On 7th December of the same year the "*Snowdrop*" left the Prince's Landing Stage at Liverpool at 7.30 a.m. bound for Manchester. Eastham Locks were reached half an hour later, and thence on to the end of the canal at Salford a careful inspection was made of all locks, sluices, bridges, etc. This voyage of inspection was concluded satisfactorily by 3 o'clock in the afternoon, when the party disembarked at No. 4 Dock.

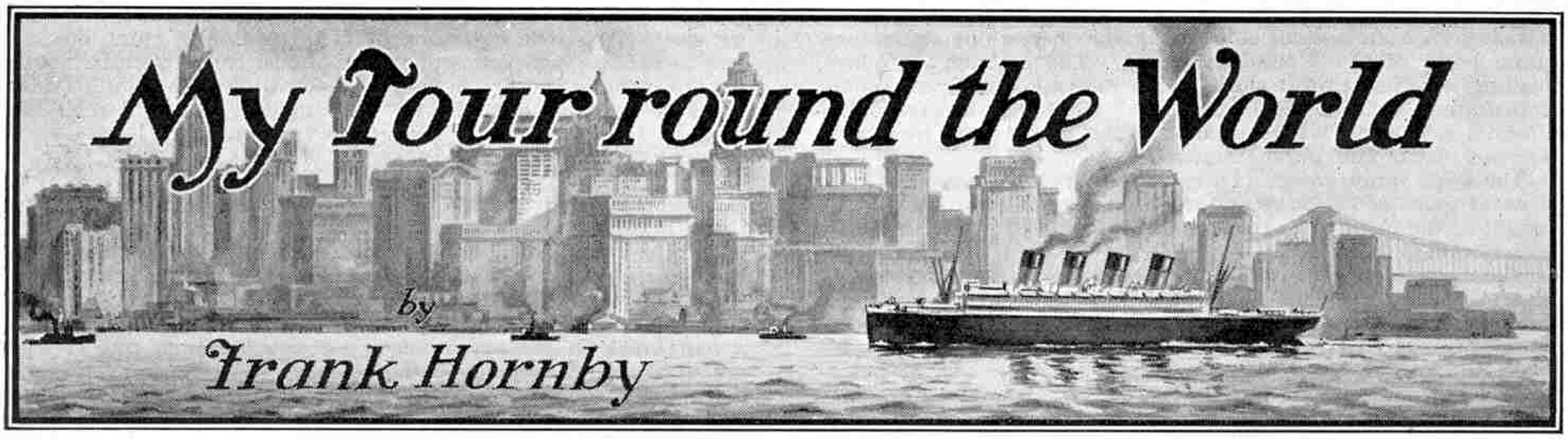
All was now ready for the great Ship Canal to be opened for traffic, and this important event took place on New Year's Day, 1894, with considerable ceremony. A procession of vessels conveying parties of officials and others voyaged up the canal. The advertised starting time was 11 a.m. from Latchford, and at that hour the vessels, many of which had come along from Liverpool for the event, queued up and the procession moved off in slow and stately fashion, the lead being taken by the steam yacht "*Norseman.*" This was followed by "*Snowdrop*" conveying the Manchester Corporation, while on a later yacht were the members of Salford Corporation. The largest vessel to sail up the canal that day was the "*Albatross,*" of 1,450 tons.

The claim to be the first vessel to be registered in the "Port of Manchester" was made by a vessel aptly named the "*Pioneer,*" and owned by the Co-operative Wholesale Society. This ship arrived at the new port on the opening day with a cargo of sugar from Rouen, and forestalled the other arrivals by unloading the same day!

Manchester's history as a cotton port began about a fortnight later when the "*Finsbury,*" a vessel of 1,900 tons, and the largest that up to then had traversed the canal, arrived from Galveston. With a skilled pilot on board and accompanied by a pair of tugs the "*Finsbury*" journeyed from the Eastham locks to her inland destination in about eight hours. Nowadays the canal is frequently navigated by ships of 15,000 tons deadweight.

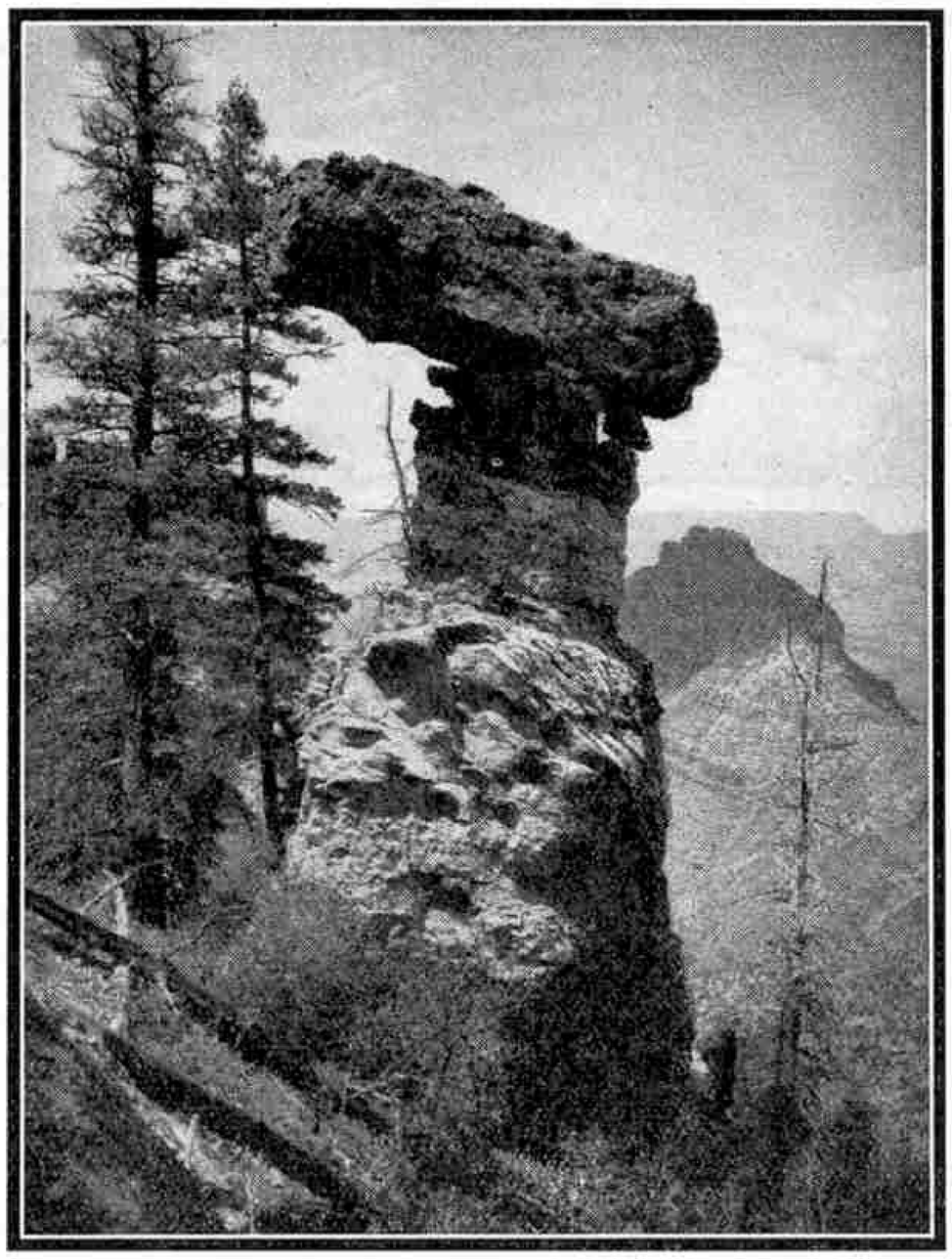
The Ship Canal was opened for traffic on the 1st January 1894, and formally opened by Queen Victoria on 21st May following.

The tonnage of its annual traffic has risen to close upon seven millions and the annual value of its imports and exports, amounting to over £115,000,000, make it the third port in the United Kingdom. It is remarkable that such an eminent position has been attained in the short period of 33 years.



I SUPPOSE every boy with imagination longs and hopes that some time he will be able to make a tour round the world. I know that when I was young I often used to build up pictures in my mind of the visits I should pay at some future time to the land where Red Indians roamed; to strange countries inhabited by folk as different as Eskimos and Zulus; of the time when I should walk through quaint and mysterious Indian temples where everything was of gold studded with emeralds and rubies; sail the high seas in search of pirates—and in fact do all those things which every live boy loves to dream of. Since those rather far-away days I have visited many lands, some of which have exceeded the expectations I had cherished, while others have brought sad disillusionment.

Last year it was my good fortune to be able to plan and carry through a trip round the world and I thought it would be of interest to Meccano boys if I were to tell them something of this great adventure. Leaving home and friends for six months is in itself quite a serious matter and this, of course, was the hard part of the trip. I remember thinking when I set sail from Liverpool that if this great big ocean liner carried none but Meccano boys as passengers what a splendid tour it would make! I then resolved that I would take careful note of all the interesting things that I should see on my tour and tell them to Meccano boys when I got back home.



Thor's Hammer. A striking formation in the Grand Canyon. This enormous rock is perfectly balanced with a long "handle," and some idea of its great size is obtained by comparing it with the figure at the lower right-hand side

I have crossed the Atlantic very many times but I always feel a thrill when I step on board one of the great ocean liners. The bustle and animation; the laughter and tears of the travellers who are saying goodbye to those who have come on board to see them off; the busy porters hurrying the luggage on board; the smell of the newly-painted woodwork and the sound of the throbbing engines—all these make an impression that never afterwards wholly leaves one's mind. It is a relief to hand oneself over for eight whole days to the care of the quiet and attentive stewards who do so much to make life happy and interesting on board ship.

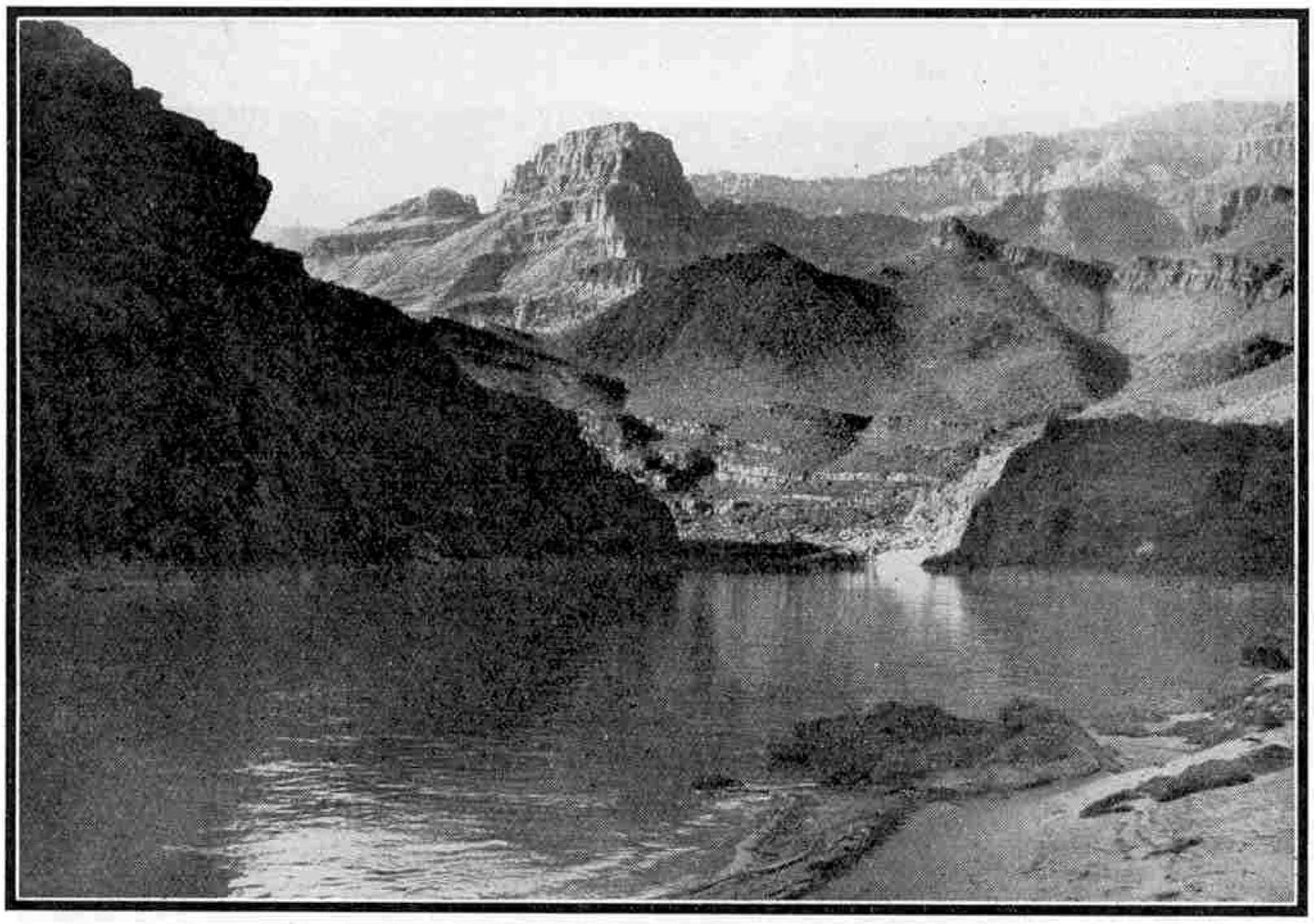
You have all read of what takes place on these voyages—sitting around in deck chairs reading a book or listening to the strains of the ship's band; playing shuffle-board or deck tennis; with dancing and card parties in the evening—so there is no need for me to dwell on this part of my trip except to say that I took my full share in all these activities and inactivities. One meets very charming people on these excursions and we form little parties and stroll along the decks or lean over the side of the ship and watch the waves, catching sight occasionally of a shoal of dolphins or porpoises careering madly along after a shoal of fishes, and on still rarer occasions marking a whale spouting in the distance.

In this manner the days passed pleasantly until finally we approached New York and met our first link with the "other side" in the shape of the pilot boat. It was dark when we arrived and as soon as the pilot boat was sighted the liner's great engines were stopped and the vessel was brought to rest. The pilot boat then manœuvred into a convenient position and the pilot was lowered into a small boat and rowed across to the liner. In spite of the smallness of the distance no chances were taken and as the little boat crossed the intervening water a powerful searchlight was focussed upon it so that any mishap that might possibly occur would be seen immediately. Soon the pilot arrived alongside the liner and ascended its tall side by means of a rope ladder, the searchlight of both liner and pilot boat being directed upon him as he climbed.

In due course we arrived at our landing place and after the usual formalities had been gone through the passengers departed to their various destinations. I remained in New York for about a fortnight, during which time I devoted my attention to the Meccano Factory at Elizabeth, New Jersey, some 12 miles from New York, in order to satisfy myself that every possible

effort was being made to supply the American boy with his Meccano for Christmas. This task concluded, I left New York to visit one of the world's wonders that I had always longed to see—the Grand Canyon of Arizona.

I travelled from New York to Chicago in one of America's most famous trains, the "*Twentieth Century Limited*" of the New York Central line, which works daily over the 798 miles between the two cities in 20 hours. In America the naming of express trains is carried to far greater lengths than it is in the British Isles and almost all the fine long-distance expresses are "Limiteds" of some kind. The "*Twentieth Century Limited*" received its name from the fact that it was introduced on the opening day of the present century. The number of passengers making the journey from New York to Chicago is so great that the train is usually run in four or five sections, each consisting of about a dozen cars having a total weight of some 900 tons.



The Colorado River as seen from the Grand Canyon. Notice the terrace-like formation of the rocks

Although I have travelled by them on many occasions, the American expresses always impress me with their great size in comparison with British trains. The locomotives in particular seem enormous, especially when one stands close beside them. Of course, one has to allow for the general effect of bigness produced by the fact that in America there are practically no platforms at all, so that one views the trains from a much lower level than is the case in the British Isles. One result of this absence of platforms is that passengers stroll across the lines or even walk along the tracks in a manner that seems to me extremely dangerous.

From the British point of view the American locomotives appear ugly. The American locomotive designer pays little attention to appearances so long as he obtains efficiency and he makes no attempt to secure a graceful outline by hiding away moving parts. There is no doubt that the American locomotives are splendidly adapted to their work, however. They are capable of extremely high speeds, and one has only to see the enormous trains that are in everyday operation to realise their vast hauling power. For the first 32½ miles out of New York the "*Twentieth Century Limited*" is hauled by electric locomotives, but from that point onward the whole of the journey is carried out by three 200-ton "Pacifics," one of which accomplishes a through trip of no less than 406 miles.

At Chicago I had to transfer to the Sante Fé Railway in order to reach the Grand Canyon. The development of this railway has been very remarkable. It originated as a line some 50 miles in length connecting the towns of Atchison and Topeka in the State of Kansas, the charter to build which was obtained in 1859. From that time the railway has grown swiftly and steadily until to-day its steel network extends over thousands of miles and stretches across the continent from the Atlantic to the Pacific.

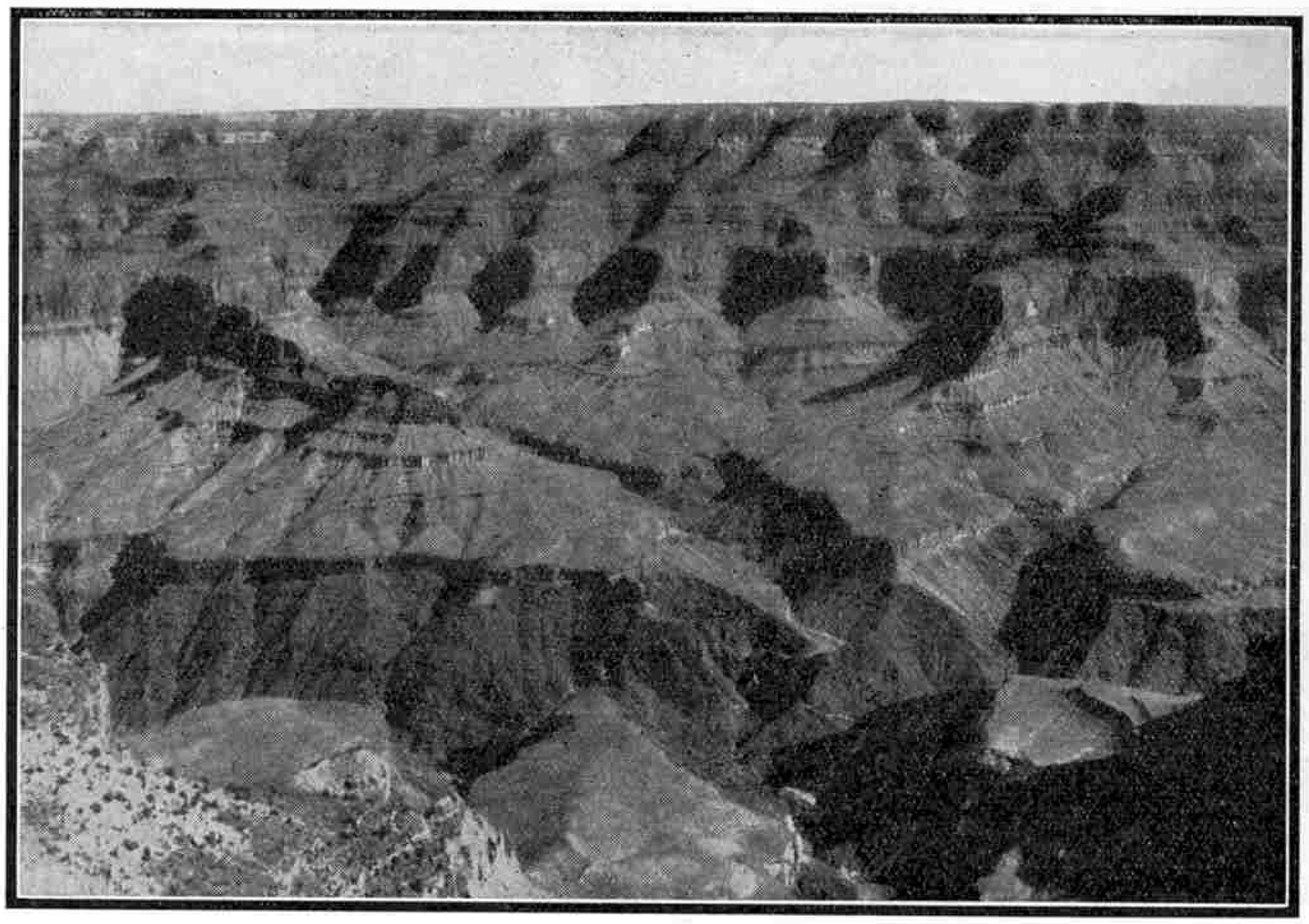
The story of the Santa Fé Railway—or to give it its full title the Atchison, Topeka and Santa Fé Railway—is that of a mighty struggle between the engineers and difficulties of almost every conceivable nature. At the very outset the scheme narrowly escaped disaster. The Federal Government offered to grant the railway 3,000,000 acres of land along the route on condition that the line should reach the Colorado border by the end of 1872. Practically nothing was done until late in 1868, and when work actually began it proceeded so slowly that by the end of the following year less than 30 miles of track had been laid. The construction continued to drag on at the same slow rate and by April, 1872, the line had only advanced some 140 miles from its starting point. Eight months were left in which to earn the Government grant and 360 miles of line remained to be completed! The position appeared hopeless, and so it would have been to any ordinary engineer. A railway-building genius was needed and fortunately he was at hand in the person of Albert A. Robinson.

On the 1st of May, Robinson took charge of operations and by sheer determination, energy and enthusiasm speeded up construction to an almost incredible degree. Day by day the line drew nearer the border, but the year was drawing rapidly on. It was a desperate race between the engineer and the calendar and, urging his men to a final supreme effort, Robinson won. Late on the night of 28th December the Colorado border was crossed; the grant of 3,000,000 acres was saved by three days!

The extension of the Santa Fé Railway westward across the great desert, which stretched for hundreds of miles, was a triumph of skill and organisation on the part of the engineers and of pluck and tenacity on the part of the men who carried out the work. The two greatest dangers were the terrible blizzards in winter and the constant menace of the Indians. The Red Men

seemed to know instinctively that once the railway crossed the prairie their day was over and they resisted its advance incessantly and with the utmost desperation. At one time the attacks of Indians became so daring that troops had to be despatched to protect the railwaymen and the trains. The struggle could have only one conclusion, however, and mile by mile the railway crept forward until ultimately the Pacific was reached.

To return now to my own journey from Chicago to the Grand Canyon. On the first day we passed through vast and apparently endless stretches of pastoral and agricultural land. During the second day the surrounding country became less and less fertile and presently we ran into the rocky and stony wastes of New Mexico. Finally we arrived at the Grand Canyon on the third morning after leaving Chicago.



The Grand Canyon from the plain above

Whenever I visit for the first time some world-famous place about which I have read innumerable descriptions and which is familiar to me through photographs, I always wonder whether my expectations will be realised or whether I shall be disappointed. I experienced this feeling as I approached the rim of the Grand Canyon, and then in a flash all the ideas I had formed were swept away in a gasp of astonishment. I never imagined that such a stupendous gash in the earth could possibly exist! It appears as though mighty hands had literally torn the earth asunder and left a gaping chasm the scars of which had never healed. Yet even as one stands on the rim of this mightiest chasm in the world one can scarcely realise its enormous size. It is over 200 miles in length, and some 12 miles in width, while its almost vertical walls go sheer downward to a depth of a mile.

At the bottom, looking very tiny from such a distance, runs the Colorado River, one of the great water-courses of North America. This mighty river, which is some 2,000 miles in length, has chiselled out for itself from the solid rock an ever-deepening bed. Confined by its granite walls to a width of some 250 ft. or 300 ft., it roars along with a volume and turmoil that equal the Whirlpool Rapids of Niagara.

The early Spanish explorers first reported the Colorado River in 1540, and 36 years later a Spanish priest found a crossing at a place that is known to this day as the "*Vado de los Padres*"—"The Crossing of the Fathers." From that time for nearly a century the Canyon seems to have been visited only by wandering Indians, Mormon herdsmen and trappers. The exploration of this great river was ultimately completed by Major J. W. Powell, a veteran of the American Civil War who subsequently became Director of the United States Geological Survey.

Major Powell started with nine men and four boats from Green River City in Utah in 1869. He launched his flotilla on 24th May and on 30th August landed at the mouth of the Virgin River, more than 1,000 miles from his starting point. The trip was extremely hazardous and cost the lives of four of the party, with the loss of two boats. These hardy adventurers must have been men of extraordinary courage and tenacity. Day after day they faced the unknown at every bend of the river, embarking without hesitation upon swift rapids, knowing that these might terminate in dangerous rocks or great falls.

Underterred by the perils and hardships of this trip, Powell undertook further expeditions during the next three years in order to complete his task.

It is impossible to convey in words any idea of the magnificence of the Grand Canyon. I spent considerable time in driving around it and viewing it from many standpoints and the impression it made upon me will live with me for the rest of my life. I had to tear myself away, however, for my time was limited and there still remained one of the main objects with which I had made my long trip—to visit an Indian Reservation.

The very name "Red Indian" carries with it a certain fascination that never leaves anyone who has revelled in boyhood, as I did, in tales of the Wild West. I had been warned by friends in America that the Indians I should see were not the Indians of the Great Plains of the north and that the days of the war-whoop and war-paint were past. I therefore prepared myself for disillusionment, but as a matter of fact I did not experience this in the slightest degree.

The first reservation I visited was that of the Hopi Indians, situated about 80 miles east of the Grand Canyon. The road lay through the desert of Arizona, with its vast expanses of rough sandy wastes and its rows of fantastically-shaped mountains. I was interested to learn that we were actually travelling over an old Indian trail, and during the trip many other of these trails were pointed out to me and here and there I saw Indians travelling along them on horseback. Whatever these Indians may have lost in other respects they certainly retain their marvellous horsemanship. I had a striking demonstration of this as we approached the Hopi Reservation. Close to the road rose up sharply a remarkably steep hill. As far as I could see there was no pathway of any kind and it seemed to me that the ascent would be impossible to any creature except a mountain goat. Yet to my amazement I saw two Indians on horseback set out up the hill and reach the summit without any apparent difficulty!

I must not forget to mention that during this journey over the desert we passed over a tract of country that was a forest long ages ago but became buried during some far-off period. The trees then buried are now being slowly uncovered by wind and rain and their petrified trunks are exposed to view. In the same district may be seen footmarks of the Dinosaur, a prehistoric reptile that attained a length of 80 ft.! These footmarks, the age of which has been estimated at some three million years, were made by the huge creature when the ground was soft and the impressions subsequently hardened and have been preserved to this day.

On arrival at the Hopi Reservation I found the Indians engaged in farming and cattle-raising. Their women-folk were occupying themselves in weaving on crude frames blankets of remarkable design and quality. The Hopi do not live in the wigwams of which we have read so much, but in strange three-storey houses reached by means of ladders. The first storey is used as a store room, the second is usually the living room, and the roof provides a sort of yard where the occupants may sit in the Sun. This arrangement no doubt developed as a matter of necessity in the old days of constant inter-tribal warfare, and as an additional security the Hopi built their houses on the summits of the table-shaped hills known as "mesas."

The Hopi Indians still preserve their ancient religious traditions and a most extraordinary ceremony that has been carried on for centuries is still observed, namely, the Snake Dance. This dance is held once a year in one of the villages, and is in reality a prayer for rain. Some few days before the ceremony is to take place the Indians set out to hunt for the necessary snakes, the particular species being the rattlesnake, the bite of which is extremely poisonous. As soon as a snake is seen, a pinch of (*Continued on page* 677)

EXPLORING THE ARCTIC

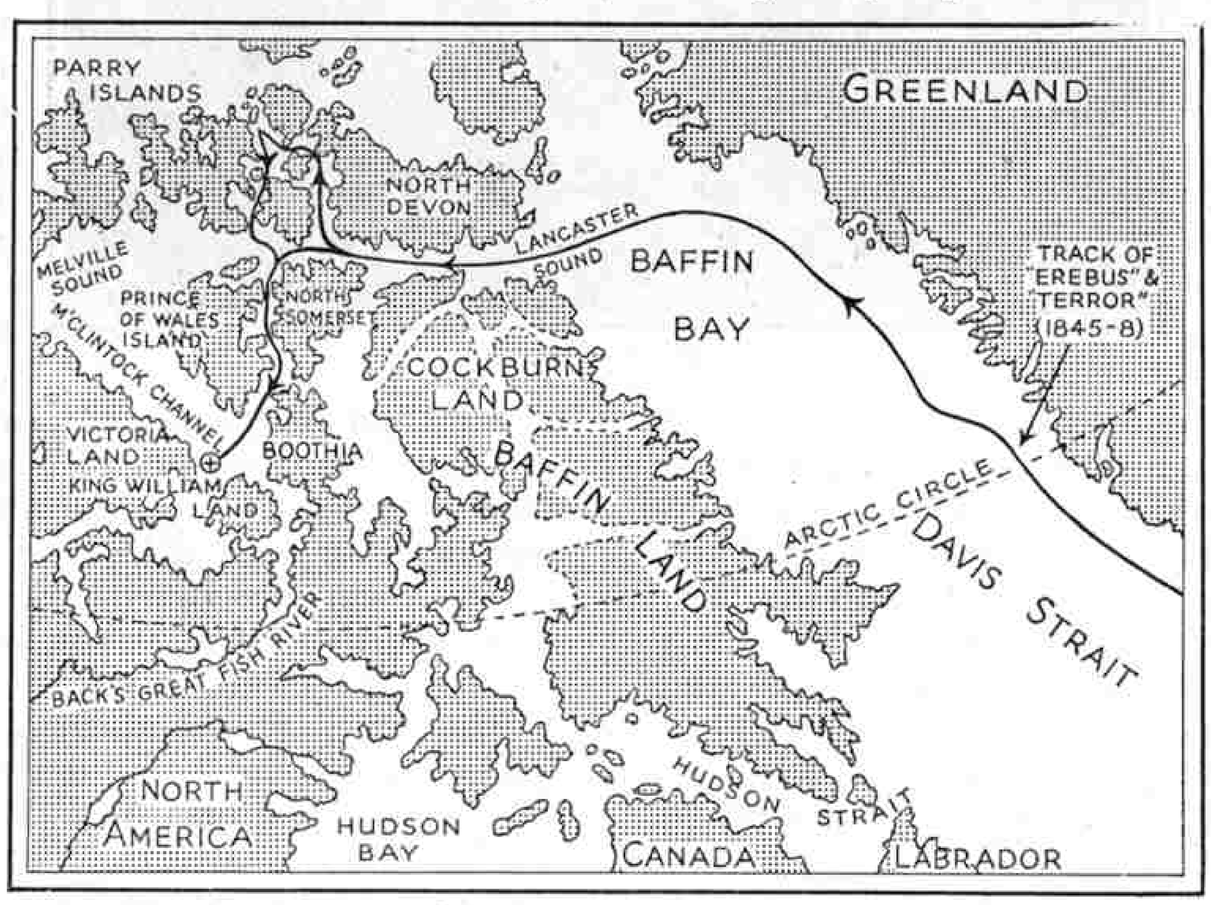
Famous Explorers and their Attempts to Reach the Pole.

XII.—SIR JOHN FRANKLIN

LAST month we read the story of Back's final explorations and now we come to the great tragedy of Arctic exploration—the fate of Sir John Franklin's last expedition. As we have already seen, this famous explorer had been very active in the Arctic, chiefly in conjunction with Back, but he was destined to become even better known, and the mystery of his fate remained an unsolved problem for many years.

The name of Franklin, in fact, dominates the annals of polar exploration for many years in the middle of last century, not only because of his own extensive and valuable work, but also because of the extraordinary efforts that were made to find him when he failed to return from the expedition we now have to consider.

John Franklin was born at Spilsbury, Lincolnshire, on 16th April, 1786. He was the youngest son of a family of 10 and was intended for a clergyman, although his boyish ambition was to go to sea. His desire was strengthened by a voyage to Lisbon at the age of 13, on which his father had sent him in the hope that the experience would discourage him, and finally he joined the navy as a volunteer.



Map showing route followed by Franklin on his last voyage to the Arctic

He was then only 14 years of age, but soon saw active service in all parts of the world and was present at the Battle of Copenhagen. A month later he became a midshipman on the "*Investigator*," an old vessel that was about to set out on a voyage of discovery to Australia, or New Holland, as it was then called. The ship, which was under the command of Matthew Flinders—a relative of the Franklin family, who had already made his mark as a navigator and explorer—sailed on 18th July, 1801, and Franklin did not see England again until 1804. In the interval he sailed round the coast of Australia, suffered shipwreck and many hardships and finally had the good fortune to be present at one of the most extraordinary battles ever seen—it could scarcely be said to have been fought, as we shall see. On reaching Canton on his way home he joined a squadron of East Indiamen that was just about to sail for England under the command of Commodore Dance. War was in progress between France and England and consequently these merchantmen were painted in imitation of warships and carried light guns for defence.

When the convoy was entering the Straits of Malacca, vessels were seen which proved to be heavily armed French men-of-war. Dance prepared to make a fight of it in spite of the disparity in armament, and his bold attitude caused the French Admiral to hesitate and finally to postpone his attack until morning. Instead of escaping during the night the British fleet stood by and next morning threatened the French with such good effect that the latter imagined they had to deal with a superior fighting fleet and turned to escape. With sublime impudence Dance hoisted the signal for a chase and for two hours the astonishing spectacle was seen of 16 English merchantmen in hot pursuit of a French squadron of war vessels. In this famous action Franklin performed the important duty of signal midshipman.

On arriving home after his adventurous voyage Franklin was appointed signal officer of the "*Bellerophon*," in which vessel he was present at Trafalgar. Over 300 men were killed or wounded on board his ship in the great fight, but Franklin escaped without injury, although he was on deck during the whole of the engagement.

Later he was engaged in important but less spectacular duties, spending two years, for instance, in the dreary task of assisting in the blockade of Flushing and Texel. He saw service also in South American waters and in the unfortunate expedition against New Orleans in 1814, being slightly wounded in the latter during a boat attack upon some American gunboats.

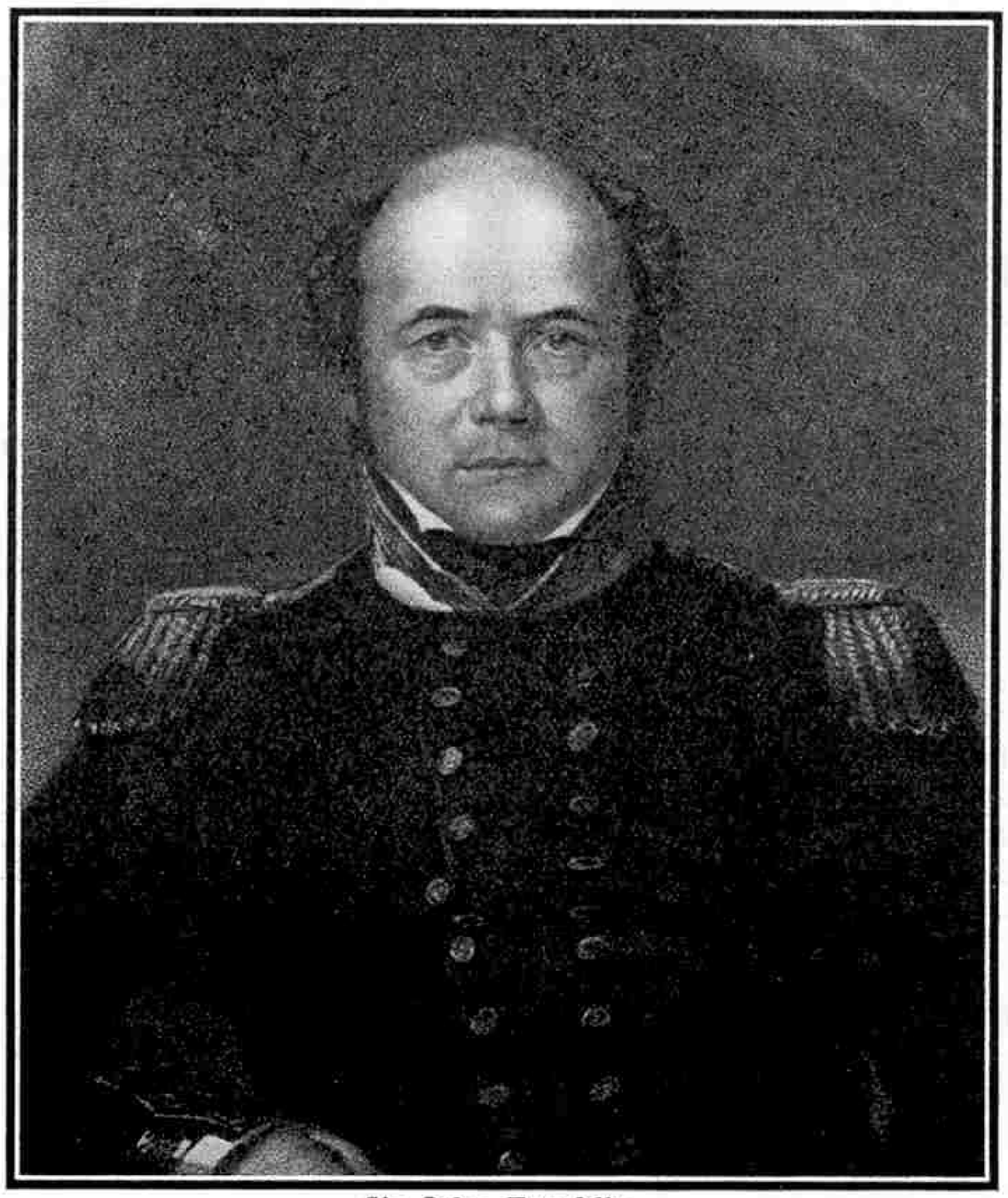
In 1818, at the age of 32, he had fought in two great

naval engagements and many minor ones and had taken part in an important voyage of exploration to Australia. Then he turned his attention to the Arctic, being chosen commander of the "*Trent*" to accompany another vessel, the "*Dorothea*," in a voyage to the north between Spitsbergen and Greenland. During this voyage he had many adventures, encountering danger from gales, walrus fights, and icebergs. The ships were so badly damaged that they had to be temporarily repaired at Fairhaven, before the voyage home could be undertaken. Again in 1819 Franklin made his first land journey to explore the Hudson Bay coast, and, with his party of Indian guides and hunters, had an exciting time with many adventures. In 1825 he was off again to survey the northern coast of America, this time taking with him a small portable boat, the canvas of which was "waterproofed by Mr. Macintosh of Glasgow, and also macintosh coats and overalls made under the newly-patented process."

The story of these journeys has already been told in full in these pages in the account given of the adventures of the indomitable Back, who was very closely associated with Franklin in the expeditions to the Arctic coast of Canada. While Back continued his work in this region Franklin led a somewhat disappointing life at home. He received many honours on returning home after his journeys, including a knighthood conferred upon him in 1819. Later he accepted the Governorship of Tasmania, where he spent seven years, during which he carried out his duties with a firmness and courage that aroused some opposition. In 1844 his advice and assistance were asked by the naval authorities in the preparations for yet another Arctic expedition. Although Franklin was by this time 59 years of age, he felt perfectly fit and immediately applied for the command of the new venture. His application was backed by the Royal Society and he was appointed to the command he so earnestly desired.

In 1845, therefore, Franklin sailed on what was to be his last expedition. His ships were the "*Erebus*" and "*Terror*," two vessels with specially strengthened hulls, recently engaged on a voyage of exploration in the Antarctic under Sir J. C. Ross, in the course of which they had touched at Tasmania while Sir John was Governor. Both were fitted with screw propellers and engines of 50 h.p., so that for the first time in the history of Arctic exploration a screw was used as an auxiliary to sail. Sir John himself commanded the "*Erebus*," while the "*Terror*" was in the charge of Captain Crozier, who had commanded the ship during its Antarctic voyage a few years before.

The aim of the expedition was the discovery of the north-west passage, the quest for which had been the cause of most of the explorations carried on in the Arctic. It was Franklin's intention to follow Parry's route through Lancaster Sound and Barrow Straits and then to turn south west in the endeavour to find a direct route to the Bering Sea.



Sir John Franklin

The expedition sailed on 24th May, 1845, and reached Disco Bay on the west coast of Greenland at the beginning of July. Here Franklin wrote home—the last letter that was sent by him to his wife—and after embarking stores the ships continued. A whaler in Melville Bay sighted them 12 days later and after that they disappeared into the Arctic, from which they were never to return.

As time went on without anything being heard of them anxiety began to be felt in England, and in 1848 a search expedition was despatched. Arrangements had been made previously with the Hudson Bay Company for large supplies to be sent overland to the Arctic coast on the chance of the explorers having been forced to abandon their ships and make for the mainland. These two efforts were the beginning of a long series of search expeditions, no fewer than 38 being sent out between 1848 and 1859.

The wonderful story of the discoveries made and the hardships endured by the members of these expeditions will be fully related in later articles in this series. We are now concerned with the history of Franklin's own expedition so far as it can be told from the clues found during the great search.

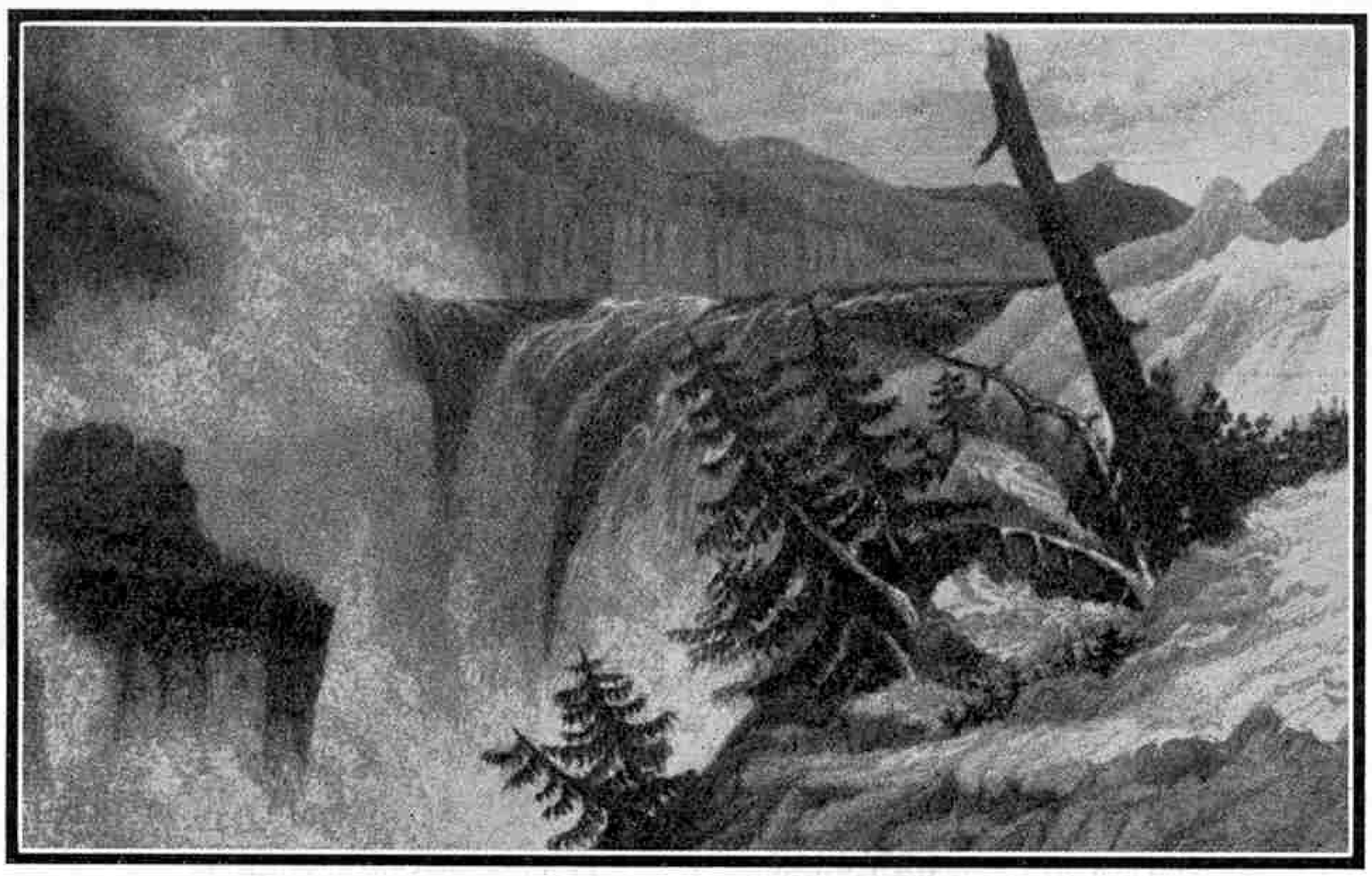
The first definite indication of the fate of the explorers was obtained by Dr. John Rae, then a surgeon in the service of the Hudson Bay Company. Rae made several notable Arctic journeys, including one down the Mackenzie River under the leadership of Sir John Richardson, this being one of the efforts of the great search. In 1853 he set out on an expedition to the mouth of the Great Fish River on behalf of the Hudson Bay Company, in the course of which he proved King William Land to be an island. Information given to him by a party of Eskimos led to the discovery of various relics of the unfortunate explorers and finally to the discovery of several bodies that were only too obviously those of some of Franklin's men.

Facsimile of Franklin's signature

Rae's discovery ended the search so far as the Government was concerned for now there was no doubt whatever that all had perished. Lady Franklin was

determined to probe the mystery of her husband's death, however, and on her behalf M'Clintock, already well-known as an Arctic explorer, went north with the steam yacht "*Fox*." Winter quarters were established at the head of the Boothia Peninsula and a series of extensive sledge journeys resulted in the discovery of other relics of Franklin's expedition and finally of records that revealed the whole story as far as it will ever be known.

It was found that Franklin's ships had passed through Lancaster Sound but were unable to penetrate the ice in Barrow Straits. Other endeavours to find a passage to the west did not succeed before the end of the summer and the expedition was forced to winter on Beechey Island. In the following summer the ships proceeded through Barrow Straits and discovered a channel leading south, to which the name Peel Sound is now given. Passing through this and the succeeding straits now known as Franklin Straits they came to the icy region between Boothia Peninsula and Victoria Land. Progress was difficult and finally the ships were frozen in twelve miles from King William Land.



The Parry Falls on the Great Fish River, discovered by Captain Back, as described in last month's "*M.M.*"

From the grip of the ice they were never set free. Sledge parties explored the surroundings and one of them left a record of the expedition at Point Victoria in King William Land in a cairn that was discovered by one of M'Clintock's officers in 1859. In this way was obtained the first authentic news of the expedition that had been lost since 1845.

While wintering here Sir John Franklin died on 18th June, 1847, probably worn out by the anxieties of the situation. He was buried in the icy waters, the scene being reproduced on the bas-relief beneath his statue in Waterloo Place in London. It is quite possible that before his death he had heard that one of the sledge parties had reached the Simpson Straits discovered from the west some years before, so he would know that the object of the expedition had been accomplished and a possible north west passage found.

It is interesting to know that in 1903 Amundsen successfully accomplished the journey from the Atlantic to the Pacific by Franklin's route, except that he passed down the eastern side of King William's Land. That a channel existed there was unknown to Franklin, for when he left England it was thought that King William Land joined on to Boothia. Rae only discovered the straits named after him in 1854.

The expedition was now under the command of Captain Crozier. Food was becoming scarce and scurvy had attacked the men, nine officers and fifteen men having already died. He resolved to abandon the ships after every effort to free them had failed and the survivors, 105 in all, made for the Great Fish River. The long journey that followed with overloaded sledges was too much for the exhausted men and all perished. In the words of an old Eskimo who saw them they "fell and died as they walked along the ice."

Thus ended the expedition of 1845, and at the same time a new era in Arctic exploration began. The intensive search that was made, at first for possible survivors and later for relics and news of the ill-fated explorers, led to a wide extension of our knowledge of the Arctic regions. During the following ten years some 40 expeditions were sent out in the endeavour to find Franklin and the members of his crew and it is a curious illustration of how good may come from evil, that as a result of Franklin's death and the subsequent searches, more was learned of the Arctic than was learned by all previous expeditions.

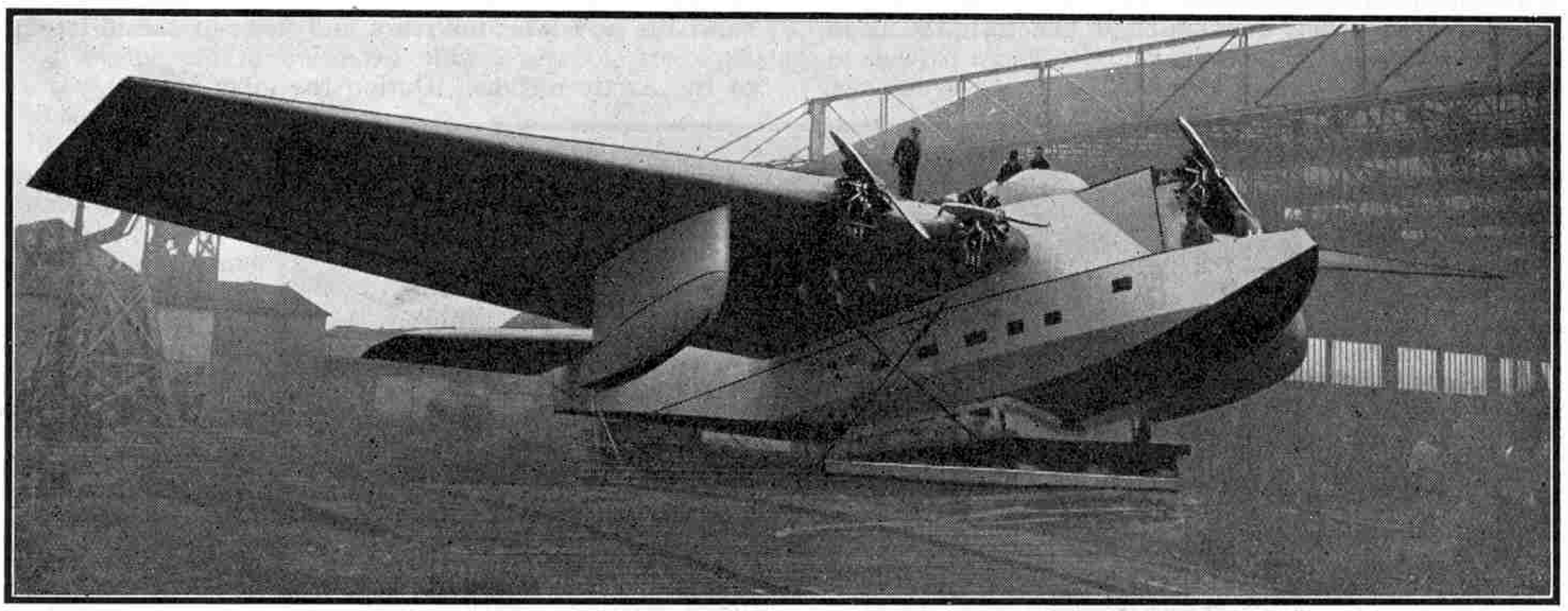
An interesting example of this was the discovery that Smith Sound was a highway to the north. This Sound was discovered by the famous William Baffin in 1616 at the head of the great Bay known by his name and until 1852 was thought to be a bay. In that year Lady Franklin sent out the "*Isabel*" under Commander Inglefield with instructions to search for her husband at the head of Baffin's Bay. This explorer steamed up the Sound finding open water for more than 100 miles, the ice stopping further progress. His search for traces of Franklin was, of course, fruitless.

The following year Dr. Elisha Kane followed in Inglefield's track, ostensibly in continuation of the search, but really with the Pole as his object. He discovered that the Sound opened out into a wide sea ending in another narrow channel, beyond which a member of his expedition claimed to have seen open sea with the midnight sun dipping in its waters on Midsummer Day, a "discovery" verified by Hayes in 1861! Several later attempts were made to penetrate into the alleged open water, which proved to be non-existent. The further explorations in this direction led ultimately to the mapping of the north coasts of Greenland and Ellesmere Land, from which Peary set out on the memorable sledge journey which ended in his attaining the Pole.

The conditions of the Franklin search were also responsible for a wide extension of sledge travelling, a method that was used to such an extent that no fewer than 8,558 miles were covered in 1852 by search parties among the Parry Islands.

The Conquest of the Air

XXVII.—The "Richard-Penhoet" Flying Boat



ONE of the most recent entries into the field of aircraft construction is that of the Chantiers et Ateliers de St. Nazaire (Penhoet), one of the largest shipbuilding firms in France. This firm, which was responsible for the construction of such well-known ocean liners as the "*France*," "*Paris*" and the new "*Ile de France*," has recently organised an aeronautical department under the control of M. Richard.

The principal machine to be constructed so far is a five-engined sea-going flying boat, known as the "*Richard-Penhoet*," which was launched last summer and has since been undergoing tests. The machine incorporates several extremely novel devices that may have to be modified to suit actual flying conditions, but on the whole the trials have been very satisfactory.

In the early tests a maximum load of 18 tons—of which five are termed "useful"—was carried, and a speed of 97½ miles per hour attained at sea level. The machine's unloaded weight is approximately 13 tons. The great capacity for weight-lifting revealed in the test appears to fit the machine particularly for long range transport work, but the present equipment is for "general purposes," permitting a speedy adaptation to the special requirements of either commercial or military operation. The designer aimed particularly to produce a machine capable of making direct trans-Atlantic flights.

Our illustrations give a good impression of the design and size of the machine, which is a thick wing, cantilever, monoplane type of flying boat. The wing spread is 130 ft. from tip to tip, the greatest width of the wings being 29 ft. 3 in., while the greatest depth is 6 ft.

The longitudinal connections of the wings are of wood, re-inforced with a special high-tensile steel, and the transverse connections are of the same metal. The hull is 87 ft. 9 in. in length and 13 ft. in width and in depth. Its construction throughout is of wood and there are two decks, in the upper of which, close to the leading edge of the wings, is placed the pilot's cockpit.

Five 420 h.p. Gnôme-Rhône-Jupiter engines are fitted to the seaplane, the huge dimensions of which are emphasised by the toy-like appearance of the engines in their mounting on the wings. It was the size of the "*Richard-Penhoet*" that prevented it from being shown in the Grand Palais at the recent French Aero Show, and an enormous photograph of the machine, 123 ft. 6 in. in length by 26 ft. in height, was exhibited instead. It is an interesting fact that nearly 50 per cent. of the machines shown in that exhibition were fitted with the British-designed Bristol Jupiter engine, made under license by the Gnôme et Rhône Company.

This remarkable preponderance of Jupiter engines in a show organised by a country noted for engineering skill is best explained by reference to a speech made in the French Chamber of Deputies by the Minister of War who, after placing large orders for Jupiter engines

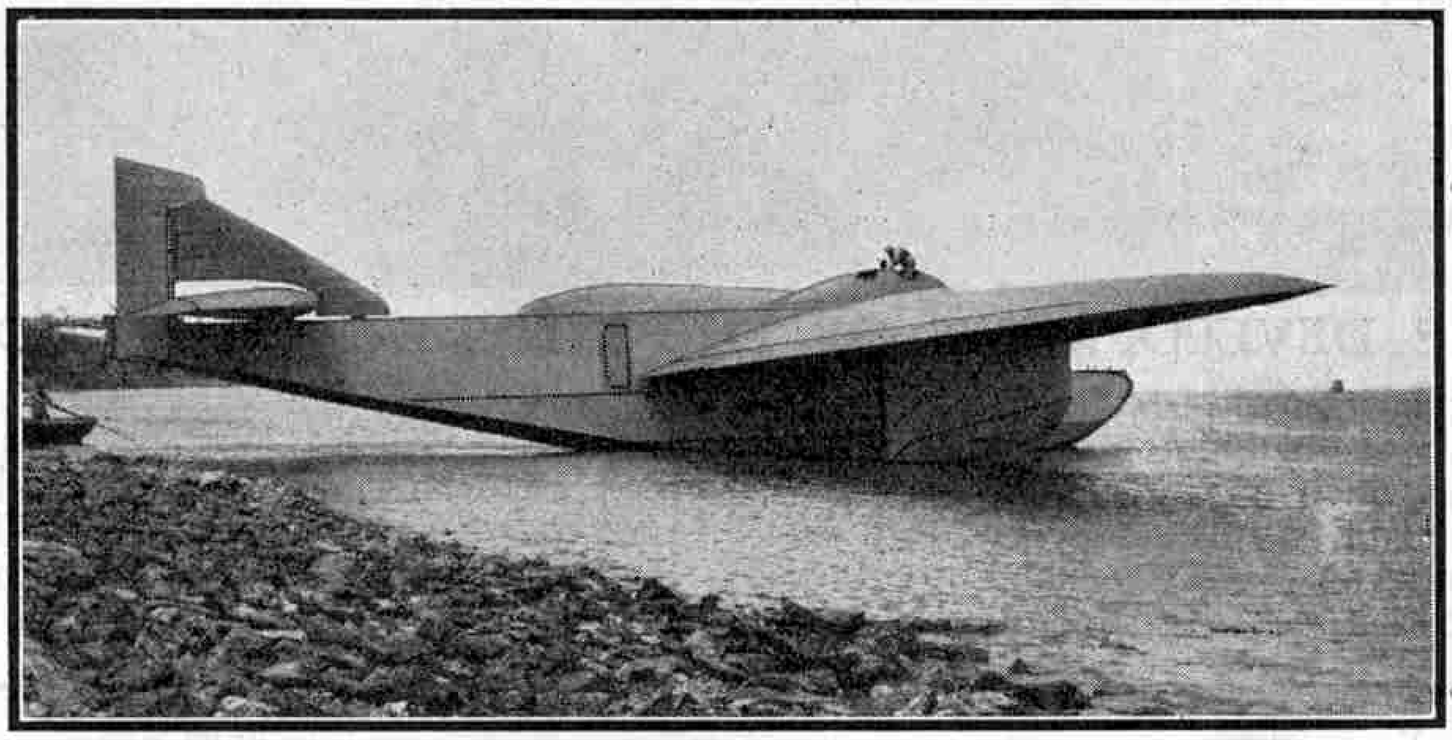
Previous articles in this series :—

1.	The Lympne Trial for Light Monoplanes	Mar.	1925
2.	Beardmore "Wee Bee I."	Apl.	,,
3.	Super-Seaplanes for U.S. Navy	May	,,
4.	Airman's Attempt to Circle the Earth ...	June	,,
5.	Parnall "Pixie III."	July	,,
6.	De Havilland "Moth"	Aug.	,,
7.	Beardmore-Rohrbach Flying Boat ...	Oct.	,,
8.	Fokker C.V. Scout	Nov.	,,
9.	Vickers "Vimy" Ambulance	Dec.	,,
10.	The Cierva Auto-Giro Flying Machine ...	Jan.	1926
11.	Boulton "Bugle"	Feb.	,,
12.	The Flight from London to the Cape ...	Mar.	,,
13.	Light Aeroplane Clubs	Apl.	,,
14.	D.H. 54 (de Havilland) "Highclere" ...	May	,,
15.	Vickers (Rolls-Royce) "Vanguard" ...	June	,,
16.	De Havilland "Hercules"	Aug.	,,
17.	Handley Page "Hampstead"	Sept.	,,
18.	The Gloster "Gamecock"	Oct.	,,
19.	The Parnall "Plover"	Nov.	,,
20.	Sir Alan Cobham's Flight to Australia	Dec.	,,
21.	"Southampton" Supermarine Flying Boat	Jan.	1927
22.	Cairo—Karachi Air Route	Feb.	,,
23.	Two Famous French Aeroplanes ...	Mar.	,,
24.	A Tail-less Monoplane	Apl.	,,
25.	The Blackburn "Velos" Torpedo-Plane	May	,,
26.	The Blackburn "Cubaroo"	July	,,

for French military machines, was called upon to defend his action. In the course of his remarks he said that 50 per cent. of the fighting units of the British R.A.F. were fitted with air-cooled engines, whereas the only really efficient engine of that type manufactured in France was the Jupiter made under British license.

The Jupiters fitted to the Penhoet machine are of the Mark VI. type, with nine radial air-cooled cylinders, $5\frac{3}{4}$ in. in diameter with a stroke of $7\frac{1}{2}$ in. The normal engine speed is 1,700 r.p.m., at which 425 h.p. is developed, and the declared maximum is 1,870 r.p.m. with a developed h.p. ranging up to 465. Over the same range of revolutions the petrol consumption rises from 24 gallons per hour at 1,700 to 29 gallons at 1,870. The weight of each engine fitted to the Penhoet is 724 lb. The power/weight fact is a great asset for with a total power of about 2,200 h.p. the total weight of the engines is little more than 3,600 lb. in all.

In addition to this the necessity for inspection of the Jupiter engine at very infrequent intervals also, without doubt, influenced the choice of this power unit. The whole of the parts are easily accessible and overhaul is a simple matter. As an instance of this the *Hampstead* three-engined commercial aircraft operated by Imperial Airways may be cited. This machine was run for 250 hours without any attention whatever being called for upon any of the engines. When these were submitted to overhaul they were found to be in perfect condition ; the cost of replacements was negligible and amounted to no more than a few shillings per engine. With five engines in service it would be impossible to contemplate the use of any other than an engine that has proved itself capable of running for long periods without overhaul as the difficulties of keeping the machine in service would have been considerable. As the Jupiters are aircooled the whole of the difficulties which would have been incurred in connection with the provision of an efficient water-cooling system for the engines has been avoided. The weight of the necessary radiators, piping and water must have totalled to a considerable amount and the saving thus effected has been added to the paying load of the machine. This is following a tendency very noticeable in French construction at the present time, namely, the fitting of multi-engined machines with aircooled engines in order to gain the greatest possible advantage in regard to the carrying of the maximum military or revenue paying load.



The "*Richard-Penhoet*" about to take off

The development of the Jupiter engine is one of the greatest romances of the British aircraft industry. In the early experiments the results were often disheartening. Eight distinct types of cylinder were used before the right one was discovered and even that would not function successfully for more than two consecutive hours in an experimental single-cylinder unit. From that first engine to those fitted to the *Hampstead* and *Penhoet* machines is a far cry but the record itself supplies the answer to any question challenging the right of the British designed Jupiter to its great triumph in the French Show.

The Chantiers de Penhoet also exhibited a model of a catapult apparatus for launching seaplanes. This is operated by compressed air and consists of a runway, 65 ft. in length, along which runs the carriage supporting the seaplane. A speed of nearly 48 m.p.h. is attained in this short run and the impetus is sufficient to send a machine off in full flight in absolute safety and without any degree of shock to the pilot. The braking gear that checks the carriage at the end of the runway also is operated by compressed air.

The complete apparatus is mounted on a pivot and can be rotated freely. This feature is of course of prime importance in naval operations for it makes it possible to launch the machine at any time without regard to the direction being taken by the ship upon which the catapult is mounted. Each of the new 10,000-ton cruisers now being built for the French Navy is to be equipped with this apparatus.

Tour Round the World—(*cont. from page 672*)

sacred meal is cast upon it and a prayer addressed to it, after which a stick with two long feathers at the end is waved slowly over it. As the reptile coils it is seized and placed in a sack.

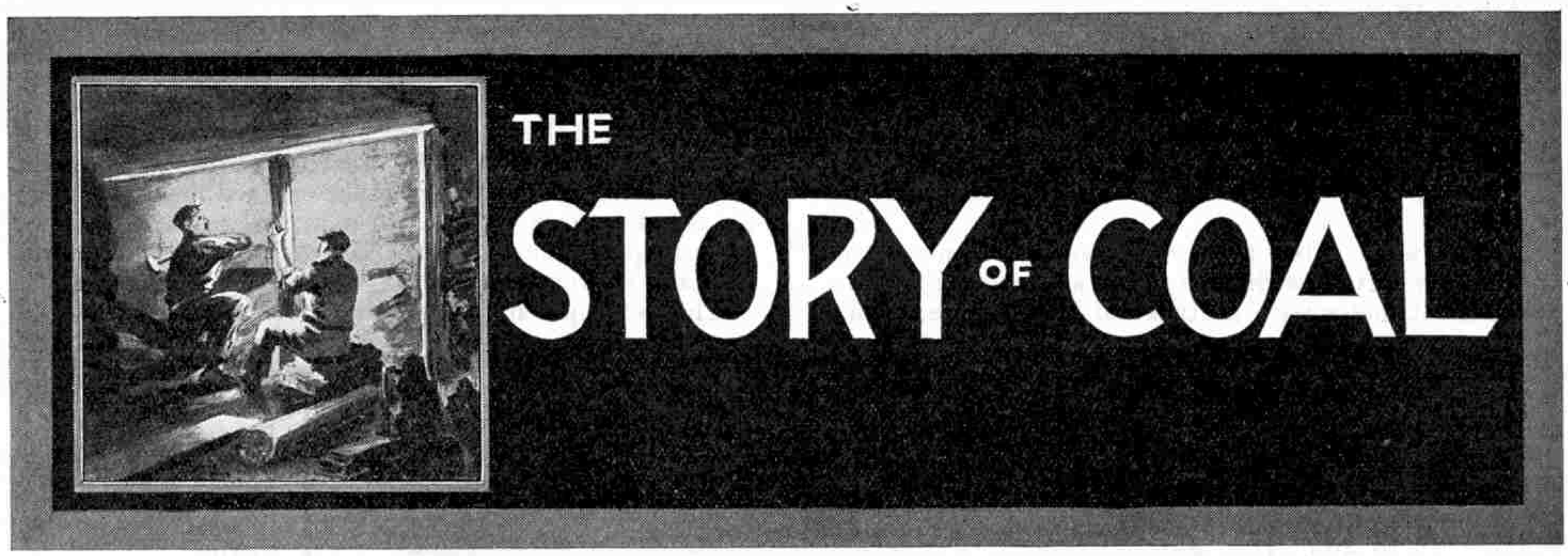
The captured snakes are eventually placed in jars and on the ninth day they are bathed in sacred water. As the creatures glide about seeking a way of escape they are driven back with feather whips. At sundown they are taken to the place where the ceremony is to be held and, amidst singing and dancing, a priest takes a snake in his mouth, while others divert its attention by brandishing a whip of feathers. When the dance is over the snakes are set free. It is remarkable that very few of the priests ever suffer from the bites of the snakes, and no doubt this is due to the fact that they have become accustomed to handling the reptiles.

Subsequently I visited the Navajo Reservation. This is one of the largest Indian Reservations in the United States, and I was particularly interested to learn that this tribe, so far from dying out, was steadily increasing in numbers. To my mind the Navajo resemble the Indians of my boyhood dreams more closely than the Hopi. Unlike the latter, they have no fixed place of abode. They are mostly shepherds and they wander from place to place to find new grazing grounds for their flocks. Their dwellings are of the simplest character and even in winter consist of nothing more solid than a rough hut of trees trunks with a covering of grass and earth.

The Navajo does not allow removal day to cause him any worry or inconvenience. When the time comes to move he simply collects such of his belongings as are worth taking, fixes them on a "*travois*"—the old tent-pole trailing arrangement so familiar in illustrations of Indian stories—springs on his pony and trots away.

Rather to my disappointment I did not see any Apache Indians, the very thought of whom used to give me cold shivers at night when, as a very small boy, I crept upstairs after reading a hair-raising story of an Indian raid with a full allowance of war-whoops and scalpings !

After visiting the Reservations I returned to the Grand Canyon and subsequently proceeded to San Francisco, where I took steamer for Japan.



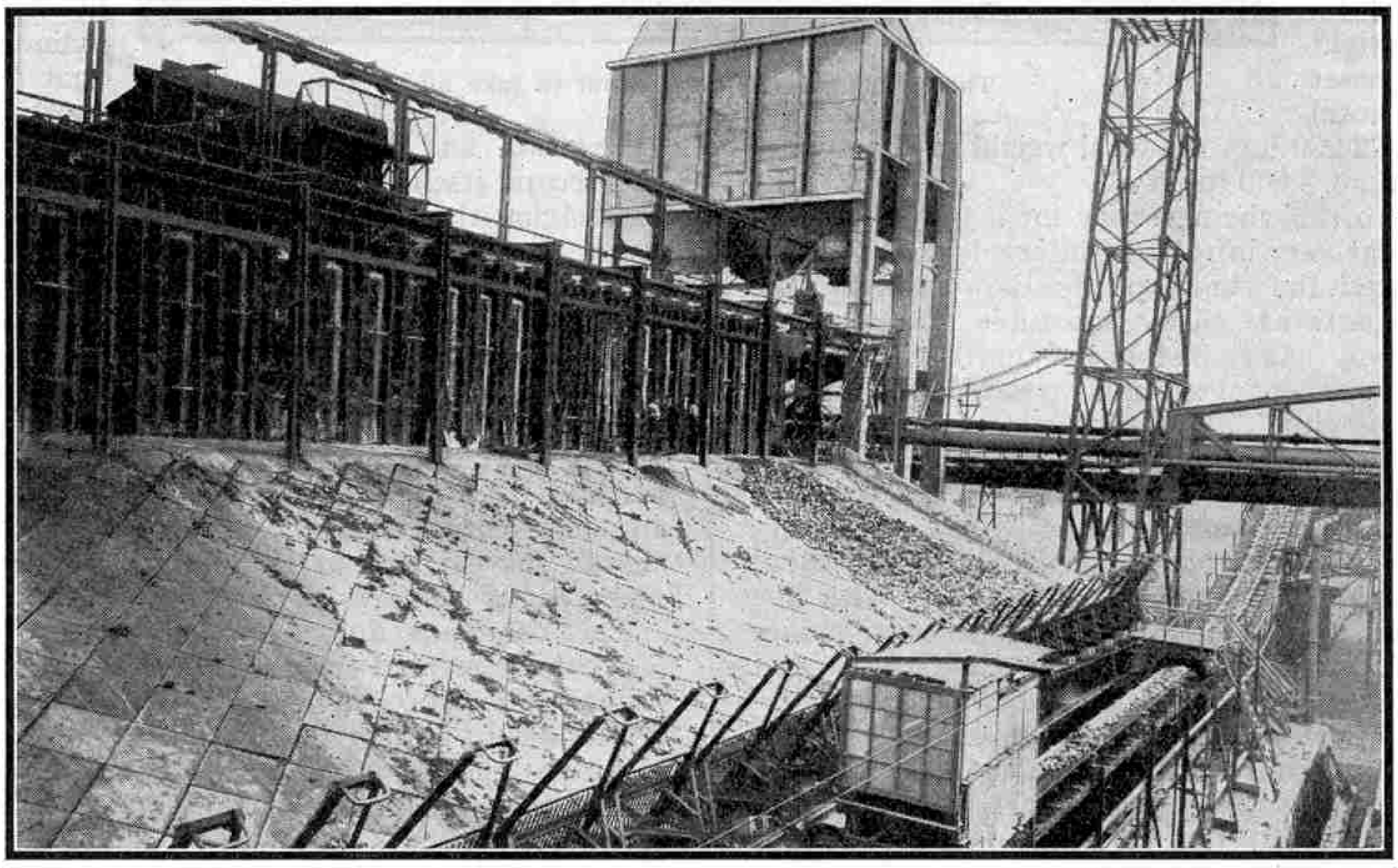
VII.—THE DEVELOPMENT OF THE SYNTHETIC DYE INDUSTRY

IN last month's article in this series the modern economical method of distilling coal was described up to the stage at which the benzol are obtained from the gases. We must now turn our attention to the tar, the highly important and valuable material that is separated out in the earlier stages of the process. This is distilled separately and the methods used are applied in the same way to ordinary gasworks tar.

The distillation is usually carried out in large iron stills that hold from five to 20 tons of tar. They have usually a concave bottom so as to give a larger heating surface, and in the later stages of the heating steam is blown through the thick residue to assist in the prevention of coking in the still at the high temperature reached. After the volatile oils have been distilled off, the residue of pitch is run out of the still while warm. Continuous systems of tar distillation have been suggested but this intermittent process is the one mainly used as yet. An illustration of a battery of stills appeared on page 591 in last month's *"M.M."*

Chemical Separation of Tar Products Impossible

The chief interest centres, of course, in the products of distillation. The many substances that distil out of the tar cannot be easily and definitely separated by any ordinary means. Some of them resemble each other very closely. Benzene and toluene, for instance, both important liquid hydrocarbons that are distilled from the tar, behave in practically the same way towards chemical reagents. It is therefore impossible to separate them by a chemical method such as that used to separate the ammonia gas from these substances in the earlier stages of the "direct recovery" process. It will be remembered that the ammonia combines with sulphuric acid and is retained in the separator in the form of ammonium sulphate. Benzene, toluene and similar substances do not combine with the acid under these conditions, and therefore pass on with the gases.



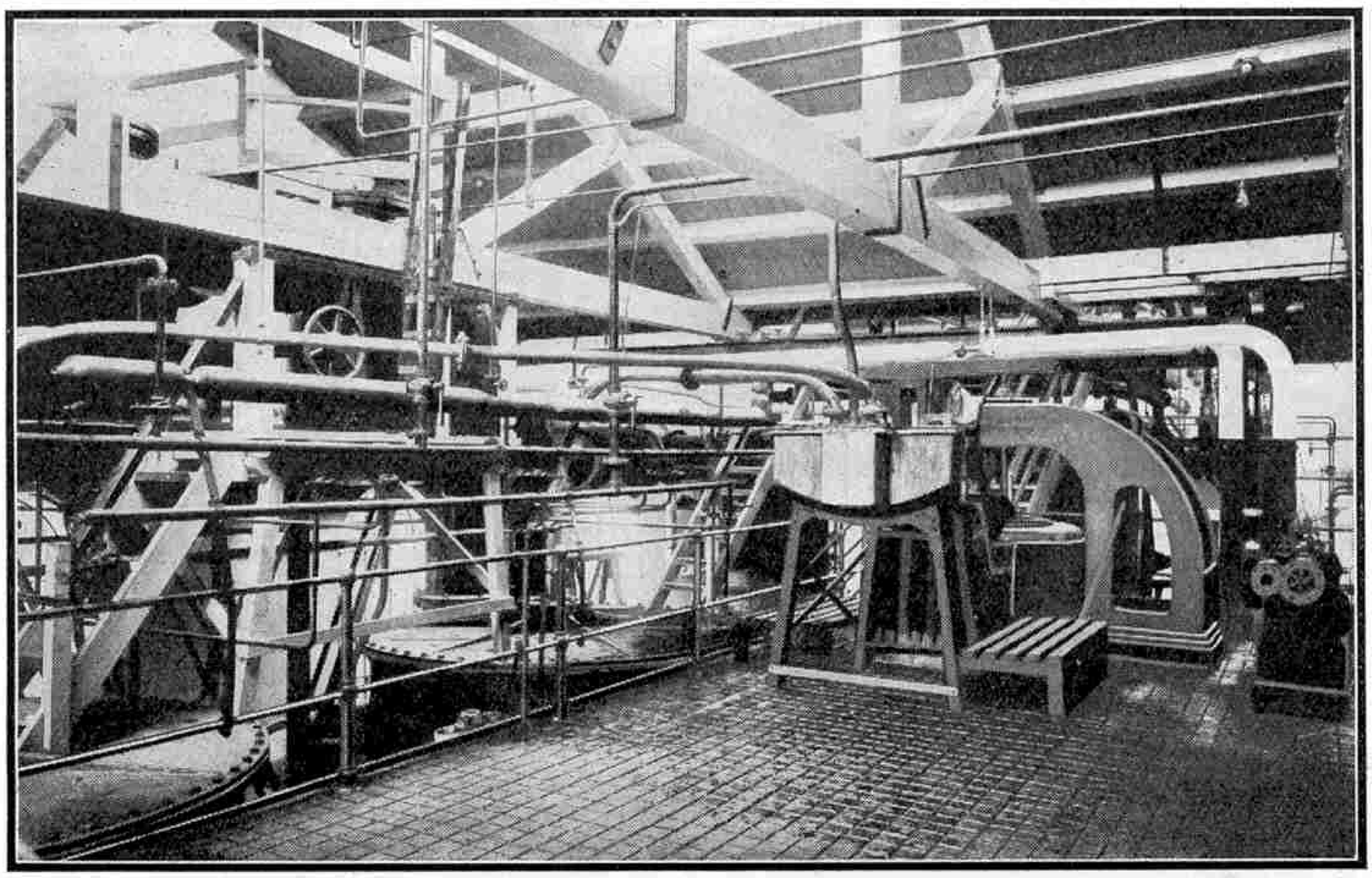
Courtesy [*Fraser and Chalmers Engineering Works*

The coke bench side of a battery of coke ovens. The coke is pushed out of the oven by the electric ram and is here quenched and discharged on to a belt conveyor

In these circumstances it is necessary to make use of a method known as fractional distillation. Toluene boils at 110°C., benzene at 80°C. If a mixture of the two in equal quantities is distilled and a thermometer kept in the vapour of the boiling mixture it is found that the temperature of the vapour as indicated by the thermometer rises quickly to about 80°C. when the mixture begins to boil, and then rises slowly and continuously. If the receiver for the condensed vapour, or distillate, is changed when the thermometer in the vapour registers 90°C., and again at 100°C., it is found that of the three fractions of the distillate the one

condensed below 90°C. contains a greater proportion of benzene than the original mixture, while the third fraction has a greater proportion of toluene. The middle fraction contains both, but is less in bulk than the first and third fractions.

On repeating this process several times, and increasing the number of fractions by restricting the temperature range for each, the liquid is gradually separated into two large fractions consisting chiefly of benzene and toluene, together with a number of smaller intermediate fractions.



Courtesy] [*Koppers Coke-Oven Co. Ltd.*

The Sulphate draining and drying plant. The centrifugal drier is on the right

The process is carried on more efficiently if a "fractionating column" is used. On a small scale this may take the form of a long glass tube filled with glass beads or containing some other obstruction such as a number of perforated discs. This is fitted vertically over the vessel containing the substance to be distilled in such a manner that the vapour must pass up it before entering the condenser, the thermometer being at the top. The vapour passing on to be condensed from the top of one of these columns is mainly that of the more volatile constituent, the vapour of the other being largely condensed and returned. The same principle is followed on the manufacturing scale, the stills and fractionating columns being usually in the form of cylindrical towers with perforated shelves at intervals.

The meaning of the term fractional distillation will now be apparent. It is not possible to separate two such liquids as benzene and toluene completely by this method except by repeated applications of the process, and the difficulty is still greater with such an enormously complicated mixture as coal tar. Fractionation, however, is the only possible method by which the tar can be treated.

Fractional Distillation on Large Scale

Practice varies slightly, but in general the distillate from the tar is divided into the following four portions :—

	Temperature Range
Light Oil and Water ...	... to 170°C.
Middle Oil	... 170°C. ,, 230°C.
Heavy Oil	... 230°C. ,, 270°C.
Anthracene Oil ...	... 270°C. and over

For convenience temperature is not used for deciding when to change the receiver on a manufacturing scale. Instead the more convenient method is employed of measuring the specific gravity of the liquid distilling over, as the density of the constituents of successive fractions increases. The steam jet referred to already comes into operation when the high temperature necessary for distilling off the anthracene oil is reached.

Each of these fractions is still a complex mixture and with some of them, therefore, treatment is necessary. The first fraction is run into separating tanks so that the light oils are separated from the water, after which they are further fractionated. Usually four fractions are collected. The first fraction, up to 75°C., contains "fore-runnings" only. The remaining three are the important ones and in collecting them the receivers are changed when the temperature of the vapours reaches 110°C., 140°C. and finally 170°C. respectively. All three are mixtures consisting of benzene, toluene and similar liquid hydrocarbons. The first of the three fractions is mostly benzene and is known commercially as 90 per cent. benzol. The second contains more toluene and is known as 50 per cent. benzol, while the third fraction is the well-known solvent naphtha. The percentage figure gives the proportion of the liquid that distils over before a thermometer in the vapour reaches 100°C., and does not mean that the liquid contains that percentage of benzene.

Each fraction is purified by agitation, first with sulphuric acid and then with caustic soda solution. After the final washing with water each of the oils is redistilled. The exact course of the final operations depends on the nature of the product required and varies in different works, but the general principles in each case are those we have indicated.

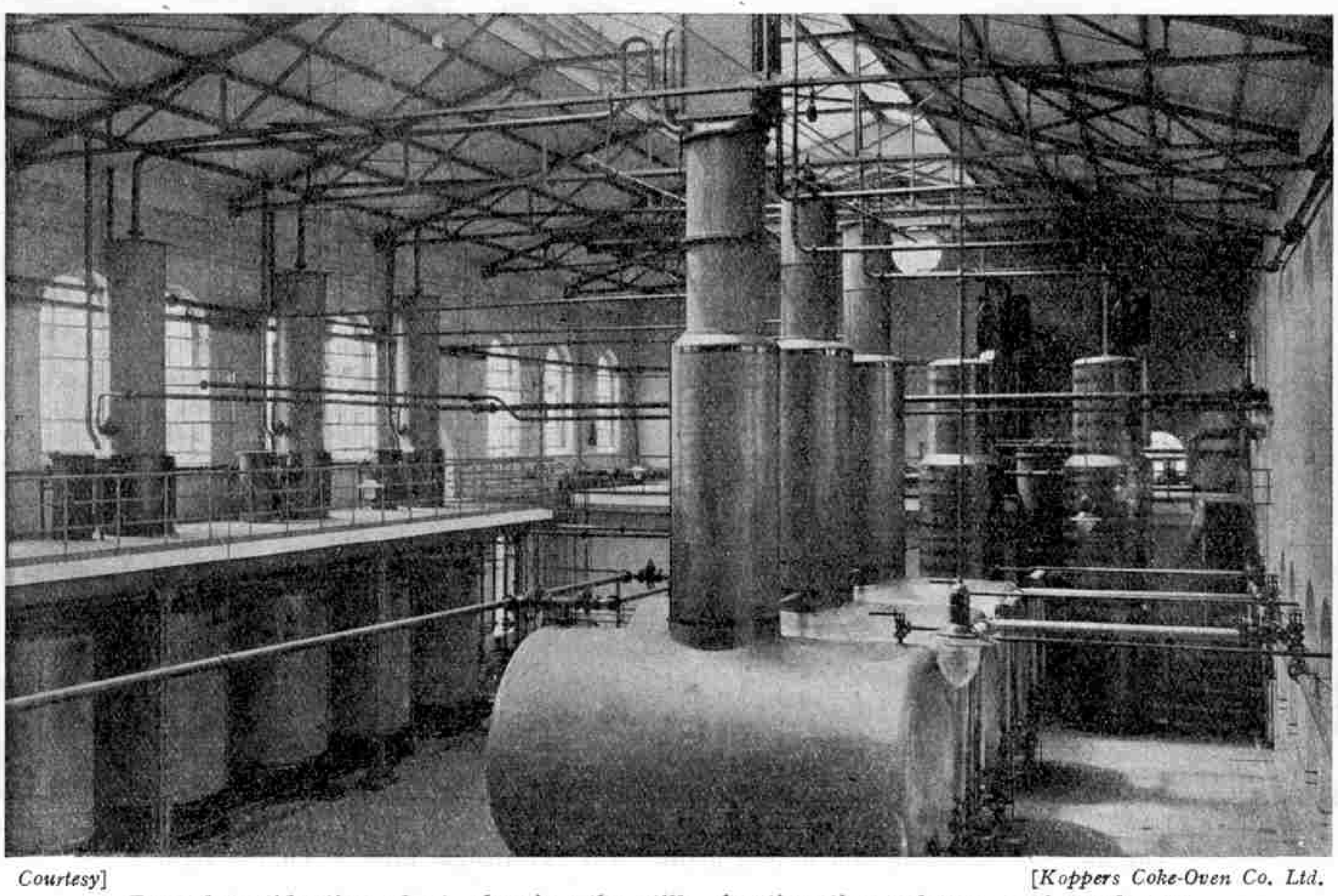
The remaining fractions of the tar-distillate undergo somewhat similar treatment, but variations occur since they contain solid hydrocarbons in addition to liquids. The middle oil, for instance, contains naphthalene and carbolic acid. The former substance separates on standing and the crystals are pressed free from oil and re-distilled. The remaining oil yields carbolic and cresylic acids, very similar substances. The heavy oil is usually sold under the name of creosote, while the anthracene oil derives its name from the presence in

it of anthracene, a solid hydrocarbon of very high melting point, which is of great importance in the dye industry. It settles out on standing from the oil and is purified by washing with solvent naphtha.

The Chief Primary Coal Tar Products

It will be as well here to summarise the many substances so far mentioned as obtained during the process of by-product coking or by distillation of coal tar. These include the liquid hydrocarbons benzene, toluene and other similar liquids constituting the various benzols of commerce. These are used as fuels for internal combustion engines, either alone or mixed with petrol, and also as solvents in various industries. The solid hydrocarbons anthracene and naphthalene are chiefly of importance for the dyes obtained from them, as explained later in this article, but naphthalene is also valuable for preserving furs and is used as a moth preventer.

In addition, carbolic and cresylic acids have been mentioned. These are similar substances that belong to a class of organic chemicals called phenols. They behave like acids and are largely used as disinfectants. Creosote, or heavy oil, is a complicated mixture of substances of the above types and is used in various forms as a fuel, for preserving railway sleepers and for making sheep dip. This list is by no means exhaustive, but includes the more important of the primary products of coal tar distillation.



Courtesy] [*Koppers Coke-Oven Co. Ltd.*

Benzol rectification plant, showing the stills, fractionating columns and condensers

When we come to deal with other uses of the various liquids and solids mentioned above as derived from coal tar we find that we are faced with a big problem. In addition to being of value themselves for many purposes, these materials are of importance as starting points for the manufacture of thousands of substances, including dyes, explosives, photographic chemicals, drugs, inks and even scents! The products of coal tar range from pitch, about the blackest and stickiest substance known, to saccharine, a white crystalline substance 200 times as sweet as sugar!

With the exception of the period of the Great War, when explosives were urgently needed, dyestuffs have always constituted by far the most valuable portion of these products. As remarked last month the starting point of the dyestuff industry was the discovery of mauve by Sir William H. Perkin. It is interesting to recall that the author of this great discovery only succeeded with difficulty in attaining his wish to be a chemist. His parents intended him to become an architect, and perhaps they were not unreasonable in opposing his design, for science as a profession offered very small prospects in the middle of last century. Indeed, at that time, the City of London School was practically the only one in which science was taught.

The First Artificial Dye

Perkin's enthusiasm led him, when only 14 years of age, to attend the lectures of the great Michael Faraday at the Royal Institution and a little later he became assistant in the chemical laboratory of the Royal College of Science. His great discovery came about in the following manner. In the course of attempts to make the well-known drug quinine he carried out some experiments with aniline, a pleasant-smelling liquid obtained a few years earlier by distilling indigo. He mixed a small quantity of it with bichromate of potash and dilute sulphuric acid, and a violent action resulted. When all the bubbling and boiling had subsided, a black sediment was left at the bottom of the vessel. He collected this and dissolved it in alcohol when a beautiful purple solution was obtained. This, when evaporated, yielded a powder, two or three grains of which gave a deep purple tint to several gallons of water. Perkin soon realised that he had made a dyestuff comparable in all respects with the natural dyes then in use.

This discovery by a boy 18 years of age was the foundation of an industry that quickly grew to enormous proportions. Although aniline had been obtained originally from indigo, it was known that the best source of it was benzene, the liquid hydrocarbon that could easily be separated, as described above, from coal tar. Perkin persuaded his father and brother to join him in setting up a plant to manufacture the new dye from benzene, and in this way the dye industry obtained a good start in Great Britain.

Unfortunately it was not long before all the advantages of the start were lost and by far the greater part of the later growth of the artificial dyestuffs industry is due to German chemists and industrialists. In 1910, for instance, of the £20,000,000 worth of dyes manufactured from coal tar products, three-quarters were made in Germany. The reasons for the pre-eminence of that country in this respect were many. One important point was that the leaders of the industry in Germany were not business men only in the ordinary sense of the word, but were themselves scientists and were always on the lookout for new substances and processes. The nearest parallels in England to the state of affairs that prevails in this industry in Germany are to be found in the position occupied formerly by the late Dr. Ludwig Mond, the scientist and business man so closely associated with the great alkali industry, and that held at the present time by Sir Robert Hadfield, who is at once a scientist of the first rank and a leading spirit in the steel industry.

The outbreak of the Great War in 1914 brought matters to a climax in this respect. The great textile industry had been so largely dependent upon German dyes that a famine inevitably ensued. More important still, the supply of high explosives necessary for carrying on a great war was quite inadequate and vigorous action had to be taken to start new works and extend old ones in order to make good the deficiencies. In consequence the dye industry is now in a better shape in Great Britain than it was prior to 1914.

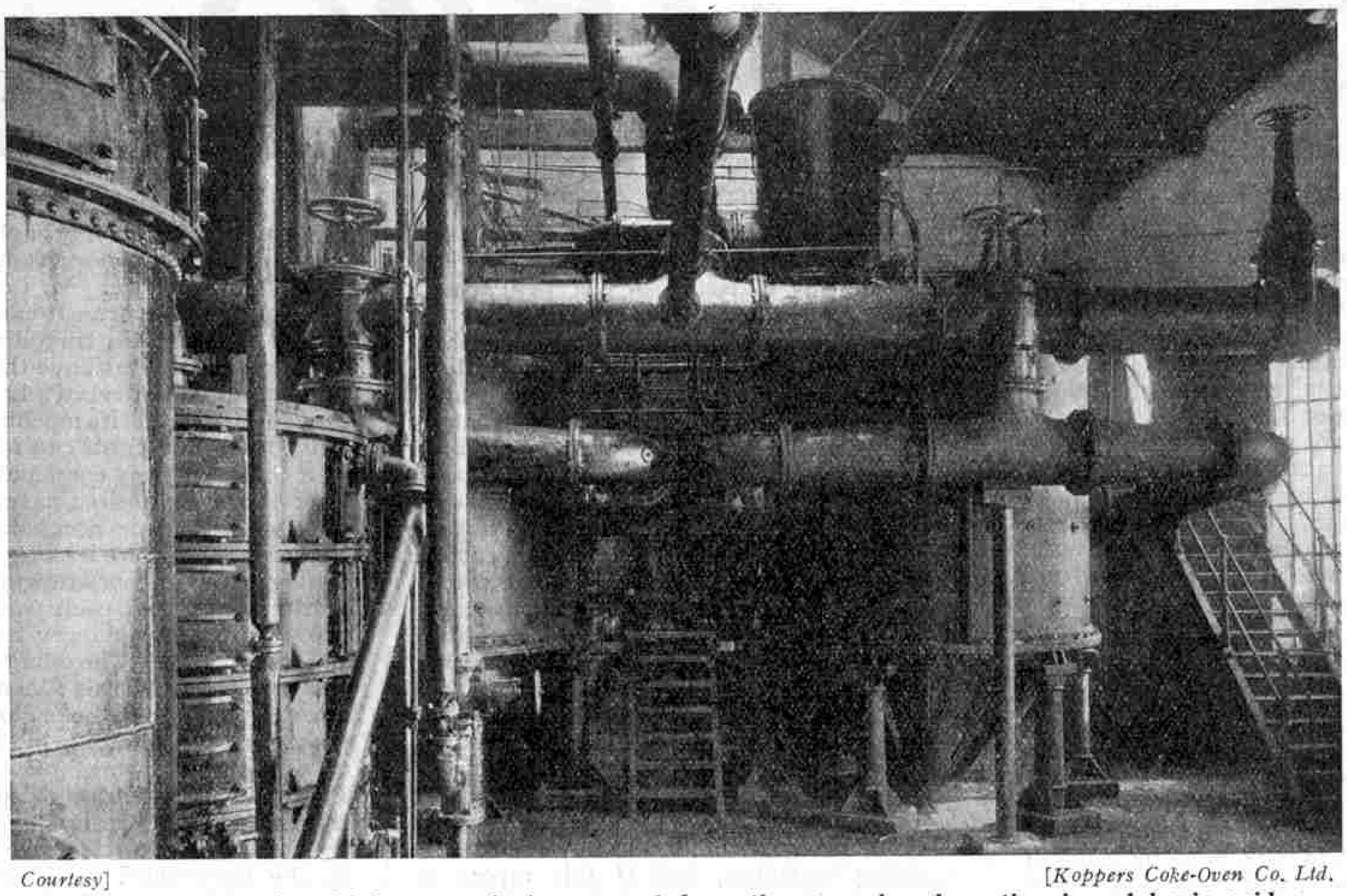
Synthetic Dyes Supersede Natural Colours

It is impossible to give anything like a full account of this great industry in the space available. Merely to enumerate the various dyestuffs now made from coal tar products would fill a large book, while the chemistry of them is complicated and difficult except to experts. Perhaps the most striking feature of the whole subject is the manner in which natural dyes have been almost completely superseded by those artificially made.

In the dye works of the first half of last century comparatively few colouring matters were used. Prominent among these were indigo, madder, cutch and logwood, all of which were vegetable products. Nothing was known of their composition and the

dyeing processes were largely matters of rule-of-thumb. Since the advent of the coal-tar dyes all this has been completely changed. Chemists have made a close study of dyes as chemical substances, and have not only produced many thousands of new dyes, the successors to Perkin's mauve, but have also learnt how to build up, or synthesise, the colouring matters present in the old natural dyestuffs. A prejudice in favour of the natural dyes died hard, but it is rare now to hear the argument that natural dyestuffs are better than synthetic ones. Synthetic indigo, for instance, is absolutely the same chemically as the natural dye, but is at the same time far purer and more easily handled.

Indigo is notable among natural dyestuffs as having to a certain extent held its own. It was formerly obtained entirely from a plant grown largely in India. The colouring matter was extracted from the leaves by soaking them in water and allowing a fermentation process to go on that slowly caused the liquid to become yellow. On subsequent agitation with air the liquid turned blue owing to the formation of indigo, which settled out as a sediment. It was then pressed and cut into cubes. The product was impure and contained other colouring matters besides indigo blue in addition to ash and moisture.



Courtesy [*Koppers Coke-Oven Co. Ltd.*

The saturators in which ammonia is removed from the gases by absorption in sulphuric acid

A study of the composition of indigo showed how the atoms of the constituent elements carbon, hydrogen, nitrogen and oxygen were arranged in it, and its synthesis from simpler chemicals soon followed. As long ago as 1870, Baeyer, a German chemist, discovered one way to make pure indigo, and since that date several other methods have been introduced. At the present time two of these are used on a manufacturing scale, one starting from benzene and the other from naphthalene, both coal tar products. It is interesting to note that three-quarters of a ton of indigo can be made from 1,000 tons of coal tar. This does not seem very large, but the dye thus made has threatened to surpass its rival both in regard to quantity and quality.

The manufacture of indigo is an excellent example of the manner in which chemical industries are inter-related. Whatever method is used, the first essentials are a supply of glacial acetic acid and pure sulphuric acid, both of which are used in large quantities in the process. Before indigo manufacture could be carried out on a large scale, therefore, the establishment of methods of supplying the required quantities of these substances was necessary. In order to supply the acetic acid no less than 150,000 cubic yards of wood must be distilled to produce the 3,000 tons or so of the acid that are needed annually. When wood is distilled this acid is present in the liquor that collects along with the wood tar. When pure it freezes to a mass of colourless crystals at temperatures slightly below normal, a property from which it derives its name.

In a similar manner improved methods for manufacturing sulphuric acid of better quality were developed. The older method involved the use of huge lead chambers in which an interaction takes place between the gas formed by burning sulphur and the fumes evolved when saltpetre is heated with sulphuric acid. The resulting acid required elaborate plant for purification and concentration. In this process the nitrous fumes from the saltpetre acted as an agent for combining more oxygen from the air with the oxide produced by burning sulphur and were unchanged in the process. In the new method the oxygen is added on by a more direct process, the gases from the burning sulphur and the oxygen being passed over finely divided platinum. The platinum when in this state has the curious effect of causing the two to combine, a rise in temperature taking place at the same time. The platinum itself is unaltered. The sulphuric acid produced in this way is purer than the acid produced by the old method and can readily be obtained in the more concentrated form necessary for indigo manufacture. Prior to the war sulphuric acid was only produced by this method abroad, but the urgent demand for the acid that arose in 1914 resulted in the establishment of works in Great Britain for carrying on the same process.

It was not until 1899 that the synthetic product was first placed on the market, the intervening time having been spent in overcoming difficulties of manufacture and in providing for the supply of necessary ingredients.

Why Indigo is a "Fast" Colour

Indigo is what is known as a "vat" dye, that is it is not applied directly to the fibre to be dyed. A "vat," or dyeing solution, is made up from indigo and various substances that "reduce," or remove the oxygen from it. This results in the formation of a substance known as indigo white, which is soluble in water. The material to be dyed is then soaked in the indigo white solution and afterwards exposed to the air, when the oxygen acts upon it to produce indigo blue once more within the material itself. Thus the colour and the material are very intimately connected, so that indigo is what is known as a "fast" dye, or one not easily removed.

An equally interesting natural dyestuff that has been completely displaced by the synthetic products is alizarin. This chemical is the colouring matter of madder, a material obtained by grinding the roots of a plant, *Rubia tinctoria*, that was once grown largely in Turkey and used for what is known as turkey-red dyeing. The use of this natural colour came to an end at an early stage in the development of the aniline dyes and again Perkin played a great part. Alizarin was first made by two German chemists named Graebe and Liebermann in 1868 and in the following year they, and Perkin also independently, discovered a better method that was more suitable for manufacturing purposes. The starting point for this process was anthracene.

Dyeing with alizarin is a very interesting process. It is chiefly used for producing turkey-red on cotton. The cotton is first freed from fatty matter by washing with caustic soda and then treated with a special oil known as turkey-red oil, prepared by the action of sulphuric acid on castor oil, olive oil or cottonseed oil, the first of these being the best. After drying it is then steeped in a solution of aluminium sulphate, containing also tannin and chalk. Finally it goes into the dye-bath proper, in which is contained more tannin and chalk in addition to the alizarin. After steeping for a little while it is boiled in this bath, rinsed and dried.

The object of this complicated preliminary process is to make the dyestuff attach itself to the cotton. This it cannot do directly, and what is known as a "mordant" is necessary. This word means biting, and its use for this purpose is usually explained by saying that the substance added helps the colour to bite into the material to be dyed. In this case the aluminium salt is the mordant, and the other constituents of the baths improve the final colour.

Air News

Persian Air Route

Difficulty has been experienced in obtaining the ratification by the Persian Government of an agreement made in 1925, allowing Imperial Airways machines to fly across Persian territory between Iraq and British Baluchistan. Attention is now being given to an alternative route along the southern side of the Persian Gulf. A survey is being made of this route along the Arabian coast of the Gulf, crossing from the extreme point to Gwadar or Pasri in British Baluchistan. It does not appear to be a particularly promising route, however, as no regular ports of call are found on this coast.

* * * *

New Gliding Record

A new gliding record has been established by the German aviator Ferdinand Schulz, who succeeded in gliding over a distance of more than 38 miles in a straight line along the coast from Rositten to Meinel, when taking part in an open competition. The previous record was held by another German, Max Kegel, with a distance of 34 miles in a straight line.

* * * *

Canadian Air Mails

The Postmaster-General of Canada has given formal authorisation for experiments to be conducted in connection with the transference of mails from ships to aeroplanes. Parliament voted £15,000 for the purchase of two modern aircraft for use in this service. The experiments will begin next month when the aeroplanes taking part in the tests will meet the incoming mail ships at Father Point (St. Lawrence estuary) and take on board the letter mails. It is anticipated that eight hours will be saved between Father Point and Quebec by the use of this method, and from 12 to 14 hours between Father Point and Montreal. Halifax and St. John also will be included in this service.

* * * *

The "*Halton 1*"

At the Hampshire Air Pageant a small two-seater biplane, christened the "*Halton 1*," was entered by the R.A.F. Training School situated at Halton, Bucks., and succeeded in gaining an award. This machine was built by some of the staff and apprentices at the school in their own time and at their own expense. Eighteen months and about £300 were spent on the construction of the machine, nearly 200 apprentices actually taking part.

* * * *

The world's first light seaplane club has been established at Singapore, under the title of the "Ex-Service's Flying Association."

New Material for Airscrews

A substance known under the trade name of "Micarta," and originally evolved as an insulating material for electrical work, is now being adopted as a material for the construction of airscrews. It consists essentially of layers of cotton fabric impregnated with certain resinous gums and compressed into a solid mass at a fairly high temperature. It is water and weather proof and can be moulded and pressed hot into almost any desired shape, in addition to being suitable for machining. In the construction of airscrews the cotton fabric base pieces can be cut to the rough shape and then pressed into a hot mould to form nearly the exact shape required. Then only drilling and balancing are required to complete the screw.

Until recently it was understood that this type of screw had proved satisfactory in experiments but was heavier than an ordinary wood airscrew. It is reported now that 250 "Micarta" airscrews have been ordered by the U.S. Navy for use on training machines, and if this report is authentic it indicates that the question of excess weight has been overcome.

* * * *

Air Taxi Services

An air taxi service has been introduced in Germany by the Westphalian Aero Company, who are operating Focke-Wulf monoplanes at a flat rate of 1.35 marks per 1,000 metres—a little over 2/– per mile.

The de Havilland Hire Service have operated a service at 2/– per mile for four passengers since 1921, while Air Taxis Ltd., are also carrying on a similar business. An air service at £4 an hour for two-seater machines has now been introduced by Lieut.-Col. G. P. Henderson, who has opened an air taxi garage at Brooklands. The machines average 75 to 80 miles per hour, so that the cost works out at about 1/– per mile.

* * * *

Plans for an air race from New York to Spokane, Washington, have received the approval of the National Aeronautical Association of America. It will begin on 20th Sept., and the prizes will amount to £6,600. An invitation to compete is to be sent to Colonel Lindbergh.

* * * *

The Empire Air Route service between Cairo and Baghdad and Basra is now weekly instead of fortnightly. The mail-carrying aircraft now depart from Cairo at 2 p.m. every Wednesday, the return service leaving Basra at 6 a.m. every Saturday.

Trans-Atlantic Air Services

Schemes have been brought forward with a view to making possible a regular trans-Atlantic air service. M. Louis Bleriot has pointed out that aircraft can develop much higher speeds when travelling through the air at great heights above the surface of the earth than in the relatively dense air near the surface, and if machines capable of flying at great heights can be built it should be a comparatively easy matter to organise a service of the desired nature.

Another scheme necessitates the provision of mid-Atlantic landing places. These could not be anchored owing to the depth of the ocean, and each would have to be provided with machinery to keep it within a certain area. The shape favoured by the supporters of this scheme is that of a horse-shoe, so that the enclosed area would provide a calm landing pool for seaplanes to alight and to take off after re-fueling. Bedrooms, restaurants for passengers, repair shops, and re-fueling stations would be constructed within the steel caissons of the horse-shoe. This scheme has the support of Franco-American capitalists and it is hoped to put it into execution within a comparatively short time.

* * * *

An Interesting Development

It has been anticipated that the next big step in the development of the aeroplane would be the elimination of all external fittings and the accommodation of engines, petrol, passengers and crew within the wings. Monoplanes are now under construction in the United States and Germany designed on "flying wing" lines, the only external fittings being the propellers and control surfaces, no fuselage being fitted.

* * * *

It is stated that during a recent period of six months no less than £5,350,000 worth of precious metal, including £500,000 worth of platinum, has been carried by Imperial Airways machines. The crews of the machines engaged in this traffic are armed with revolvers for the protection of their cargoes in case of forced landings and other unforeseen events.

* * * *

Aeroplanes are to be used to enable passengers to Australia by the Orient Line to see something of the beauties of South Australia. Machines will attend the liners during their stay in Adelaide.

* * * *

It is stated that undergraduates at Oxford have been forbidden to make aeroplane flights.

Alaskan Survey from the Air

A huge survey of Alaska, extending over an area of 40,000 sq. miles of almost inaccessible territory, has now been completed by personnel and aeroplanes supplied by the United States Navy. This work would have taken many years if the survey had been undertaken in the ordinary way, but it has been accomplished in less than four months, all information desired by those responsible for the venture having been obtained.

The expedition was under the direction of Lieut. B. H. Wyatt, of the United States Navy. An old mine-sweeper, the "*Gannet*," acted as tender to the machines, while the personnel were housed in a wooden hut erected on a 100ft. freight lighter that was towed to any desired position.

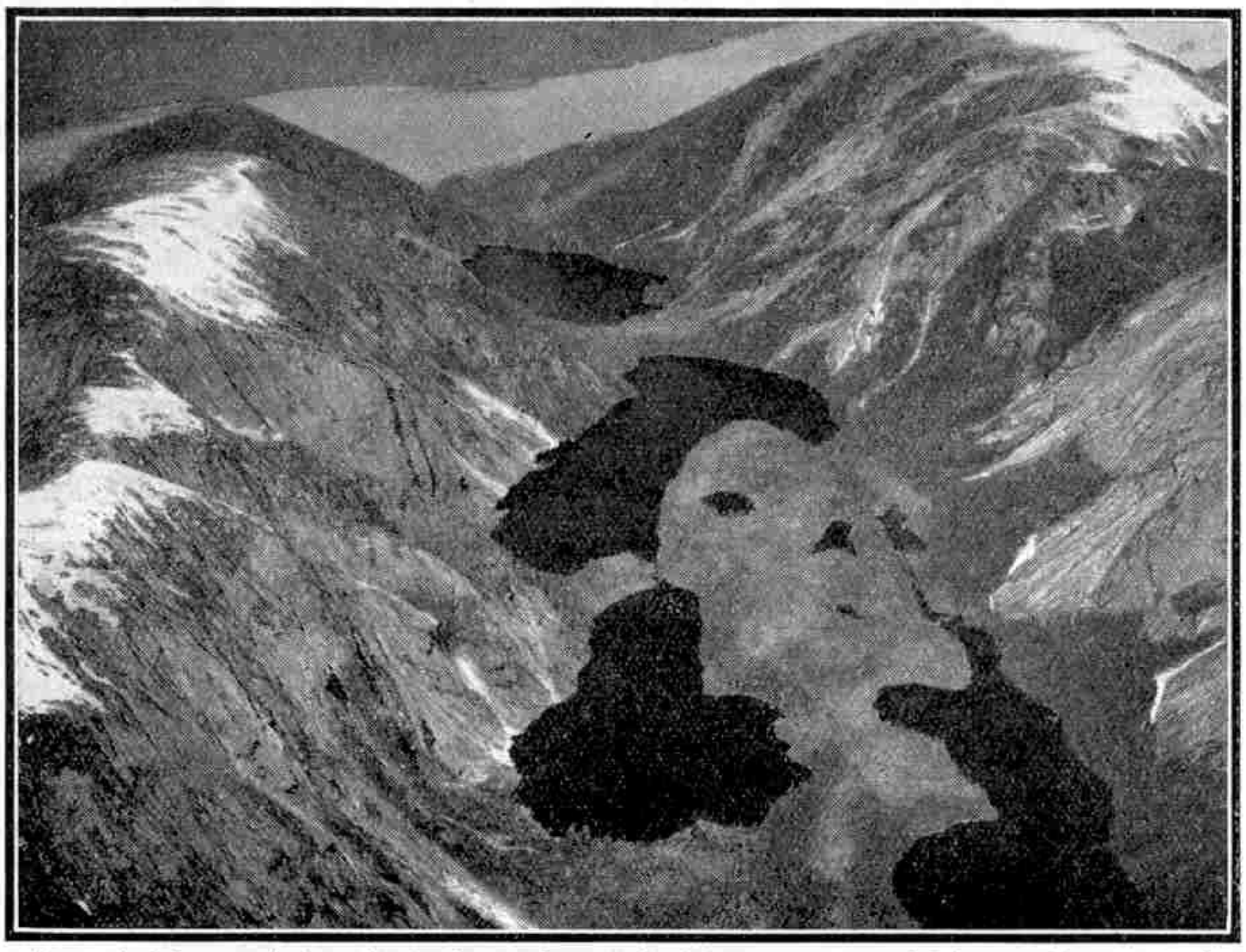
In addition to general photographs of the islands and mainland, close-up views of the forests, rivers and lakes were obtained. The international boundary was photographed carefully with a view to clearing up any misunderstanding existing between the United States and the Canadian Governments on this point. During the whole of the work great difficulties had to be overcome by the pilots, particularly when near views were being taken. For example, sudden winds, known locally as "willie waws," blow from the mountain tops with a velocity ranging from 50 to as much as 100 miles an hour. If these winds were encountered at a low altitude only exceptional piloting could save the machines from crashing. One machine that encountered one of these winds in these circumstances was forced down and had to fly for a distance of 20 miles only a few feet above the ice.

It is interesting to note that a hitherto unsuspected lake was discovered near to Ketchikan. This lake is nine miles in length and four to five miles in width and is a promising source of power, while the presence of suitable timber indicates the possibility of exploiting these natural resources in the production of paper.

* * * *

It was stated in Parliament recently that the number of aircraft with valid certificates of airworthiness in Great Britain and Northern Ireland, excluding those owned by the Air Council, by Imperial Airways and by subsidised light aeroplane clubs, is 138, of which 36 are light aeroplanes. In addition there are 40 subsidised aircraft, 20 being owned by Imperial Airways and 20 by the subsidised light aeroplane clubs.

Alaska from the Air



A wonderful aero photograph showing a large and picturesque group of lakes on the mainland north of Rudyerd Bay

French Commercial Aviation

Some anxiety regarding the progress of French air services is being felt in that country and it is considered that the creation of new international air lines should be undertaken by France in the near future. The service considered to be the most important is that from Toulouse to Buenos Aires via Dakar, Cape Verde Islands, Noronha Island and Pernambuco, several references to which have appeared in the "*M.M.*" Fear has been expressed that unless some definite step is taken immediately other countries will have obtained secure footings wherever an air route is likely to be at all satisfactory from a financial point of view.

Until recently the lack of French-built seaplanes has been a great drawback but it is possible that the Richard-Penhoet seaplane described in this month's "*Conquest of the Air*," will overcome this difficulty. Another obstacle to international air services from France is the lack of local lines radiating from the big air stations. An attempt to remedy this want has been made in the northern departments with Lille as a centre. At a meeting in Bordeaux it was decided that air lines should be inaugurated from Bordeaux to Geneva by way of Lyons; to Nantes, Cherbourg and England, with branch lines to Havre and the Nord; to Toulouse, Marseilles and Nice and to Portiers, Tours and Paris.

* * * *

Proposals have been made for the following new air routes in Italy; Venice-Rome (extension of the Vienna-Venice route); Palermo-Cagliare-Balearic Isles-Barcelona; Brindisi-Rome and Rome-Bologna-Munich.

Belgian Plan for Night Air Services

An important air station is to be established at Evere, near Brussels, where an aerodrome already in existence will form the nucleus of a new aerial route centre. The aerodrome stretches over an area of about 225 acres and is used for the present services from the Belgian Capital to London, Paris, Amsterdam and Berlin via Cologne. A complete reconstruction of this aerodrome is to be undertaken to enable night services to operate along these routes and others to be decided upon later.

At Evere beacons will be erected for the guidance of the machines and it is intended to establish a system of red lights that will show clearly the outlines of the field, an illuminated "T" on the ground in the centre of the field indicating the landing stage. In addition a lighthouse about 164 ft. in height and with a range of 130 ft. will be constructed, this power being about the same as that of the lighthouse at Le Bourget, near Paris. A wireless station to maintain communication with the machines is also to be constructed.

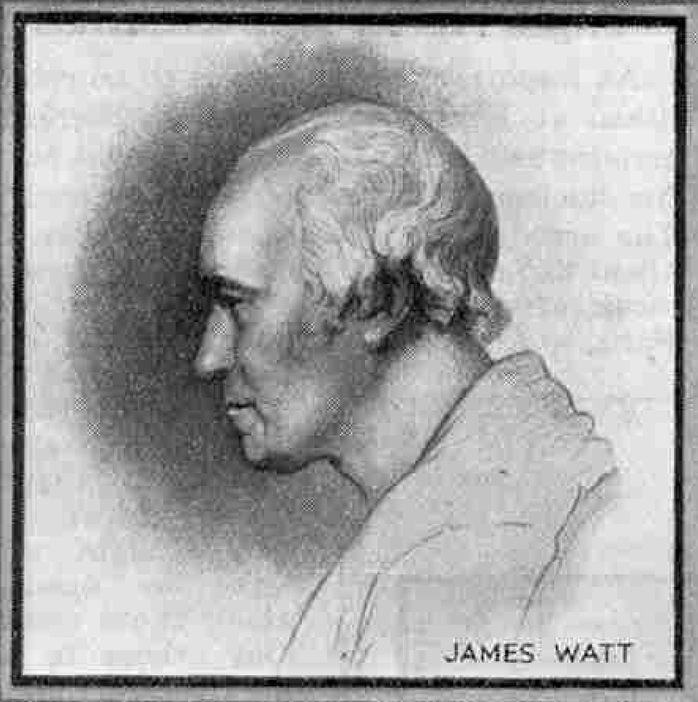
Twelve large sheds are to be constructed to house the postal machines and eight to accommodate commercial passenger aircraft. A large concrete platform is to be used for the arrival and departure of the passengers, the machines drawing up to this platform in order to save passengers from a long walk to the waiting air liner. This platform is part of a station comprising offices, waiting rooms, sheds for merchandise, Customs facilities, and telephone and telegraph office. Probably a large hotel and restaurant will be constructed later. It is estimated that the total cost of the work, to be commenced early next year, will be about £800,000.

The whole of this scheme is under the direction of the Sabena, a concern controlled by the State. The work will not be completed until next May or June.

* * * *

Seven-and-a-Half Miles High

A new altitude record for all types of aircraft has been established by Capt. Hawthorn C. Gray who, in control of a free balloon, rose to a height of 41,000 ft., that is, 7½ miles. During the descent the balloon gathered such speed that Capt. Gray feared a crash and descended the last 8,000 ft. by parachute. The altimeter and other instruments were sent to the Bureau of Standards for official confirmation.

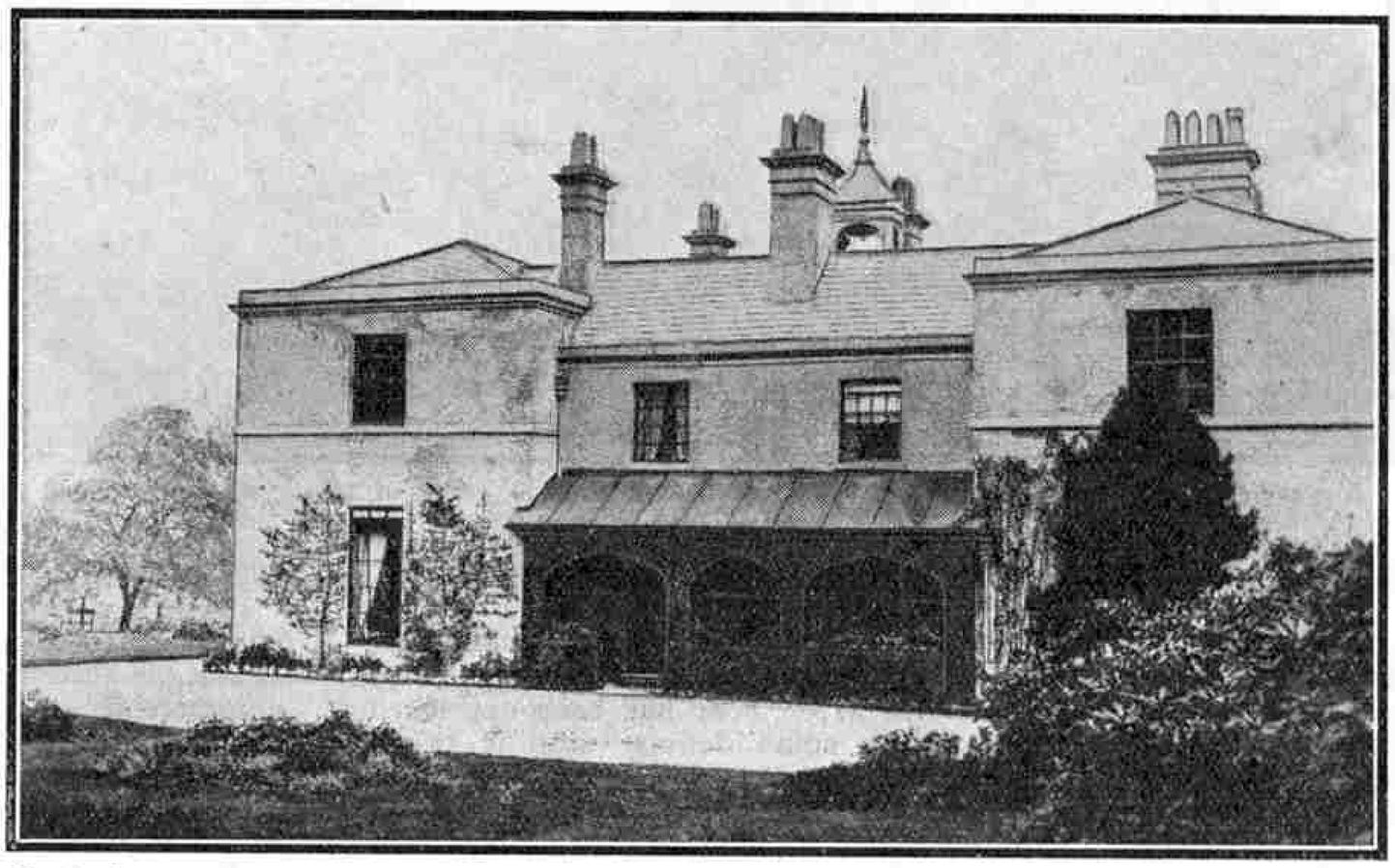


LIVES OF FAMOUS INVENTORS

VI WATT AND THE STEAM ENGINE

IN addition to the numerous important improvements patented by James Watt in reference to his original steam engine and described in the previous articles in this series he perfected also many subsidiary contrivances which nevertheless were of very great value. One of the most important of these was an improved governor.

Watt had early devised a simple throttle valve for the single-acting pumping engines to enable the enginemen to regulate steam and the speed of the piston. When the steam engine was improved, however, and adapted to many new uses, Watt sought for a means of automatic regulation and finally adapted the governor to his purpose. Governors were then in common use for regulating the supply of water to water mills.



Courtesy [*W. & T. Avery, Ltd.*

Heathfield Hall, Birmingham, where Watt lived after his retirement from business

As reconstructed by Watt the governor consisted of a vertical rod rotated from the engine fly wheel through the medium of a narrow belt passing to gearing fitted at the base of the rod. Two arms, each bearing a heavy metal ball at their lower extremity, were connected to a movable socket near the top of the rod. In operation, as the speed of the engine increased, the balls—responding to centrifugal force—swung farther out, causing a downward motion of the socket. The motion was immediately imparted by the socket to an arrangement of levers above, which in turn actuated a crank connected with the lever of the throttle valve. Steam was thereby gradually shut off in proportion as the speed of the engine increased, and similarly admitted as speed was reduced.

The centrifugal governor is used nowadays in a variety of forms, and is still the most reliable method known for automatically controlling an engine's speed.

In order to advertise the capabilities of rotative steam engines Boulton decided to erect a large corn mill in London and equip it with Soho engines more powerful than any hitherto made. His efforts to form a company to finance the scheme were strongly opposed by the London millers, who declared that machinery capable of accomplishing all Boulton claimed would bring ruin upon the existing wind and tide-mills and thereby cause much unemployment. They further protested that bread would become so cheap that there would cease to be any profit in making it, and millers would have to close down! Boulton was not deterred by these pessimistic prophecies, although he saw that if his scheme were to materialise most of the cost would have to be borne by himself and Watt. Before the close of the year 1784 a company was formed, plans for the mill were drawn up and passed, and the work of erecting the buildings to house the machinery was commenced.

Watt Engages John Rennie

While Watt was busy designing the powerful engines for the mill he received a visit one day from John Rennie, then a young millwright of 23, who had left his native Scotland in order to increase his engineering knowledge by visiting important works in England. His journey from Edinburgh to Birmingham had been made by a somewhat devious route to enable him to visit Brindley's Bridgewater Canal. He also inspected the Liverpool Docks, which greatly interested him.

Rennie was in possession of a letter of introduction from his late University professor, Dr. Robison, who, as mentioned earlier in these articles, was a personal friend of Watt. The famous inventor received his young visitor with great kindness, and the two men were soon deep in a discussion concerning the machinery

of corn mills, for whereas Watt knew little of millwork, Rennie already had had practical experience in repairing flour mill machinery entrusted to his skill by the famous millwright Andrew Meikle, under whom he had served for two years. Watt was in great need of a skilled millwright to superintend the work in London at what was to be known as the Albion Mill. Rennie appeared to be a very suitable young man to undertake this task, and after Watt had consulted Dr. Robison and obtained a highly favourable reply, he invited Rennie, then back in Scotland, to undertake the supervision of the proposed mill as regards the planning and erection of the machinery.

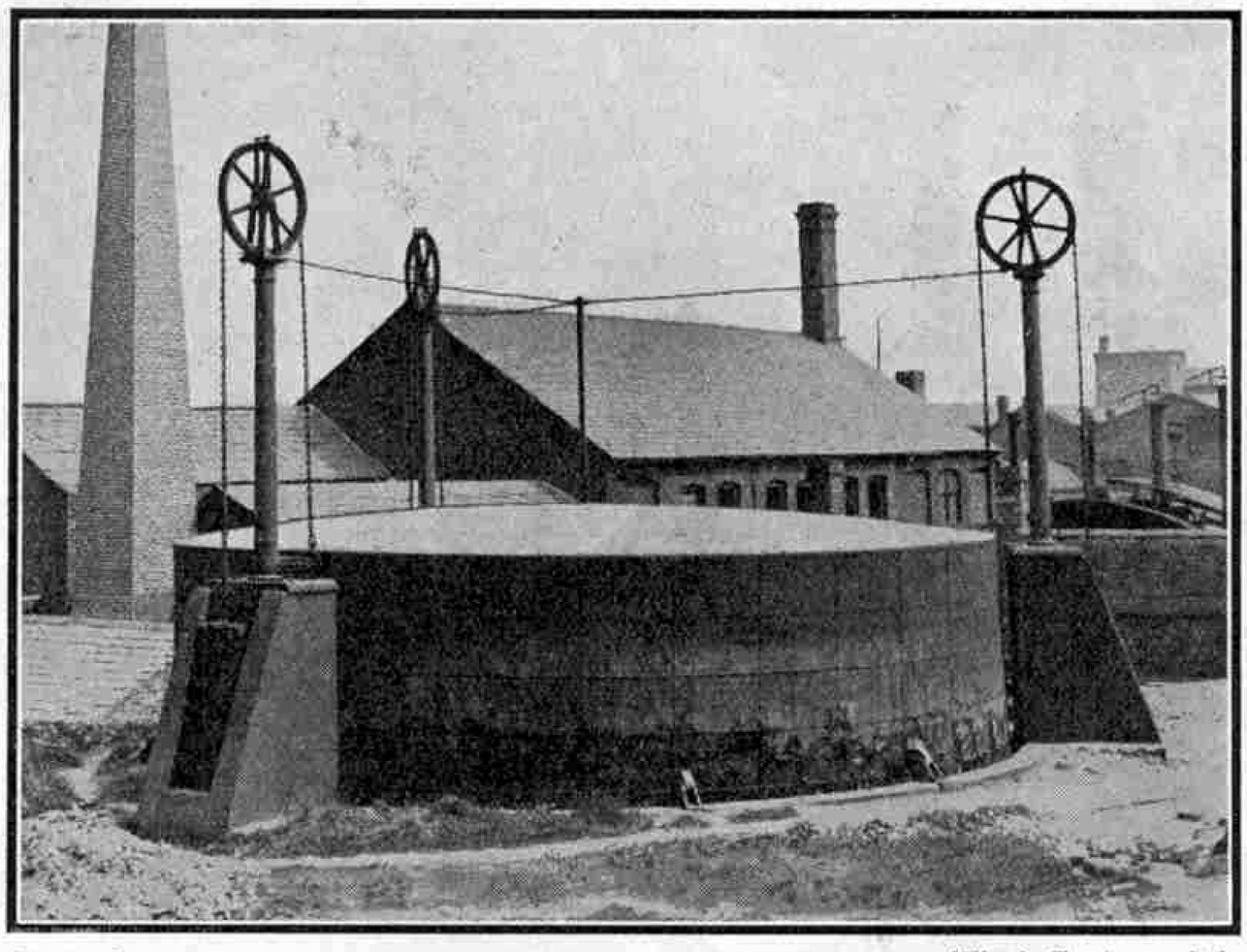
Rennie decided to accept the offer, and after completing his engagements in Scotland, he set out in September 1784, for Birmingham again. After a stay of two months at Soho, during which time he acquainted himself fully with the details of the engines by which the mill machinery was to be driven, Rennie went to London.

The Albion Mill was erected on the bank of the Thames near the south-east end of Blackfriars Bridge, and the building and equipping of the structure was not completed until March 1786. The two double-acting rotative engines installed were the first of their type to be erected in London with parallel motion (described last month). They were each 50 h.p. and had a steam pressure of 5 lb. to the inch. Accurately toothed gear wheels of cast iron were adopted instead of the wooden wheels customarily fitted to Soho engines. Shafts and axles also were of iron, and brass bearings were fitted.

The engines operated 20 pairs of millstones, each 4 ft. 6 in. in diameter, 12 of which generally worked together, each pair grinding ten bushels of wheat per hour. The two engines working together were capable of dealing with 150 bushels an hour, an output far in excess of that of any other mill of the time.

In due course the mill was ready for use. After the correction of a few minor faults the machinery worked excellently, and its efficiency occasioned the astonishment and admiration of all who saw it. The mill seemed assured of a profitable future, but a disastrous fire abruptly closed its career in March 1791. Apparently the mill was fired by enemies of the new machinery, for the outbreak occurred in several parts of the structure simultaneously at the time of low tide in the adjoining Thames, so that the drawing up of water was rendered as difficult as possible. A sinister discovery was also made later, the main cock of the water cistern at the mill being found tied up.

The destruction of the Albion Mill meant a loss of £6,000 to Boulton and £3,000 to Watt, in addition to smaller misfortunes to minor shareholders. A reward was offered for information as to the culprits, but it was never claimed and they were never discovered.



Courtesy [*W. & T. Avery, Ltd.*

Murdock's original Gasholder at Soho, first used for coal gas about 1798

Boulton Takes up "Coining"

Although the installing of Watt steam pumping engines in the Cornish tin mines was completed, large sums of money in respect to the purchase of engines and the payment of the annual dues on them were still owing to the Soho firm. As stated previously the Cornish industry had fallen on evil times and Boulton and Watt had become shareholders in several important mines. In an effort to keep these working Boulton from time to time purchased large quantities of copper. He had long desired to prove the steam engine adaptable to working coin-stamping machinery and an opportunity finally presented itself when, in 1786, he secured a contract to fashion more than 100 tons of copper coin for the East India Company of London. The order also furnished him with an excellent outlet for his large stock of copper.

The steam engine was in due course successfully adapted to meet this new requirement, and several coining presses of a French pattern were installed at Soho. These proved so noisy in operation, however, that Boulton, never satisfied with less than the very best, immediately set about remodelling them according to his own ideas. By the close of 1788 six new large presses, designed and built to Boulton's own plans, were ready to take over the duties of the noisy French machines. The latter had been kept busy dealing with the East India Company's order and two other important contracts, one of which was for a silver coinage for a Sierra Leone company and the other for a copper coinage for the American colonies.

Boulton later increased the number of his coining presses to eight, each of which could be easily adjusted to strike from 50 to 120 pieces of coin per minute according to diameter and design. Several smaller machines capable of striking small coin at the rate of 200 pieces per minute were also made and installed in the Soho mint.

After his entry into the coinage profession Boulton took an active part in the efforts of traders to move the Government to action in preventing the widespread issues of false coin. At length he was called before the Privy Council and invited to say what he thought should be done. This he did very fully, and claimed that at his mint he could manufacture coins so superior in quality and cut that they would put all counterfeiters out of business. The Council thereupon commissioned him to prepare at the Soho mint a model farthing, halfpenny and penny, and to submit same to them for examination. His coins were in due course approved, but by dint of one excuse and another the officials of the Royal Mint, who resented Boulton's intrusion into the coinage profession, succeeded for over ten years in

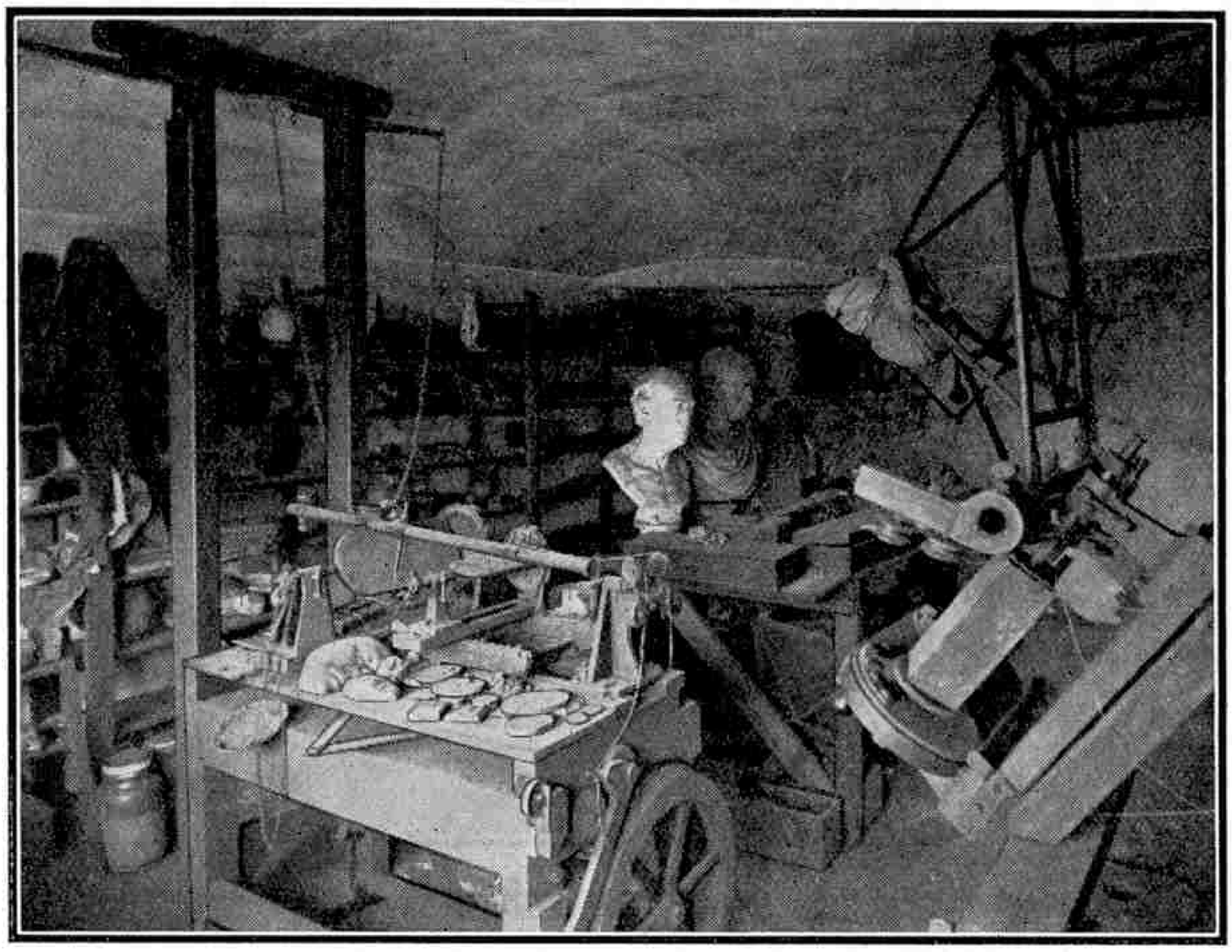
dissuading the Government from granting him an order to strike a coinage in accordance with his examples.

The Soho firm could not afford to have the presses standing idle, however, and when it became evident that the hoped-for Government order was likely to be delayed indefinitely, foreign commissions were sought and Boulton secured several large contracts that kept the coining presses busy for long periods. When the large presses were all in regular work the Soho mint turned out fully 1,200 tons of coin per year. The stocks of copper at Soho were soon used up and when Boulton sought to purchase further lots from the Cornish mineowners they, realising his need, raised the price to £6 per ton, despite the material help Boulton had generously rendered them in their numerous past difficulties.

The Lunar Society

Boulton had many friends, ranging from Cornish villagers whose affections he had won, to learned men of science and philosophy who were attracted by his deep knowledge of men and affairs. Among them were such men as the famous poet and philosopher Dr. Erasmus Darwin; Dr. Small and Josiah Wedgwood, of whom we have already spoken in these articles; and many others, all of whom were later joined by Watt on his removal to Birmingham in 1774.

It became the fashion of these men to meet together once a month to discuss among themselves their latest discoveries and inventions. These gatherings were held at the house of a different member of the group each month, and from the habit of holding them on the night of the full moon—to enable members who came long distances to ride home by moonlight—they became known as the meetings of the "Lunar Society." Members were each permitted to bring a friend and in this capacity Smeaton was several times a guest of the Society.



A view of Watt's garret workshop, now in the Science Museum, South Kensington

One of the youngest members of the group was Dr. Joseph Priestley, a Presbyterian Minister, whose spare time was devoted entirely to scientific research. He is famous especially for his discovery in 1774 of a gas he termed "fire air," but which is now known as oxygen. His enthusiasm was infectious and his continued experiments in search of new gases became the leading topic of discussion at the monthly meetings. Both Watt and Boulton were among those who decided to indulge in experiments themselves. Boulton converted into a laboratory a room at his house that Murdock had used prior to removing to Cornwall and as time went on this became stocked with a variety of weird apparatus. Priestley's extensive laboratory was situated some distance from his house at Fairhill, as a precaution against fire, and there in seclusion he zealously pursued his investigations.

Mob Destroy Priestley's House

Priestley held strong religious views that brought him into conflict with the local clergy, and apart from the associations of the Lunar Society he was not very popular. These differences became acute when, on receipt of news that the French Revolution had broken out, he commenced writing and preaching in favour of the uprising in France, and allied himself with a local body of people who applauded the revolutionaries. The dramatic events that led to Priestley's departure from Birmingham on 14th July, 1791, are related by Watt in a letter to a friend, written five days later.

"The affair originated from some gentleman very foolishly celebrating the French Revolution by a dinner on the 14th," wrote Watt. "They were warned that some tumult might ensue, and advised against it; however, some of them met, were insulted as they went in, and, therefore, dispersed by five o'clock. About eight o'clock a mob assembled, broke the windows of the hotel where the company met, pulled down two dissenting meeting-houses, then Dr. Priestley's house, which they razed to the ground (he and his family made their escape in time); they then destroyed a very good house in town, and from that proceeded to destroy some others in town, and some of the best houses in the country, mostly belonging to dissenters, they say to the number of ten or fifteen, and to the amount of above £100,000. Then was the sovereignty of the people established in full authority for three days and nights! Quiet subjects were panic-struck; and after some feeble efforts to establish peace, people submitted quietly to their fate.

"We on our part, finding there was no likelihood of any other protection, applied to our workmen, convinced them of the criminality as well as imprudence of joining the mob, and kept them all at home, procured some arms, and had their promise of defending us and themselves against all invaders. . . . We had everything most portable packed up, fearing the worst; however, all is well with us. . . . . Some military arrived on Sunday night, since which there has been no rioting in the town, and we hope they are dispersed."

After escaping from Birmingham Priestley stayed at Clapton for three months, at the end of which period, deeming the trouble to have blown over, he proposed to revisit Birmingham. Watt learned of his intention, however, and immediately wrote advising him to remain away for some further time. Priestley was greatly discouraged to find it was not yet considered by his friends safe for him to resettle in Birmingham, and later he gave up the idea and emigrated to Northumberland in America, where he spent the remainder of his life. He was greatly missed by the Lunar Society and his departure proved to be the beginning of the end of that body.

Boulton and Watt Junr.

In 1794 there occurred the death of Roebuck, whose last years seem to have been passed in comparative obscurity and privation, for he never recovered from the distress and shock of his bankruptcy at Carron in 1772. Fate sometimes turns one man's misfortunes to another's good and, as we have seen in these articles, had it not been for the disaster that befell Roebuck, Watt's partnership with Boulton might never have come about.

In the same year that Roebuck died Boulton and Watt took into partnership their eldest sons—Matthew Robinson Boulton and James Watt—both of whom had been given a good education. The confidence, enthusiasm and freshness of the young men proved an excellent stimulus to the firm, and in time the sons were able to relieve their respective parents of various cares and anxieties of the business that was now so large and comprehensive.

There remained but six years during which Watt's original invention would enjoy legal protection, and many bold persons were already copying the steam engine without permission. One of the least agreeable of the tasks taken over by the sons was that of prosecuting rivals guilty of infringing the firm's patents, and of claiming from these dishonest parties annual dues such as were paid by users of the genuine Soho-built steam engines.

The letters of the youthful partners about this time contain some interesting references to their efforts to obtain justice for the firm. In a letter from Leeds to Soho dated 24th February, 1796, Watt junior reports a conference with the owners of the Bowling Ironworks near Bradford, where several illegal "Watt"

steam engines had been detected.

"Inclosed you have a copy of the treaty of peace, not amity, concluded at Leeds on Saturday last, between me, Minister Plenipotentiary to your Highnesses on the one part, and the Bowling Pirates in person on the other part. I hope you will ratify the terms, as you will see they are founded entirely on the principle of indemnity for the past and security for the future."

There was also trouble in Cornwall, where mineowners who knew that the patent would only be in force until 1800 ceased making any effort to pay Boulton and Watt the dues to which they were entitled. "The rascals seem to have been going on as if the patent were their own . . .," declared Watt to Boulton in a letter of 25th March, 1796. "We have tried every lenient means with them in vain; and since the fear of God has no effect upon them, we must try what the fear of the devil can do." The Cornish disputes took three years to settle but, when the patent had barely a year to run, the final verdict of the courts was obtained in favour of the Soho firm. A little later they had the satisfaction of extracting about £30,000 during an authoritative 'round up' of the evasive users of the steam engine. Among those against whom the courts decided in Boulton and Watt's favour was the Hornblower family.

Second Soho Works Built

As orders for the several types of steam engines that were now made by Boulton and Watt steadily increased, it became clear that enlarged premises were necessary, and in 1795 a second works was erected at Soho. The new building was "dedicated" by Boulton in January of the following year, and a "Rearing Feast" given to the engine smiths and other workmen who had participated in its erection and equipment. Boulton commenced his speech at the "dedication" ceremony, as follows:—

"I come now as the Father of Soho, to consecrate this place as one of its branches; I also come to give it a name and my benediction. I will, therefore, proceed to purify the walls of it by the sprinkling of wine, and in the name of Vulcan and all the Gods and Goddesses of Fire and Water, I pronounce the name of it Soho Foundry. May that name endure for ever and ever, and let all the people say Amen, Amen.

"This Temple now having a name, I will propose that every man shall fill his pitcher, and drink success to Soho Foundry.

"May this establishment be ever prosperous, may no misfortune ever happen to it, may it give birth to many useful arts and inventions, may it prove beneficial to mankind, and yield comfort and happiness to all who may be employed in it."

At the new works the building of steam engines and the work of coinage were carried on for many years. The old establishment became known as the Soho Manufactory and in it the various other trades followed by Boulton were carried on.

In 1797 the firm received the long hoped-for coinage order from the British Treasury, in anticipation of which the coining presses at Soho had been increased in number 10 years previously. The contract proved to be for a copper coinage comprising farthing, halfpenny, penny and twopenny pieces, and during the following 10 years about 4,000 tons of copper was used for this work.

The enginemen at the Cornish mines had now become thoroughly familiar with the Watt steam pumping engines in their charge. As a result mishaps and breakdowns were less frequent and it was no longer necessary for Murdock to be in constant attendance. In 1798, therefore, he returned finally to Birmingham where, in addition to his manifold labours at Soho on behalf of Boulton and Watt, he found time to experiment and invent. Here also he pursued his investigations in regard to coal gas (as described in the "*Story of Coal*," June "*M.M.*") and at the new Soho foundry he erected the first gasometer. From 1798 until 1813 Murdock resided at No. 13, Foundry Row, situated close to the works, and an illustration of this house was given in the June "*M.M.*"

As the years passed by and the younger Boulton and Watt took firmer hold of the reins at Soho, the senior partners gradually withdrew from active management of the concern. On the expiry of the patent in 1800 the business was formally handed over by Boulton and Watt to their sons, and the original partnership formed a quarter of a century before was declared dissolved. Watt retired to his new house, Heathfield Hall, and to his life there we shall refer later.

Memorial to James Watt

Despite the fact that he was now over 70 years of age, Boulton refused to be regarded as an old man past his days of enthusiasm, and to Watt's frequent appeals to him to retire fully from business and spend his later years in well-earned leisure and peace, he turned a deaf ear. His love of industry was as yet undiminished and he maintained a keen interest in the affairs of the business which, by dogged persistence and refusal to be discouraged, he had brought to success and prosperity.

Defeat of Soho Thieves

Boulton's physical vigour and clearness of thought at this time were revealed in the manner in which he frustrated an attempt in 1800 to rob the counting house, containing money for the wages of 600 employees, and the silver-plate house at the Soho manufactory, just before the Christmas holiday. A large gang of house-breakers equipped with false keys bribed the night watchman to let them through the works' gate at night. The watchman agreed, and later in the day confided the plot to Boulton, who was quick to act, and when the works closed that evening armed workmen remained behind, hidden in various parts of the building.

The burglars kept their appointment and were admitted by the watchman. Owing to their keys failing to open the desired doors in the works, however, they reluctantly put out their lanterns and retired. A couple of nights later, armed with fresh keys, they made another attempt, but still without success. Their failure to effect an entry was as disappointing to the hidden night watchers as to themselves!

Gentle tactics were now abandoned and on the following night the marauders broke into the counting house by force and quickly got to work. The hidden watchers remained silent, watching the thieves pack up the wealth, and waiting impatiently for Boulton's signal to attack.

Just as the raiders were about to quit with a load of silver and roughly £150 the word was given. Many lights were suddenly turned on and the thieves found themselves surrounded by grim looking men, all formidably armed. Nevertheless they did not immediately surrender and to the joy of most of the men who had watched so long a first-class fight took place. The conflict ended in the capture of four of the burglars and the severe wounding of a fifth who, however, succeeded in getting away over the roofs of neighbouring houses.

During 1804, Robert Fulton, one of the American pioneers of steam navigation, visited the Soho firm concerning a steam engine that he required made to his own plans. This in due course was done and the engine shipped to New York, where in 1806 Fulton had a boat built for it. The cylinders of the engine were 2 ft. in diameter and of 4 ft. stroke, while the horsepower was roughly 19. Dry pine wood was used for fuel and when in service the steamboat, which was the famous "*Clermont*," presented a striking picture as she forged ahead, "defying wind and tide, and breathing flames and smoke."

Death of Boulton

In the autumn of 1807 Boulton was taken seriously ill and never wholly recovered. He rallied somewhat after a while and resumed his periodical visits to his beloved works. One of his last

journeys down to the Soho Mint was to superintend the despatch to the Queen of a box of medals that had been struck. As time went on Boulton's health gradually failed and he finally passed away on August 17th, 1809. He was greatly respected and beloved by the Soho workmen and his death was deeply mourned. He was buried at Handsworth Church, wherein a memorial tablet was erected.

Watt's deep sorrow at the death of Boulton was mingled with memories of the latter's generosity, for throughout the trying years when the reputation of the steam engine was still unestablished and profits were almost nil Boulton maintained the handsome income of his partner.

While on a visit to Scotland, a short time before Boulton's death, Watt revisited Glasgow University and dined with the professors there. He owed much to the sympathy of the University in his early years and he now rewarded this kindness by presenting the Institution with more than £300 for prizes to Natural Science students.

Pipeline on the Principle of a Lobster's Tail

In 1811 the Glasgow Waterworks Company consulted Watt as to the best means of conveying pure spring water to their Dalmarnock engine house, from a point on the other side of the Clyde. The river bed thereabouts was shifting and uneven and it was seemingly impossible to secure a pipeline. Watt soon solved the problem, however, and forwarded to the company a drawing of a long iron tube composed of lengths movably jointed, on the principle of a lobster's tail. His idea was accepted and a jointed pipe 1,000 ft. in length and 2 ft. in diameter was constructed and laid and proved entirely successful. The aged inventor would not accept any remuneration, but the company presented him with a handsome piece of plate, worth 100 guineas, in token of their esteem and thanks.

The years of Watt's retirement were in some respects the happiest of his life. He now seldom suffered from the prostrating headaches of his earlier years, and in the interval of occasional journeys to Scotland or London his time was spent in pleasant invention at his home.

A large attic at the top of his house was fitted up as a workshop and became known as his Garret. The room was reached by a narrow stairway leading up from the kitchen and had a double window overlooking a shrubbery. In this attic Watt spent many happy days going over his old experiments in search of possible mistakes and in inventing new contrivances. When deeply engrossed upon some particular problem he would confine himself to his workshop for days at a time, even cooking his own meals on the attic stove rather than tear himself away from his hobby long enough to dine downstairs.

Watt's Last Invention

While on a visit to Paris in 1802 Watt had seen an ingenious machine for tracing and multiplying the dies of medals, and the later years of his retirement were mainly devoted to inventing a machine along similar lines for copying statuary. He developed his machine to the extent of a rough working model and with it he executed a number of beautiful pieces of statuary, some in ivory and others in marble, alabaster and mahogany. He was very proud of these busts and statuettes, and also of a number of accurately finished medallions that he cut on the machine.

The principle of the invention was that of a "feeler" or guide point directed upon the piece of statuary to be duplicated. As the feeler passed over the carved surface of the model it caused a second arm, to the end of which was fitted a fine drill or tool, to cut out an exactly similar course upon an uncarved block with which it was placed in touch. Watt was surprised to learn one day that another resident in the district, named Hawkins, had also invented a similar device. It was suggested that they should combine and take out a joint patent, but Watt was not disposed to bother with more patents so late in life, pursuing his hobby merely for amusement.

As time passed, the days spent in the attic workshop became less frequent, and during the last year or two of his life Watt made but small progress with this, his last invention.

In the autumn of 1819 Watt was taken ill, and passed away peacefully on 19th August at the age of 83. He was interred close to Boulton in a side aisle of Handsworth Church, where later a beautiful monument, carved by the famous sculptor Chantrey was erected in his memory. Chantrey also executed the magnificent statue of Watt placed in Westminster Abbey.

Few pioneers in science and engineering have lived a life so remarkably full in years and achievement. Labouring for many years under the disability of almost constant ill health, Watt nevertheless brought his steam engine to a state of efficiency that enabled it to usher in the age of modern mill machinery, to pave the way for the birth of steam locomotion, and to find employment for nearly a million people. Many honours were conferred upon him during his lifetime by learned societies. He was also offered a baronetcy, but this he modestly declined.

Some years after the death of Watt the Soho Manufactory was closed down and the business of the firm all accommodated at the newer works.

Although the famous firm of Boulton, Watt & Company ceased business many years ago, the Soho Foundry still stands, and it is to-day in the possession of W. and T. Avery Ltd., who are as well known for their weighing machinery as their predecessors were for steam engines. As far as possible the firm have retained the original structure, and though a few of the old buildings have been pulled down and replaced by more modern premises there still remain some interesting relics of the past. Many of the original Watt workshops are occupied at the present time, while the old coining mint is now used as a smithy. As recently as 1913, when getting out foundations for the laying down of new machinery, old coining blanks were found, and it is supposed that these must have slipped down one side of the previous foundations, made over 100 years ago.

A wall planer, supposed to be the first of its kind ever built, is still working in one of the old Watt buildings, and on a shelf at the side of this machine is a long screw that has been in readiness for over 30 years to replace the screw at present in the machine, and which has done excellent work, probably ever since the planer has been in use. As the old screw shows no signs of becoming worn out, the spare one may remain unused for another 30 years! Interesting illustrations of several of the Soho machines that are still working were given last month.

An Ancient and Famous Bridge

Photo] [*A. G. Allan*

The Brig o' Balgownie, shown above, crosses the Don near Aberdeen. It has a single pointed arch of about 67 ft. span and was built in 1281 by Bishop Cheyne.

In 1605 a bequest of £2 : 5 : 8½ was made for its maintenance and to-day this sum amounts to £26,500. The bridge, which is well known for its associations with Lord Byron, is the subject of one of the new L.M.S. posters.

Killing Fish With Dynamite

An Exciting Fishing Expedition Off the Coast of Peru

By Mannin Crane

MAY the shade of Izaak Walton forgive me when I state that dynamite is a very great help in fishing on a fairly large scale. There are many out-of-the-way places in the world far beyond the reach of law and order, and one such place is Santa Island, off the coast of Peru. As a fishing ground, the coast-line of this small Pacific island has been undisturbed throughout the ages.

It was my lot to form one of the crew of a sailing ship lying at anchor near this island. The nearest outpost of civilisation was over twenty miles away, which made it difficult for us to obtain fresh food. We decided to fish for food.

Maybe we became as lazy as the natives owing to our prolonged stay in the locality. Whatever the cause, we broke away from the conventional methods of fishing and used dynamite.

Properly used, this explosive is remarkable in its effects and fruitful in its results. But let me describe a dynamiting expedition. It was usually undertaken by the captain in person, an elderly but genial Scotsman. Accompanying him were the four apprentices in the ship's gig, a nice, handy, four-oared boat.

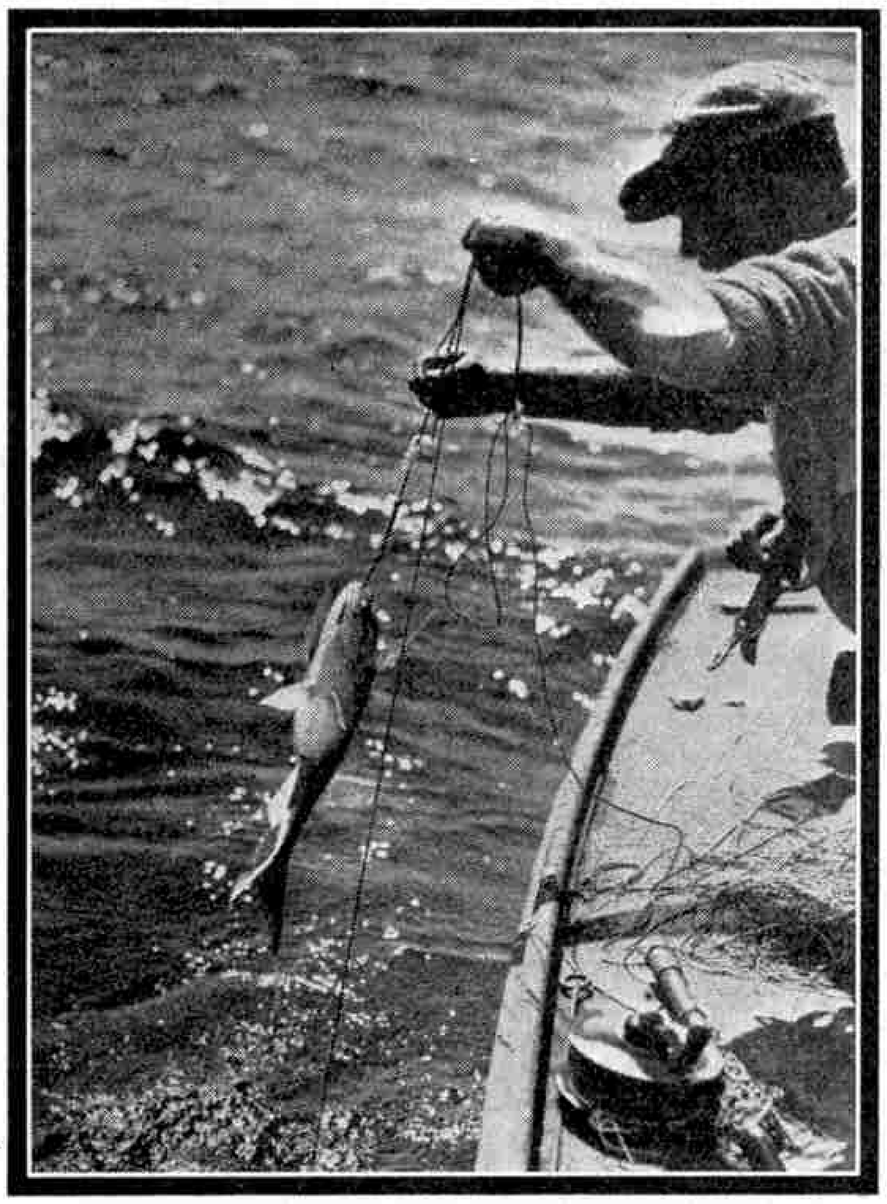
Having had breakfast we manned the boat and pulled round to the accommodation ladder to embark the captain and take such stores as were necessary. These mainly consisted of food, water, and a small Primus stove for a snack at midday.

The apprentices always felt a thrill if the captain lurched into the boat rather heavily, for we never went fishing unless the weather was too bad for working the cargo. There was an additional thrill when he slapped his coat pocket with his hand just to make sure that he'd got the dynamite with him.

Sometimes we had to row four or five miles to what we considered was a suitable spot. We knew nothing of the signs, good or bad, but certain conditions had to be fulfilled. The main one was that the locality chosen must be sheltered from the weather, and consequently, we had to pull round to the other side of the island, which itself was well over a mile in length.

On arrival at a likely site the boat was stopped and she was turned round, with her bows pointing out to the open sea. Then the "Old Man" produced the dynamite from his pocket. A stick of dynamite in shape resembles the old-fashioned tallow candle, and in appearance is very like almond icing.

The first time I saw the "Old Man" cut a stick into three portions with a pocket knife I held my breath, not even daring to use it for a muttered prayer. The next thing produced was a length of time fuse. This was cut into convenient lengths, to occupy from five to seven minutes in burning. At one end a tiny detonator was fixed, and this end was inserted into the end of a piece of dynamite stick. When the fuse was properly alight the dastardly machine, to which a stone had been attached, was thrown as far away as possible. The stone, of course, was merely a sinker to take the explosive to the bottom quickly.



An Anxious Moment!

Once, however, the paper was insecurely wrapped and the stone fell out, reaching the bottom, no doubt, but the paper formed a nice float for the dynamite, which duly made a big noise and blew over the "Old Man" into a most undignified position in the bottom of the boat! This, in spite of the fact that four boys tried to cover a quarter of a mile in two minutes, which was not bad going for a heavy ship's boat. Had it not been for several minutes wasted in panic we might have admired the big splash.

There was another occasion when the explosive charge slipped out of his hand and flew back over his shoulder amongst us.

For one hectic minute we searched the bows of that boat without result. We even stood stock still in the hope of hearing it fizz. Then we arrived at the conclusion that it had dropped overboard after all!

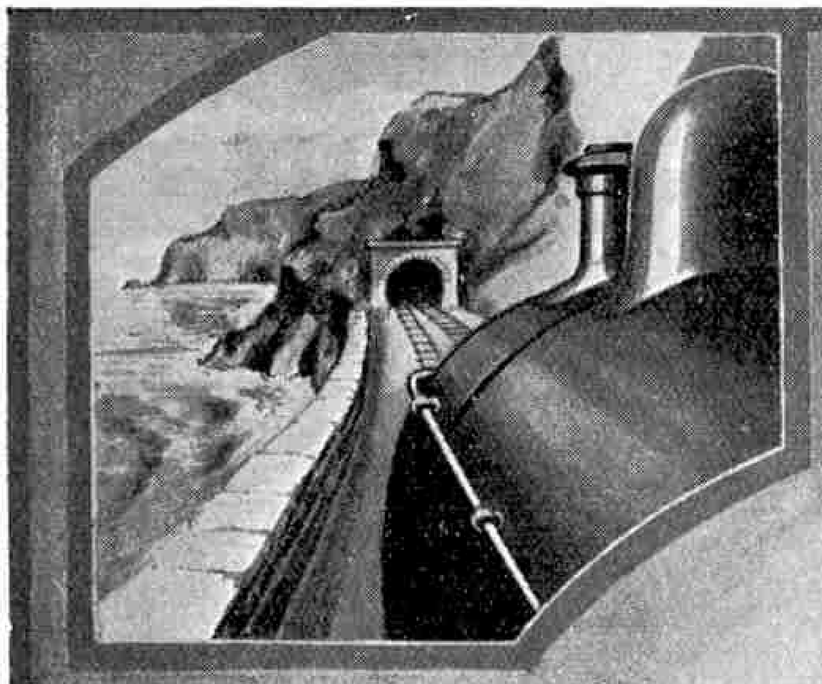
In the ordinary way, however, the "Old Man" would be able to throw the charge of explosive about thirty yards, whereat we boys pulled away to what we regarded was a safe distance. In due course the bang came, which was exactly as if four upstairs doors were slammed simultaneously. There was little or no disturbance at the surface of the water, unless the charge had been dropped in shallow water.

Immediately following the bang the boat was backed in to the situation of the explosion. Even as we approached, the fish would come up to the surface in hundreds, and float on top. The shock of the explosion stunned them for several minutes, and we had to be extremely nippy indeed before they commenced to show signs of life. First, one would go hard-a-starboard in sedate circles, just like the old-fashioned circus horse. A beauty of a rock cod would shake a tail. A big albacore, feeling undignified with his heavy list to port, would make desperate efforts to get on an even keel. But meanwhile we plied net, boat-hook and hands to gather all we could. At the end of three or four minutes every fish in the neighbourhood, including those in the boat were as lively as crickets. Sometimes our catches were very good, and as many as five dozen would result from one charge. On other occasions our greediness resulted in a poor lot.

There was much variety in the captures. Occasionally we would land some herrings, but mostly it was mackerel and rock cod. Snappers and devil fish —which are something like the English gournet—came frequently, as well as a kind of mullet. Bonitoes and albacore were fairly common, but our best catch of all was a rare type of seal-otter, known amongst sailormen as a sea-cat. This possessed a valuable kind of fur which eventually adorned the shoulders of the Captain's wife. There is one thing I must mention about that sea-cat. It had a dreadful temper, and it took complete charge of the boat for a while. We won eventually, but you can be assured that there are five sailormen in this world who have a great respect for sea-cats—and incidentally, for fishing with dynamite as well.

Dynamite is sometimes used by poachers in Great Britain on their nocturnal raids, for which purpose it has the merit of being sudden in action. After the explosion the fish may be collected in a few minutes and the poachers thus are able to get away quickly enough to evade capture.

*By permission of the Editor, "*Cunard Magazine*"



Railway News of the Month

Lord Nelson "Passes Out"

No. E.850, "*Lord Nelson*" of the Southern Railway, described in detail in our February issue, has now earned its right to be called a "journeyman" engine, having recently passed the final tests of its "apprenticeship." Its last test consisted of hauling the "*Atlantic Coast Express*," normally an eleven-coach 360-ton train, but for this occasion specially made up to 16 coaches totalling 521 tons, from Waterloo to Exeter, 171¾ miles.

The run is usually performed by engines of the "King Arthur" class and consists of two portions, Waterloo to Salisbury, 83¾ miles, and Salisbury to Exeter, 88 miles. The latter stretch includes the famous Honiton Bank, a seven-mile gradient at 1 in 100 and 1 in 80. A change of engine is made at Salisbury and the scheduled times for the two sections are 90 and 103 minutes respectively.

Despite its load being considerably greater than any single engine had ever been called upon to tackle on this run, "*Lord Nelson*" was given the normal schedule, and made light work of it. But that was not the end of the job, and on arrival at Salisbury the change of engines was dispensed with and "*Lord Nelson*" went on to Exeter, later in the day to perform the homeward run. No special running was attempted, but between Chard and Seaton on the down run, eight consecutive miles were rattled off at over 85 m.p.h.

* * * *

The Non-Stop Rumours

Ever since the installation by the L.M.S. of the new water troughs north of Carlisle, there has been considerable speculation as to whether it was intended to make a bid for the honour of running the longest non-stop service in Great Britain. There has been much talk of a non-stop run between London, Edinburgh and Glasgow, but we are able to state authoritatively that there is not the faintest possibility of such a service being instituted. Neither men nor machines could stand the strain.

Actually the intentions of the East and West Coast Companies are these. The 10 a.m. trains in each direction between Euston and Edinburgh, L.M.S., King's Cross and Edinburgh, L.N.E.R., will run with *no publicly-booked stop* between London and the Scottish cities. Stops will be made for train examination and change of engines and crews, however, as follows :—

West Coast : Carnforth, 236¼ miles from Euston, Carstairs (to divide the train) 136¼ miles from Carnforth. (This run will include the negotiation of Shap Summit, 915 ft., and Beattock Summit, 1015 ft. above the sea).

East Coast : Newcastle-on-Tyne, 268½ miles from King's Cross (the "Flying Scotsman") and then Edinburgh, 124½ miles from Newcastle.

The honour of operating the longest daily non-stop run will belong, however, to the L.M.S., for the L.N.E.R. service is booked only for four days per week.

These trains will run from mid-July to mid-September only, and there is to be no acceleration of service.

* * * *

"Gladstone's" Farewell

Railway enthusiasts had a field day at Waterloo recently when the famous old Stroudley engine "*Gladstone*," built in 1882 for the London Brighton and South Coast Railway, was hauled into the station on its last journey by the Southern Railway's "*Lord Nelson*."

The "*Gladstone*" was withdrawn from active service some years ago and is now to be exhibited at the Railway Museum at York prior to permanent preservation at the South Kensington Museum. Repainted in its old familiar gamboge with red, black and green lining, it made a striking picture beside "*Lord Nelson*," and the public was not slow to take advantage of the opportunity of inspecting these two famous engines, the one the "crack" locomotive of 1882 and the other holding the same exalted position in 1927. An item of personal interest was that the repainting of "*Gladstone*" was carried out by Mr. William Crick who was one of the original team of painters that painted the engine when it was first built.

* * * *

SHEFFIELD NOTES

Many local trains from Sheffield (Victoria) are worked by the small 0–4–4 tank engines built for the Lancashire, Derbyshire and East Coast Railway, and later on taken over by the Great Central Railway. Nos. 6402, 6403 and 6407 were noticed among engines of this class recently. These engines were built in 1897 by Kitson's of Leeds. Most of the trains they operate consist of somewhat out-of-date six-wheeled carriages. Other locals are worked by 4–4–0 tender engines of the numerous "Pollitt" class, fitted with weather-boards on their tenders for reverse working. More important express working is in the hands of rebuilt 4–4–0's of Mr. Robinson's first design and of this class Nos. 6027, 6031, 6034, 6041, also 5106 and 5111, were seen recently.

An express of Great Western carriages arrived at 3.4 p.m. from Barry Docks, Southampton and South of England behind No. 5425, "*City of Manchester*" (4–6–0) and left at 3.10 for York and the north behind 6027. A through G.W. Coach for Doncaster and Hull was taken off this train, which leaves Victoria Station in the opposite direction to that in which it arrives.

From Liverpool and Manchester an express for Rotherham, Mexborough, Doncaster and Hull was brought in by one of the earlier "Director" class, No. 5435, "*Sir Clement Royds*." With the Great Western coach attached, this express left again behind 4–4–0 No. 5111. The corresponding express to Liverpool was taken by 4–6–0 No. 5428, "*City of Liverpool*." A Manchester-London "flier" was hauled by "Director" No. 5506, "*Butler-Henderson*." This consisted of six carriages only.

DONCASTER NOTES

King's Cross to Leeds expresses change engines here, and owing to the heavy gradients of the latter portion of the run, powerful Great Central type 4–6–0's of the "Immingham" class are largely employed. Nos. 6099 and 6100 of this class took heavy trains over from Pacifics 4473 "*Solario*" and 2559 "*The Tetrarch*." Up expresses were hauled largely by "Pacifics" and "Atlantics," but a four-cylinder G.C. mixed traffic locomotive No. 5465, was also observed. An up Scottish "flier" was double-headed, presumably in the absence of a "Pacific," and old 4–4–0 as train engine being piloted by a Doncaster "Atlantic." Other engines noted include 2544 "*Lemberg*" (Pacific); 109, a new 2–6–0 of standard L.N.E.R. design; Great Eastern 4–4–0's 7706 and 7719 and 0–6–0 tanks 7266 and 7361; North Eastern "S1" 4–6–0 No. 2114; Hull and Barnsley domeless 0–8–0 mineral engine No. 2501; ex-Lancashire, Derbyshire and East Coast Railway, 0–4–4 tank No. 6403. Trains of the London, Midland and Scottish Railway were mostly hauled by Lancashire and Yorkshire 2–4–2 tanks, which seem to be visitors to so many stations up and down the country; and Midland 2–4–0 tender engines, of which No. 270 was marshalling empty trains. Most of the station shunting is performed by small but very sturdy saddle tanks of the several Great Northern classes, all having the 0–6–0 wheel arrangement.

NEWS FROM GLASGOW

Sunday excursion trains to Fort William recently left Queen Street with 9408 "*Glen Sloy*" piloting 9241 "*Glen Ogle*," 9490 "*Glen Dessary*" piloting 9281 "*Glen Murran*," and 9153 "*Glen Fruin*" piloting 9493 "*Glen Luss*." On the first train 9408 came off just outside Fort William leaving 9241 the honour of being the first engine to arrive at Fort William Station on a Sunday. At Fort William Shed—the foreman of which is the former driver of 6380 "*Evan Dhu*" (Eastfield)—were G.N.R. 2–6–0 4691/6/8; 0–6–0 9651, 9784 and 9665 (in steam for shunting); 9258 "*Glen Roy*" and 9298 "*Glen Shiel*" (both recently repainted). There were thus at one time eight "Glens" at the shed. The first train had 310 tons, and the second and third 345 tons, the third including an all-steel diner. Each train would carry over 500 people.

On a subsequent Sunday 9493 piloted 9221 "*Glen Orchy*" on 345 tons, while a second train of similar composition had 9408 piloting 9490. More recently, 9241 piloted 9493 and 9490 piloted 9408 (always on 345 tons). On a recent Saturday, 9500 "*Black Duncan*" hauled the 1.56 p.m. to Edinburgh, while the two o'clock had a 6 ft. "Glen," 9256, the loads being 260 and 300 tons respectively. It is unique for a "Glen" to work the two o'clock.

The 6.29 Edinburgh-Glasgow recently had "Scott" 9416 "*Ellangowan*" on instead of a "Director" and kept exact time, whereas for two nights running "Director" 6401 lost three minutes—the driver blaming bad steaming. A brisk run was made on the 12.10 ex Edinburgh recently, 9281 (6 ft. driving wheels) knocking off three minutes on 225 tons. 9425 "*Kettledrummle*" (Haymarket) has been doing good work on "Director's" turns on the Glasgow road, working on Sundays as well.

After "Pacific" 2564 had been overhauled at Cowlairs, 2566 "*Ladas*" came in; 4–4–0, 9597 (Haymarket) recently left Cowlairs with her first coating of green paint, about two months after 9769 had been similarly treated, and these are among the very last engines to lose the old N.B.R. colour.

G.N.S.R 4–4–0 6858 is scrapped.

L.N.E.R. Notes from London

The following "foreigners" have been noted working on the G.E. Section :—

N.E. Section—4–4–0's 1540, 1880, 1927, 1929.
0–6–0's 379, 1017, 1024, 1027, 1034, 1052, 2357, 2358, 2359, 2361, 2362, 2387, 2388, 2389.

G.N. Section—0–6–0's A3640, 4085.

G.C. Section—4–4–0's 5113, 6399 "*Allan Bane*."
0–6–0's 5141, 5797, 5811, 5814, 5815, 5829, 5834.

G.E. Section—0–6–2T 8006 was recently observed working on the G.N. Section.

G.N. Section—0–6–2T's 4581, 4589, 4615, 4731, 4732, 4743, and 4749 have been fitted with the Westinghouse brake.

Station as Dance-Hall

The announcement recently made by the Southern Railway that Ramsgate Harbour Station is to become a dance-hall is not, as might be supposed, a joke; it marks the completion of important railway changes in Thanet (East Kent). The old London, Chatham, and Dover line followed the coast as nearly as possible and came to a full stop down by Ramsgate Harbour. Its rival, the old South Eastern, on the other hand, reached Ramsgate by an almost direct line from Canterbury. Subsequently a "spur" line was run out northward to Margate sands, which adjoined the Margate West Station of the Chatham and Dover Co. One result of this layout was that passengers going inland had to walk or take a cab from Ramsgate Harbour to the Town Station.

That unpopular procedure will no longer be necessary, for a new branch has been constructed from the old Margate-Ramsgate line which cuts out the tunnelled approach to Ramsgate Harbour and connects conveniently with the Ramsgate-Canterbury line of the former South Eastern Railway. At the junction a new station has been erected, called "Ramsgate." Margate Sands Station was closed some time ago, and Margate West also will soon be but a memory, as it is to give place to a commodious new station built on modern lines. The Harbour Station at Ramsgate will be adapted for use as a dance-hall, and although obsolete railway stations have been put to many varied uses, this is probably the first occasion upon which such a change-over has been made.

These changes are part of a large development scheme that is being put in hand by the Southern Railway in the East Kent area. Other important alterations include the rebuilding of Dover Priory Station and the removal of Dover Harbour Station. It is probable that no other of the grouped railway companies has tackled its development problems and possibilities so wholeheartedly as the Southern, as is witnessed by its large electrification schemes in the London district, and the remodelling of Cannon Street Station, already described in the *"M.M."*

* * * *

There is considerable activity in new railway work in South America and the Governments of Bolivia, Ecuador and Salvador have schemes in hand.

Harmless Pneumatic Doors

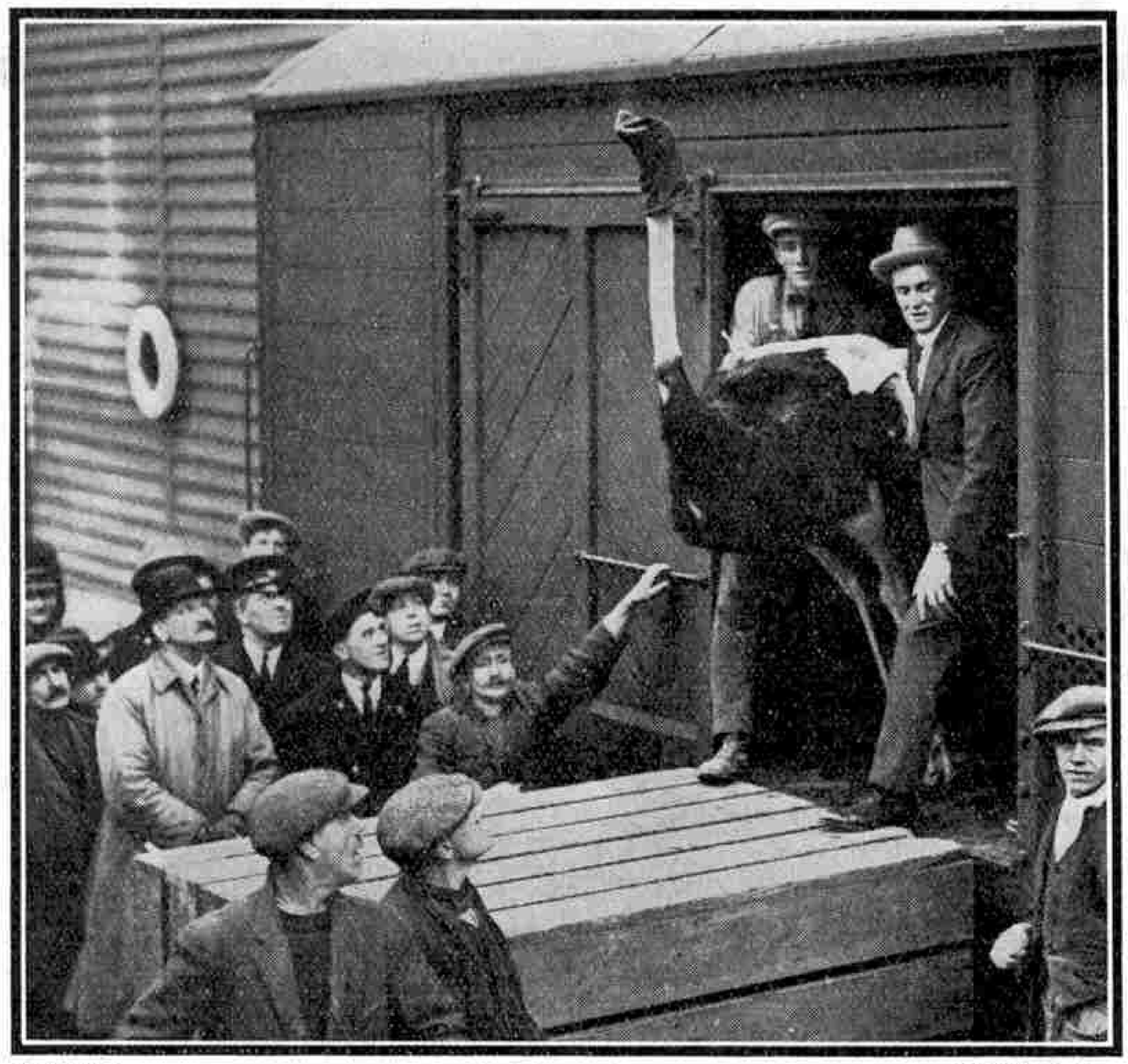
The London Underground Electric Railways have recently issued an interesting repudiation of the stories current of passengers having been caught by the pneumatically-operated sliding doors of the tube trains, thereby sustaining injury. It is pointed out that there has been no serious accident of any kind during the company's four years' experience in the operation of pneumatically-controlled doors, and it is claimed that these are considerably safer than gates of the manually operated type.

The doors are controlled and operated by the guard on whose platform the controlling device is placed, and it is impossible for the train to start unless all the doors are closed. Only when the doors are closed can the guard give the "all clear" signal to the driver, and it is obvious, therefore, that when any obstacle, such as a passenger's coat-tail, prevents a door from closing, the train must remain stationary. The air pressure of the doors is retarded during the last 5 in. of the closing stroke and so gentle is the action that it is possible to hold the doors open by hand. Thus passengers can quite easily free themselves if necessary. The company state quite definitely that it is impossible for any physical injury to be caused by the closing of the doors.

* * * *

The L.M.S. boat services from Fleetwood to Belfast are to be transferred to Heysham.

An Unusual Freight



Courtesy] [*Southern Rly.*

This photograph, published by the courtesy of the Southern Railway, shows an ostrich being unloaded at Nine Elms. It will be noticed that the bird's head is hooded and its legs pinioned

American Locomotive Colour Schemes

Overseas visitors—especially Americans—frequently express admiration for the artistic finish that adds interest to most British locos. The practice abroad is to regard anything in the way of adornment as out of place on a machine built purely for utilitarian purposes, but news comes from the United States that a serious attempt is being made on some railroads to take a leaf out of the British book. New engines for the Baltimore and Ohio line, for instance, are being placed in service with an elaborate finish. Their boilers, tenders, cabs, and other main surfaces are finished in an attractive green shade, lined with red and gold. The wheel-spokes and centres are also lined out in the latter colours. A new class of express "Pacifics" is now appearing in these attractive colours. Furthermore, the engines bear names.

A very striking scheme of painting has been adopted for some new "Pacifics" built by the "Big Four" system of railroads. They are finished in what is termed "battleship grey," relieved by black and aluminium-coloured panelling. The engines of the Chicago and North Western Railroad are now appearing with a monogram of the company's initials adorning the tender panels. Certain other railroads in their latest decorative schemes provide for aluminium paint for the running boards and even the tyres of the engines, while the names of the regular engine crews appear in red and gold lettering on the cab sides. An innovation is the providing of mascots, generally similar to those in favour with motorists, fixed to the headlights and boiler fronts of the great engines.

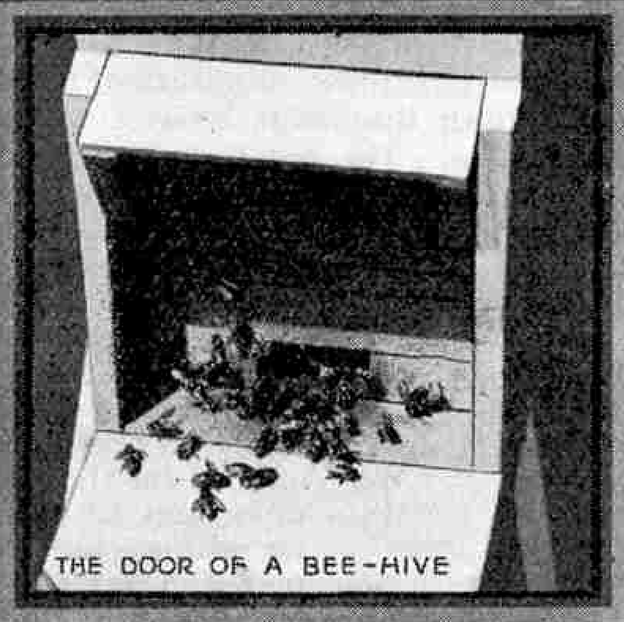
* * * *

Concrete Railway Track

A quarter of a mile of experimental track, consisting of strongly reinforced concrete slabs 10 ft. in width and 21 in. in thickness, has been laid in America, in an endeavour to discover a means of eliminating the never-ending and expensive process of re-surfacing railway tracks. The rails are to be laid direct on the concrete and the only doubt as to its suitability is its lack of resiliency.

* * * *

The Japanese Government has sanctioned the Osaka Municipality's scheme for an underground electric railway, 35½ miles in length, at a cost of £16,000,000.


THE DOOR OF A BEE-HIVE

The OUTDOOR WORLD

AND ITS HIDDEN BEAUTIES

V.—AN OLD-TIME CRAFT: FLINT KNAPPING

THE village of Brandon in Suffolk possesses the distinction of being the centre of the art of flint knapping, the name given to the process of forming various articles out of flint by means of a hammer.

At one time the only method of obtaining a light was the flint and steel, and as flint-lock guns were in daily use, these two requirements kept the craftsmen busy at their trade, forming the flints for the tinder boxes and the small pieces that screw into the hammers of the guns.

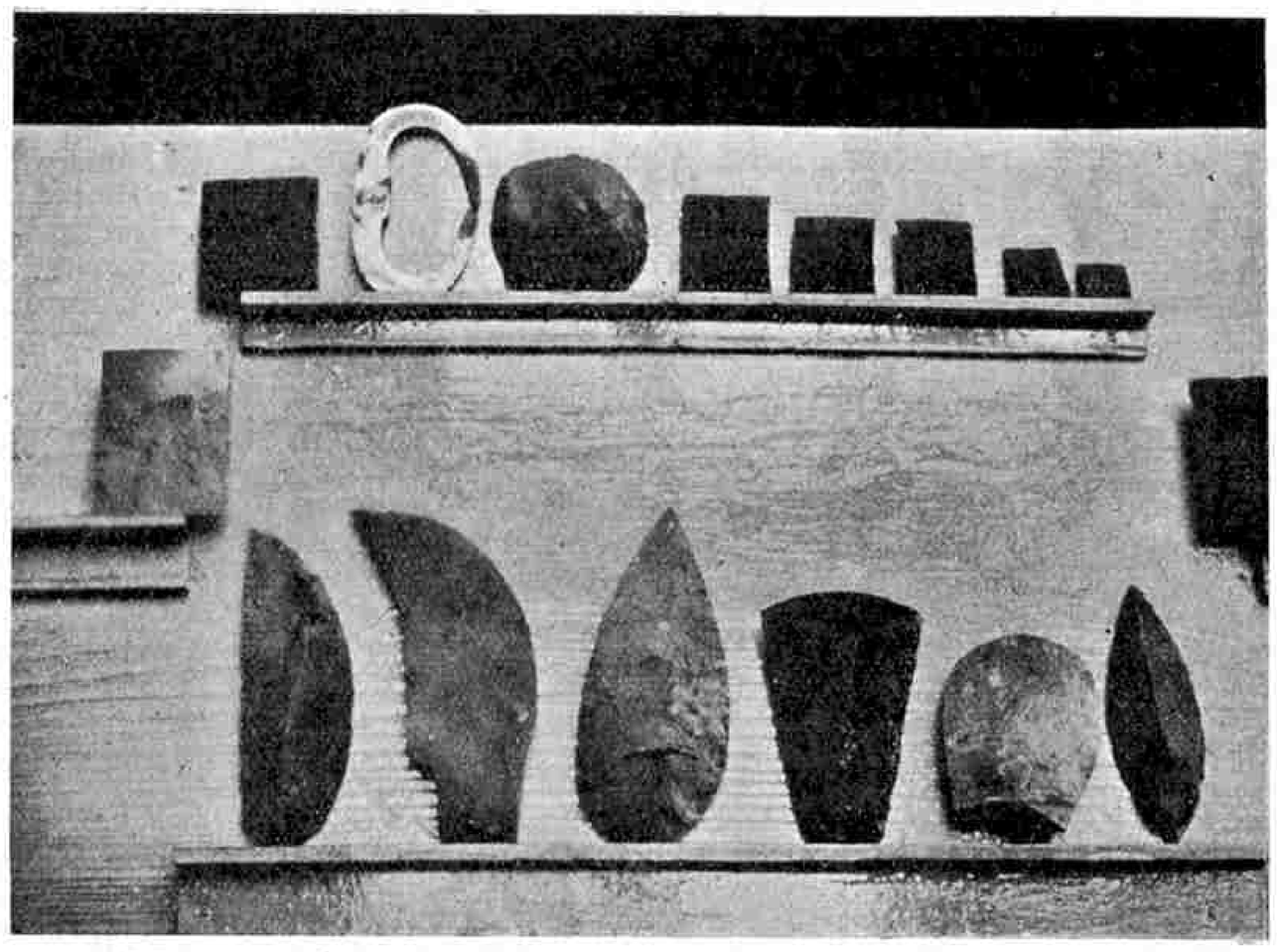
It will be readily understood that the formation of any article in flint, which is exceedingly hard, is not easy particularly as the forming process is not done by any cutting action, such as the ordinary mason employs. All the forming is done by cleavage and fracture and it is one thing to dress up and carve a block of stone by means of many blows with a mallet and chisel, and quite another to hit a flint with a hammer in such a way that a piece will break off of a certain shape.

Quartering Flints

Since the days of flint-lock guns, flint knapping as an industry has declined, until to-day it is represented in Brandon by Mr. Fred Snares, whose photograph is reproduced on the accompanying page. Recently the writer spent some hours with this exceedingly interesting gentleman and the information obtained has resulted in this article.

The flints are obtained by quarrying through the chalk (which underlies the Counties of Norfolk and Suffolk) in the neighbourhood of Brandon. It is held that flints are petrified marine growth and small fossilised shell fish, such as cockles, often are found embedded in stones which lie about 40 ft. in the chalk.

Occasionally the flints are found to be hollow when broken with a hammer and contain sea coral. Also there is sometimes found a small marine worm that is capable of boring a hole through an oyster shell to get at the meat. This water worm has bored its way presumably into the mass of marine vegetation, before petrification took place and its fossilised remains are found very frequently in the flints when broken, sometimes forming curious designs, such as letters and faces.


Copies of Prehistoric Flints Found in the District

Flint knapping may be said to be a heriditary art that has grown from almost prehistoric times, and Mr. Snares' ancestors have lived in Brandon and carried on the trade for generations.

The sportsmen who handle their hammerless ejectors on the 12th of August are probably unaware that there are to-day in existence many thousands of flint-lock guns. These have been distributed to the natives of various semi-savage countries where arms of precision are forbidden, and in

providing flints for these people Mr. Snares finds quite a large part of his occupation. Another of his activities was the manufacture of tinder boxes for the troops in the trenches during the great war. Yet another is the cutting of flints to form pieces of a mosaic design for the ornamental floors of churches, institutions, and mansions. Last, but by no means least, is the copying of genuine prehistoric flint implements such as knives, spears, arrow heads, etc., for inclusion in the exhibits of those museums that are unable to obtain a set of genuine prehistoric articles on account of their scarcity. This latter art is wonderfully clever and the implements Mr. Snares makes with a few blows of his hammer would deceive anyone but an expert upon prehistoric flints.

Mr. Fred Snares with his Flints Packed for Export

The implements shown in the photograph on page 692 consist (top row from the left) of a square flint and "C" shape steel out of a tinder box. The round flint was made in a few minutes whilst we looked on. The five square flints on the right are the different sizes that screw into the hammers of flint-lock guns. The square pieces on the middle shelves, right and left, are portions prepared for a mosaic design, whilst the bottom row (reading from the left) are copies of prehistoric implements found in the neighbourhood—a saw, a knife, a spear, a chisel, a skin scraper for dressing hides, and an arrow head.

Mr. Snares' house is a positive museum of interesting articles connected with his trade and one of the most curious things he showed us was two photographs of ancient skulls upon which an operation of trepanning had been performed by means of flint implements. The area of bone to be removed had been drilled round in series of holes with a flint pointed drill and the operation completed with a fine flint saw.

The actual working of a flint was then illustrated by Mr. Snares from start to finish. Putting on an apron, and strapping a pad composed of many thicknesses of leather upon his left thigh, he took up a large flint as big as a football and with his 7 lb. hammer broke it into four, the operation being called quartering. He selected one of the quarters and taking a hammer about 4 lbs. weight with a sharp point at each end, and something like a very stunted pickaxe, Mr. Snares dealt the flint a series of short quick blows. Each blow produced a flake of flint three or four inches in length and a couple of inches in width, varying between $\frac{3}{4}$ in. to $\frac{3}{8}$ in. thick, which may be seen resting on the right leg. In striking the blow, the hammer is not swung but pushed at the stone as if the worker were delivering a punch, and the result is a flake or thin sliver of flint of the form, thickness and shape that the skilful worker desires.

The process of knapping is really trimming. The hammer used is quite light and made from an old file from which all the temper has been drawn. An iron stake about two inches by half an inch is driven into a substantial wood log and the flake of flint rested upon this by the left hand whilst the right fore-arm and wrist rests on the groin. The knapping hammer is used by the wrist only and delivers a quick rain of blows upon the edge of the flint as it is turned about by the fingers of the left hand upon the stake. Squares, ovals, rounds and crosses are formed, apparently with the greatest ease. Mr. Snares is quite able to make a flint bracelet or girdle composed of round rings of flint, and showed us photographs of several such ornaments of his manufacture.

Whilst watching these operations the writer was struck with the accuracy with which the light blows were delivered, and felt that one part of the secret of flint knapping is to be able to deliver a light, quick, blow in the place required with hair-breadth precision.

Slating Flints

It is an arresting idea to feel that from the small work-yard at the rear of Mr. Snares' premises, flints are being exported to the west coast of Africa, Borneo, Singapore and the Arctic regions. The flints are packed in small bags made of sacking and taken into uninhabited regions on the backs of dogs, working along trails that would be impassable to any other form of transport. For the purposes of shipment these small bags of flints are packed into elongated wood barrels, to be seen in the photograph of Mr. Snares standing at his back door.

The historical side of the art will be appreciated when we see that the village of Brandon is mentioned in the Doomsday Book and that men from Kent were sent there to obtain flints and implements (*Continued on page 711*)

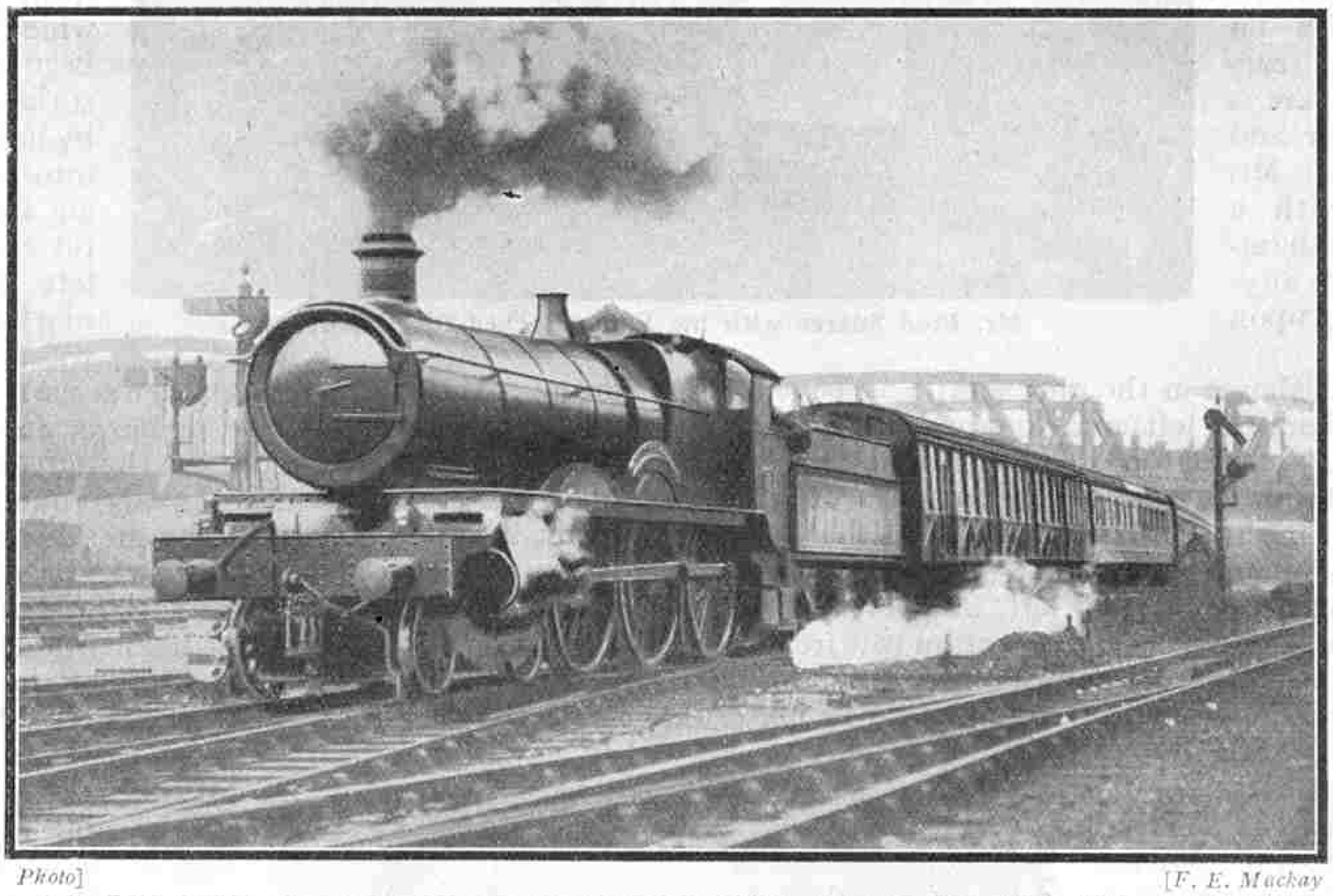
FAMOUS TRAINS: VIII.

The Fishguard Boat Express, G.W.R.

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

ONCE again the subject of our consideration is to be a "boat" express—that is, a train run in direct connection with a steamer service. North-eastward and south-eastward we have hurried from London, in the last two articles, in order to cross to the Continent of Europe; this month we are going due westward, *en route* to Ireland.

In one sense Fishguard is unlucky. For a time it figured as a transcontinental port, when the Cunard liners from America were calling there to set down passengers and mails for London and the Continent, on their way to Liverpool. While this arrangement was in force, the Great Western Company made some wonderful running between Fishguard and Paddington, doing the 145¼ miles from Cardiff to town at an average speed of over 60 miles an hour on several occasions. Some of the fastest overall times in history between New York and London were made during the period in question.



Photo] [*F. E. Mackay*

The Paddington-Fishguard Express leaving Paddington, Engine No, 2933 "*Bibury Court*"

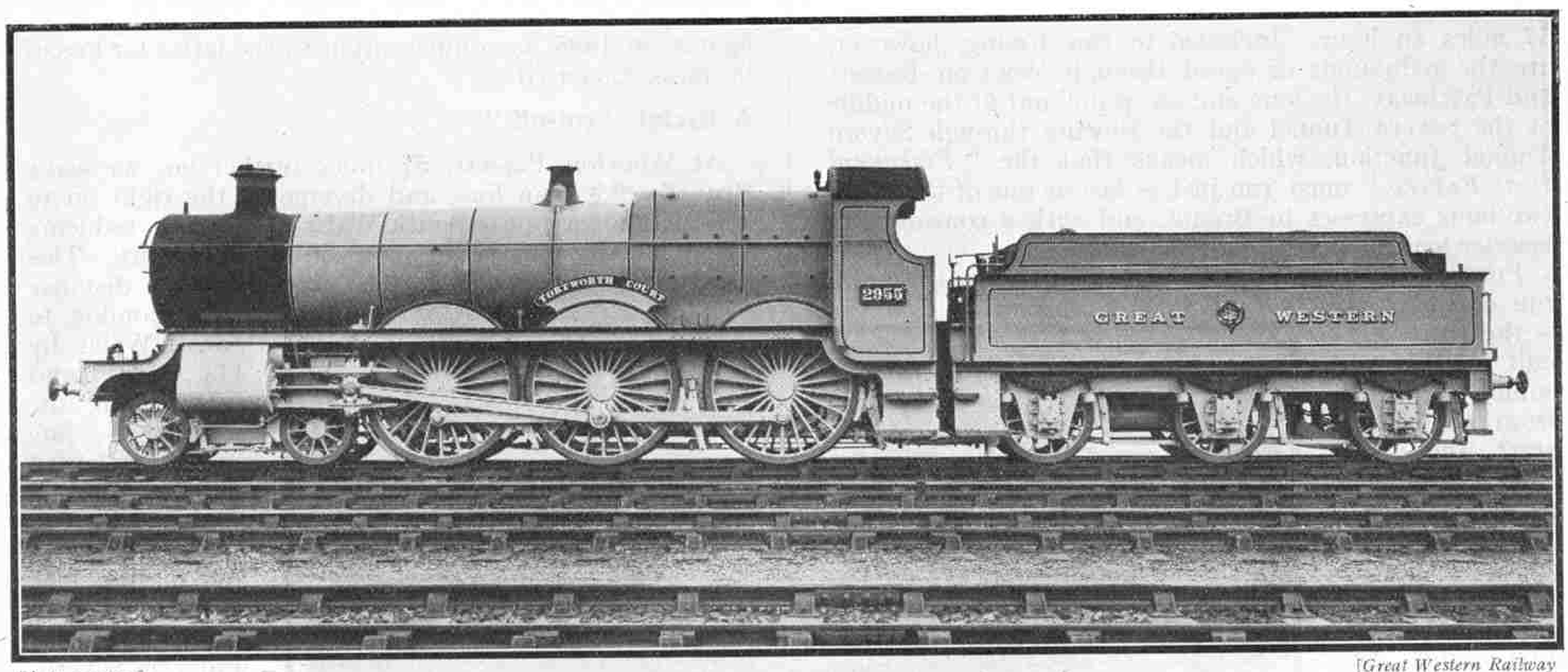
But the Cunard Company succumbed later on to the superior charms of Southampton, instead of Liverpool—as most of the big trans-Atlantic lines have done, the Southampton route making possible also a direct Continental call at Cherbourg—and this added glory of Fishguard therefore ceased to be. The Great Western have lately derived a good deal of compensation, however, from the calling of various Atlantic liners regularly at Plymouth, on the inward journey, whence passengers and mails are whirled to Paddington by Great Western "fliers" in but little over four hours.

A Great Western Railway Creation

When the port of Fishguard, which is a Great Western Railway creation, was completed, day and night steamer services were instituted between there and Rosslare, a new port on the Wexford coast of Ireland, with special connecting trains from there to Waterford and Cork. From Paddington the boat expresses left at 8.45 in the morning and 8.45 in the evening. During the war, however, the day service vanished, although the connecting express, with its important South Wales stops and connections, still runs at the slightly altered departure time of 8.55 a.m.

The night service was first altered to 8 p.m. out of London, and then, in harmony with the systematic departure times of expresses that were standardised a couple of years ago — whereby you now leave Paddington for Birmingham and the North at 10 minutes past the hour, for Bristol at 15 minutes past, for the West of England at 30 minutes past, for the Oxford and Worcester line at 15 minutes to, and for South Wales at five minutes to—it became 7.55 p.m., which is the present starting time. The train has a total distance of 261¼ miles to cover, which has, on the occasions of special "day excursions" to places as far afield as Killarney, been done on several occasions without intermediate stop. To-night we shall stop at Reading, next at Newport and the closely adjacent city of Cardiff, and last at Swansea. The longest of these stretches is the 97½ miles from Reading to Newport, so that the train does not actually cover any distance in excess of 100 miles without intermediate stop.

Before we start, we must take a look at the train, which we shall find at No. 2 platform at Paddington. It varies a great deal in its composition, according to the season of the year, so that it is difficult to give precise details. At the rear end we find two or three coaches for Bristol, and we may well wonder how they are going to get there, seeing that we do not stop between Reading and Newport, until we notice on the back of the outermost coach the familiar red-and-white tail signals which indicate that this is a "slip" portion. They are to be dropped off at the back of our train away in the open country at Stoke Gifford East Box, some 6½ miles away from Bristol, and there a tank engine will take them in charge, and run them down



[Great Western Railway

Photo courtesy]

The Fishguard Express is generally hauled either by an engine of the "Court" class or one of the "Saint" class. Our illustration shows Engine 2955 "*Tortworth Court*"

into Temple Meads, what time we are diving downward in the opposite direction into the recesses of the Severn Tunnel.

Next come a couple of the vast Great Western 75-ft. "Ocean Mails" vans, destined to be next the engine when the express leaves Swansea. A sleeping car is the next vehicle, and if we fail to recognise its external lines as being truly "Great Western," it is possible that this is one of the cars acquired some time ago by the G.W.R. from the late London and South Western Railway, after the unsuccessful experience of the latter company in running sleeping cars between Waterloo and Plymouth. In front of this comes the ordinary passenger portion of the train, which may consist of five or six 70-ft. corridor coaches, or more, and then next the engine, the all-important "diner," which is to be left behind at Swansea.

Good Qualities of "Saint" Class Locomotives

Usually, therefore, the complete train is very heavy, and on this account it is the more surprising that its haulage, until quite recently, has been customarily entrusted to one of the two-cylinder "Saint" class 4–6–0 engines. These engines have always been at home on such moderately-weighted trains as, say, the up Bristol two-hour expresses, and Great Western drivers look on them as the freest-running and fastest engines on the system; but a train of 400 tons, and up, at times, to 450 or even 480 tons or so, is a tough proposition indeed for engines of this class. But, given a clear road, we shall find that our engine can just about manage it.

It was with No. 100 (now No. 2900) "*William Dean*," the first engine of this type, built in 1902, that Mr. Churchward set some striking new fashions in British locomotive design. Never before had so long a piston-stroke as 30 inches been tried in this country. It was done in order to make full use of the expansive properties of the steam, and to encourage the full-open regulator and short cut-off driving practice that has since become general on the Great Western Railway. In those days, too, 200 lb. per sq. in. was a high working pressure, and when, in following the purchase of three French-built compound "Atlantics," the figure was further advanced to 225 lb.—where it has since remained in the chief Great Western express locomotive designs—Mr. Churchward laid the foundation of some of the finest locomotive constructional practice that this country has yet seen. Now even the figure of 225 lb. per sq. in. working pressure is eclipsed by that of the new "Cathedral" class 4–6–0 engines, which is fixed at 250 lb. per sq. in.

Leading Dimensions of 2-Cylinder 4–6–0 "Saint" Class Express Engines, Great Western Railway

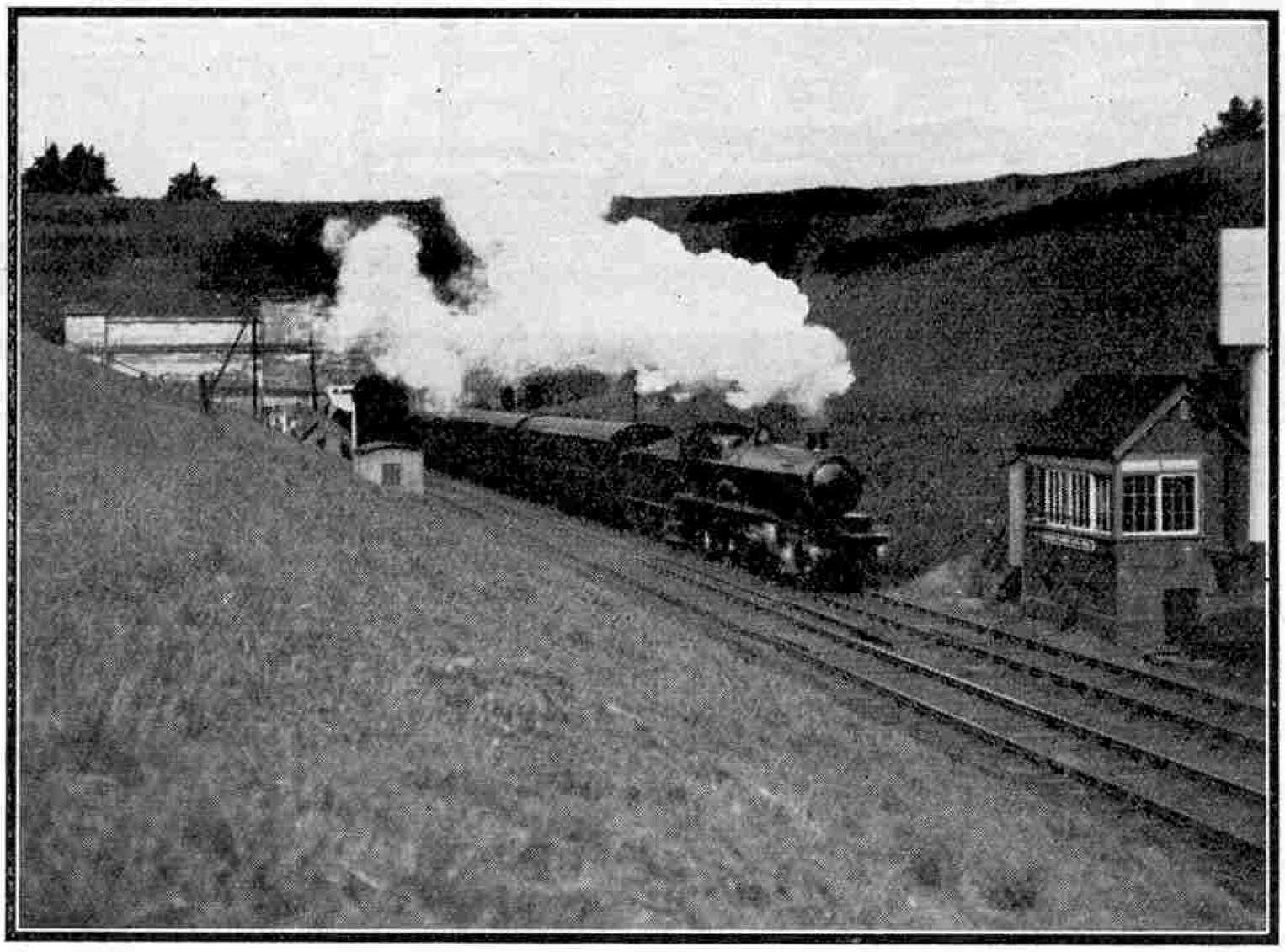
Cylinders, diameter	18½ in.
,, stroke	30 in.
Driving Wheels, diameter	6 ft. 8½ in.
Heating Surface, tubes	1,687 sq. ft.
,, ,, firebox	155 ,,
,, ,, superheater ...	283 ,,
,, ,, total	2,125 ,,
Fire-Grate Area	27 ,,
Working Steam Pressure	225 lb. per sq. in.
Adhesion Weight	50¼ tons
Weight of Engine (in working order)	72 ,,
Water capacity of tender ...	...3,500 gallons
Coal ,, ,, ...	5 tons
Weight of engine and tender (full)	112 ,,
Length of engine and tender overall	64 ft. 2 in.
Tractive Effort (at 85 per cent. working pressure)	24,550 lb.

When at last we get away from Paddington, we find the first stretch of the journey constitutes what is perhaps the easiest of all its schedules, though certainly not the slowest. We have to cover the 36 miles out to Reading in what is now the standard start-to-stop time of 40 minutes, at an average speed of 54 miles an hour. At Southall, or shortly afterward, we reach and cross the "sixty" line; by Slough we may be doing 65 an hour and upward; so that, apart from checks, the negotiation of Brunel's stretch of straight and perfectly level track will not involve our engine in any difficulties, load notwithstanding. There is much to be done at Reading, to which point important connecting trains bring luggage and mails for South Wales and Ireland. Hungry passengers for Bristol who have snatched a hasty meal in the dining-car on the way from Paddington hurry back to the "slip" and quite possibly the time-table allowance of 5 min. may not prove quite sufficient.

The next section, from Reading to Newport in Monmouthshire, is probably the hardest stage of the journey. The distance is 97½ miles—the nearest to 100 miles of all our point-to-point runs—and the time allowed is 103 minutes, entailing an average speed of all but

57 miles an hour. Included in this timing, however, are the reductions of speed through Wootton Bassett and Patchway, the long and steep pull out of the middle of the Severn Tunnel and the slowing through Severn Tunnel Junction, which means that the "*Fishguard Boat Express*" must run just as fast as one of the down two-hour expresses to Bristol, and with a considerably heavier load.

From the standpoint of the driver and fireman, too, a run of this kind is the more difficult in that for some 65 miles from the Reading start the locomotive has not a moment's "breathing space." There is no downhill worth the mention, and the gradients, though ever so slightly yet none the less continuously "against" the engine, require almost unbroken effort in order to maintain time.



Courtesy] [*G.W. Rly.*

Severn Tunnel, English side

Brunel's Old Main Line

For 47 miles from Reading, Brunel's old main line to the West of England is still followed. On the first level stretch of 17 miles to Didcot, the first set of water-troughs is passed at Goring, and our thirsty steed picks up a good supply. At Didcot, 53 miles out of London, the old Birmingham route diverges on the right, making first for Oxford ; now, of course, trains to the North take the much more direct route through High Wycombe. Didcot, too, sees the end of the four-track section from Paddington ; the tracks now converge to two. For 17 miles from here the line is definitely uphill—faintly, it is true, but a continuous grade of even 1 in 660 to 880 is felt by the engine when loaded as heavily as this, and our speed may drop back from 65 an hour or so to about 60 an hour or a shade less, on to Swindon. If it is still light enough and we look out on the north side of the train, just beyond Didcot, we shall notice the big Government depot that extends for several miles alongside the track, and specially careful observation may reveal one of the Great Western 0–6–0 tank engines that has been specially fitted with a chimney of vast size, in order to catch all sparks that may be emitted when the engine is working near sheds that contain inflammable material.

So we hurry on through Shrivenham, and then through Swindon, with its miles of sidings and its great locomotive, carriage and wagon shops. It is interesting to recollect, as we pass Swindon Station at full speed, that the Great Western Railway only succeeded in obtaining release from their obligation to stop all trains at Swindon for 10 minutes by paying over to the Swindon Hotel and Refreshment Room Company a sum of money in five figures, in 1895, as compensation to the latter for loss of business so caused.

A Useful "cut-off"

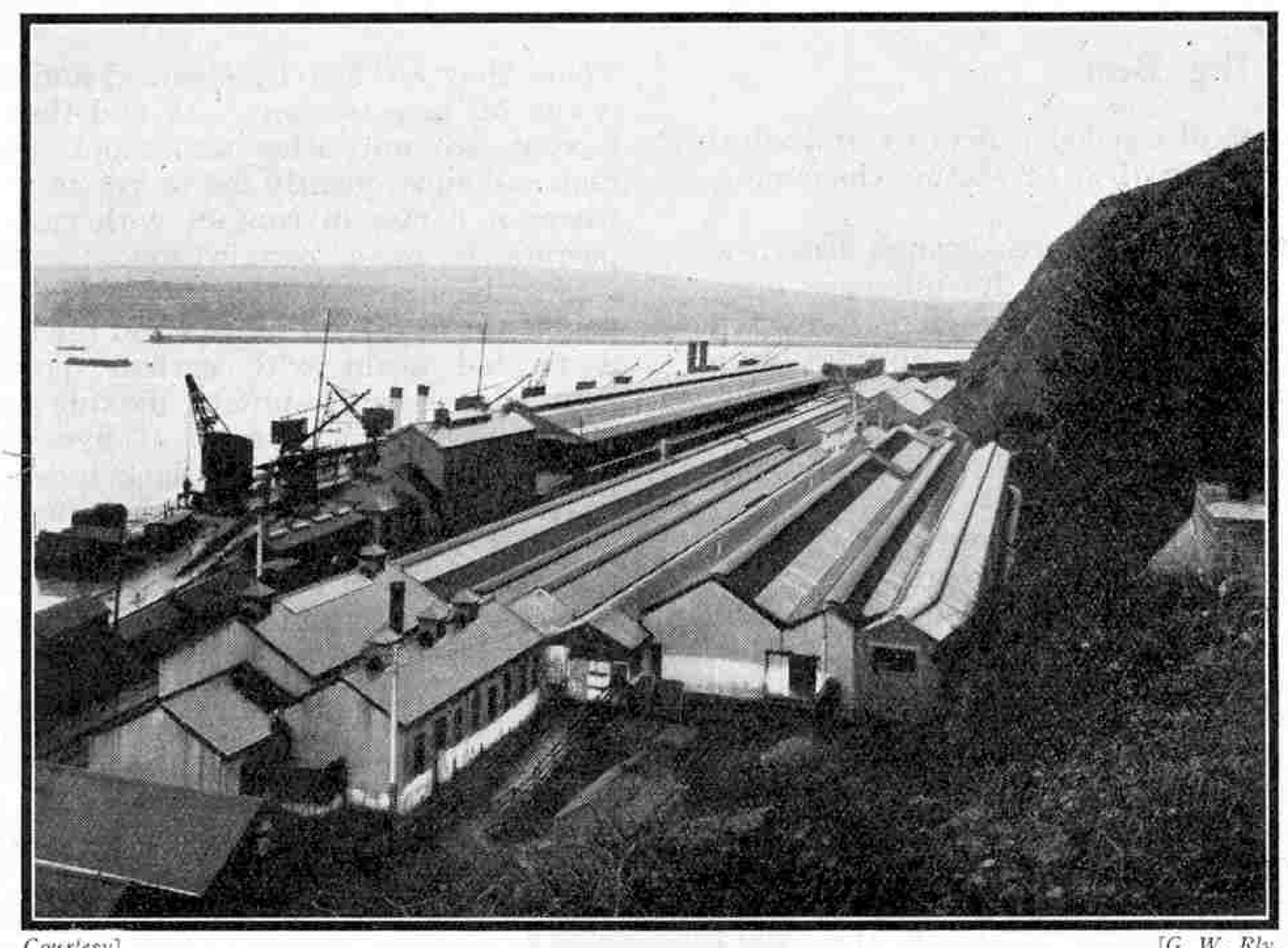
At Wootton Bassett, $5\frac{3}{4}$ miles further on, we leave Brunel's old main line, and diverge to the right on to what is known as the South Wales Direct line, reducing speed for the purpose to about 50 miles an hour. This "cut-off" was opened in 1901, curtailing the distance from London to South Wales by $11\frac{1}{2}$ miles and cutting out the congested line and awkward curves through Bath and Bristol. With this route and the previous Severn Tunnel line from Bristol under the Severn, to which we shall come presently, the route from London to South Wales is now shorter by 25 miles than it was in the old days, when trains travelled right round from Swindon by Gloucester and the down right bank of the Severn.

At first the line falls from Wootton Bassett, but then follows a trying ascent which, from Little Somerford nearly to Badminton, is unbrokenly for nine miles at 1 in 300. Here again it is, of course, the weight of the train that constitutes the real difficulty, although with a two-cylinder "Saint" and no less than 485 tons I have timed a minimum speed of 55 miles an hour at Badminton—a marvellous feat indeed. Quite probably we shall drop to about 50 an hour at the summit of the ascent. Badminton is 64 miles from Reading and exactly 100 miles from Paddington ; from Reading the time-table allows us 66 minutes. An interesting point about the Badminton line, by the way, is that the sleepers throughout are not of the usual creosoted pine variety, but are cut from the Karri and Jarrah hardwoods of Australia, which are very long-lived and need no preservative treatment.

At Badminton we are at the highest altitude of the journey between Paddington and Newport, and 20 miles of downhill now lie ahead. Immediately after Badminton we plunge into a long tunnel, and the uninitiated traveller, blissfully unconscious of the fact that we have been climbing for some time, immediately jumps to the conclusion that he is passing under the River Severn. But this is not just yet, though Sodbury Tunnel, under the Cotswold Hills, is quite a respectable bore, being just over $2\frac{1}{2}$ miles in length. Directly we are through, the driver sees ahead of him the troughs at Chipping Sodbury, and once again the engine is glad of the opportunity of replenishing the greatly depleted

tender tank.

A swift run down 11 miles of 1 in 300, from Badminton Station, brings us to the sidings at Stoke Gifford, where the Bristol slip portion drops quietly off the rear, as we pass the East Box. For the curve from the West Box round to the old South Wales main line from Bristol which we join at Patchway, speed is reduced to 45 miles an hour or so. Immediately after Patchway we see the up line beginning to fall below us, finally passing into a tunnel; shortly after this we also pass into a tunnel, and emerge to find the up line now well above our heads. The reason is that the old Severn Tunnel line, on which the down trains now travel, is inclined steeply downward, first for a mile mostly at 1 in 80, and then for another at 1 in 68, followed by a mile of level. To ease this intolerable gradient for up trains, half-a-mile was taken from the short "levels" on both sides, and for roughly three miles a separate location was found for the up line, with a smooth gradient of 1 in 100 throughout.



Courtesy [*G. W. Rly.*

The Station and Quay, Fishguard

At Pilning Station there begins the real descent into the famous tunnel itself. This continues for 3½ miles to the very centre of the Severn, at an inclination of 1 in 100, after which comes the pull out of the north end, for three miles at 1 in 90. Drivers are not allowed to rush the descent at full speed in order to lift their trains quickly out of the other end, and although we may have noted a startlingly rapid acceleration down the first incline from Patchway, we shall not find any speed much in excess of 60 miles an hour being made through the Severn Tunnel.

The Severn Tunnel

With the story of the tunnel, and the dogged perseverance of those who carried through its construction, one might easily fill a whole issue of the "*Meccano Magazine.*" Time and again water broke into the workings, both from the ends and in the middle. The curious natural phenomenon known as the "Bore," which at certain times sweeps up the Severn like a kind of tidal wave, was responsible for the former irruption, and most of the latter trouble was caused, not by the Severn itself breaking through, but by a vast underground source of water which became known afterwards as the "*Great Spring.*" Even since the completion of the tunnel it has become necessary to lay down permanent pumping plant capable of evacuating from the tunnel some twenty million gallons of water every day, as well as an elaborate plant for supplying fresh air to the tunnel, in consequence of the impossibility of boring the usual ventilating shafts. Altogether the Severn Tunnel used up 77,000,000 bricks and 37,000 tons of cement, took 11 years from its first beginnings to its completion—largely in view of the water difficulties—found occupation for 3,628 men in all—and cost some two million sterling.

At the top of the ascent out of the tunnel our speed will probably be under rather than over 30 miles an hour, but after negotiating the crossings at Severn Tunnel Junction, where we join the oldest of the South Wales routes—the original one through Gloucester, which has come along the Severn past Chepstow, and has passed over our heads just before we left the tunnel—and a brief level run, of just under 10 miles brings us into Newport, 133½ miles from Paddington, at 10.23 p.m. The third set of track-troughs is passed over just beyond Severn Tunnel Junction.

We are now well into the industria areas of South Wales, and between Newport and Swansea, were it not the dead of night we should see many evidences of mining and manufacturing activity. Railway after railway, coming down from the mountain valleys on the southern slopes of the Brecon Beacons and their outlying hills, comes down either to join us or to cross our path. Before the war these were all separate concerns, but they have now been merged into the Great Western, and so the Taff Vale, the Rhymney, the Barry, the Cardiff, the Brecon and Merthyr, and many other railways have lost their separate existence. After a stop of six minutes at Newport, there follows the brief run of 11¾ miles to Cardiff, compassed in 16 minutes, and for a large part of the distance through the middle of mile after mile of sidings, filled with coal trucks or "empties."

Cardiff, reached at 10.45 p.m., was at one time always an engine-changing centre, but now quite possibly our engine will run through to Swansea. When we leave Cardiff at 10.49 p.m., the engine is faced with some more difficult grades ahead. From Ely, just beyond Cardiff, the line rises for 11 miles to Llanharan, with a final 1½ miles at 1 in 106, and then drops sharply for 3½ miles at 1 in 126–157 nearly to Bridgend. From there we go up for three miles at 1 in 132-163, and then down again at 1 in 93-139 for 3½ miles past Pyle. The engine has now some short respite on to Neath, but there is a severe slack over the curves through Neath, where (*Continued on page 702*)

FROM OUR READERS

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

"Big Ben"

Through the kindness of our local Member of Parliament I recently had the privilege of visiting the famous "*Big Ben.*"

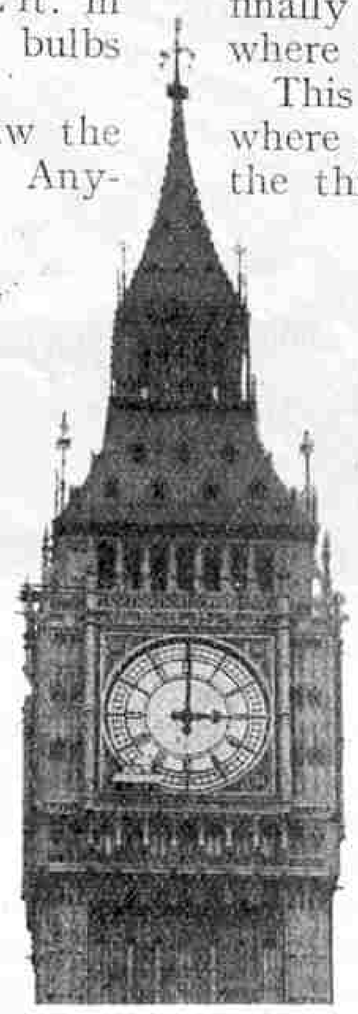
After climbing 374 steps we passed through a narrow doorway and there before us was the immense open face of the great Westminster clock. Here I learned that each minute space measured 1 ft., so that in a single day the minute hand travels 1,440 ft., which is roughly 100 miles in a year. The figures are 2 ft. in length. The clock is electrically lighted by 28 bulbs totalling 10,000 c.p.

We then went up to the clock room and saw the immense mechanism, which is over 75 years old. Anything more unlike a clock I have never seen, as it looks more like the "heart" of a large crane. A ½ in. cable wound on a 12 in. drum supports the 2½ ton weights. The gear train is composed of wheels 2 ft. in diameter and about 2½ in. thick. The pendulum is 13 ft. in length and beats every two seconds; while the bob of the pendulum weighs 4 cwt. Small dials at different points among the "works" register seconds, minutes, hours and the depth to which the weights have fallen. Twice a day the clock telegraphs its time to Greenwich Observatory to be checked.

Passing up a winding iron stairway to the belfry we come to the place where "*Big Ben*" himself and the four quarter bells are hung. "*Big Ben,*" which weighs 13½ tons and is struck by a 4 cwt. hammer, is suspended from huge girders about 18 in. in thickness. The four quarter bells are hung at the corners of the square belfry; they weigh 8 tons between them. The chimes of "*Big Ben*" are set to the following lines:—

"All through this hour
Lord be my guide.
And by Thy power,
No foot shall slide."

G. GORDON (Ilford).



"Big Ben"

The Manufacture of Beet Sugar

A short time ago I was able to visit the sugar beet factory of the West Midland Sugar Beet Co. Ltd. at Kidderminster.

The process is extremely interesting. When the beets arrive at the factory they are washed along flumes into the works and lifted by means of a wheel into a washer. From this they are discharged on to a moving picking table where the tails, etc. are discarded. The beets then pass by means of a bucket elevator to an automatic weighing machine which drops them to a slicer below.

Having been sliced they pass into a continuous diffuser where they are heavily steamed and the diffused liquor is run off to a settling tank and then measured. It is next passed into other tanks and treated with milk of lime and subsequently led to yet another series of tanks where it comes in contact with carbon dioxide which purifies it to a certain extent. Through all these stages the liquor is kept hot. The next process is to pass it through filter presses and the liquid thus collected is treated again with carbon dioxide and filtered; then treated with sulphur dioxide and re-filtered and finally passed to a series of five evaporating boilers where it evaporates to a dark brown syrup.

This syrup then goes to a different kind of boiler where it is crystallised very carefully and from there the thick juice runs into basin-shaped vessels of fine copper gauze which are rotated at high speed. The juice passes through, leaving the crystals on the gauze, and these are collected and dried in a rotating drier that keeps them from clogging together. Finally the crystals are allowed to cool and are conveyed to a storage bin from which they are placed in sacks. Thus the sugar is made from beet.

It may be added that the pulp left after passing through the continuous diffuser is dried and sent away for use, chiefly in America, as cattle fodder. A. L. MORLEY (Stourbridge).

Making Corrugated Iron Sheets

One day I had the good fortune to visit a Corrugated Iron Works. To these works the trains and boats bring loads of iron bars, which are unloaded by large magnets capable of lifting five tons. These magnets are suspended, by means of chains, from overhead travelling cranes. The bars are cut into lengths, put into the furnaces and, when they are white hot, passed through rolling mills, coming out as sheets, which are then cut into the required lengths.

The sheets are placed in gas furnaces to make them soft, after which they are pickled in acid to get the scale off, and then washed in water tanks. Next comes the galvanising process, in which the sheets are covered with a protective film of tin by passing them through a bath of the molten metal. The galvanised sheets are then passed through drying rollers, and by means of special machines they are corrugated.

Three of the large rolling mills are driven by electricity, the other 21 mills being divided between three steam engines. In other departments are made rain water spouts, buckets, gutters, stove-pipes, and many other small things. The sheets, the principal product of the works, are despatched in large quantities to all parts of the world, such as South America, Africa, Jamaica, and Buenos Ayres.

J. DALE (Little Sutton, Birkenhead).

How Biscuits are Made

Probably most of us think of biscuits as something nice to eat and never raise sufficient curiosity to wonder how they are made. The operations involved in the making of biscuits are, however, very interesting.

The flour, which comes straight from the mills, has first to enter the Storage Lofts and there await the result of the analysts' tests before being used. This analysis is necessary to ascertain the quality and grade of the flour, as certain flours are not suitable for use in the making of biscuits. When the flour is passed as suitable it is conveyed to the Flour Loft where it is put through a huge sieve to remove nails, string, hairs from the sacks and any other impurities that may have got into it since it was milled.

The ingredient department is now reached. Here a mixing manager opens a trap-door in the floor connected by an enclosed or box chute to a mixing machine in the room below.

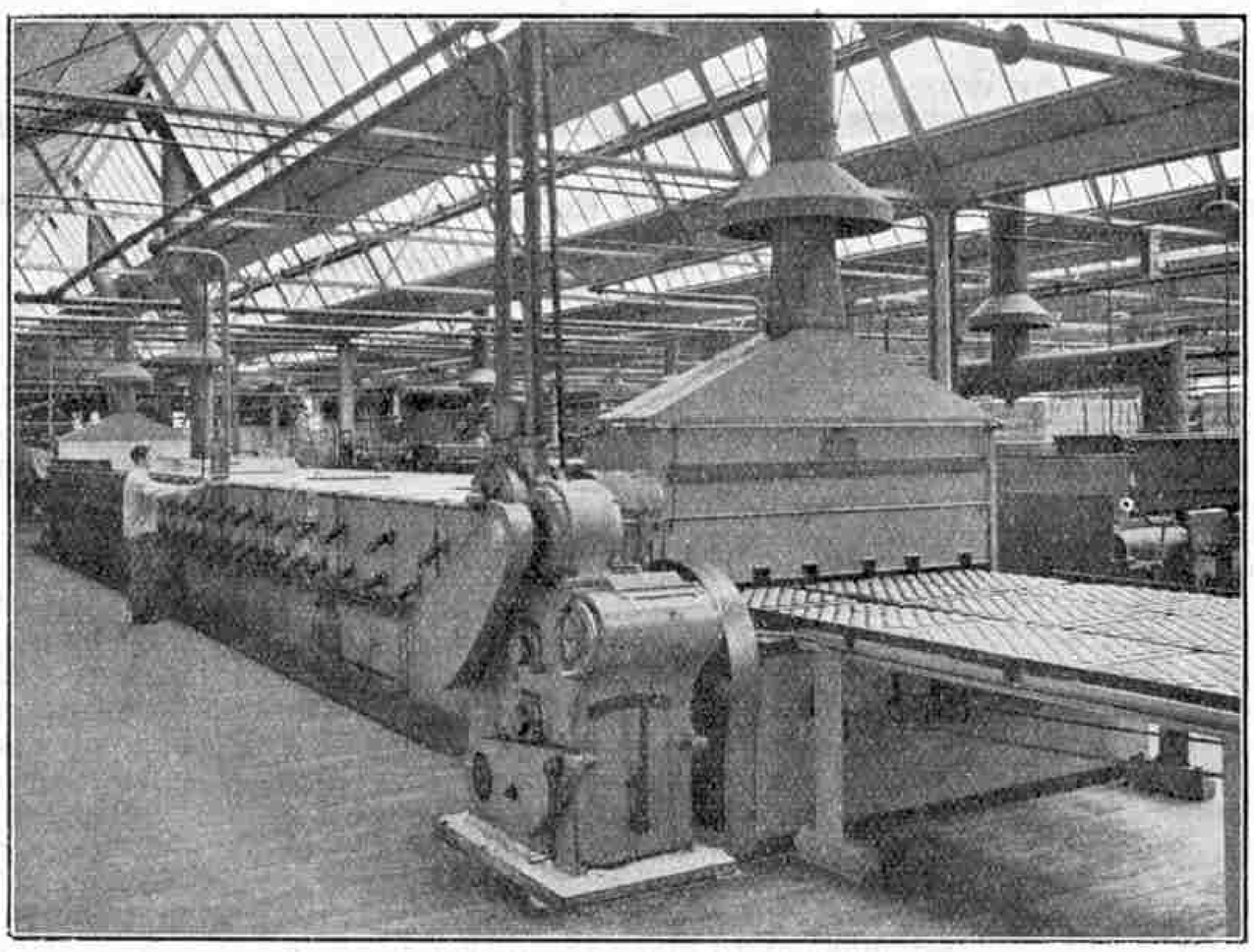
Through this trap are dropped the flour, eggs, milk and other ingredients necessary for the class of biscuit that is to be made. The mixing machine is then started up and by means of its revolving arms or knives it pounds the ingredients together until a dough of suitable consistency is formed. When the dough is properly mixed the knives are stopped and the body of the machine is turned on to its side. The knives are then restarted and they throw out the dough into a waiting wagon which wheels it away to the Bakehouse.

The Bakehouse is the most interesting place to be visited. Here we see the dough thrown on to a machine known as a "Break," which is in reality a huge rolling machine. Two men clad in white coats, trousers and caps, push the dough through the rollers, which are on an average about 5 ft. in length and 2 ft. in diameter. The dough is thus rolled out into a long sheet about $\frac{3}{4}$ in. thick. This sheet is then lifted to the biscuit cutting machine, where it passes through smaller rollers from which it finally emerges at a thickness of about 1/16th in. The sheet is then carried along on a travelling band of canvas to the cutter, which cuts the dough to the required size and shape. After passing under the cutter the dough is perforated all over with the shape of the biscuit and these shapes continue their journey along the canvas band to the pan chain. There they drop off on to pans about 2 ft. square, which travel out on a continuous chain.

The dough that remains after the shapes are cut out resembles wire-netting and is known as scrap. It is placed on a separate canvas belt and taken away to be kneaded up and rolled out again.

The baking stage is now reached and the shapes enter the oven. This is a huge affair about 25 ft. in length by 15 ft. in width and it contains four sets of endless travelling chains. These chains carry the bands through the carefully regulated heat, supplied by gas or electricity, to the outlet end, where they arrive perfectly baked and ready to be coated with sugar or icing if necessary and then packed for transport.

A. J. E. Moss (Dublin).



[Courtesy [W. & R. Jacob & Co. Ltd.

Biscuits emerging from a travelling oven

How Motor Car Engines are Tested

I have had the good fortune to make a very interesting visit to the engine-testing department of a famous motor works and to watch the whole process of testing.

The engines are run very slowly at first, partly to "run them in" and partly to give the mechanic a chance to rectify possible faults before any damage is done. There may be, for instance, a leak in the oiling system, but a pressure gauge is fitted and if it does not show the correct pressure after a few seconds' running the engine is stopped and the mechanic proceeds to investigate matters.

Every engine passes two main tests—one for power and the other for smooth and silent running. In addition there are minor tests for easy starting, quick acceleration, etc. The power test is called "pulling the load." A brake consisting of two wooden blocks, well cooled with water to keep them from catching fire, is clipped around the fly wheel and is prevented from moving by a projecting lever that pulls against a spring balance anchored to the ground. The force exerted by the engine is shown on the spring balance, and from the reading taken, together with the engine speed and the length of the lever, the horse power is calculated. It is an impressive sight to see an engine, its exhaust pipe glowing red, roaring away at 2,000 revolutions per minute under its heavy load.

Sometimes an engine does not develop a standard horse power and the mechanics have to search out the reason and rectify it. The trouble is usually due to something very trivial. A sparking plug may be oily and not sparking, rendering that particular cylinder useless; or the carburetter may need tuning up. While I was watching I saw a mechanic strip one down and enlarge the petrol jet very slightly. It was all that was needed. The carburetter was replaced and the engine roared away triumphantly.

The next stage is to take the engine to pieces in order that the working parts may be examined and attended to if necessary, before re-assembling for the final test. It is then given a second power test.

Last of all the engine is tuned up for sweet running. The tappets, etc., are adjusted to a minute fraction of an inch and the slightest noise is traced to its source and dealt with. It is a revelation to see an engine that has just been exhibiting the power it will need to propel a laden car at speed running as smoothly and silently as a wrist watch. The silence is greater, in fact, for the engine does not "tick!"

W. A. Croft (Birmingham).

Electrical Timing Invention

Mr. J. S. Streeter, a Cape Town electrician, has patented an invention that will completely cut out the human element in the timing of races. It is a lamp standing 8 ft. in height which projects a beam of infra-red light across the course. Readers are aware that the infra-red rays, or rays longer than those constituting red light, are invisible, so that the beam will stretch across like an unseen tape, and like a tape be broken or interrupted by the winner.

The beam plays on a delicate electro-chemical receiver or photo-electric cell of the type used in speaking pictures or in television systems. This is placed on the opposite side of the course and is wired to a clock. As soon as the shadow falls across the receiver the result is communicated to the clock, which will be stopped instantaneously. The time taken by the winner will then be registered to a fraction of a second and will be visible to all.

Extensions of this to the timing of races and the taking of time records generally are obvious. The invention would have been impossible a few years ago, for the selenium photo cells then used were not nearly so sensitive as those now developed.

* * * *

Safety Device for Railway Crossings

On the stage horses or men are often seen running at full speed and not getting any further. The illusion is due to the fact that the portion of the stage on which they run is itself moving at practically the same speed as the runners so that relatively to the rest of the stage and to the audience they remain in the same place. The same principle has been applied in an invention to prevent motor-cars from going over railway crossings when a train is approaching, a frequent cause of accidents in America.

Rollers are sunk in the pavement of the road that extend all the way across the road in front of the crossing gate and are rotated backwards. A car standing on them then continues to stand even when its wheels are revolving as the part of the roller on which the wheels grip simply turns backwards away from the crossing gate. A roller platform 18 ft. in length is fixed on each side of the crossing, tests having shown this length to be sufficiently effective.

The idea of the invention is that the rollers are to be actuated by machinery for an adequate period before the approach of a train, so as to prevent reckless drivers or even runaway cars from crossing the line. In its fullest development the approaching train itself is intended to switch on the current and also to operate the locking switch on passing out of the danger zone.

A Super Rocket

The idea first suggested by Jules Verne of reaching the Moon in a rocket is still in the minds of several inventors. Professor Goddard in America has been studying the subject for some time and more recently M.M. Mas and Drouet, two Parisian engineers, have designed a five storied rocket with kitchen, navigation room, wine cellar and parachutes in which they believe they could accomplish the journey through space in eight days.

A huge steel cylinder would be erected in which the rocket would slide along rails submerged in oil to reduce friction. The rocket would be projected from the cylinder by compressed air and in order to allow it to reach the necessary speed of 7½ miles per second a vacuum would be maintained in front of it. A flap at the outer end of the cylinder would open at the last moment to allow the rocket to shoot out into space.

Travellers in the rocket would expect to be able to guide it on its course by gas explosions through escape valves in the sides, the effect being the same as in sending up an ordinary rocket. The actual landing on the Moon would be made with the aid of the parachutes, the rocket being left as it would strike the Moon's surface with great force. Presumably a projecting cylinder would have to be constructed on the Moon for the return journey.

Whether these inventions will ever reach the practical stage is doubtful as yet. Professor Goddard has now suggested a less ambitious use for his rocket in the shape of a journey across the Atlantic. He has already made some comparative experiments which he believes to show that the projected journey is possible in a few hours.

* * * *

Stereoscopic Motion Picture Camera

Two Chicago inventors have spent five years in perfecting a rapid motion picture camera that acts stereoscopically. This has been developed by them into an instrument that will make sculpture much easier both for the artist and the model.

The camera is fixed on a circular track and is actuated at a high speed with the aid of gearing driven by an electric motor. The subject to be modelled is placed at the centre of the circular track of the camera, which is capable of taking pictures at the rate of 450 in 30 seconds. Pictures from every angle are then taken as the camera rotates and these are projected on the screen in the studio for the artist to study at leisure.

The invention displays great ingenuity. It will be noticed that its effect is to make a short sitting take the place of a long and fatiguing ordeal.

Burglar Photography

A knowledge of the identity or a correct description of a thief is invaluable and indeed almost indispensable when it comes to catching him. Great interest, therefore, is attached to a method of securing an actual photograph of a thief at work that has just been invented in America.

The camera for the purpose is hidden in the wall, an electric control being used in the form of a switch so placed that the intruder is almost sure to come into contact with it. Thus in a house the switch may be incorporated in the door knob or the handle of a drawer, while in banks and offices the concealed camera may be pointed towards the safe and brought into action as soon as the lock is tampered with.

When once started, the camera continues to take pictures automatically so as to seize every possible opportunity of securing a good photograph. Secret foot switches or press buttons also may be installed in various places to actuate the camera at the will of the operator.

* * * *

A Quickly Erected Floating Breakwater

When time and cost are important a type of breakwater recently invented is likely to prove of great value. It is built in sections in the form of a framework supported by floating cylinders so that its upper surface rises above the normal level of the water by an amount nearly equal to the height of an ordinary wave crest. The cross framing of the upper and lower surfaces of the floating portion then effectively damp out the wave motion of the sea and under ordinary circumstances give adequate protection to shipping stationed behind them. It does not seem likely, however, that a breakwater of this type will be as effective in really stormy weather as one constructed in the ordinary manner of stone.

A double line of sections moored between selected points completes the breakwater, the sections being attached by chains to heavy concrete blocks sunk to the bottom of the sea to hold them in position. A breakwater of this kind should be particularly valuable when new harbours or extensions are required quickly and when trying out various positions before choosing one to be the site of a permanent stone and concrete erection.

* * * *

Quick Turning Motor Car

Getting out of a traffic jam is quite easy with a car recently constructed in Paris. Its front wheels can be turned right round independently so that they are almost in line with each other and the car can be reversed in its own length.

Curious Ideas of Inventors of the Present

The patent files of all countries are full of quaint and fantastic notions as our illustrations of "*Curious Ideas of Inventors of the Past*" have shown. Fifty years hence many of the inventions that we regard seriously to-day will no doubt appear very curious. In the meantime a glance through the published patent specifications reveals many ideas that are decidedly queer, although no doubt some of them will be of real utility.

Among such ideas noted recently was one for a hair pin that has all the advantages of the old type but is self-locking and specially adapted for bobbed hair. Other inventions with feminine appeal are a "Pie Conformer" that automatically divides a pie into sections during baking, and rouge that will not wash off—except with soap! This latter material seems to lack something in durability.

Folding tables seem to have a special attraction for American inventors, and the products of all of them are declared to be absolutely rigid when in use, in spite of having legs that can readily be reduced to something about the size of a walking stick! Other American devices are a money tray for bankers which can be moved electrically into a safe place in the event of a bank hold-up; a pen that takes up a very large supply of ink and is guaranteed to write at any angle; and a pipe with a plate on springs in the bowl to keep the tobacco pressed down throughout the operation of smoking.

The announcement of the invention of a "Bean Stringer" aroused hopes that the man who put the strings into beans was at last discovered and could be dealt with. But on further reading it was discovered that stringing was merely an Americanism for cutting into strings or strips.

Quite a useful idea is a tooth brush that can be obtained, along with a small amount of tooth paste, from a "shilling in the slot" machine. This seems to foreshadow the days when shopping will consist merely in passing along a row of machines and inserting coins in those containing the required articles. The gem of the collection, however, is a "propelling mechanism" that will climb and move over any obstruction, take any hill, move in any direction and travel over land and through water! Polar exploration and climbing Mount Everest should be quite easy with this mechanism, but why did the inventor not make this machine to travel through the air as well?

* * * *

A Mysterious Alarm

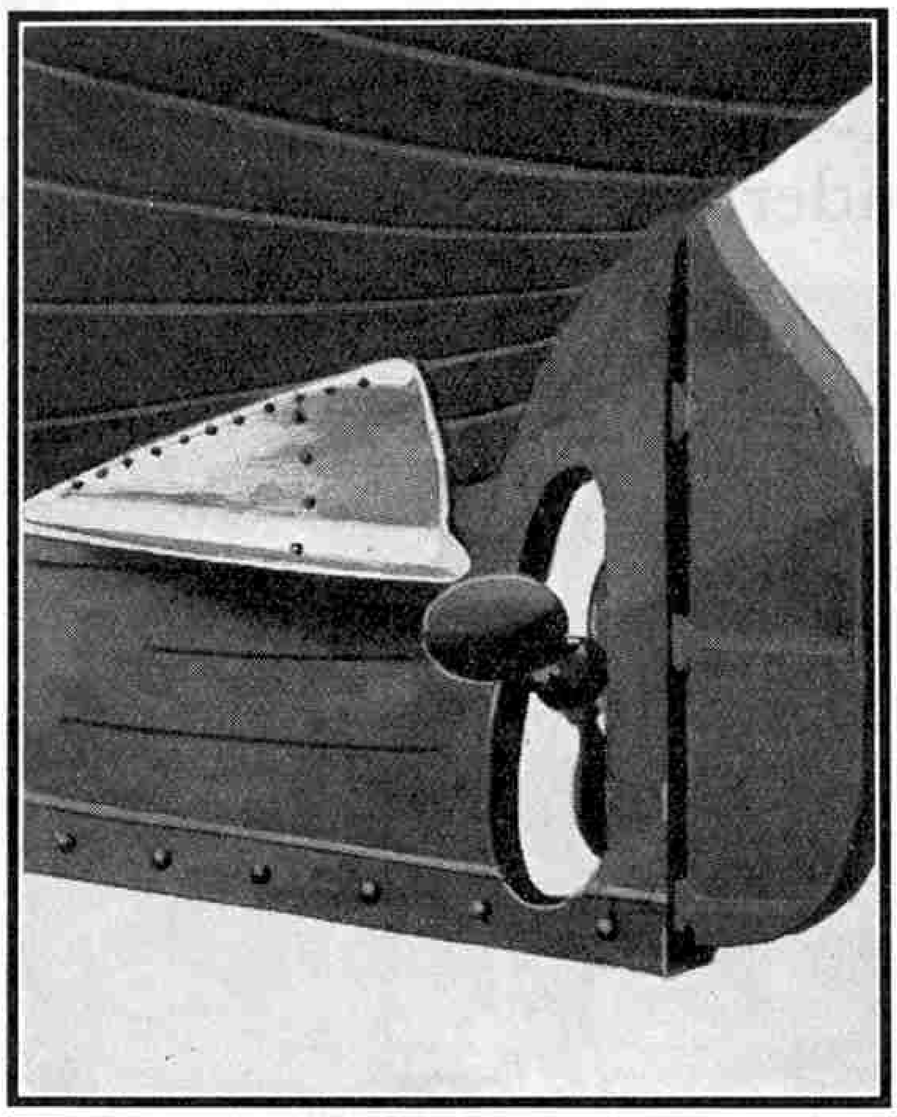
An invention that will be of interest to many wireless enthusiasts has been produced by a French engineer. It is a burglar alarm that makes ingenious use of electrical principles.

In the room to be protected an electric field is set up with the aid of oscillations in balanced circuits. The body capacity of any intruder in the room upsets the equilibrium with the result that an alarm bell is rung. This apparatus has been thoroughly tested and is now in use in Paris. Unlike the older type this electric burglar alarm has no wires or visible electric connections to reveal its presence and consequently it is not so easily put out of action.

Fins to Increase the Speed of Ships

A simple idea has occurred to an English inventor by which he hopes to increase the speed of ships. It is to attach a horizontal plate or fin each side of the hull just in front of the propeller, the two fins being slightly above the level of the boss of the screw.

The invention is the result of noticing that in the ordinary way the water flows to the propeller in an upward direction, while it flows away horizontally. The screw would work more efficiently if the water moved horizontally all the time, as no energy would then be used in diverting the stream; and it is the task of these horizontal plates, jutting out rather more than the distance reached by the propeller blades, to change the direction of the water in which the screw moves. Greater speed, fuel economy and easier steering are all expected from this simple suggestion which has already been put into operation with, it is said, good results.



The horizontal plate referred to on this page fixed to the hull of a ship

* * * *

Boat Launching Speeded Up

Easy and rapid launching from the deck of a ship is claimed for the invention of a Birkenhead ship's rigger. The design evolved has the great advantage of being easily worked by one or two men only if necessary.

Four chocks are used to keep the boats in position on the deck. The movement of a lever attached to one of the forward chocks tilts the baulk on which the seaward chock rests slightly downward. The chock is thus released and the boat by its own weight then knocks it out of its groove and swings it out on its davit tackle. The chocks supporting the stern of the boat rest on a swivelling bed and the outward movement of the bow of the boat swings them round so that the keel is able to slip out.

There is no need to touch anything whatever on the bulwark side of the boat. The mere act of pulling a lever starts the process of lowering, and this proceeds quickly and automatically.

Steam Raising by Electricity

This process is the reverse of the usual one, but the feasibility of the Kaelin boiler invented for the purpose has been demonstrated by its actual installation in factories. An electric current passes through the water to be heated, between a metal electrode dipping into it and the boiler itself. As water is not a good conductor, heat is developed by its resistance to the passage of the current, and this is quite sufficient to raise steam at a good pressure.

The heat is actually produced in the water itself and not supplied from an external source, and therefore much wear and tear of the boiler is eliminated. The radiation loss is cut down considerably by wrapping the boiler with material that does not conduct heat well. This can be done with great efficiency, as there is no part of the plant to which access is required during operation, as is the case with coal-fired boilers. The result is a silent and smokeless steam-raising plant.

The amount of current consumed depends on the depth of the electrode in the water, and if by any accident the water runs too low the supply of heat is cut off immediately the electrode is left dry. Automatic methods can be used for controlling the supply of current and absolutely no attention is needed for hours.

The Kaelin electrical boiler can be used for the steady production of steam, but it is likely that its greatest application will be found in the use of surplus electrical power. This surplus may arise in various ways. For instance, electricity supply companies may divert current when small demands are being made, and store up in a steam accumulator a volume of steam to be used later when the load reaches its peak. When the accumulator reaches its full capacity the current supply to the boiler is cut off.

Another possibility is the use of electric power derived from waterfalls for raising steam, which is often required for other purposes than power, and in this connection it is interesting to learn that the Niagara Falls Power Company has installed the Kaelin boiler.

* * * *

Patent Office Profit

Details of the activities of the Patent Office of Great Britain are always of interest. For the year 1926 the total number of applications was 33,080, an increase of 77 upon the number in the previous year. There is no doubt that our inventors are busier than ever, for the number of complete specifications filed last year was the highest on record, with the exception of the year 1920. In that year, however, there was a rush to overtake arrears.

The applications received from women inventors numbered 537, as compared with 608 in 1925. The number for 1925 was exceptional, however, showing an increase of 115 over that for 1924.

The Patent Office is a Government Department that shows a really handsome working profit. The report for 1926 shows that the receipts for the department totalled £488,152, an increase of £12,108 on 1925. Salaries showed a slight reduction at £254,691, and there was a surplus of receipts over expenditure of no less than £98,813.

Famous Trains—(*continued from page* 697)

some of the high ground of South Wales comes down nearly to the sea, followed by a stiff climb of 2¼ miles at 1 in 90 to Llansamlet, and an equally steep drop from there into Landore. On the way up to Llansamlet, at Skewen, we pass the vast oil refineries that have been established of quite recent years.

South Wales Avoiding Lines

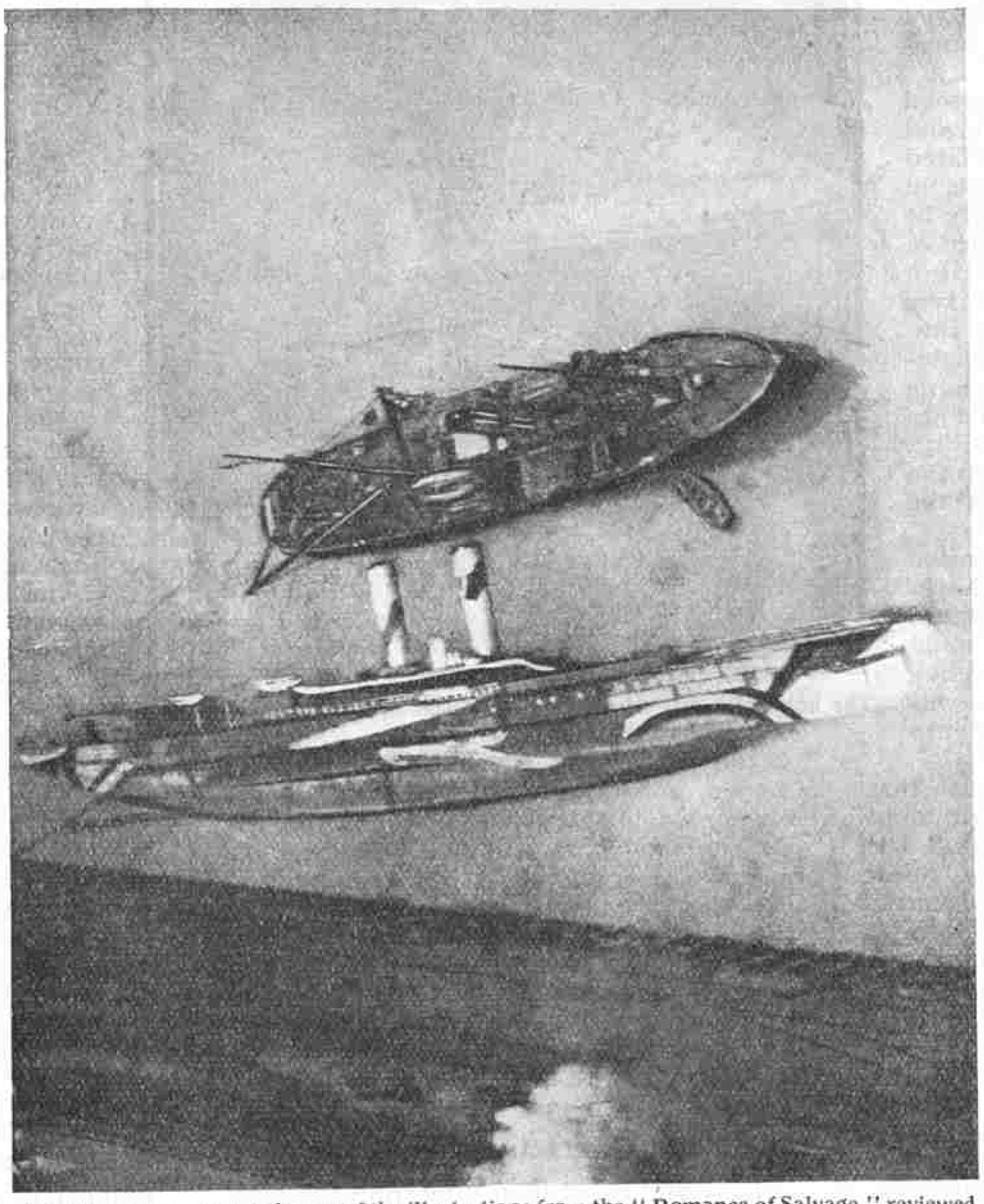
We could miss Neath and Swansea altogether by following from Court Sart Junction the "South Wales Avoiding Lines"—a new main line, opened some years ago, largely no doubt, in view of the probable development of Fishguard as a trans-Atlantic port—and though this would cut out some difficult grades, as well as saving distance, Swansea is too important a place to miss. At 11.47 p.m. we reach the centre of the "tin-plate" industry, having covered the difficult 45¾ miles from Cardiff in 58 minutes. Until quite recently the Swansea connection was made at Landore Junction, 1¼ miles away, which avoided the reversal of the train at Swansea, but the latter procedure has now become standard with all the expresses proceeding to West Wales. So here we leave behind the engine that has brought us from Paddington, and the dining car as well, and with—probably—another two-cylinder 4–6–0 on our reduced train of about eight vehicles, we head westward again at 11.51 p.m. for Fishguard.

The remaining run of the journey is 73 miles in length, bringing the total mileage of the train up to 264 miles. This last stretch has a number of obstacles, the first of which is the very severe Cockett bank of 1½ miles at 1 in 52; up this quite possibly we may receive the assistance of a "pilot" or a "banker." But after the descent to Gowerton we have a long stretch of some 35 miles of almost dead level track, past Llanelly, Carmarthen and St. Clear's, followed by short but increasingly sharp undulations to Clarbeston Road, where we leave the original Milford line. Some nine miles of these ups-and-downs are round about 1 in 100 in steepness, Clynderwen and Clarbeston being both "summit" points. The "cut-off" from Clarbeston to Letterston, which preceded the opening of Fishguard Harbour, has also a sharp three-mile descent and 2½-mile ascent in the middle of it, at the same inclination. And then, last of all, there comes the tremendous three-mile descent from Manorowen into Fishguard, two miles of which are at 1 in 50, up which all the London-bound trains of any weight have to be banked.

Fishguard is another wonderful Great Western achievement of which much might be written. No expense was spared in equipping the port, again doubtless with a view to trans-Atlantic traffic which, alas! has not come to full fruition. Two million tons of rock were blasted out of the hillside and dumped into the sea, making available a level area of 27 acres on which to make the station and the quay, and also going towards the construction of the great northern breakwater, which stretches 2,000 ft. out to sea and has created a magnificent harbour. Before the coming of the railway Fishguard was a remote little village, completely shut off from England by several counties of Wales.

To-morrow morning, when you wake up, will be the time to see all these things; now, at 1.25 in the morning, it is high time to get to bed. But let me tell you that before you wake the "*Fishguard Boat Express*," on which you have travelled so comfortably from Paddington will be well on its way back Londonward with its passengers from Ireland. Less than two hours after its arrival, at 3.15 a.m., its hard-worked rolling stock is again on the move, to complete its daily round of some 535 miles.

Wonderful Aerial Photograph



This wonderful photograph, one of the illustrations from the "Romance of Salvage" reviewed on page 718, shows the camouflaged troopship "Onward" lying on her side off Folkestone Quay after having been scuttled to put out a fire. A salvage lighter is standing by

In this column the Editor replies to letters from his readers, from whom he is always pleased to hear. He receives hundreds of letters each day, but only those that deal with matters of general interest can be dealt with here.

Correspondents will help the Editor if they will write neatly in ink and on one side of the paper only.

R. Gunderson (London, N.W.3)—It is quite evident that the "*M.M.*" has "caught on" at your school and we are interested to hear that you suspect one of your masters of sitting up late at night reading it, although he says he buys it for his seven-year-old son! Several readers have suggested a "Motor News of the Month" page and we may introduce this feature later on in the year.

M. Appleby (Embleton).—We are afraid that at present it is not possible to extend the Editorial Page but we are glad to note that you find this so interesting. We are not surprised that some of your chums who discontinued taking the "*M.M.*" when the price was advanced, renewed their subscriptions subsequently after reading your copies.

E. Harwood (Rondebosch, S.A.)—Your descriptions of your outings are splendid and make us wish to be there with you! Many readers have written to express sympathy with the Australian boy whose Dad sends him to bed early when the "*M.M.*" arrives; we are glad to hear that, although you have a little trouble in this respect with your own Dad, it is not quite so serious!

A. Dawe (London, N.)—You have certainly made a good start as a poet, Alec, and your verses describing the Air Pageant at Hendon are quite good. We are sorry that we cannot spare the space to publish your poem but send us some more of your work later on and we will see what can be done.

R. J. S. Horsham (Hornchurch).—Your suggestion for devoting a small section of the "*M.M.*" to explaining the technical words that appear in the various articles is very interesting. We agree that it is very annoying to come across a word that one does not understand, and we shall give your suggestion very careful consideration.

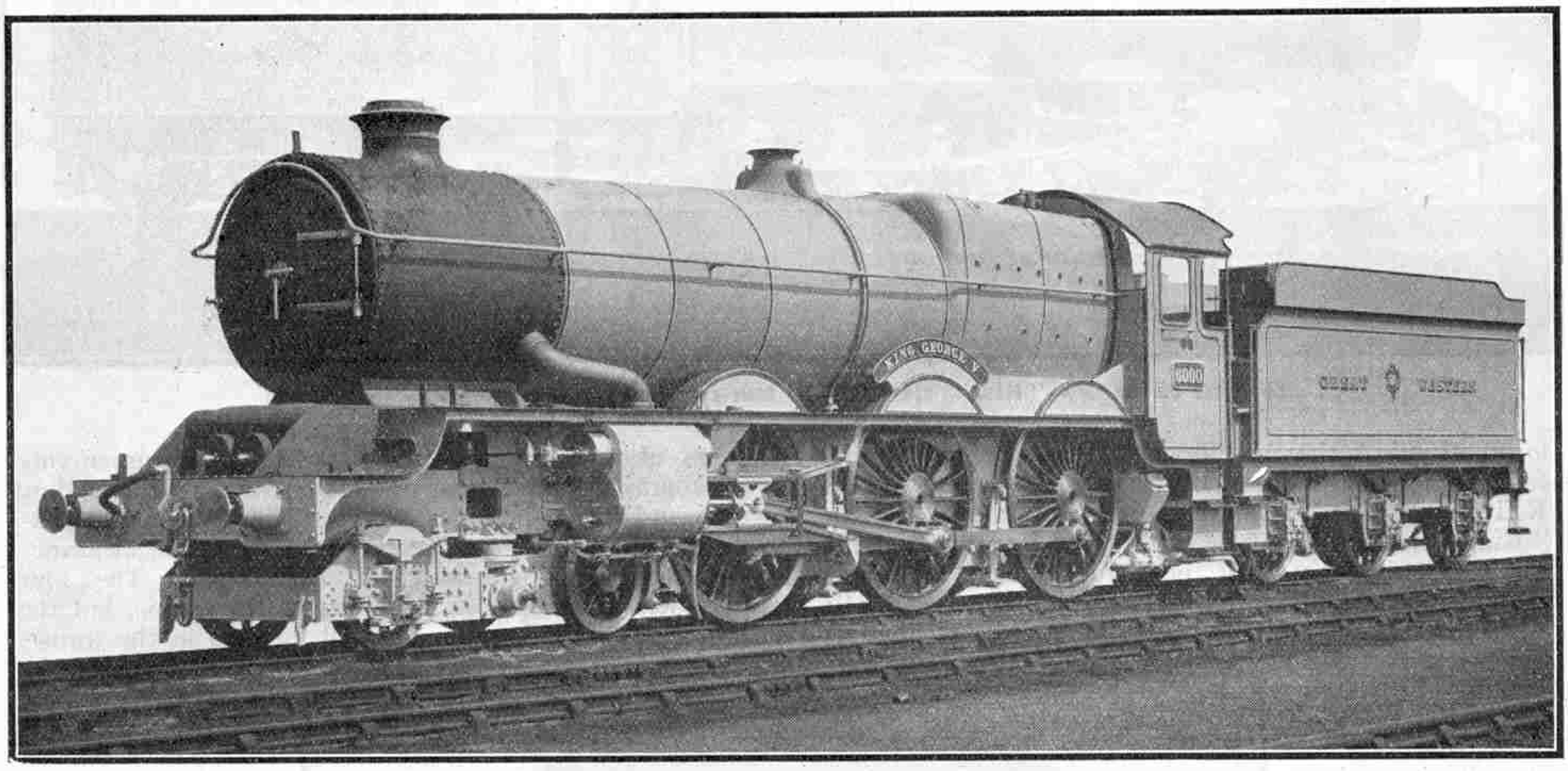
D. C. Young (Sheffield).—The "Outfit" Contests have proved remarkably popular and the explanation is no doubt, as you suggest, that such contests make every reader, however small his outfit, feel that he has a chance of winning a prize. In regard to your old nickelled parts, your best plan is to avail yourself of our offer to exchange such parts for similar new ones at half the cost of the latter, plus postage.

A. Hodgkinson (Fleetwood).—Your letters are always welcome because you have the happy knack of describing things in an interesting manner. In regard to the non-stop train rumours, you will find these referred to in our Railway Notes in this issue.

W. G. Davies (Adamstown, N.S.W.)—"During the past few months I have had never-ending pleasure with the various Meccano Models that I have invented and built." We hope you will continue to experience this pleasure for many years, and we feel sure that you, like the many engineering apprentices who have written to us, will find Meccano of really practical value in your work. Let us hear from time to time of your progress.

Britain's Mightiest Locomotive

G.W.R. "*King George V.*"—Our Most Powerful Passenger Engine



IN no department of engineering has there been a greater advance in the past century than in the design and construction of railway locomotives. Generally speaking the main development during recent years has been in the direction of power rather than speed. Many of the early locomotives could and did attain very high speeds. Going back as far as the Rainhill trials we find that Stephenson's "*Rocket*" attained a speed of 30 m.p.h. and on other occasions it almost certainly exceeded this speed, although there appears to be little foundation for the claim that it once achieved 60 m.p.h. Coming to later days, some of the "singles" of Daniel Gooch attained an authentic speed of a trifle over 78 m.p.h., and one of Mr. Pearson's 9 ft. "singles" reached a speed of over 81 m.p.h. down Wellington Bank on the Bristol and Exeter line.

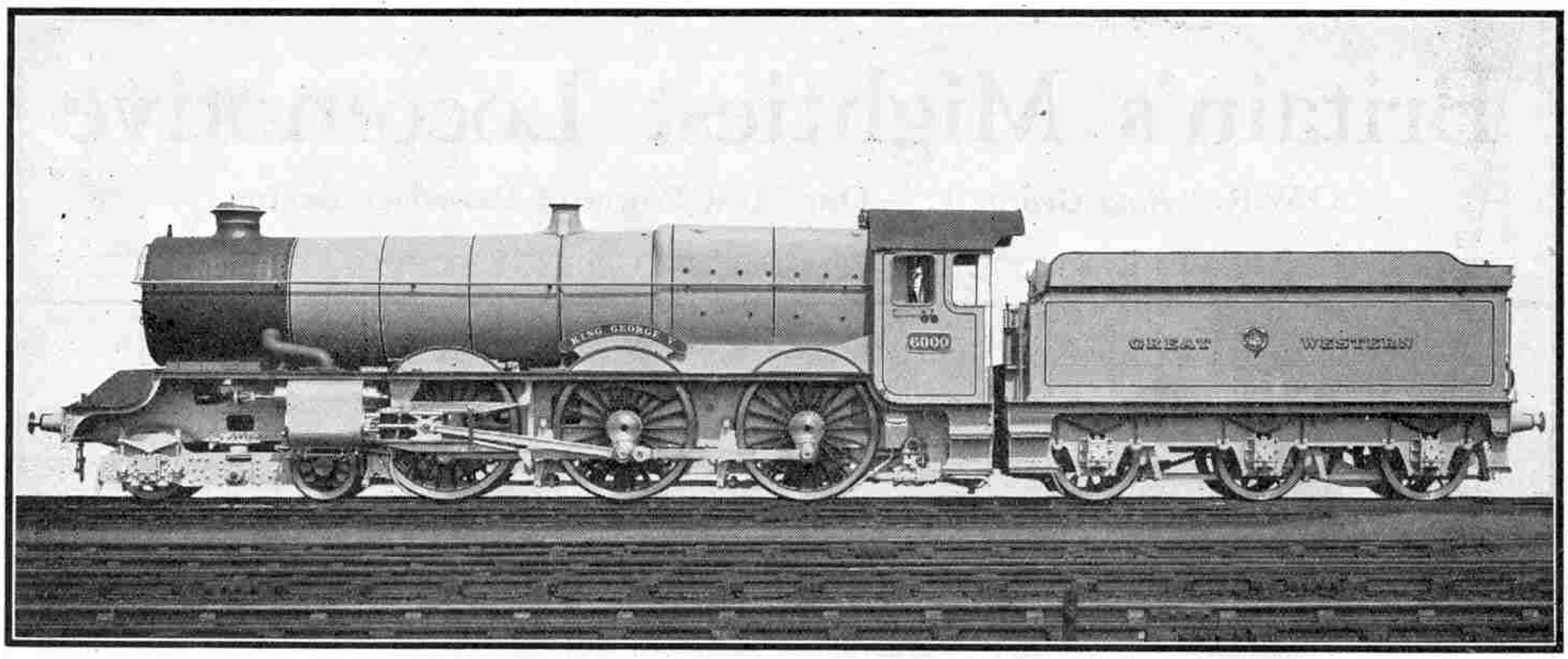
From these figures it will be seen that the single-drivers had great capabilities for fast running, but their hauling power was very limited. The average weight of trains increased steadily and it soon became obvious that these locomotives were not capable of dealing efficiently with heavy loads. The principle became established that as many wheels as possible must be coupled together in order to achieve the best results, and the singles thus gradually disappeared.

The increase in tractive effort obtained in the past few years has been very remarkable. For example, let us take the "*Great Bear*" built by the Great Western Railway in 1908. This was the first locomotive of the "Pacific" type to be built in this country, and for some time it was the largest and most powerful express passenger engine in the British Isles, its tractive effort being 27,800 lb. At the time it was built many people thought the "*Great Bear*" was about the "last word" in British locomotive development, but its performances have already been surpassed by several locomotives. Among its successful rivals may be mentioned the famous Great Western 4–6–0 "*Caerphilly Castle*," with a tractive effort of 3,825 lb. more than the "*Great Bear*," and the more recent 4–6–0 "*Lord Nelson*" of the Southern Railway, which exceeds the tractive effort of the "*Caerphilly Castle*" by 1,875 lb.

Cylinders (four)	
Diameter	**16½ in.**
Piston stroke	**28 in.**
Wheels	
Bogie, diameter	**3 ft.**
Coupled	**6 ft. 6 in.**
Boiler Pressure	**250 lb. per sq. in.**
Barrel length	**16 ft.**
,, diameter (outside) ...	**6 ft. and 5 ft. 6¼ in.**
Firebox length (outside)	**11 ft. 6 in.**
Heating Surface, total	**2,514 sq. ft.**
Grate Area	**34.3 sq. ft.**
Tractive effort at 85 per cent. B.P. ...	**40,300 lb.**
Weight of Engine in working order ...	**89 tons**
Weight of Tender in working order	**46 tons 14 cwt.**
Total weight	**135 tons 14 cwt.**

The "*Lord Nelson*" deprived the Great Western Railway of the honour of possessing the most powerful express passenger locomotive in the country and great curiosity was felt among railway enthusiasts as to what the reply of the Great Western Company would be. The reply has now been made in the shape of the "*King George V.*," which exceeds the tractive effort of the "*Lord Nelson*" by the astonishing figure of 6,800 lb. This remarkable locomotive has been designed and produced by Mr. C. B. Collett, Chief Mechanical Engineer to the G.W.R.

"*King George V.*" is the first of 20 express passenger

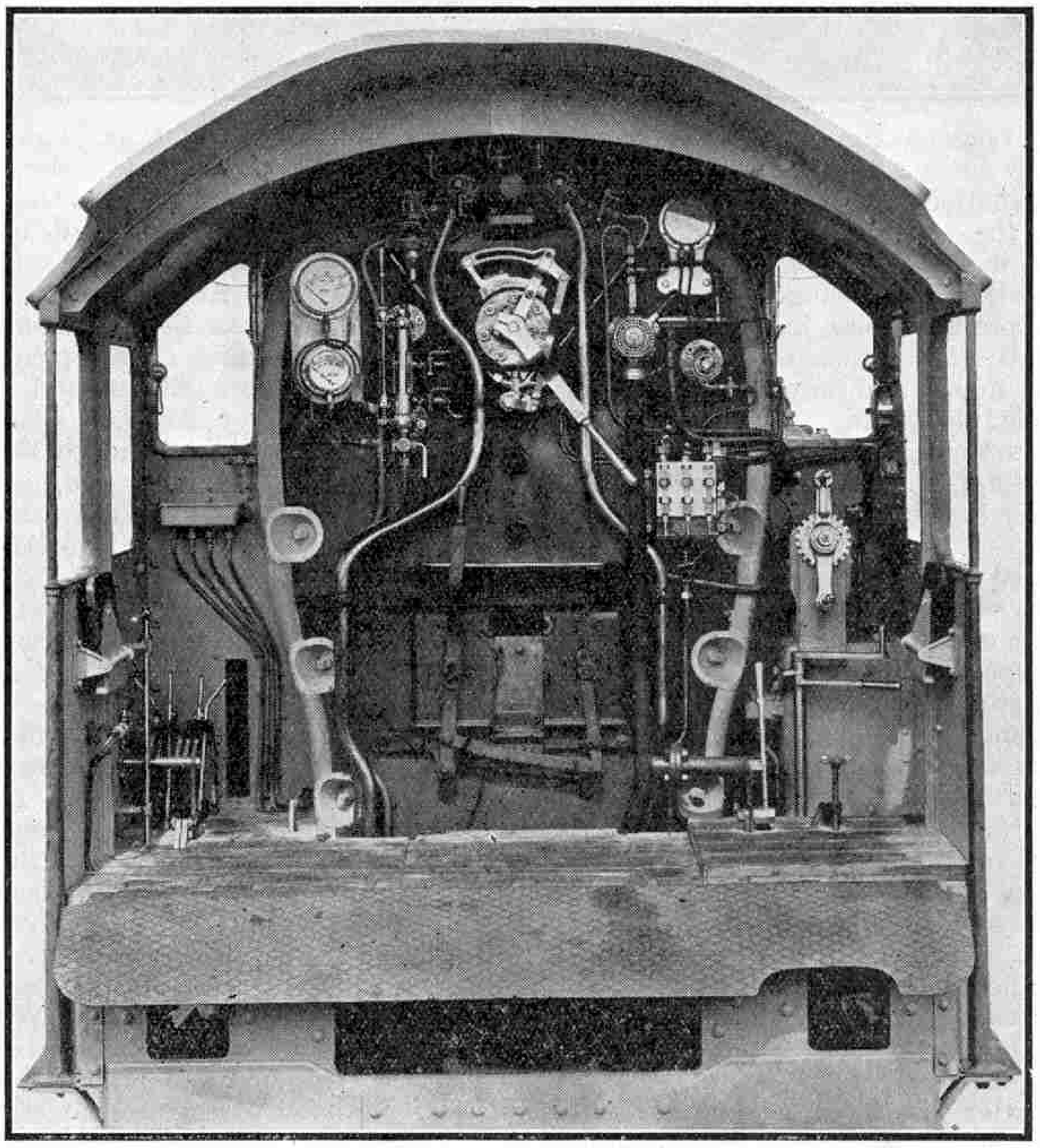


The first of the new "King" class G.W.R. four-cylinder, 4–6–0 type express locomotives

locomotives of the 4-cylinder 4–6–0 type now under construction at the Swindon Works of the Great Western Railway. These locomotives will be known as the "King" class and named after the Kings of England. They will be the most powerful express passenger locomotives in this country, their tractive effort, 40,300 lb. at 85 per cent. of the boiler pressure, being considerably higher than that of any others in Great Britain.

Distribution of the adhesion weight is effected by an equalised arrangement on the six coupled wheels, the aggregate being 67 tons 10 cwt., and the weight on the bogie 21½ tons. The total weight of the engine in working order, without tender, is thus 89 tons. The tender is of the standard Great Western six-wheeled pattern and it is equipped with water pick-up apparatus. It has a coal capacity of six tons and a water capacity of 4,000 gallons. The tender weighs when full 46 tons 14 cwt., and therefore the total weight of engine and tender in working order is 135 tons 14 cwt.

The bogie, which is spring controlled, is of unique design and presents features of outstanding interest. As the accompanying photographs show, it has outside bearings on the leading axle and inside bearings on the trailing axle, this arrangement being necessary in order to obtain clearance between the bogie and the cylinders. The four cylinders are not set in a line across the engine, but the two inside cylinders are set well forward in the frames and drive on to the leading coupled axle, while the outside pair drive on to the middle coupled wheels.



The spacious and well-equipped cab

Steam is supplied to the inside cylinders by piston valves operated direct from the Walschaerts' gear placed between the frames, the valves for the outside pair being operated by rocking levers from the inside gear. The inside connecting rods have forked big ends fitted with gib and cotter; the outside rods have solid bushed ends.

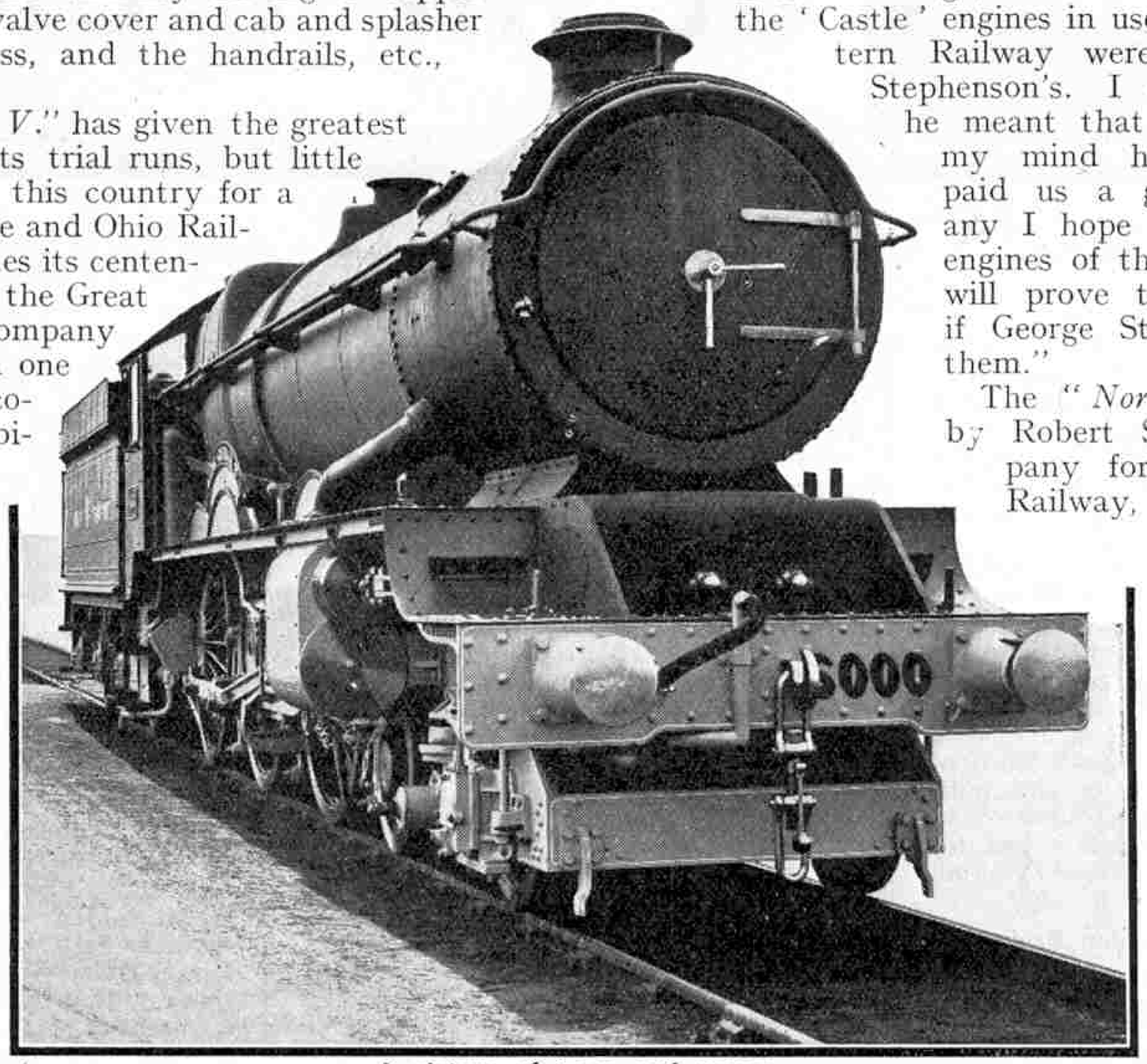
The-high pressure superheater boiler is pressed to 250 lb. per sq. in. and is built with conical barrel and Belpaire firebox with no dome. Steam is taken from an open pipe at the highest point over the firebox and the safety valve is mounted on the barrel. The

inside firebox is of copper stayed entirely by direct steel and copper stays to the outside casing. The superheater is of the standard Swindon 16-unit type. The boiler is fitted with top feed, the water being fed through pipes in the safety valve casing. Vacuum brakes, equalised on all the coupled wheels, are fitted.

The cab is spacious and well protected and gives the driver an excellent view forward. Audible signal gear is fitted for use over sections of the line that are equipped for automatic train control.

The locomotive is finished in the same style as that adopted for other Great Western Railway express passenger engines, the chimney having a copper top while the safety valve cover and cab and splasher beadings are in brass, and the handrails, etc., are polished.

The "*King George V.*" has given the greatest satisfaction during its trial runs, but little will be seen of it in this country for a while. The Baltimore and Ohio Railroad, U.S.A., celebrates its centenary this autumn, and the Great Western Railway Company were invited to send one of their latest locomotives for an exhibition to be held at Baltimore. "*King George V.*" has been selected for the purpose and by the time these lines appear in print will either have arrived in America or be on its way. It will be accompanied by the reconstructed "*North Star,*" which was exhibited at the British Empire Exhibition at Wembley. In regard to these two locomotives an interesting letter from Mr. C. B. Collett to Sir Felix J. C. Pole, General Manager of the G.W.R., appears in the "*Great Western Railway Magazine,*" and we quote the following extracts :—



A picture of grace and power

"You asked me the other day if I would write you a line for the Magazine in regard to the design of the new engines of the "King" class. I should like to say that any credit there may be in connection with their design and construction should be shared by the whole of my staff. . .

"With regard to my own feelings, if I may say so without presumption, my ambition has been to follow, even if a very long way off, very humbly in the footsteps of the great George Stephenson, and it is remarkable how events have sometimes associated our efforts at Swindon with his name.

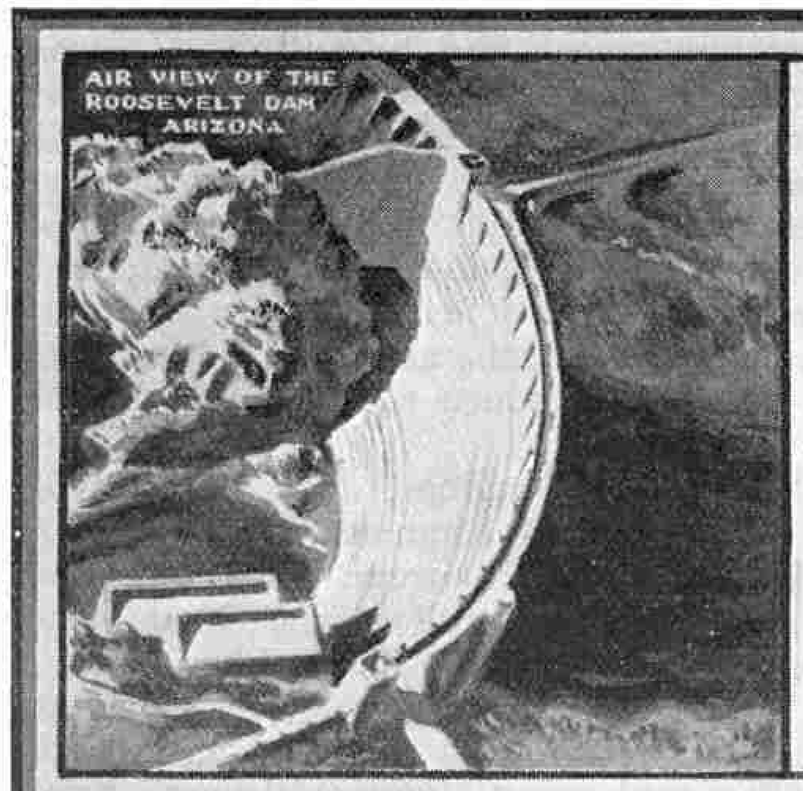
"It is only a short time ago that you yourself were good enough to give me an excellent bust of him, and you will remember that when our "Castle" engines were produced and it was thought that one might be sent to the Wembley Exhibition, you remarked on what a shame it was that George Stephenson's '*North Star*' had been scrapped, and you asked me to get together some of the pieces and rebuild it. It was remarkable how these pieces came together; some of the principal parts, including the crank axle and wheels were found to be still in the works—no one had had the heart to cut them up—and people from different places sent us many other parts, including the nameplates and some of the buffers, one of which was in use as a music stool in a house at Bath, and so Swindon was proud of being able to reproduce the original '*North Star.*'

"Coming to the present engines, at a meeting of the Institution of Mechanical Engineers in London a little while ago, the Chairman remarked that the 'Castle' engines in use on the Great Western Railway were just like George Stephenson's. I do not think that he meant that for praise, but to my mind he could not have paid us a greater compliment, any I hope and trust that the engines of the new 'King' class will prove to be also, just as if George Stephenson had built them."

The "*North Star*" was built by Robert Stephenson & Company for the New Orleans Railway, U.S.A. As the result of certain financial conditions this locomotive was not delivered, and was bought by the Great Western Railway in 1837. It had a working pressure of from 50 to 60 lb. per sq. in. and a tractive effort from 2,000 lb. to 2,400 lb. —a striking contrast to the mighty "*King George V.!*" Brunel was highly pleased with the "*North Star*" and wrote of it in 1838 :—"We have a splendid engine of Stephenson's, it would be a beautyfull ornament in the most elegant drawing room."

As originally built, this fine old engine was fitted with cylinders of 15 in. diameter by 18 in. stroke and was equipped with what was known as "Gab" motion. A dome was fitted on the boi'er and two separate safety valves were provided, one locked and one spring loaded on the barrel. About the year 1854, however, the boiler was lengthened some five inches, the dome removed and the safety valves combined and placed together on the existing manhole on the fire-box. At this period "Gooch" expansion gear was also fitted and the diameter of the cylinders was enlarged by one inch. The driving wheels were 7 ft. in diameter—a size much favoured at that period by the old broad gauge railways. The leading and trailing wheels were 4 ft. in diameter and the engine had a total heating surface of 724.8 sq. ft. It worked until 1870 and covered 429,000 miles!

"*North Star*" appears to have been a favourite name with the firm of Robert Stephenson & Company, for an engine bearing the same title was built by them in 1830 for use on the Liverpool and Manchester railway.



Engineering News of the month.

Road Metal from Rubbish

An interesting plant has been erected by the Corporation of Brighton for reclaiming clinker and for saving scrap iron from household refuse. A separate part of this plant mixes the crushed clinker with bitumen for use as road material.

The refuse is passed direct into furnaces and during combustion provides all the power necessary to drive the rest of the plant. After passing through the incinerator only clinker and scrap iron remain, all organic matter having been destroyed. The larger part of the iron is then removed by hand. During the next stage the clinker is crushed and the small pieces of metal are separated and the clinker is then subjected to the action of a magnetic separator that removes any small pieces of iron that may remain. After this purification the crushed clinker is transferred to the section of the plant established for converting it into bituminous road material.

* * * *

Long Brazilian Suspension Bridge

A suspension bridge having a main span of 1,113 ft. 9 in. has been completed at Florianopolis, Brazil. It connects Florianopolis, on the Island of Santa Catherina, with the mainland of Brazil, and was designed to carry a 28 ft. roadway with a metre-gauge electric railway, and a 24 in. water main. A 9 ft. roadway is supported on an outside bracket along the north truss of the bridge. Several departures from orthodox construction have permitted a reduction in the size and reinforcement of the supporting piers. The towers are 230 ft. in height and the total weight of steel used in the construction of the bridge is 4,400 tons.

* * * *

A Substitute for Petrol

Some interesting experiments are being made by Canadian scientists with a view to discovering an effective substitute for petrol, their chief aims being directed towards the utilisation of the waste material from sulphite mills located in many places in the Dominion. These mills, in the manufacture of sulphite pulp for newsprint, waste a large amount of liquor from which alcohol could be reclaimed.

It is stated that, although acohol has less heating power than petrol, it can be mixed with benzine in such proportions that properly designed motors can obtain a mileage per gallon equal to that of petrol.

Belfast Harbour Improvement Scheme

An important improvement scheme is under consideration by the Belfast Harbour Commissioners. The plans include the strengthening of a portion of Albert Quay in order that electric cranes can be installed. In addition certain re-arrangements would be undertaken with a view to increasing the working spaces on the quay to 1,800 sq. yds. The estimated total cost is £30,000.

* * * *

Tenders for the construction of a large reservoir have been asked for by the Melbourne and Metropolitan Board of Works. This reservoir, which will be the largest in the water supply system controlled by this corporation, is to be formed by an earthen embankment, about 2,100 ft. in length and 136½ ft. in height, the highest of its kind in Australia.

* * * *

Atlantic-Mediterranean Ship Canal

Among the schemes that have been revived within recent months is that for a canal crossing France and joining the Mediterranean and the Atlantic. This idea originated about 50 years ago and after many years of controversy it was decided to disregard the difficulty of keeping a sufficient depth of water at the Col de Naurouse, the highest part of the canal, and the estimates were obtained. These varied from 950 million francs to 2,000 million francs (between £7,660,000 and £16,130,000 at the present exchange), the larger estimate providing for the construction of concrete walls throughout the whole length of the canal. The smaller sum was obtained but the project was never undertaken. In view of the knowledge gained from the Panama Canal, the Kiel Canal, and other important undertakings of this nature, efforts are being made to revive the scheme, the chief value of which would be to render France independent of the Straits of Gibraltar.

* * * *

Huge Concrete Bridge for U.S.A.

A huge concrete bridge, five miles in length, is being erected across Lake Pontchartrain in the United States. When completed it will connect New Orleans with the Mississippi Gulf Coast. Two bascule bridges, one 150 ft. and the other 110 ft. in span will be incorporated, while the viaduct will be an arched beam concrete structure, 30 ft. in width between the kerbs and having 35 ft. spans supported on reinforced concrete piles. The roadway, 15 ft. above water level, will be sufficiently wide to accommodate three lines of vehicular traffic, and a handrail will be provided along each side of the bridge, although no footway for pedestrians will be constructed. The estimated cost of this project, which is being carried out by private enterprise, is £1,140,000.

* * * *

A New Road Surface

A comparatively modern method of laying a road surface has been undergoing tests on Hammersmith Broadway, a London thoroughfare subject to the constant wear of heavy traffic. During the last year this section of the road has shown that "Surfastel" road-surfacing, as the method is called, is entirely satisfactory. The process consists of laying steel strips 1¼ in. in depth and 0·1 in. in width so that the upper surface of the metal is flush with the intended road surface. These strips are bent in a zigzag shape so that when laid near to each other a mesh of 4½ in. steel-sided squares is formed. The interspaces are then filled with asphalt or concrete. The rate of wear on this surface is limited, of course, to that of the steel edge.

* * * *

A bridge is to be constructed over the Forth and Clyde Canal at Castlecrag. It is to be of the swing type supported on a pivot and so designed that it can be opened in three minutes by one man.

* * * *

Avonmouth Dock Extensions

Important alterations and extensions are being carried out at the Royal Edward Dock, Avonmouth. The work comprises the construction of an eastern arm for the dock, with reinforced concrete wharves for the extension, granaries and transit sheds. The extension itself will be about 1,700 ft. in length and 400 ft. in width and will be provided with three deep water berths on each side. On the east side there will be erected two grain transit sheds, a grain conveyor gallery, and a silo granary.

A steam navvy on caterpillar wheels has been used for the excavation work but the last 10 feet of the depth of the dock is being dredged.

Building Ships in Dry-Dock

Experiments conducted by American naval experts at a shipbuilding dry-dock on Puget Sound indicate that the orthodox method of building ships on shore and launching them by means of runways may be superseded by the more modern system of constructing the hull in a dry dock. As the size and weight of ships have increased, so the length of the launching structure has had to grow until very elaborate frameworks are needed for the latest vessels, while, in addition, the question of launching space, governed by the width of the river and other factors, is important. A typical example of the importance of this latter consideration was given by the American aircraft carrier "*Lexington*" which, when launched at the River Fore, attained a speed of 19 ft. per second as it left the runways. In order to prevent the ship from continuing its rush and from beaching itself on the opposite bank of the river, a complicated system of chain drags had to be used.

In contrast with this, launching from a dry-dock consists merely of allowing the dock to fill with water and towing the hull out. The naval dock mentioned above cost less than a well-equipped building way, and has already been used in the construction of two 10,600 ton ships, the "*Nitro*" and "*Pyro.*" The hulls of these ships were laid down while the building of the dock was in progress, the latter being completed about the time the ships were ready for launching.

* * * *

The Latest French Liner

The latest French liner "*Ile-de-France*" incorporates several very interesting features. The tonnage of this vessel is 43,584 tons and it has a speed of more than 23 knots. Two full-sized tennis courts, a large gymnasium and a shooting gallery are provided, while a permanent chapel has been built in the heart of the ship, extending through the height of two decks. This chapel has a capacity for 80 people. The "*Ile-de-France*" is to be used on the Atlantic service.

* * * *

German Naval Construction

The second German post-war cruiser, "*Konigsburg,*" has been launched at Wilhelmshaven. The first of this class, the "*Emden,*" was launched in January, 1925, and is at present on a world cruise. The newer vessel differs only in minor details from the "*Emden*" and has approximately the same dimensions, having an overall length of 508 ft., a displacement of 6,000 tons at normal draught and a speed of 29 knots. It is interesting to note that the extensive use of electric welding is stated to have resulted in a much lighter hull than would otherwise have been the case.

New St. Lawrence Channel

A channel 10 miles in length is being excavated along the south-east side of the island of Orleans in the St. Lawrence River in order to enable vessels to reach the nearly completed and safer North Channel of the river. The whole of the route has been buoyed and is now available for navigation, even at low water, by ships drawing 25½ ft., but dredging is to be continued until a channel 35 ft. in depth at lowest tide has been excavated.

The new North Channel when completed will be greatly superior to the South Channel and it is considered improbable that the upkeep of the latter will be maintained. The completion of the whole work will provide a channel 35 ft. in depth from Montreal to the sea, and no less than 127,135,508 cu. yds. of material will have been removed in the course of the undertaking. Of this amount 101,500,000 cu. yds. have already been removed. The work has been undertaken by the Dominion Department of Marine.

* * * *

An order for the construction of three destroyers has been placed with a British firm by the Argentine Government. These vessels will be of the latest type and will take about two years to construct. Their cost will be about £1,000,000.

* * * *

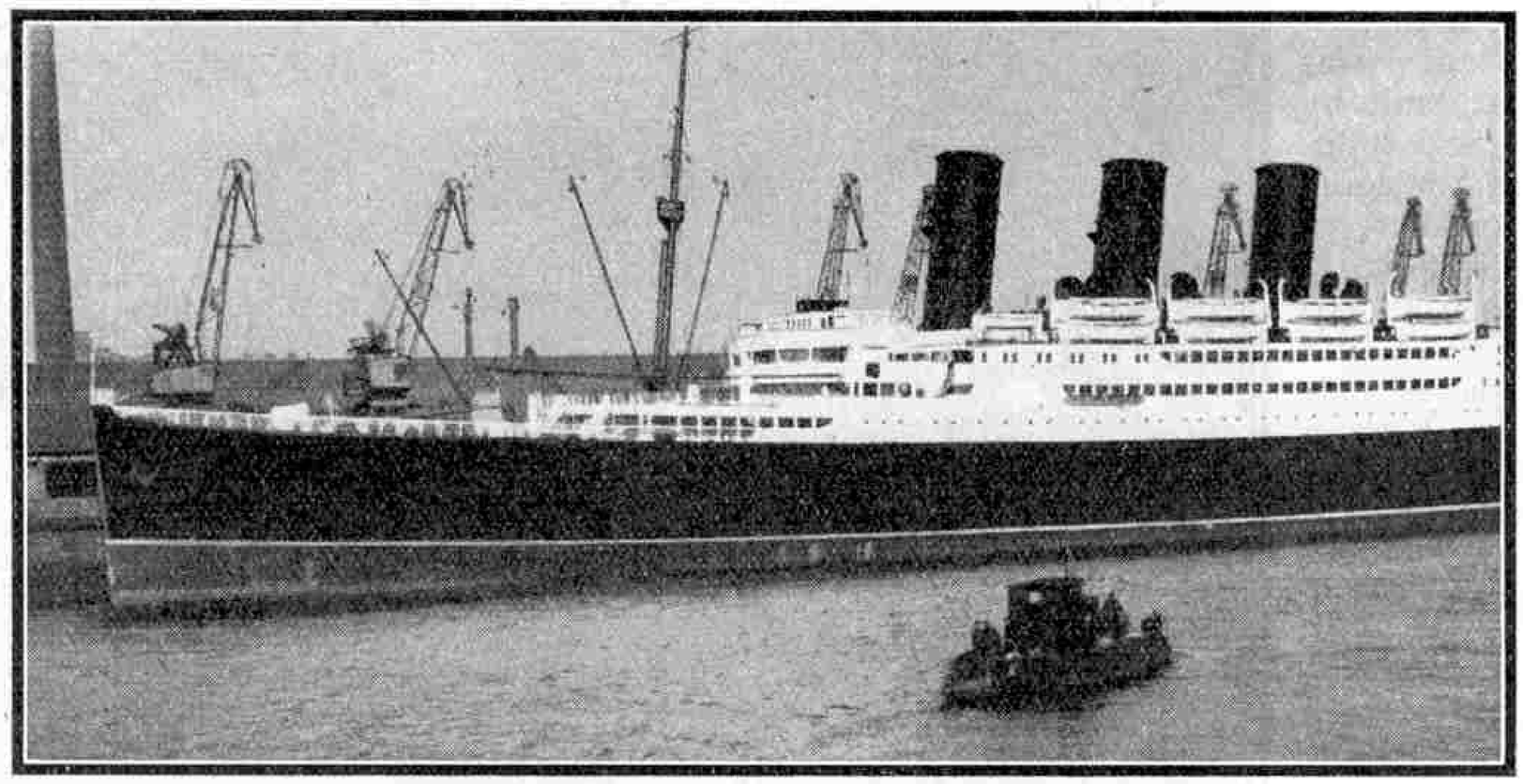
New and large newsprint mills are under construction at Bathurst, New Brunswick, and will be completed in 1930. More than 50,000 h.p. will be developed, necessitating an estimated expenditure of £1,800,000 for power plant and storage basins. The output of the mills will be increased to six times their present capacity.

* * * *

A bridge is to be built across the Danube for railway, road and pedestrian traffic, with a total length of approximately two miles. The weight of the material to be used in its construction is estimated at 3,000,000 tons and it is anticipated that the bridge will be completed in four years.

* * * *

An old bridge across the Coleron River, India, that was wrecked in 1924, is being replaced. The new bridge is to consist of 38 spans of 60 ft. each, supported on brick well piers, and will be nearly a mile in length.



This photograph, of the Anchor Liner "Transylvania" lying at Yorkhill Wharf, Glasgow, was taken by our reader H. S. MacKinnon

Electric Supply Plant in conjunction with Gasworks

The electricity supply undertaking inaugurated recently at Retford, Nottinghamshire, is believed to be the first of its kind to work in conjunction with a gas-works. This station has been constructed in the gas-works yard and comprises two generating plants. The main plant consists of two gas engines supplying 700 h.p. and directly coupled to alternators giving a total of 470 kw. The two gas engines on this part of the installation are fitted with interchangeable cylinders and are supplied with gas direct from the holders.

The subsidiary plant consists of a horizontal tubular boiler and a small condensing steam engine connected to a 50 kw. alternator. The boiler is heated by hot gases drawn from the main flue of the gas plant by means of an electrically-driven fan, and the steam so produced is passed through a superheater contained in a chamber near the main flue, thence passing to the steam engine. The condensed steam is pumped to an overhead tank by two double-pump motor-driven sets.

Unusual difficulties had to be overcome when the foundations for the main engines were laid, owing to the presence of a bed of sand about 5 ft. 6 in. in thickness at a distance of 10 ft. from the surface. Holes 12 in. in diameter were drilled to a depth of 22 ft. and piles were put in position. Concrete beds were constructed on the piles, liquid cement being pumped into the ground at a pressure of 300 lb. per sq. in. to replace the sand beneath the beds.

* * * *

Rubber Bearings

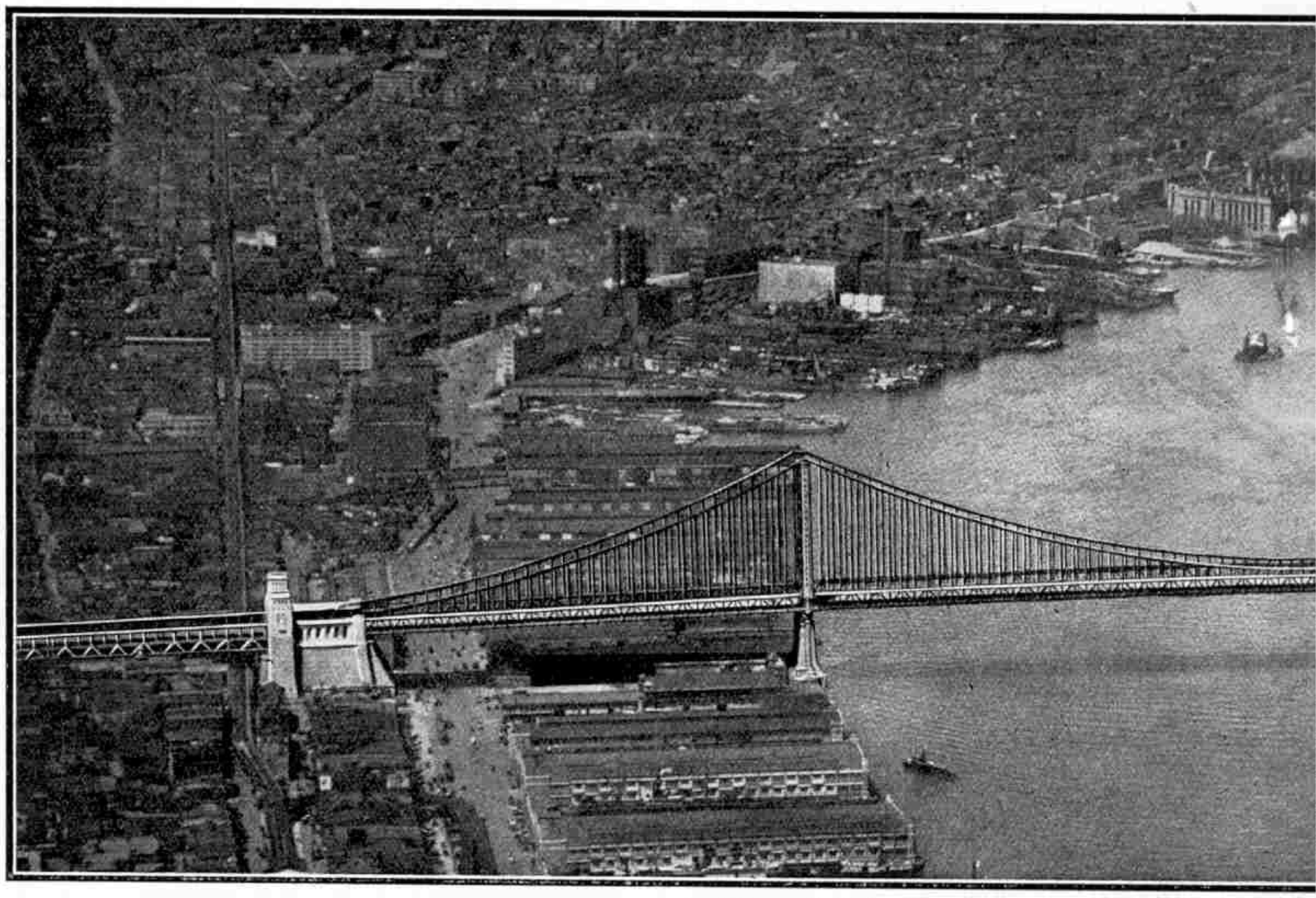
Experiments conducted with a view to utilising rubber in the manufacture of bearings have given very encouraging results. The particular design of bearing tested has a helical groove to permit water lubrication. Any grit that is trapped in the bearing, instead of grinding between two metal surfaces, is rolled across the surface of the rubber, which yields to it, until it reaches the groove where it is washed away by the lubricating water. The friction between the shaft and rubber bearing when a constant film is maintained is said to be less than that between the shaft and oil-lubricated metal bearings. Speeds up to 5,000 revs. per min. have been tried with this type of bearing.

* * * *

A Canadian Commission at Vancouver have decided that a bridge across the "Lions' Gate" should be built. Under their recommendations this bridge is to have a clear span of 1,400 ft. and to be 190 ft. in height above water level, while the channel is to be dredged to a depth of 35 ft. for a width of 1,400 ft.

THE LONGEST SUSPENSION

Across the Delaware River,



A unique photograph, taken from an aeroplane, of the

THE earliest form of suspension bridge was probably that built by the natives of tropical countries, who utilised the long, thick stems of tropical creeping plants for cables. A pair of these stems would be drawn across a river and numerous cross-pieces attached to them to form a footway. Sometimes ropes were used in preference to creepers, and in Japan and China many centuries ago chains were often adopted. The sag of these primitive bridges was sufficiently small to enable both pedestrians and animals to negotiate them safely. Simple structures of this nature are still erected by the natives of Africa, South America and other tropical countries.

The present-day suspension bridge across the Quiniault River on the Olympic Peninsula, Washington, U.S.A., is an elaboration of these primitive rope bridges. This bridge consists of a footwalk carried upon wire cables stretched across the river and attached at each end to tall, strong fir trees. A pier in midstream, built up on a foundation of rocks and branches, gives support to the cables carrying the footway, while undue oscillation of the bridge sideways is prevented by overhead cables to which the bridge is linked by vertical stays attached at intervals along its length. The bridge is only 2 ft. in width but is 994 ft. in length, and at the time of its construction was the longest suspension bridge in the world.

Suspension bridges with level roadways came into use in Great Britain and in America about the end of the 18th century.

First Large Suspension Bridge in England

In England the first large suspension bridge to be erected was designed by Sir Samuel Brown, who is remembered as the first engineer to utilise iron rods instead of chains for suspension bridge cables. This bridge spanned the river Tweed at Berwick and was known as the North Union Bridge. It was begun in 1819 and completed in the following year, but after only a few months of service it met with disaster. It had a span of 449 ft., and the wrought iron rods used for the suspension cables were 15 ft. in length and 2 in. in diameter.

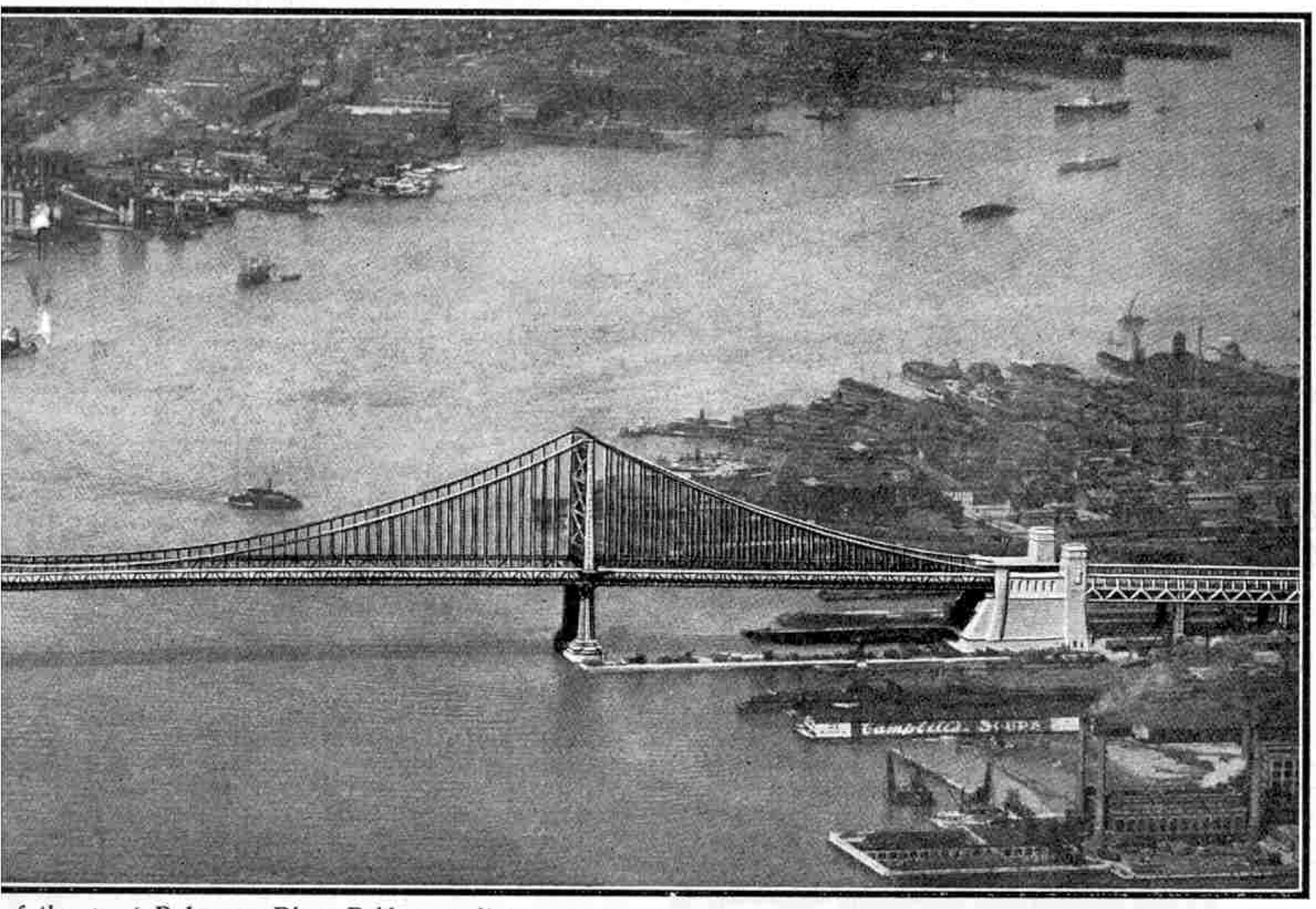
The advantages of a suspension bridge are numerous from the point of view of the builder. Every part of the bridge is in tension, and additional strengthening as a precaution against bending, as is necessary with long girder bridges, is not required. Moreover, the wire cables offer a resistance to tension considerably greater than the average strength of the metal itself, by reason of the great tensile resistance of the outer skin of the wire.

On a suspension bridge the strain is least in the centre of the span, and here the weight of the bridge per unit of length is also reduced to a minimum. The weight increases toward the bridge towers or piers from which the overhead cables hang, by reason of the gradual upward trend of the latter and

The Bridge from the top of

N BRIDGE IN THE WORLD

ver, at Philadelphia, U.S.A.



of the great Delaware River Bridge, as it appears to-day

top of one of the towers

River separating the island of New York from the mainland. They are known respectively as the Brooklyn, Manhattan, and Williamsburg Bridges.

The Brooklyn Bridge was the first of these to be built, and it was planned by John Augustus Roebling, a Prussian who emigrated to the United States in 1831 when 25 years of age. There he became one of the pioneers of wire rope making, and the firm founded by him in Pittsburg is to-day one of the largest wire rope-makers in the world.

Roebling was greatly impressed by New York's great need of improved traffic facilities to the mainland, but his scheme to achieve this by bridging the East River with a mammoth bridge suspended from wire cables was ridiculed by the foremost engineers of the day. The intense opposition to his scheme did not deter Roebling, however. He was a stubborn man, full of confidence in himself and his project, and it was a great triumph for him when his plans for the Brooklyn Bridge were accepted in 1867.

The actual work did not commence until 1870, and in the meantime Roebling died. His son, Washington Roebling, determined to carry out his father's plan, and under his supervision the work was completed.

The Brooklyn Bridge is carried on four main cables, the immense strain on which is relieved by auxiliary cables spreading out on both sides of each pier. It has a central span of 1,595 ft., a total length of 5,989 ft., and cost fifteen million dollars. This bridge was officially opened in 1883, and 20 years later its extensive span was exceeded by the Williamsburg Bridge, with a single span of 1,600 ft.

World's Longest Suspended Span

To-day the honour of having the longest suspended span in the world belongs to the Delaware River Bridge, which was formally opened on 1st July last year. This bridge connects Philadelphia, Pa., on the west side of the river, with Camden, N.J., on the east bank, and took five years to construct. It is 3,450 ft. in length over the cable anchorages and has a centre span of 1,750 ft., that is 150 ft. longer than that of the Williamsburg Bridge referred to above.

When the erection of the Delaware Bridge was being considered, the United States War Department, who

the increased length of the suspending rods. On the shore side of the piers, anchor cables extend down from pier to earth, where they are firmly secured.

The principal disadvantage of the simple suspension bridge lies in its lack of rigidity, and in almost all modern large span suspension bridges the structure is steadied with horizontal stiffening girders, which also serve to prevent distortion. The first large suspension bridge to be stiffened in this manner was one built across the river Thames at Battersea in 1862 by Barlow, the originator of this idea.

Three Great Bridges

Three of the greatest suspension bridges in the world span the East

have control over all navigable streams, stipulated that no piers or obstructions were to be placed in the navigable fairway. As the Delaware River at the site of the bridge is between 1,700 ft. and 1,800 ft. in width, this stipulation rendered it necessary to build the bridge with a centre span of record length.

The accompanying illustrations show that the bridge deck is upheld by suspension rods from two massive cables. These are as much as 30 in. in diameter and weigh about one ton per foot run. The limiting of the number of cables to two of large diameter is a contrast to the four cables used in the construction of each of the three large suspension bridges at New York. The cables of the Manhattan bridge are 20½ in. in diameter; those of the Williamsburg bridge are 18⅝ in., and the four cables of the Brooklyn bridge each 15¾ in.

The Delaware Suspension Bridge almost completed, as seen from the shore

Cables Composed of 18,666 Wires

The great strength of the two cables used for the Delaware Bridge may be gauged from the fact that each is composed of 18,666 individual wires compressed very tightly together and sheathed. The cables are 89 ft. apart and are supported at each side of the river by a tall steel tower, over the top of which they pass down to the anchorage. These steel towers rise from granite piers to a height of 347½ ft., and the cross-section of each post increases from 7 ft. by 12 ft. at the top to 7 ft. by 40 ft. at the base. They are so designed that they will bend as required to compensate for the expansion and contraction of the cables due to temperature changes. Some of the massive blocks of granite used in building the base structure around the steel towers weigh as much as 19 tons each.

The cables pass down toward the anchorage at an angle of 45°, flattening out to about 8° with the horizontal at the point of actual entry into the anchorage structures. At a point 40 ft. down from the top of each tower, each cable is cased in a cast steel band, below which the individual wires comprising the cable flare out in all directions and are looped about a group of 61 cast steel shoes. Each shoe is connected by a 9 in. pin to a pair of 10 in. eyebars.

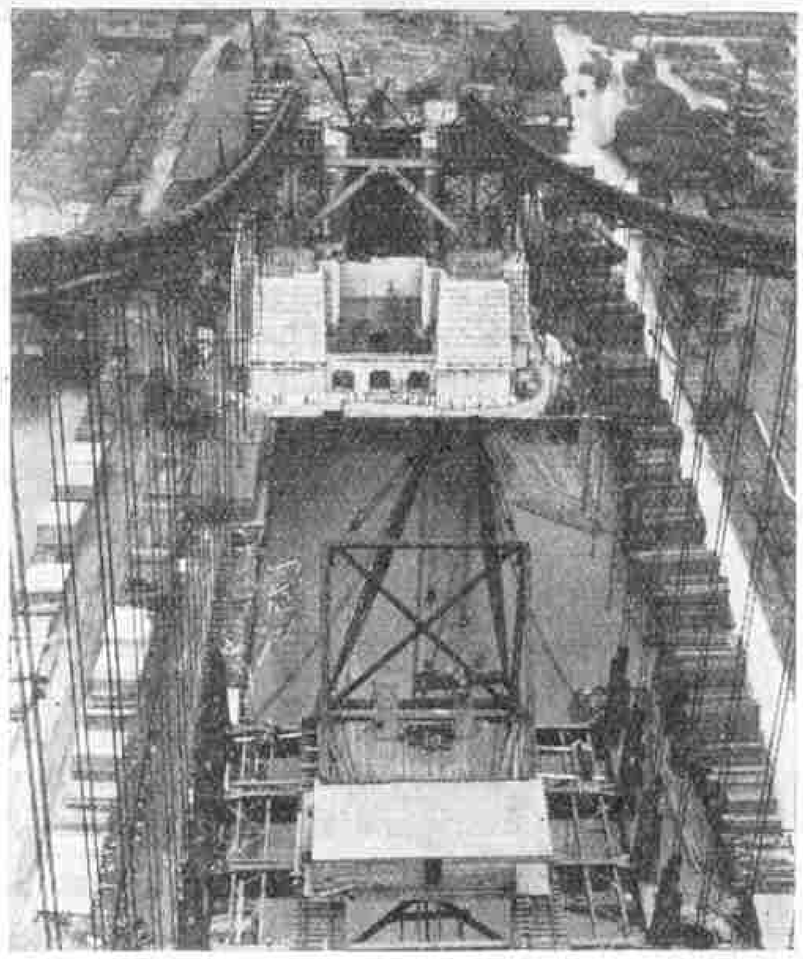
The group of 122 eyebars taking the pull of one cable is passed down into the mass of concrete, flaring out all the way, and is connected to a row of nine anchor girders. There are three lengths of eyebars between the cable shoes and the anchor girders, making a total of 732 eyebars in each anchorage. The box girders are 40 ft. in length.

Each suspension cable is subjected to a pull of 20,000 tons, while the two anchorages holding the cables have a combined weight of 400,000 tons.

Reinforced concrete towers containing lifts and stairways from the ground level to the bridge are situated one on each side of each anchorage.

Ample clearance is allowed under the centre span for the passage of the largest vessels using the river, as the bridge deck is 135 ft. above high water line. Two lines of stiffening trusses, 28 ft. in depth and spaced the same distance apart as the suspension cables, are provided.

The bridge carries a centre carriage-way 57 ft. in width that can accommodate six lanes of traffic. This road is paved with 3½ in. creosoted wood blocks laid upon a reinforced concrete base 5 in. in thickness. It is flanked on each side by a trolley car track, while outside the line of the cables is a rapid transit track on each side of the bridge, used by the electric trains of the Philadelphia underground railway. The footwalks for pedestrians are 10 ft. in width and are supported by brackets at the top of the truss posts, being thus elevated over the two railway tracks.



A view from the top of one of the towers looking landward, showing construction of the bridge in progress

The bridge is being worked as a toll bridge and the revenue from this source used in part to redeem money borrowed for the construction work, and also to meet maintenance costs.

Bridge Builders' Hazardous Work

The Delaware Bridge provides an excellent example of the hazardous nature of the work of the bridge builder. Imagine yourself perched on the top of the tower from which the photograph reproduced on the previous page was taken. You would be quite certain to hang on for dear life, and you would have neither time nor inclination to do anything but prevent yourself being blown off by the force of the wind. To the bridge builder, however, working in such precarious positions is merely everyday routine and does not present itself as a sensational feat of daring. The exacting nature of his work demands steady nerves and a clear head, for a slight mis-step would send him hurtling to instant death hundreds of feet below.

Bridge workers naturally become very expert at maintaining their balance in climbing about the structure, and this expertness leads at times to over-confidence. The consequence of this is that they tend to become careless and to take unnecessary risks. Unfortunately, every great construction of this kind is accompanied by some loss of life, and in the course of the erection of the Delaware bridge at least a dozen fatalities occurred.

It is not the case, however, that all bridge-building accidents are due to over-confidence on the part of those involved. Perhaps the most appalling disaster that has ever occurred resulted in the death of between 60 and 70 men. This was the collapse of the southern cantilever of Quebec Bridge on 29th August, 1907, which resulted in 15,000 tons of carefully placed steelwork, representing three years' work on the bridge, being converted into a shapeless mass of partially submerged wreckage. Investigation showed that the collapse had been caused by the compression chords failing to withstand the burden imposed upon them. Our cover this month shows one of the huge girders for the Quebec Bridge being lowered into position, and it gives an excellent idea of the enormous mass of steel that had to be handled and of the risks faced by those engaged in the task.

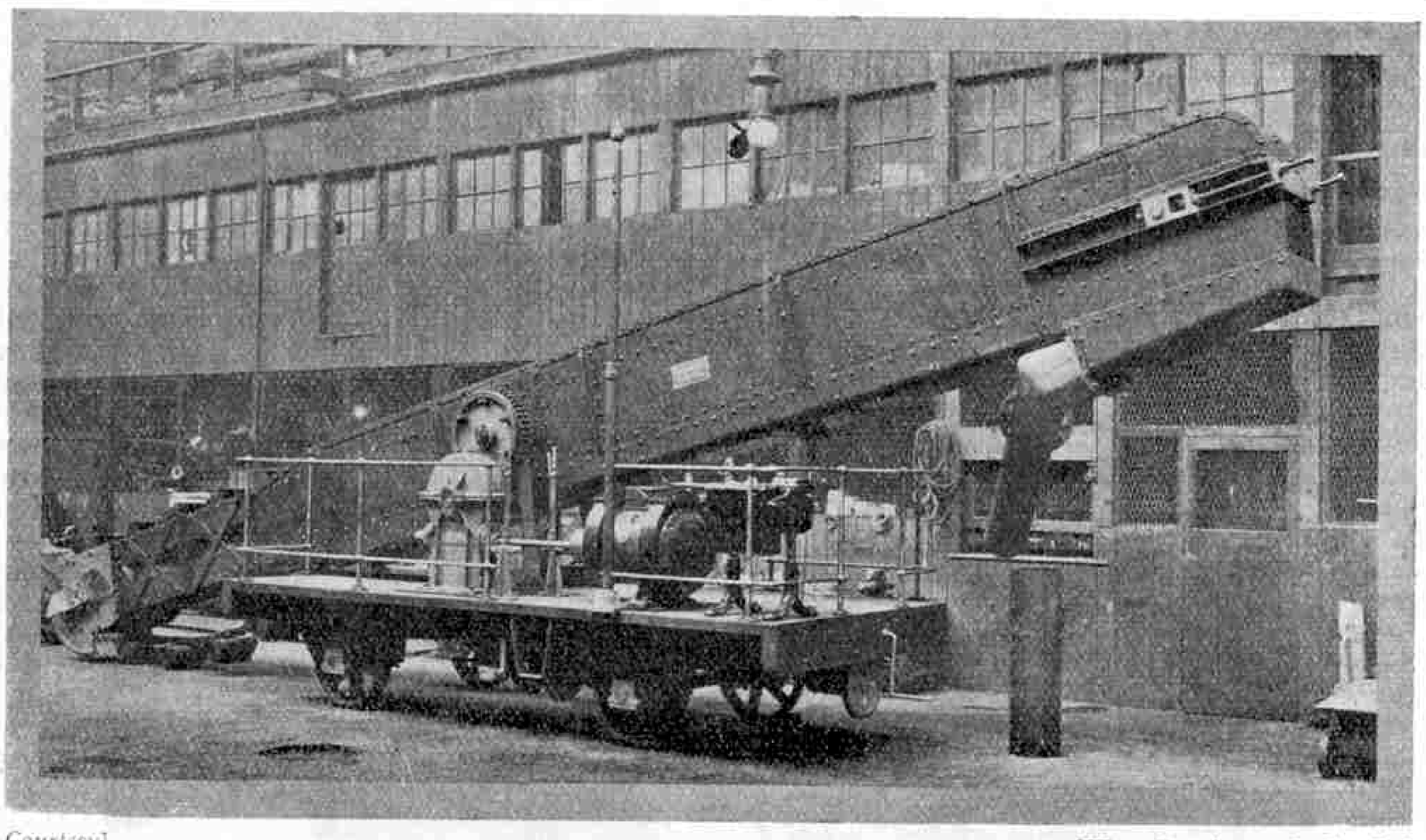
In spite of the great dangers that they must face daily, bridge-builders are a happy, good-natured lot of fellows. When one of their number pays with his life for being too reckless or clumsy, they mourn his loss and then return to their hazardous labours, each knowing that the same fate might overtake him at any moment. Nevertheless they will not change to other occupations, and they declare that there is in bridge-building a fascination that cannot be equalled in any other form of construction work.

A Travelling Dredger Elevator

OUR illustration shows a travelling adjustable dredger elevator of a type that is used by sanitary authorities for working in conjunction with sewage farms.

The elevator casing is made of steel plates, the side plates being bent over to form the joints as this design is superior to corner angles.

The buckets are 15 in. in width, rigidly attached to a large-pitch chain, which has skidder bars running on renewable hard cast-iron strips fixed to the guide angles. The buckets are perforated to allow water to run off and the chains are driven by large sprocket wheels set at 34 ft. centres approximately.



Courtesy [*Wm. Beardmore & Co. Ltd.*

This dredger will make an interesting subject for a Meccano Model

The casing has adjustable tension gear at the top, and at the bottom a cast-iron rest shoe is fixed for steadiment. The bottom spindle has two rotating vanes, which assist the motion of the elevator as it is being lowered into the material.

In the position of the elevator arm, as shown, it is possible to move the dredger from pit to pit as all the machinery is above the floor level. To enable the elevator to be lowered to empty the pits, the truck runs on rails carried over the pit, and the discharge is arranged at the sides so that the sludge is shot into hopper trucks running along the boundary wall.

The drive of the elevator is from a 15 h.p. motor, through a machine-cut worm reduction gear, and a set of spur reduction gear, to a driving shaft which passes through the trunnion on which the elevator casing is swung.

From this shaft there are two chain drives, one passing to the elevator head, and the other down below to a shaft lying across the underframe of the truck; on this shaft are two sets of reversing bevel gears which are controlled by the two operating levers which can be seen above the surface of the truck.

These two motions, controlled by these levers, are for travelling the truck up and down, or for raising and lowering the elevator casing through the operation of a steel wire wound on a winch drum. There is also an arrangement whereby these motions can be obtained by hand in addition, if desired.

To protect the motor a slipping coupling is incorporated with the main gear spur wheel, so that if there should be any binding of the elevator due to foreign substance, the motor will slip its load instead of damaging the armature. The controller of the motor is shown on the truck floor, and the current is derived from the trolley arm which is attached to the vertical pole shown in front of the truck.

It should be possible to build an interesting Meccano model of this dredger elevator. Meccano Dredger Buckets secured to a Sprocket Chain will serve admirably to represent the chain of buckets used in the actual machine.

Outdoor World—(*continued from page* 693)

before William the Conqueror invaded these shores.

To-day, the quarrying of the flints is carried on very much as it was in ancient days. The burrows as stated are about 40 ft. in depth and are lighted and ventilated by means of a candle stuck upon a stone or into a hole in a brick set upon a shelf cut in the chalk of the sides of the burrow. In working, the quarrymen frequently came across evidence that the ancients used a lamp made of a hollow stone containing fat in which floated a moss wick which was set upon a similar small shelf cut in the chalk.

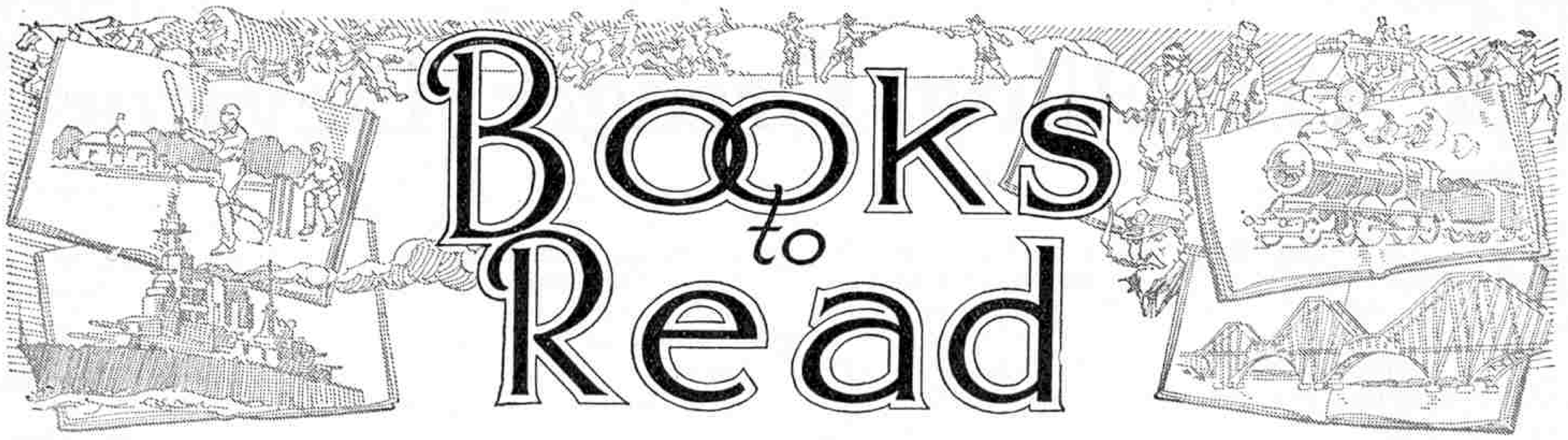
In the days of the Roman occupation there is little doubt that some of the prehistoric burrows were open, because Roman remains are frequently discovered. No doubt they were buried by the sides falling in and closing the working with the passage of time.

Mr. Snares has not spent the whole of his life in the little work yard amongst the flints. He possesses a very fine military record and points with pride to a signed photograph of Lord Wolseley, under whose command he served. Before taking up military duties he was a craftsman in flints, and his grandfather at one time employed nearly 200 men in the industry. To-day he is one of the most interesting and refreshing personalities one could wish to meet, entirely in love with the lore of his art and most courteously eager to place it at the disposal of any genuinely interested caller.

For permission to reprint this interesting account of a curious and ancient art, we are indebted to the Editor of the "Bombshell," the house organ of Thos. Firth & Co., Sheffield.

A New Stamp List

An interesting new stamp price list has come to hand from Mr. H. C. Watkins of Barnet, and contains details of over 600 different sets of stamps and various packets. Many interesting bargains are offered and the young collector engaged in building up a general collection will find the list particularly useful. A copy will be sent by Mr. Watkins to any reader who forwards a 1½d. stamp and mentions the "*M.M.*"



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

"The South Seas of To-day"

By A. J. Douglas and P. H. Johnson
(Cassell & Co. Ltd. Price 21/-)

This is an account of the cruise of the yacht "*St. George*" in the South Pacific, and of the explorations and experiences during a 30,000 mile voyage from April 1924 to September 1925. The book portrays the South Seas as they are to-day, with a wealth of information as to quaint customs and age-old ceremonials.

The "*St. George*"—a barquentine-rigged auxiliary-engined yacht (commanded by Captain Blair, formerly in the White Star Service) set sail from Dartmouth. After calling at Madeira she headed for Trinidad, passed through the Panama Canal, visited Cocos and the Galapagos Islands, and then sailed across the Pacific for the Marquesas. From here to the Society and Austral Islands, then a voyage directly eastward brought the adventurers to Easter Island, from which they returned to England by way of the Panama and the Bahamas.

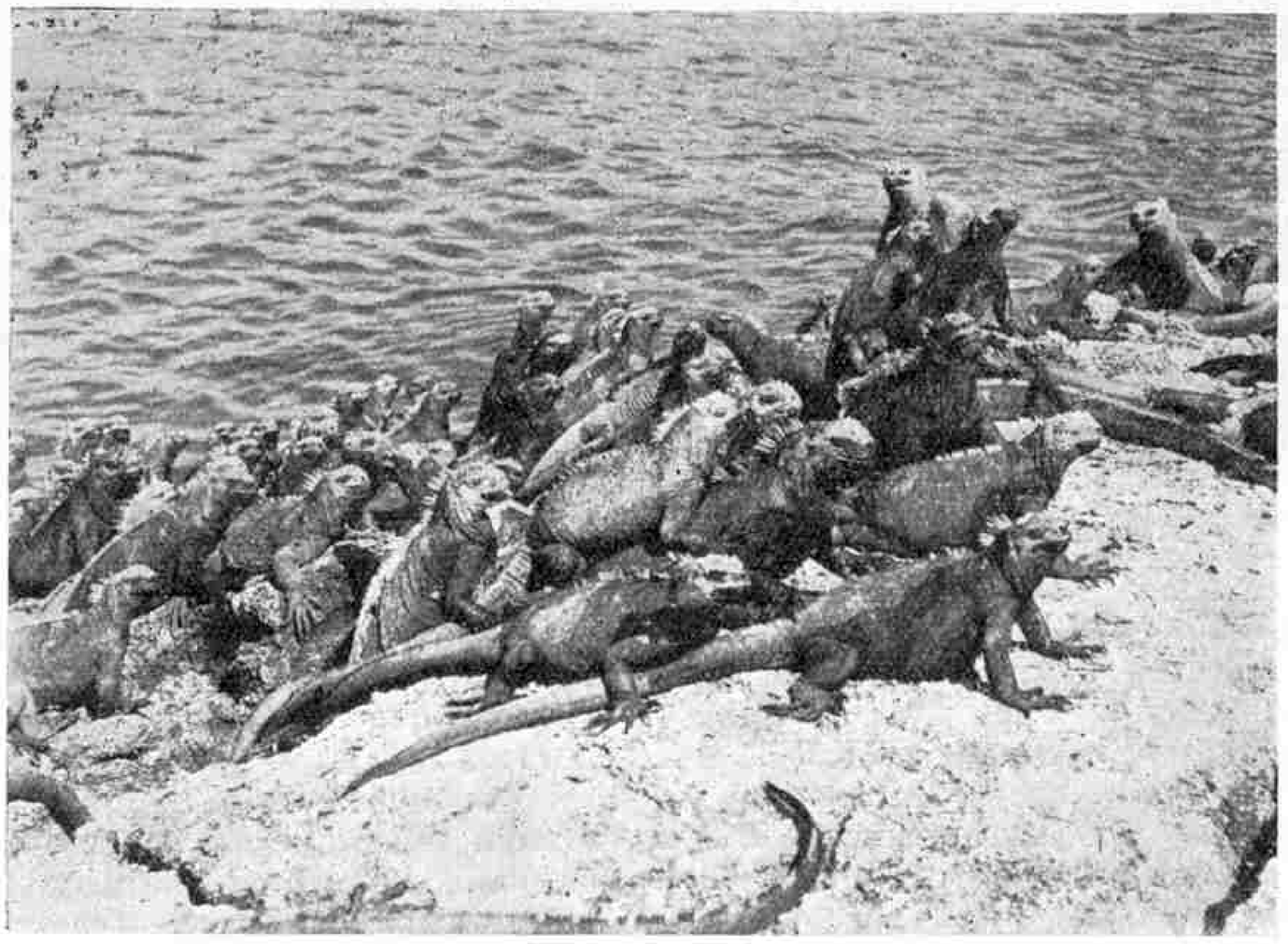
It was in the Marquesas that the explorers gained their first sight of the wonderful lavishness with which nature has endowed some of the islands of the South Seas. "Every house was surrounded by bread fruits with their deep-cut leaves and rough-skinned globes of the natives' staff of life. Banana plants threw patches of shade under their broad ragged fronds; while orange and lime trees, covered with both fruit and flowers, grew singly or in thickets. Here would be a graceful kapok tree with its fluffy seed-pods; there a perfumed frangi-pani, its bulbous finger-like branches ending in waxen clusters of white and yellow flowers. Chili plants displayed their red or green capsules, whilst scarlet hibiscus bushes were everywhere."

Here it was learned that the old true-blooded inhabitants of the Marquesas had almost been exterminated, and it seems a great tragedy that such a splendid people should disappear. A French missionary expressed the opinion that "they must have been physically the finest race the world has ever seen, but even before the coming of the Europeans they had begun to decay, and civilisation, with its attendant evils, only hastened the process."

At Papeete, one of the most famous islands in the South Seas, the explorers found all the old-time romance had disappeared. The inhabitants of the island have lost most of their former simplicity and the glamour of the place has gone entirely. The arrival of the mail boat twice a month brings crowds of tourists. Motors dash about the streets and on Sundays the roads are thronged, most of the motors being filled with natives singing and playing guitars. Garages are everywhere and even in villages distant from the capital there are large numbers of youths riding bicycles. There are three cinemas in the town and crowds of natives jostle each other to get a seat "at the pictures." Although most of the films shown are very old and have been discarded long since in Europe and America, they are watched with breathless interest and the audience yells with delight at any feat of daring.

At Rapa, the "*St. George*" ran aground on a coral reef and the captain and the crew thought the boat would break up. Boats were lowered and Major Douglas collected his films, diary and papers when suddenly there came a great gust of wind and a perceptible movement. "She's off!" cried Edwards, and sure enough she was!

Conditions at Rapa are so bad that even lepers are living in the same huts as the healthy inhabitants and the only missionary there was about to leave. Some of the crew attended the Sunday service at which there were a number of children. During the long sermon the pastor secured their attention by tapping them on their heads with a long stick whenever their eyes strayed to the benches where the white men were seated!



Marine Lizards (*Amblyrhynchus cristatus*) seen on Narborough Island
(From "*The South Seas of To-day*")

Easter Island, the next call, has figured a great deal as an island of mystery, on account of the huge stone figures that lie strewn about its hillsides. Even on Easter Island there is a motor-car, however, but it is a mystery how it manages to keep going, since its tyres have long ago succumbed to the trials of running on an island where there are no roads. The inner tubes are gone, their place being taken by a stuffing of sheep skins. Every now and then the outer covers have a quaint habit of leaving the wheels and of rolling away into the wayside fields! At the present time the island is leased by the Chilian Government to a ranch-owner, Mr. McKinnon, who has been there for 25 years. It is interesting to learn that he has a holiday every five years which he usually spends in visiting his native city of Birmingham, but is always glad to get back to his lonely island in the South Seas!

* * * *

"Observation"

(Leplay House. Price 6/-)

This book—which is described as being a collection of observations of people, activities and places—is one of a series that is intended to be "a survey of mankind from China to Peru," to quote the words of Samuel Johnson. It consists of a number of contributions from various writers and makes very interesting reading, the general idea being to encourage observation of the interesting things

of our everyday life.

The people we meet, or pass in the street, for instance, present a wide field for observation in the manner followed by trained detectives. There are half-a-dozen things to observe in these people, such as their build and make-up, whether they are tall or short, thin or sturdy; the shape of their heads, faces and hands; the colour of their skin, eyes and hair, and so on. In the case of foreigners it is always interesting to observe how they are organised—how they work and play, and the kind of family life they have; how their ideas run, their religion and their customs; the stories they tell and listen to; their books, newspapers, and the pictures they like and choose.

Then there is also great scope for observation in the activities that people carry on—their work, trade or profession, and their pastimes. In the case of places, one may observe such things as rock or soil; hills and valleys; climate; rivers; trees; plants and animals; and the things that have been built and placed by man. In short, observation may be made of folk, work, and place, and of the connections between these three.

We learn how to make a Domesday Book of the district in which we live, and find that even here there is just as much to discover as there is in the African forests, the deserts of Asia, or at the North Pole. A chart is provided at the end of the book on which are set out the questions a real explorer has to ask himself when exploring an unknown country, and it is suggested that if we desire to explore our district, these same questions may be applied. "If you know how to explore your district," we are told, "you know how to explore the world."

The present volume, the first of the series, includes well-illustrated articles on the Surroundings of a Well-known English Town; Native Life in Malabar; An Observer on the Downs; A View of Hastings; The Folk of the Peak District; The Dutch Bulb Fields; Snakes in the New Forest; Sarawak, a Land of Perpetual Summer; Bird Life in the Scillies; London and its Buildings; Wild Flowers and Place Names; A Day in Bardsey Island and A Smuggler's Cave.

* * * *

"The Story of the Tramway"

By C. W. MALLINS

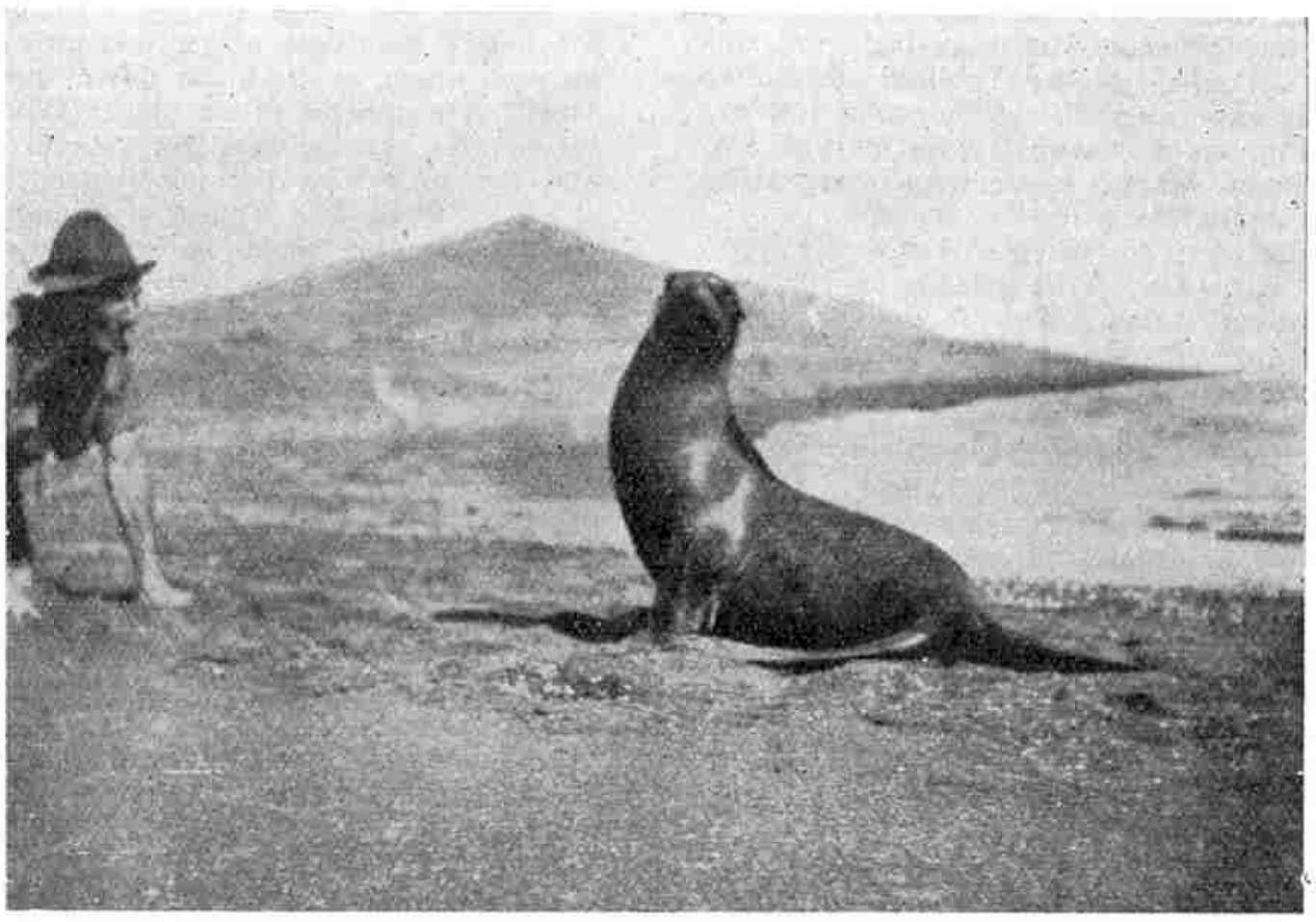
(Willmer Bros. & Co. Ltd., Birkenhead. Price 1/-)

This little book, describing 50 years of tramway progress in Liverpool, is worthy of a wide circulation. Its author recently celebrated the 50th anniversary of his entry into the tramway and omnibus world and it is only to be expected that the particulars he gives of the progress made during his many years of service are interesting.

He mentions that Birkenhead and Liverpool were the first towns in Europe in which tramways were introduced, the late Mr. G. F. Train, an American, obtaining permission, in 1860, to construct an experimental tramway in Birkenhead. The line was completed and opened for public traffic in the same year and soon afterwards an experimental line was constructed in Liverpool. The tramway was considered to be a public nuisance, however, and had to be removed, and it was not until 1865 that a practical scheme was brought forward for the construction of tramways in the streets of Liverpool.

The Liverpool Tramways Co. was formed three years later and was transferred to the Corporation in 1897. It is interesting to note that in 1876 16,545,682 passengers were carried, and the receipts were £155,828. In the year in which the Corporation took over the tramways the mileage run during the year was 6,013,121 miles, the number of passengers carried had more than doubled, being 38,409.098, and the receipts were £288,322. In 1920 the mileage run was 14,296,886 miles, the number of passengers carried 220,219,091 and the receipts £1,422,571—no doubt these figures are typical of the development that has taken place in the tramway systems of other cities, but they are of considerable interest as showing the rapid growth of this particular form of road transport.

The book is written in a racy way and deals also with particular incidents Mr. Mallins has witnessed and persons he has met. There are many amusing reminiscences included.



Colonel Kelsall making friends with a Sea Lion ("*The South Seas of To-day*")

* * * *

"Commercial Air Transport"

By EDWARDS AND TYMMS. (Pitman. Price 7/6)

This is one of the volumes of Pitmans' Transport Library and is believed to be the first real text book on the absorbing problem of air transport. It is written in the hope that it will supply the student with food for thought by including the principles on which air transport is founded, and the lines on which development and progress are likely to follow. The subject is, of course, highly technical and the present book is not intended to be a full and complete guide, but is rather a general survey of the various problems that are associated with the foundations on which air transport is being built. Opening with a chapter on the "Early History of Flight," the book goes on to deal with such subjects as State v. Private Operation; Legislation; General Principles; Economic Effects; Ground Organisation; Traffic Control; Air Navigation; Night Flying, etc. There is also a chapter on aircraft and engines and technical development.

In the opinion of the authors air transport must still be regarded as being in its infancy. They think too, that the airship will undoubtedly play a great part in the expansion of air communications in the future. The airship will carry out long non-stop flights between important world junctions, and the aeroplane will operate the services radiating to and from these junctions and carry out independent services not connected with the airship trunk routes. In the course of time, we are told, the main traffic routes will be in operation by day and night along the highways of the world and shorter routes will radiate from them in all directions. That "regularity, reliability and safety will be attained to an extent equal to that of any other means of transport there can be no doubt, since even to-day a very high standard has been reached, and this will be far exceeded when the technical developments, which are almost perfected, are taken into practical use. . . Air transport is no longer dangerous and hazardous as many still regard it. It has come to take its place in the scheme of evolution which is unfolding so rapidly aided by modern science. It has come to bridge time for matter in the same way that electricity made it possible to bridge time for mind. The day is not far distant when commercial aviation will come into its own, and let him who places a value on progress fail not to take stock of it."

* * * *

"Practical Glass Manipulation"

By D. B BRIGGS (Crosby, Lockwood, 2/6)

This is one of a series of manuals dealing with industry, trade and craft, and it gives detailed instructions for the preparation of some of the commoner forms of apparatus for laboratory use. As the author points out, only too often the art of glass-blowing is relegated to a back place and its importance and usefulness under-estimated.

A certain amount of apparatus is, of course, necessary for glass-blowing, including a blow-pipe and bellows. Glass-blowing is a fascinating subject and no doubt every one of our readers at one time or another has tried his hand at it by inserting a piece of test tube in the flame of a bunsen burner. Some wonderful results can be obtained with the exercise of a little patience, and to those engaged in laboratory experiments the pursuit will have an added interest in that it will be of service to them in providing them with home-made apparatus.

Chemical Gardens

More Interesting Experiments in Diffusion

IN the article entitled "Falling-an Inch in 2½ Months" on page 401 of the May "*M.M.*" the method of carrying out some interesting experiments on diffusion was described, and this introduced the subject of colloids. Modern colloid chemistry as developed from these early experiments is of enormous importance to-day in tanning, dyeing, textile chemistry, agriculture and the disposal of sewage, while its importance in medicine is increasing rapidly. Even such a humble industry as the manufacture of ice-cream makes use of it, for when this delicacy is made on a commercial scale a little gelatine is added to give it a smooth velvety taste. This it does by acting as a protective emulsion, exactly as it does in the case of the preparation of the emulsion for photographic plates and films.

In the present article we give details of further experiments in continuation of those already described. These also can be carried out without any very elaborate apparatus or any large stock of unfamiliar chemicals and they are very striking and spectacular.

The first is a case of direct diffusion into jelly, which gives very unexpected results. It was pointed out in May that ordinary soluble substances such as blue vitriol will diffuse when in solution into a jelly made from gelatine. If we first dissolve one chemical in the water used for making a jelly and then allow a solution of the second to diffuse into this, remarkable effects may be obtained with a suitable choice of materials.

The experiment may be performed with silver nitrate and bichromate of potash, for instance. Both substances are easily obtainable from almost any chemist. The former is somewhat dear, but only a very small quantity is necessary; in fact two or three crystals will suffice to make the amount of solution required and a little persuasion will extract this minute quantity from your regular chemist. Bichromate of potash is sold in the form of red crystals that give a yellowish-red solution in water. If a drop of a solution of silver nitrate is added to a little of the dilute solution of bichromate of potash a thick red precipitate is formed. The two chemicals interact with the formation of silver chromate and as this is not soluble in water it separates out in solid form.

A Striking Experiment

Now for a variation of this experiment. Instead of using an ordinary solution of the bichromate, make a jelly of it. Dissolve a little gelatine in hot water—4 grms. of gelatine in 120 c.c. of water will make a good jelly—and add to the solution while hot just sufficient bichromate of potash to give it a faint yellow tinge. Very little is necessary for this. Pour the solution into a narrow tube and allow it to set. When the jelly is cold pour on top of it a smaller layer of silver nitrate solution.

In the first experiment the two chemicals were mixed together directly in solution; now they only come into contact as the silver nitrate diffuses into the jelly, a process that takes place slowly. At first the jelly near the surface will become a red solid-looking mass owing to the formation of the insoluble silver chromate as before, but as the silver nitrate diffuses into the jelly a change takes place. The red precipitate is formed in rings with a small interval between them in which the almost colourless jelly is plainly visible as shown in Fig. 1.

In about two days the formation of the rings will be more evident, as the further the silver nitrate diffuses into the jelly the further apart are the rings formed. Using dilute solutions the rings formed at the depth of an inch may be as much as one-eighth of an inch apart, while lower down the interval may increase to as much as a quarter of an inch. When sufficient rings have been formed the remaining silver nitrate solution may be poured out and the surface of the jelly rinsed with water, after which the rings will remain permanently visible.

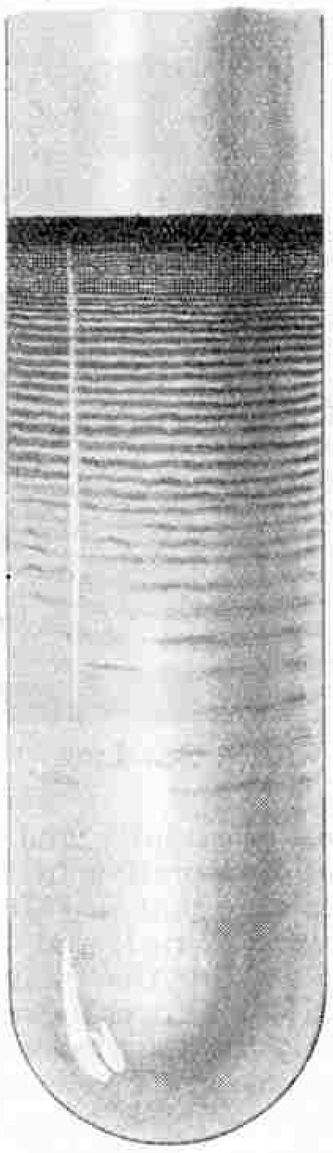


Fig. 1

This phenomenon was discovered by Liesegang, a Continental scientist, after whom the rings were named. Generally the process is spoken of as rhythmic precipitation.

A striking variation of the form of the experiment may be made by forming the jelly on a shallow plate or in a dish and putting one drop of concentrated silver nitrate solution in the centre of the surface of the jelly, when the rings will be formed concentrically round this spot. A section cut across the centre of the jelly will then show the manner in which the rings are formed.

Further variations may be obtained by using other substances. An easily obtained chemical which may be used in place of silver nitrate, and which incidentally is cheaper, is lead nitrate. This forms lead chromate, which is also insoluble in water but in this case the rings will be yellow instead of red.

Rhythmic Precipitation Explained

The explanation of the formation of the Liesegang rings is not very simple, but as a rough approximation the following has been suggested. After penetrating for some distance through the jelly the silver nitrate exhausts the bichromate of potash in its immediate neighbourhood and also a little further ahead, owing to the slow diffusion of the bichromate. It will be realised that the particles of bichromate of potash that diffuse towards the advancing silver nitrate will be transformed into silver chromate, while those drifting away will not be immediately in contact with the silver nitrate. Thus a narrow gap is created containing practically no bichromate of potash, and consequently the silver nitrate must diffuse a little further before any more red silver chromate can be formed.

The way in which the Liesegang rings are formed in a thin layer of jelly on a plate suggested the very attractive idea that the coloured rings on the wings of butterflies were formed in a somewhat similar manner by the slow diffusion of some chemical through the material of the insect's wings. This somewhat fanciful idea has proved wrong, however.

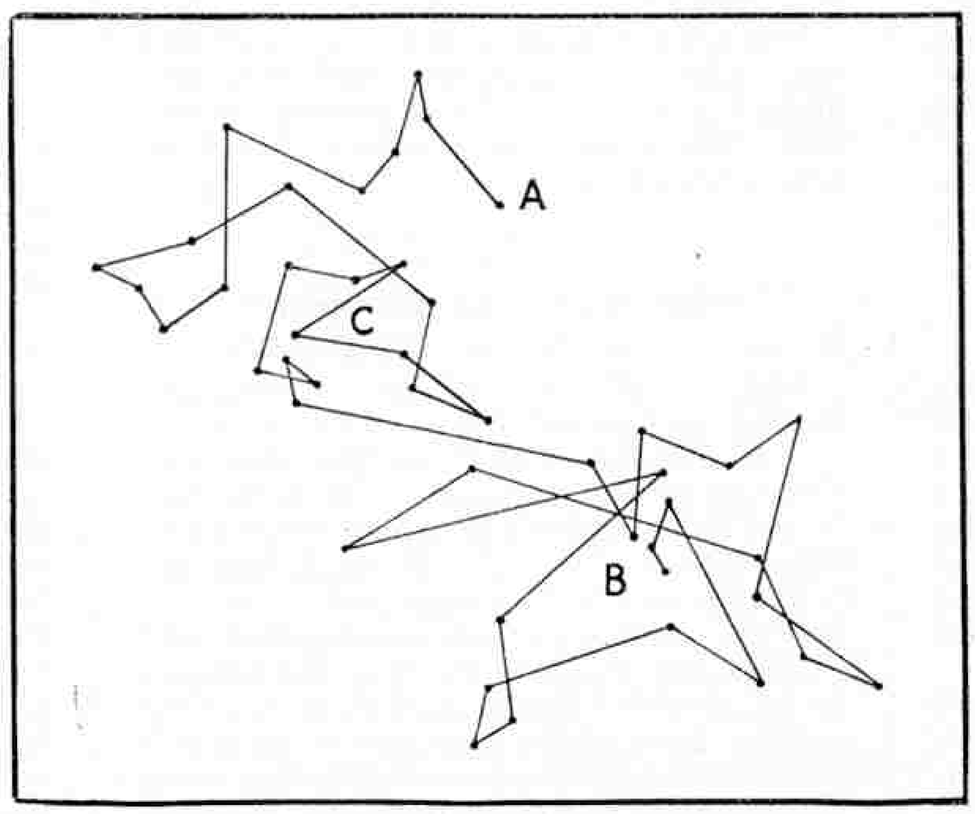


Fig. 2

The Patriotic Tube

Those who have access to a few extra chemicals may make another interesting variation of the experiments on diffusion into jellies. In making the jelly, include with it a small proportion of potassium ferrocyanide and just sufficient phenolphthalein to produce a pink coloration. This latter substance is an indicator that is pink in alkaline solution and colourless in the presence of a trace of acid. Above the jelly, which should be set in a tube, pour a layer of ferric chloride solution. In a day or two it will be found that the tube contains three distinct layers that are red, colourless, and blue respectively. The name "patriotic tube" is sometimes given to this, "colourless" and white being confused in this description.

What happens in the formation of this is that the ferric chloride

reacts with the potassium ferrocyanide to form a thick precipitate of prussian blue as it diffuses into the jelly. The small travelling particles, or "ions" to use their scientific name, of chlorine in the ferric chloride diffuse into the jelly at a greater speed than those of the iron. The portion of the jelly into which these advanced ions have diffused thus becomes acid and the colour of the indicator is therefore discharged, while at the bottom of the tube there is, of course, the unchanged pink jelly.

Making a Chemical Garden

Another interesting experiment is one that results in the formation of what is sometimes described as a chemical "garden." This is a case of diffusion through a membrane as in the experiments with a dialyser. This time, however, the membrane is not of parchment, but is a chemical membrane that can easily be broken; in fact the success of the experiment depends on the rapid breakage of the membrane.

Water-glass is necessary for this purpose. This is the familiar substance sold in syrup form and used in solution in water for the preservation of eggs. As much of the syrup as a tablespoon will pick up is dissolved in half a tumblerful of hot water and allowed to cool. Larger quantities of solution may be made, of course, but it is not wise to keep the solution standing for any length of time except in a well corked bottle, as the carbon dioxide of the air slowly displaces silica from it forming a white incrustation on the glass of the containing vessel. For the same reason the tin containing the syrup must be kept airtight. Into the liquid a fragment of ferric chloride as large as a pea is then dropped.

A bubble or two will be formed on the surface of the fragment almost immediately. These promptly burst and it is then seen that a solid substance has been formed in the place of the bubble. With the continued repetition of this process a series of long twig-like growths of the new solid is formed in the water-glass solution. These growths are brown, but similar growths of other colours are obtainable by using different chemicals. Thus cobalt gives a purple growth, that obtained by using nickel salts is green, magnesium sulphate, or Epsom salts, forms a white tree, while manganese salts give a light pink formation. By growing these together in a fairly narrow jar a compact growth is obtained. The brown growth from the iron towers over the others, which themselves grow to various heights, and it was the appearance of this formation that suggested the name chemical "garden." The growths form very slowly except in the case of iron and cobalt, when the growth is very rapid, so that for a complete garden these two should not be added until the others have "grown."

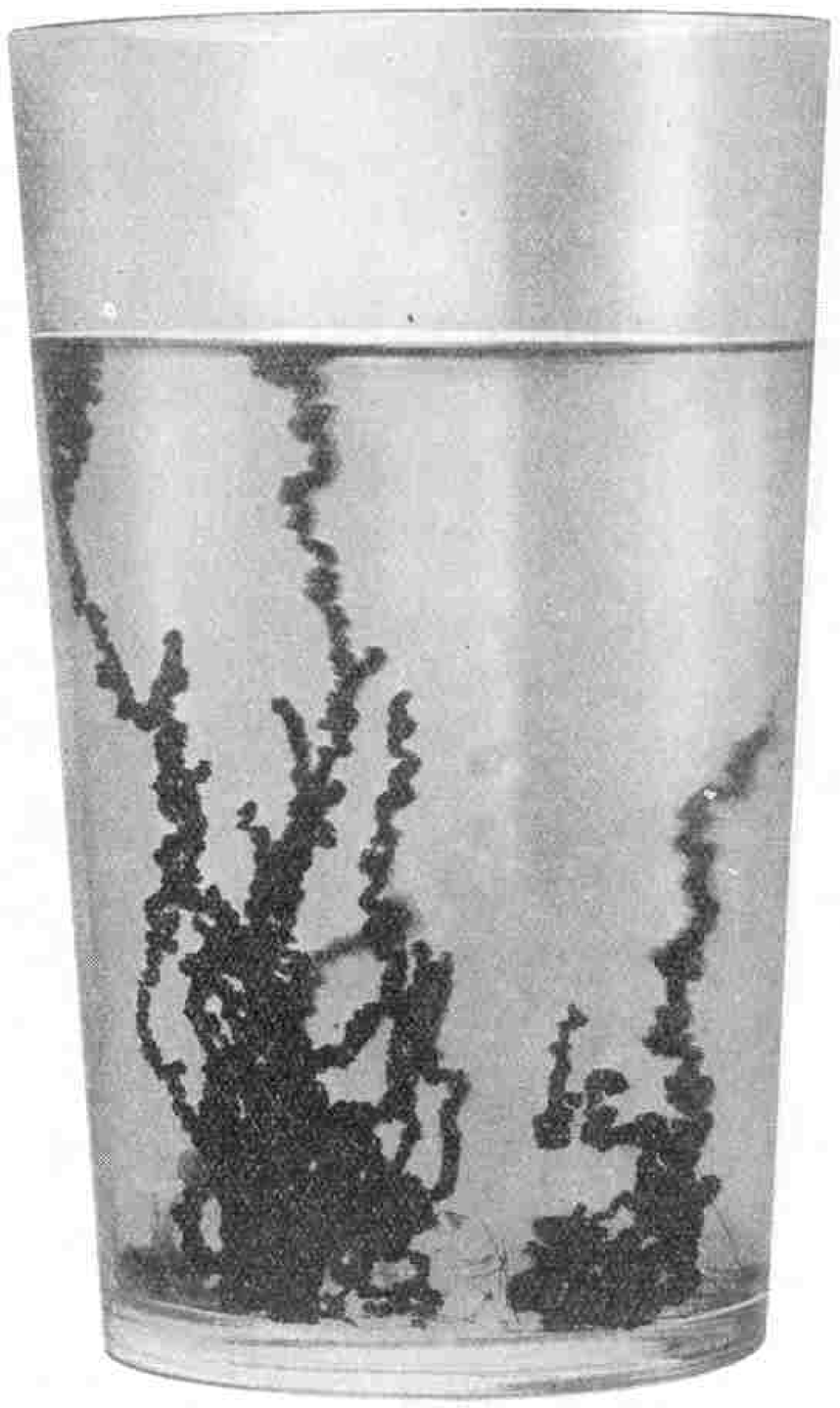


Fig. 3

An iron "tree"! This is an actual photograph of the growth obtained on placing a piece of ferric chloride in water-glass solution as described on this page

How the Chemical Plants Grow

Very little knowledge of chemistry is necessary to understand these curious growths. Water-glass is a compound obtained by melting together soda and silica in the form of sand. This makes sodium silicate which, as we have seen, is soluble in water. Ferric chloride contains iron, and iron silicate is not soluble in water. Consequently when the water-glass solution comes in contact with the ferric chloride as it begins to dissolve, iron silicate is produced. This separates out in a gelatinous form, making in fact a membrane between the water-glass solution and the ferric chloride that acts in the same way as the parchment in the experiments already referred to. The water outside the small bubble enclosed by this membrane diffuses into it more quickly than the solution inside diffuses outward, thus causing the bubble to burst. This again brings the water-glass solution into contact with more ferric chloride solution and the process is repeated continuously. The same combination of membrane formation and diffusion takes place in the case of the other metals, but more slowly.

Reference was made in the May "*M.M.*" to the colour variation of colloidal gold and silver solutions. The actual colour depends on the size of the particles contained in the colloidal solution, and a very interesting example of how it varies with size in this manner is to be observed daily. Smoke direct from a burning cigarette is always blue, but after this smoke has been inhaled it is found to have a grey colour. The reason is that the particles in the blue smoke are very finely divided, while after inhaling they are coarser, as time has been allowed for their coagulation. The same blue coloration can be observed in the fumes from a motor car exhaust or the smoke from a wood fire.

An easy experiment in which a somewhat wider variation of colour is observed can be made with photographer's hypo, the chemical name of which is sodium thiosulphate. When hydrochloric acid is added to a solution of this substance sulphur is precipitated. By using dilute solutions it can be precipitated slowly, when it separates out in the form of tiny particles of increasing size. A teaspoonful of hypo should be dissolved in a tumbler full of water and a few drops only of dilute hydrochloric acid added. After a while the liquid will become slightly opalescent and if it is held with a strong light behind it its colour is seen to be yellowish. The small particles of sulphur then grow larger slowly and the colour as seen in this manner changes to orange and red. In the end, of course, the sulphur is precipitated completely and the contents of the glass become merely opaque. This experiment is often carried out in a small glass vessel with parallel sides, which can be placed in the path of a beam of light from a projecting lantern, so that the changes in colour may be observed on a screen.

Botanist's Discovery 100 Years Ago

It will be remembered that in the previous article the rate of settling of very finely divided particles in a liquid was calculated for the case of a suspension of gold in water, when it was found that 2½ months would be necessary for the settlement of red gold particles in a layer of liquid one inch in depth. Actually it would take even longer than this, for there are other causes operating that help to keep the gold particles in suspension, and one of these causes is closely connected with diffusion. We have seen that diffusion is brought about by the movement of the small particles constituting the liquid or solution. We cannot actually see these very small particles in water and trace their movement directly, but we can easily visualise them by noticing the effect that their movement produces. To understand this we must go back to a discovery made as long ago as 1827 by a Scotsman, Robert Brown, who was generally regarded at the time as the foremost of contemporary botanists.

Brown was born at Melrose in 1773. He intended to become a doctor and studied for this purpose at the universities of Aberdeen and Edinburgh, but he found a greater attraction in botany. While still a student he discovered many rare plants not previously known to grow in Scotland. After leaving the university in 1795 he joined the army in the rather peculiar capacity of ensign and assistant surgeon, being stationed in northern Ireland. He continued his botanic studies and fortunately was able to spend several months of each year in London, where he made the acquaintance of Sir Joseph Banks, President of the Royal Society, and himself a botanist.

By the good offices of Sir Joseph a splendid chance came his way in 1801, when an expedition set out under Captain Flinders to survey the coast of Australia, which was then known as New Holland. Brown immediately abandoned his somewhat uncongenial military career and eagerly accepted the post of botanist in Flinders' expedition.

Curiously enough, Captain Flinders, the leader of the exploring party, had also originally intended to become a surgeon but had joined the Navy instead. After service in the "*Bellerophon*" in Lord Howe's battle of the "glorious first of June" in 1794, he was able to give full play to his love of adventure in a voyage to

Australia, or New Holland as it was then called, and for some years he was engaged in exploration around that continent. This work led to his appointment by the Admiralty as leader of another expedition to make a complete survey of the coasts of the land for which he himself suggested the name of Australia. Another member of the staff besides Brown became famous in after years. This was a relative of Flinders, a "middy" named John Franklin, the central figure in the great Arctic tragedy of the nineteenth century.

Sailing Round Australia

Flinders on this voyage was successful in making a complete circuit of the coast of Australia in spite of illness and difficulties with the leaky vessel of only 334 tons in which he sailed. His further experiences were far from happy as he was shipwrecked while on his way home to obtain a further exploring commission from the Admiralty, and a second attempt to reach England led to his detention at Mauritius, then a French colony, as a prisoner of war, although he had a passport from the French Government. This unfortunate and unjustifiable captivity lasted until 1810 and the hardships he was forced to undergo were such as to bring about his death at the early age of 40, only four years after his return to England.

Brown was fortunate enough to escape the fate of his leader and reached England in 1805 with a magnificent collection of botanical specimens. He now settled down to regular scientific work, and the rest of his long life passed without any incident more exciting than the publication of a book on the botany of New Holland, written in Latin. He never finished this book, and even withdrew the first volume because a reviewer alleged that the Latin was bad! He died in 1858 after having long enjoyed the reputation of being the first botanist of the day.

The Brownian Movement

In 1827 Brown noticed that microscopic bits of pollen suspended in water had a curious vibratory motion. This had been seen before, but Brown was the first to examine it thoroughly and it is now referred to as the Brownian movement. At first it was thought that the movement was due to chance shaking or vibration, and very little importance was attached to it. But as further instances of it were discovered it was found that this explanation was not sufficient. In order to test it experiments were carried out in cellars in which there was not sufficient vibration to cause the surface of mercury to quiver, and yet the Brownian movement continued. In another experiment pollen suspended in water was sealed up in a glass vessel so that the water would not evaporate away, and the movement was found to be still taking place after the lapse of a year.

Another suggested explanation was that the movement was a sign of life in the pollen grains, but we know now that all very small particles, whether from a plant or not, show the movement under proper conditions. Anyone possessing a microscope of good magnifying power may easily see the movement for himself with pollen, or better still with gamboge or even clay. Gamboge, the well-known water colour paint, does not form a solution with water as is usually imagined, but a suspension. Some of the colour is ground with water and a drop or two of the liquid thus obtained is placed on a slide and examined under a microscope in which the central portion of the condenser has been covered with a little gummed paper to give a dark background. The gamboge particles are then visible as small points of light, which can be seen to vibrate. Another method of preparation is to place a little gamboge in alcohol, in which it dissolves easily, and to pour some of the solution into water. A little of the resulting liquid placed on a microscope slide shows the Brownian movement admirably. The movement is similar to that shown by shreds of camphor on the surface of water.

Even the red-gold particles referred to in the previous article show the Brownian movement. When such a suspension is examined in the ultra-microscope, points of light are seen to move about in the manner shown in Fig. 2, and it is possible to measure the actual distance moved by any one particle by having a micrometer scale in the field of vision. The figure shows the path of one particle that has moved from A to B by zig-zag steps measuring 15 times the direct distance. It will be noticed further from the figure that the particle remained for a considerable time, first in the neighbourhood of the point C and afterwards near B.

Various other attempts were made to explain the movement in addition to the two already mentioned. It was known, for instance, that these small particles always possess an electrical charge, but no explanation founded on this was satisfactory. Eventually the very simple explanation was suggested that the particles were being knocked about by the molecules in which they were suspended.

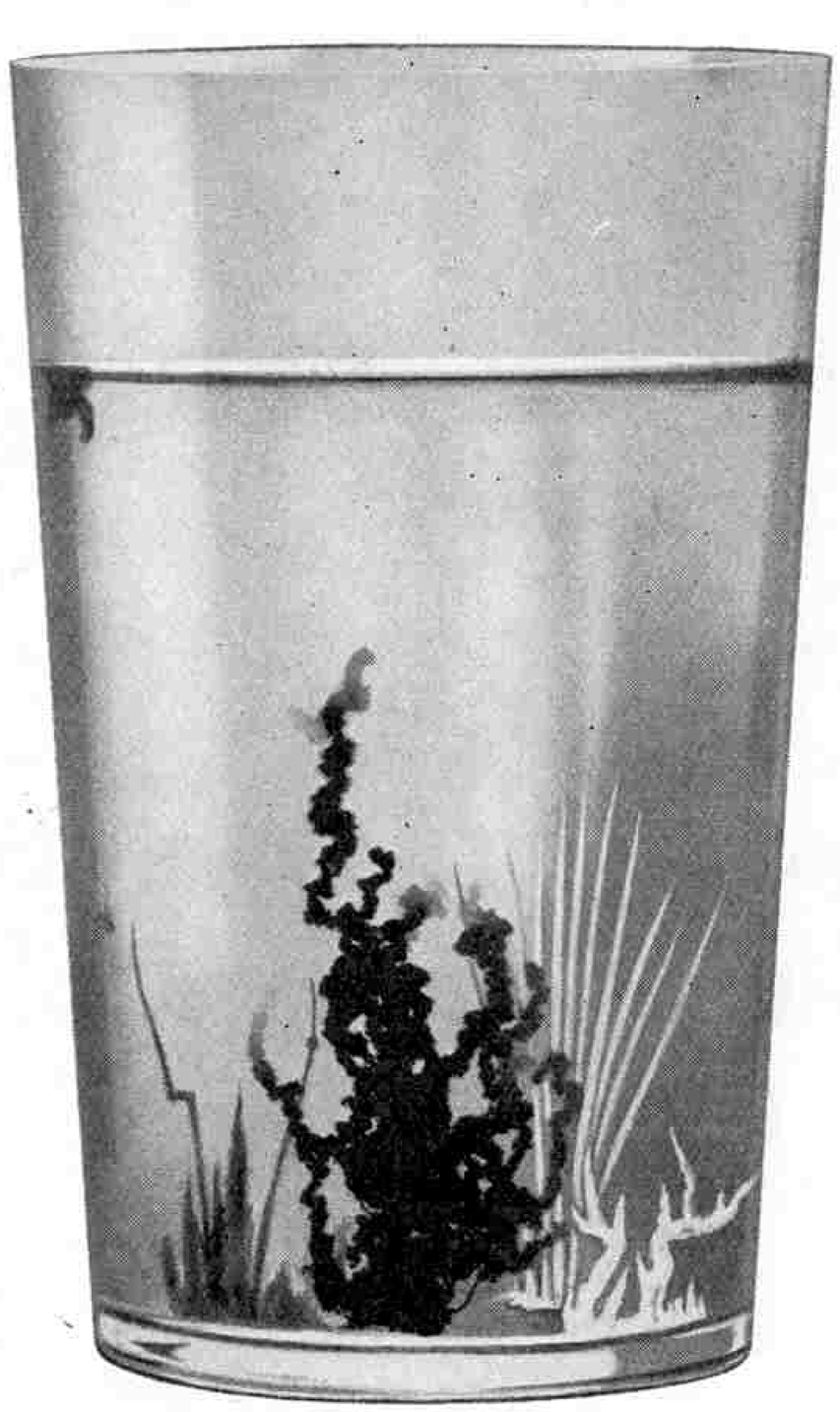


Fig. 4

This illustration shows an iron "tree" in the centre. On the left is the smaller growth obtained from a cobalt salt, while on the right and behind are magnesium and manganese "trees" respectively

Push-ball under the Microscope!

The game is something like push-ball. When two bodies of men are pushing or charging the big ball on opposite sides, it moves backward and forward over short distances for a little while without moving far from its original position, but at intervals longer runs are obtained with it as a result of variations in the pressure to which it is subjected. In other words an extra push on one side sends the ball towards the opposite goal. In the game visible under the microscope the minute particles of pollen or gamboge represent the push-ball, while the still more minute particles or molecules of the liquid are the players. But now there are no sides and the players are invisible! The blows and charges are received on all sides, and the particle acting the part of the push-ball will move according to the accident of the number of charges received on one side or another. That the explanation is a reasonable one is made quite clear by an examination of the actual paths of the suspended particles of gold shown in Fig. 2.

The theory has been completely tested in a "backwards way" sort of fashion. On the assumption that it is correct, calculations have been made of the average distance over which the particles would be knocked at each collision. This calculated average distance agrees so well with the actual distance measured that little doubt is left that the explanation given is the true one.

It may be noted here that these calculations were made by Albert Einstein, the scientist who introduced the modern theories of relativity, and also a Polish scientist Smoluchowski, whose name will be easily remembered! Their calculations did not lead to exactly the same result, but in each case it was clearly shown that the explanation suggested was on the right lines, while the figures of Einstein agreed almost exactly with measurements.

Why Diffusion Takes Place

Thus Brown's somewhat accidental observation of bits of pollen in water under the microscope has enabled us to form a picture of the interior of a liquid such as water, and of the movements of small particles suspended in it as they are hustled around by the continual movement of the molecules of the liquid. After this revelation of the internal conditions of a liquid it is easy to realise why one liquid will diffuse into another and even penetrate into a jelly although more slowly.

The Brownian movement assists also in keeping the small particles of a solid in suspension. If the particles in a red-gold solution are merely settling slowly down, $2\frac{1}{2}$ months will be required to fall one inch as we have seen. But each particle in falling, if such a word may be used for such slow motion, receives blows from the moving particles of liquid by which it is surrounded, some of which will knock it upward so that its rate of falling will be retarded. In some cases it may happen that a particle will receive two or three blows in an upward direction in succession, so that it will actually move upward instead of continuing to fall.

Mention has just been made of the electrical charge that the particles have been found to possess. This also will assist in the prevention of settling, as the particles of any one suspension colloid have charges of the same kind and repel

(*Continued on page 733*)

RESULTS OF

The Eclipse Competitions

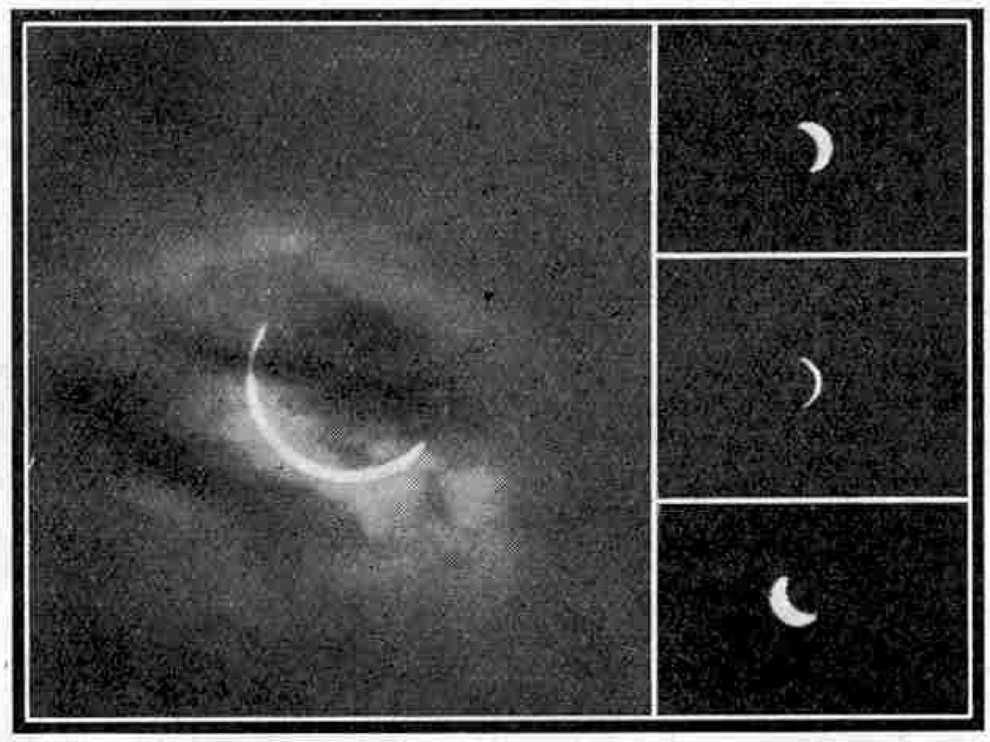
The event of a lifetime has come and gone. Accompanied by the most dismal of climatic conditions, the great Solar Eclipse of 1927 proved to be the most ill-fated spectacle that ever has been presented to so vast an audience, comprising some millions of folk scattered across the totality belt throughout England and Wales. We must confess we were most bitterly disappointed with the weather conditions that prevailed and the poor response to the very careful preparation to view the wonderful event that thousands of readers had made. We do not regard, however, our efforts of the past four months and the many pages of "*M.M.*" devoted to the subject, as mere wasted effort. The spectacle, even in its lessened majesty, was the most impressive we have ever witnessed.

The "*M.M.*" has good reason to be proud of itself in that it led the way in catering for the great demand for popular articles on the eclipse. The eclipse of 1925 in America, was claimed by Americans to be the best "observed" of all time. We have insufficient data to refute the claim but we are quite confident when we declare that the eclipse of 1927 was the best advertised.

Never previously has the British public had so intensive a coaching in scientific matters as it received in the great flood of "eclipse articles" that was so prominent a feature of the British Press in June. As a result, the phenomena to be expected and looked for were catalogued in the mind of every would-be observer. Consequently, even though all missed something and some missed all, the majority of the millions who gave hours of their sleep to gaze upon the temporary passing of King Sol, were amply repaid for their efforts.

As was to be expected in view of the conditions that prevailed, the number of entries to the Eclipse Competitions was small in comparison with what might have been. Nevertheless, as if in compensation, the quality of entries that came to hand was excellent and in the drawing section a slight addition to the prize money was necessitated. Several photographs of the corona were received but the best efforts were those showing the partial phases. We received several complete sets showing stages of the eclipse from the moment of contact to finality, and we illustrate several photographs from these.

The entry for the second section of the Competition, that calling for a description of readers' experiences, was well supported. Reports came to hand from all parts of the country, including Southport, Blackpool, Preston, Richmond and, among other places, the most successful of all, Giggleswick. In all parts of the country the weather conditions seem to have been much the same and the reports nearly all indicate that very little was to be seen. That, however, did not damp the spirits of the competitors and we were exceptionally interested to read reports of various school expeditions that made long-distance journeys into the totality belt. Most of these expeditions were doomed to disappointment, but nearly every participant was agreed that he had had a rattling good time. Most of the boys used "ginger pop" bottles as telescopes; at least that is our impression from the constant reference to "bottles of pop." It is evident that observing the eclipse was far from being as "dry" as some of the lectures our schoolboy readers claim to have endured beforehand.



Readers' Photographs taken during the Eclipse

The awards in the various competitions are as follows:—

Part 1. Drawing Contest. Section A: 1. R. Simpson (Liverpool); 2. G. E. Owen (Bishopston, Bristol). Section B: Prize money increased to one guinea and divided equally between H. Henshaw (Bolton) and S. C. Willson (Shepherds Bush).

Part 2. Observers' Experiences. First Prizes: Section A: H. Shaffer (Southport); Section B: C. N. Beattie (Lewes). Second Prizes: Section A: G. O. Holt (Levenshulme, Manchester); Section B: D. S. Waite (Anerley, S.E.20).

Part 3. Photographic Contest. First Prizes: Section A: N. B. Massey (Cardiff); Section B: D. Brass (Inverness); Second Prizes: Section A: R. L. Waland (Dumfries); Section B: S. Johnson (Lancaster).

The Consolation Prize-winners' names are withheld owing to lack of space.

Competition Results:—(*cont. from page 727*)

22nd Drawing Contest

The entries for this competition generally were well up to the high standard of achievement that we have come to associate with the "*M.M.*" drawing competitions. Many of the locomotives, in addition to being well drawn, showed that the executant possessed a very clear grasp of the probable future trend of rail transport and many of the designs, without departing radically from accepted practice, were highly interesting.

The prizes were awarded as follows.

First Prizes: Section A, B. HERRING (Seven Kings, Ilford); Section B, G. ALLEN (Firth Park, Sheffield). Second Prizes: Section A, E. A. ROBBINS (Kidderminster); Section B, H. LANE (Stokesley, Yorks.) Consolation Prizes: F. HEMMING (Handsworth, Birmingham); A. BLAIR (S. Shields, Co. Durham); E. C. BRACE (Balham, S.W.17); R. CLOUGH (Gainsborough, Lincs.)

Overseas Result

Drawlines Competition

Our Overseas readers rallied their powers in great style for this competition and an exceptionally heavy entry was the result. As "Uncle Ern's" own version of the cartoon has already been published, detailed comment on the entries is not called for.

The list of successful competitors is as follows:—1. S. P. SENJI (Trichinopoly); 2. W. H. C. WILLIAMS (Bombay); 3. LAM SECK WENG (Malacca, S.S.); 4. D. SHORES (Winnipeg, Canada). Consolation Prizes: D. BLACK (Newcastle, N.S.W.); C. CROMPTON (Toronto 8, Canada); T. S. NILSEN (Port Elizabeth, S. Africa); Miss LUCY TUCKER (Hastings, N.Z.); LAM BOON WENG (Malacca, S.S.); B. WHYTE (Hastings, N.Z.)

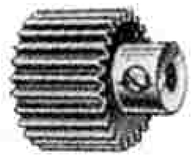
New Meccano Parts

Three important additions to the Meccano system are illustrated below. The new parts are now available.

The double-width Pinions, Parts Nos. 25a and 26a, should prove extremely useful in connection with Meccano gear boxes and drive-changing mechanisms, etc. They engage respectively with the 50 and 57-teeth Gear Wheels, and are similar to the existing Pinions except in the width of the tooth face, which has been extended in each case to $\frac{1}{2}$". This allows a shaft on which one of these Pinions is secured to move longitudinally through an increased distance without disengaging the Pinion from its Gear Wheel, thereby permitting the various gear changes to be effected more easily.

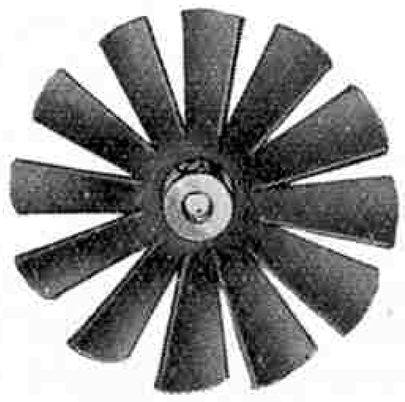
The Fan should prove of value in several models. It is specially suited, for instance, for use as a radiator cooling fan in Meccano motor cars, etc.

The uses of the Crank with centre boss are too numerous to enumerate in full, but outstanding examples are its adaptability as a reinforced bearing for shafts and as a method of securing Axle Rods to Meccano Strips or Plates, etc.

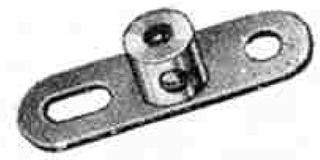


No. 25a, Pinion, $\frac{3}{4}$", double width face, Price 9d. each.

No. 26a, Pinion, $\frac{1}{2}$", double width face, Price 6d. each.



No. 157, Fan, 2" diameter, enamelled red, with brass boss. Price 3d. each.



No. 62b, Crank with centre boss. Price 3d. each.

The Wonders of Salvage

By Rev. J. Henry Martin

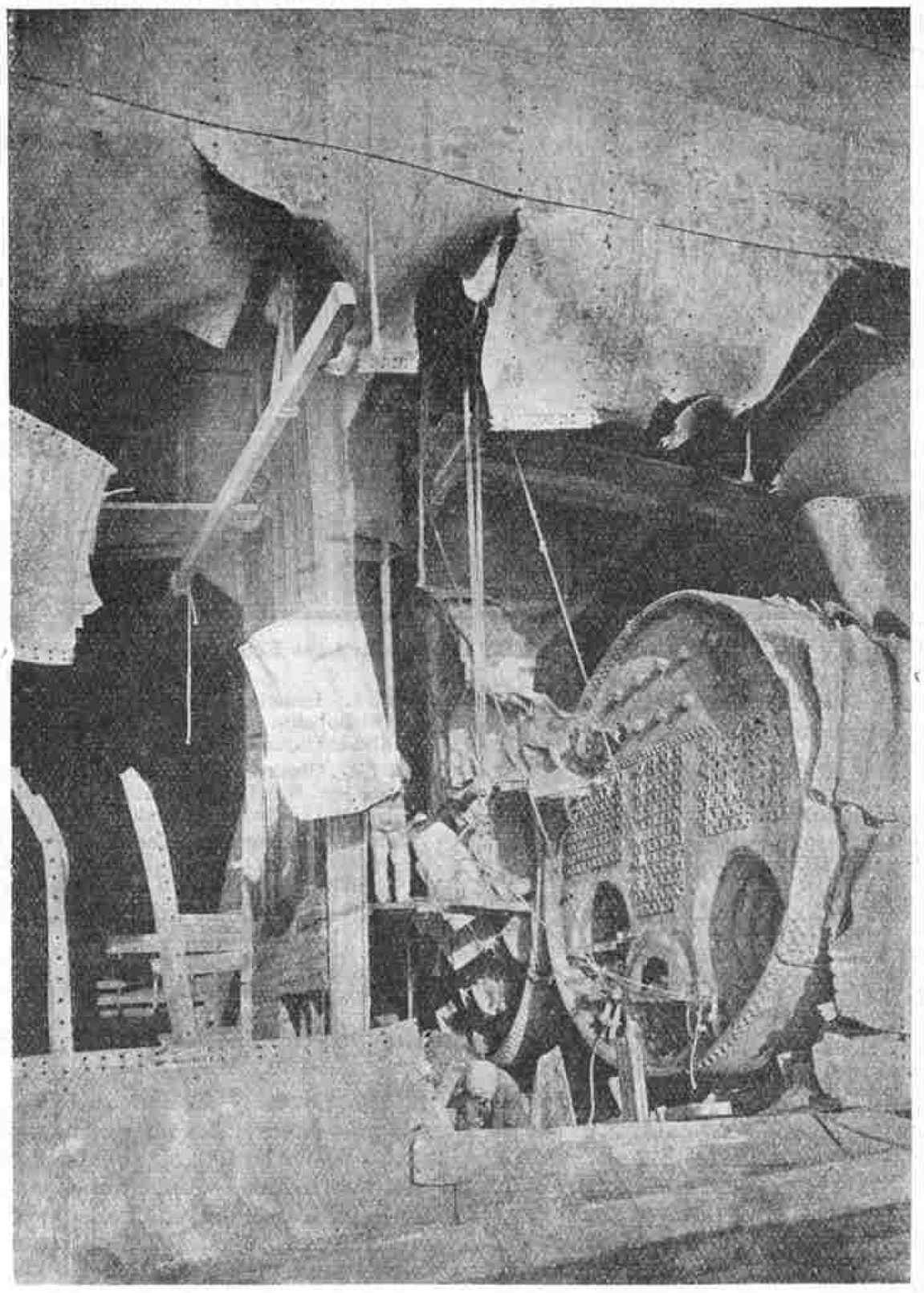
WHEN was a ship raised from the bottom of a harbour by railway engines? Have the crew ever been got out alive from a sunken submarine? Has anyone ever eaten butter that has been at the bottom of the sea for weeks?

These fascinating questions are answered by Mr. David Masters in his interesting record of "*The Wonders of Salvage.*"* For thrill and sheer amazement this book would be hard to beat, for its well-illustrated pages are a passport to a land of history and romance of which most of us are ignorant.

Take, for instance, the work of the diver whose special task is sea salvage. How far down can he go? American divers in 1915 established a record for deep diving operations by successfully salving the American submarine F4, which was wrecked in 304 ft. of water outside Honolulu harbour.

The going down is quite simple, for in a few seconds a diver can reach 120 ft., which is the usual limit. His coming up is fraught with many perils, however. If, for instance, he should stay more than half an hour at that depth, he must not reach the surface in less than 57 minutes. He rises to 40 ft. from the surface and exercises his arms and legs for five minutes. Rising 10 ft. more he exercises for 15 minutes, and at 10 ft. from the surface he must rest for 25 minutes to get the excess of nitrogen out of his blood. If a diver went down to 200 ft. he would need four hours to reach the surface, even though his stay at the bottom was limited to 12 minutes, beyond which he dare not go. All over the world travel these experts and here are recorded their exploits, not only on the sea bed but also in mine and tunnel.

The greatest treasure hunt of modern times was the salving of the gold and silver ingots from the "*Laurentic*," which task occupied five years. The treasure amounted to £5,000,000 and was intended for the payment of American munition workers for war supplies. The "*Laurentic*," which left England in January 1917, lurched and shivered in the explosion that tore her open when north of Ireland, and 354 men out of her crew of 457 perished instantly. Down she went in 120 ft. of water. A cargo of such immense value could not be abandoned and salvage operations were commenced.



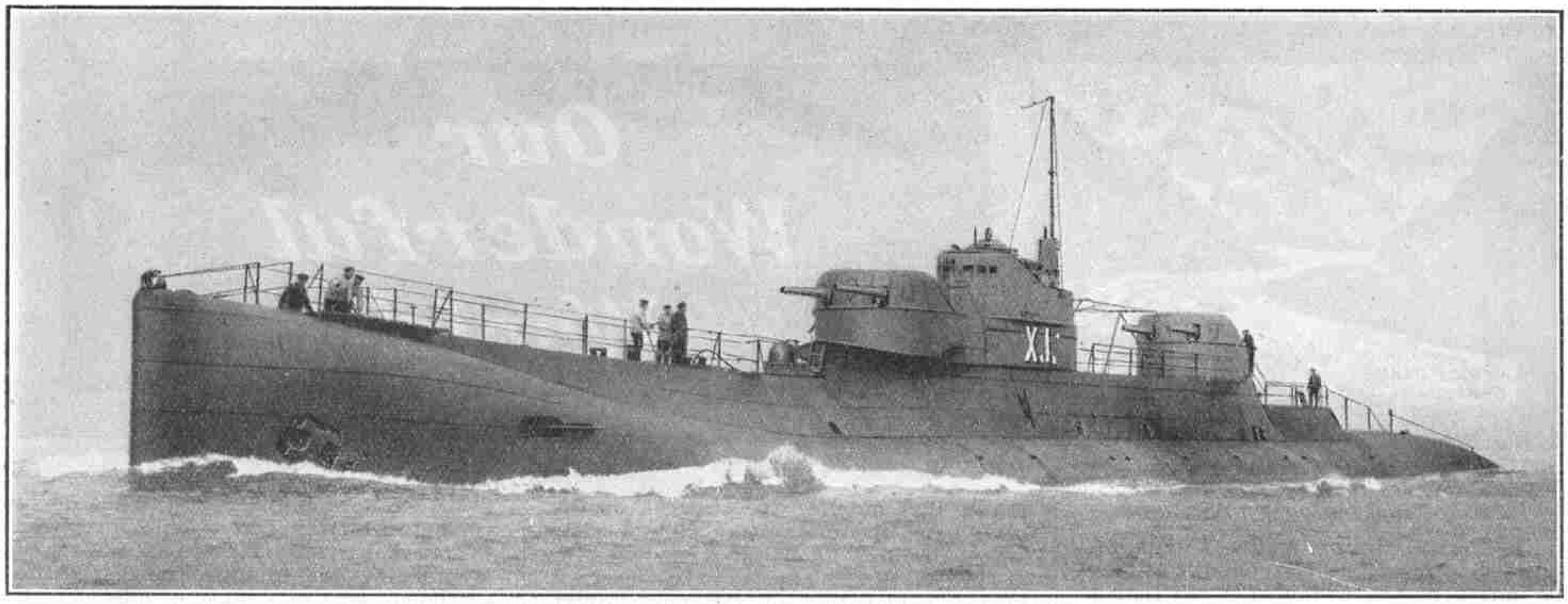
Damage to a liner caused by a German torpedo. Note the ship's boilers seen through the torn side

The Admiralty salvage vessel "*Racer*" tackled the job but was watched by German submarines, so that her work was hampered. Protection was quickly provided, however, by a British destroyer, and the search for the treasure began. Before success was finally achieved, explosives, bombs and unlimited British pluck were needed. The task was not completed until 1923, by which time £4,750,000 had been salvaged and then the "*Racer*," in the true spirit of the "Silent Service," went off to her next job.

The most wonderful story in this remarkable book is surely the record of the submarine K13. Seventy-three men stepped aboard K13 for her trials, paying no heed to the fact that their new boat bore a number generally considered unlucky. She was a wonderful craft, 334 ft. in length, nearly 27 ft. in width amidships and with a displacement on the surface of 1,880 tons. She was a fast boat on the surface and could overtake most battleships and easily steam along with them at full speed. She was driven by steam turbines and had two funnels, which folded down when she dived. Of course, big ventilating scuttles were needed under these conditions to expel the hot gases from the boat quickly. In order to make her dive, 800 tons of water had to be drawn into her ballast tanks and perfect team work was essential for successful submerging.

K13 was built on the Clyde and was taken to the Gareloch for her underwater trials. At last the order "Trim for diving" was given; watertight doors were shut and the sea began to flow into her ballast tanks. And now occurred disaster, for instead of going down

* "*The Wonders of Salvage.*" (John Lane, The Bodley Head Ltd. 8/6 net)



Britain's largest submarine, X.1, and the first submarine to have a canteen on board

in the proper fashion, she began to sink at the stern. A scuttle had been left open, the after part of the submarine was flooded with water, and the 31 men in that part of the vessel met their doom. Forward, 42 men faced the end without a trace of panic. For them it was a choice between drowning, starvation or suffocation. They calmly obeyed orders and for two hours pumped out the ballast water—but the vessel did not move.

Commanders Herbert and Goodhart determined if possible to reach the surface for help. If they could only get out and give the alarm there was just a chance that the men might be rescued. Their plan was to enter the conning tower and have the air pressure there raised to the equivalent of that of the water above. They then hoped to be carried to the surface by the upthrust of air when the conning tower lid was blown off.

Into the conning tower went these heroes; the little space was partially flooded and gradually the pressure was increased. Presently the imprisoned air burst its bonds and the lid was blown off. Goodhart was killed instantly by being crushed against the side of the tower, while Herbert was blown to the surface and rescued, although almost dead with exhaustion.

Then divers descended and began to search in the dark water for the submarine. They found it at last and began to tap on the side of the vessel. Anxiously they listened and to their great relief there was an answer from within. The problem now to be solved was how to lift the vessel, for it meant a pull of 3,000 tons. Finally it was decided to rest it on end so that when the nose broke surface the men might be cut out.

In the subsequent operations the divers did unbelievable things; one worked for 12 hours continuously on the sea bed. Presently a valve was opened in the side of the K.13 and a pipe was attached, through which air, soup and chocolate were passed down into the vessel from the watchers on the surface. Last of all was sent down a pack of cards, and while death peeped over their shoulders the imprisoned men played their game.

For hours work went on with feverish energy and at last the bow of the submarine came into view above the surface. With frantic haste, in a gathering storm, the salvage men set to work with an oxy-acetylene flame to burn a way through the outer plates. Presently the inner steel shell was burned through and the rush of air from within blew out the roaring flame. "Give us some matches," called the salvors to those above, and to their surprise a box was passed out from the submarine!

Gradually the hole was enlarged until it was big enough for a man to pass through, and in a few minutes all were free. Barely had they been rescued when the cable snapped and the submarine once more sank to the bottom.

Thus ended a 57-hour fight with death, and after reading the story one can only say: "Hats off to the divers and to the men they saved."

This and many other thrilling stories are contained within the pages of this book, which is the greatest record of the Wonders of Salvage that has ever been written.

Salving the Cruiser "*Moltke*"

Readers of the "*M.M.*" are familiar with the wonderful salvage operations carried out at Scapa Flow by Cox & Danks Ltd., in raising the sunken German warships. This firm has recently achieved a further triumph by raising the battle cruiser "*Moltke*," which was sunk off the island of Cava in over 70 ft. of water and has lain there for seven years.

Salvage operations were commenced in September 1926 and have been carried on intermittently as weather conditions permitted, work being impossible in stormy weather. All apertures in the submerged hull were sealed up and when the vessel had thus been rendered watertight, compressed air was pumped in. In this manner the imprisoned water was then driven out by way of openings in the exposed area of the cruiser's upturned hull.

The "*Moltke*" lay with a list to port of roughly $16\frac{1}{2}^{\circ}$ and in the early stages of pumping in air, this list increased considerably. Two pontoons each equipped with a dozen 10-ton hand-operated winches and the requisite air-compressing plant, were moored along the port side of the wreck. From the winches steel cables 9 in. in diameter were passed below the wreck and secured by divers to various parts of the inverted structure. With the aid of the pull thus obtained the acute list was largely remedied. The bows of the "*Moltke*" were slightly above water, but it was not until 9th June that the stern of the vessel lifted from the sea floor and rose to visibility, the seaweed-covered propellers presenting a weird spectacle.

With the heavy guns and the remains of the bridge etc., just clearing the sea floor, the "*Moltke*" was then towed to Cava for beaching, prior to being broken up.

Our Wonderful World

Power Transmission by Wireless

The electric currents produced in aerials by wireless waves are very minute, as may be judged by the weakness of the signals in crystal receivers. The object of valves is to magnify these currents so as to produce a greater effect in the telephones or loud speaker, but it must be remembered that the amount of electrical power received is no greater with a valve set than with a crystal receiver, the intensification being due to currents supplied locally. The amount of power transmitted is thus at present very small.

By studying transmission methods, however, there is no doubt that ultimately it will be possible to radiate a greater amount of power in this way. Dr. Thomas, a research engineer of the Westinghouse Electrical Co., has been making experiments on the subject and has succeeded in deriving sufficient power from a vacuum tube to light a small electric lamp. He used a wave of very high frequency, its length being only about 8 ft. To receive the radiated energy he made use of a copper rod 4 ft. in length, and the current produced in this small aerial by the wireless waves was sufficiently strong to make the little bulb attached glow brilliantly. The vacuum tube, it may be noted, radiated 30 watts.

In order to make the method a commercial one a much more efficient tube and means for concentrating the waves are essential. Continuous experimental work will no doubt produce the former and the Beam system introduced by Marconi promises to solve the second difficulty.

Even before the war, Nikola Tesla, the well-known electrical inventor, constructed a huge tower on Long Island from which to radiate electrical energy by means of an invention that he called a "magnifying transmitter." This tower was dismantled at the outbreak of the war, but the inventor now plans to construct a similar tower at Niagara that will be supplied with electrical energy derived from the energy of the waterfall. We are, no doubt, a long way as yet from a practical method of radiating electrical energy, but Tesla's activities are significant of what may happen in the future.

* * * *

The Gulf Stream Too Far to the North

Last winter in the Atlantic provinces of Canada was easily the mildest on record. January brought with it violent rains that swept the country clear of the snow that had fallen earlier, and on only a few occasions did the mercury in the thermometer get as low as freezing point, although very low temperatures are usual during that month. In Montreal, on the other hand, the temperature fell well below zero as usual.

The Gulf Stream appears to be concerned in the explanation of the mild winter experienced in Nova Scotia. It seems to have been diverted 500 miles to the north in some manner, with the result that the water off the coast of Nova Scotia was far warmer than usual. At the same time the greater outward swing of the stream meant that its course towards Europe was much longer and passed through colder regions than is normally the case. In consequence its heat was dissipated, and the result was the cold weather experienced in England, Scotland and the South of France last winter. This may also be the explanation of the unusually low temperatures that have prevailed during the early summer months in this country.

The theory is not at all improbable. It is hardly to be expected that an ocean current will remain as definitely in its usual course as an ordinary river, and many circumstances may arise to bring about changes of a temporary character from time to time. The notable hurricanes of the past winter in the West Indies and Florida may be intimately connected with the unusual geniality of the climate on the east coast of Canada, for they suggest a preponderance of south winds. Actually the wind has been usually from the south, and it may be that the warm surface water in the Gulf Stream has been spread out further than usual to the north by it with the results described.

* * * *

Why the Dead Sea is Lifeless

It is difficult to think of the Dead Sea as a beautiful lake well stocked with fish and having its banks covered with reeds and water plants, yet, according to Dr. Stoy, a Viennese scientist, this was the case some thousands of years ago.

The water of the Dead Sea contains a large proportion of various salts. It is the centre of a district in which asphalt is found, along with other traces of past volcanic eruptions in the shape of a bed of sulphur and a stratum of sand containing more of this combustible material. This state of affairs has suggested that some great catastrophe must have taken place, probably in historic times, which reduced the surroundings to their present condition, and it has been thought that the well-known story of the destruction of Sodom and Gomorrah refers to this catastrophe.

The poisonous nature of the water to fishes is ascribed to the presence of sulphur from the volcanic eruption or earthquake that overwhelmed these cities. Traces of some action of this kind are undoubtedly present, but the enormous proportion of dissolved matter in the water of the lake is probably due to the existence in the catchment area of a range of hills of rock salt, seven miles in length.

Evaporation of the water is very rapid, as the lake lies in a deep basin that forms what might be called a sun trap. The heat is oppressive and on the hillsides may be seen ancient shore lines that show the surface to have been at one time at the same level as that of the Mediterranean Sea, instead of 1,308 ft. lower as it is at present. Dissolved salts are, of course, not evaporated with the water, and thus have reached their present concentration of nearly 27 per cent. The water is still transparent and quite pleasant to bathe in, but it contains too much dissolved matter to allow even sea fish to live in it.

Dr. Stoy does not accept the catastrophe theory but gives quite a different explanation. He ascribes the presence of sulphur in the water to the action of certain microscopic bacilli to which the name "*Beggiatra*" is given. These bacilli produce a very small quantity of the noxious gas sulphuretted hydrogen and by the continued action of millions of the tiny creatures the waters of the lake have become so poisoned with it that fish life is impossible and even plant and grasses on the shore have been killed. Finally the bacilli themselves succumbed after all life in the neighbourhood had been poisoned.

Dr. Stoy says that the deadly bacilli have invaded the Black Sea and he prophesies that in years to come it will be as lifeless as the Dead Sea is to-day.

* * * *

Gold Recovered from Smoke

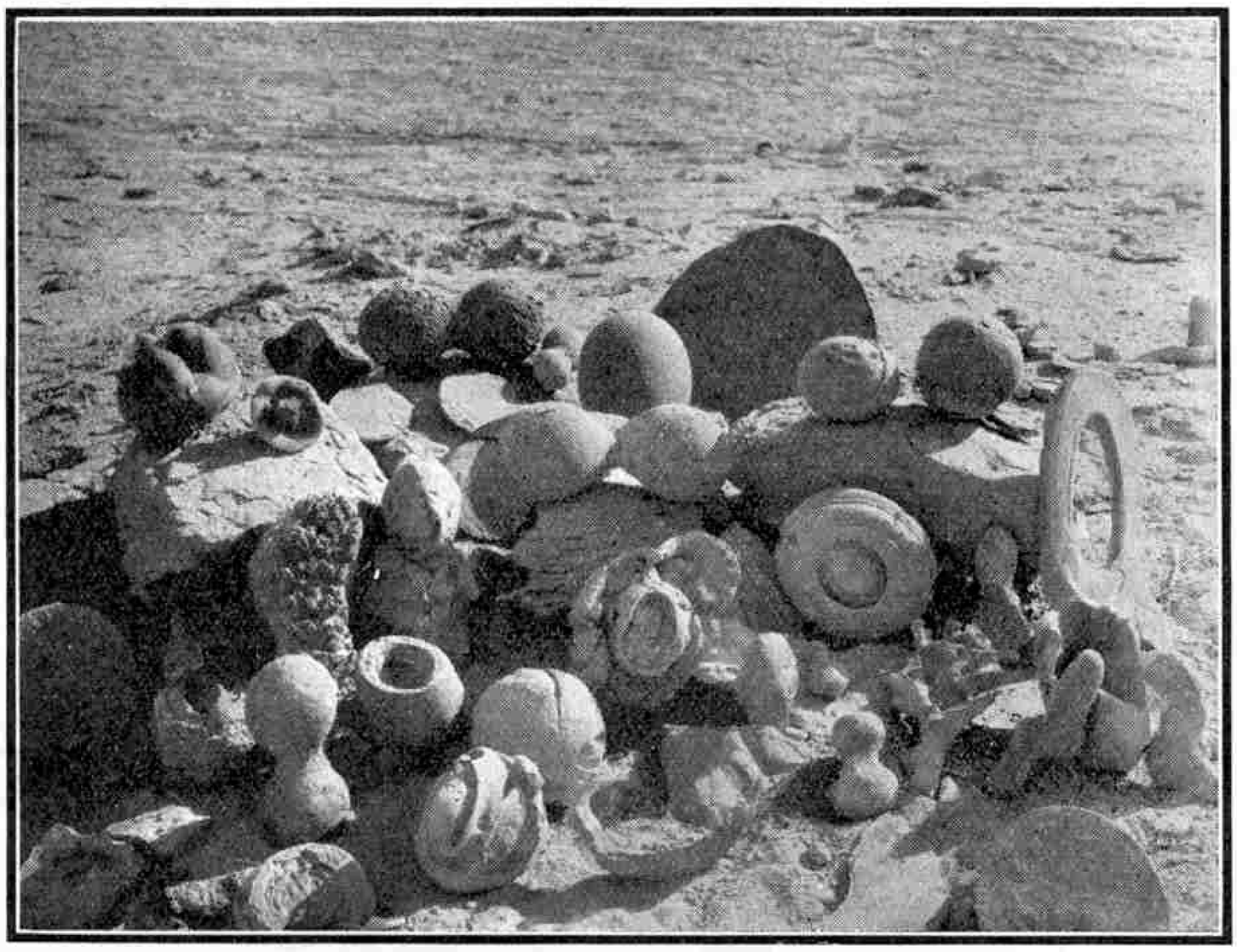
During the process of smelting gold for coining purposes quite considerable amounts of the metal are liable to disappear up the chimney. The United States Assay Office have evolved a method of recovering gold from the fumes and already several thousand pounds' worth of the metal have been obtained in this manner.

An electrical method is employed for the purpose. The fumes from the electric furnace are driven by a fan through flues containing two metal plates placed fairly close together. These plates are charged with electricity and as the particles of gold in the fumes pass between them they also become electrified and settle on the plates. The precious particles are afterwards shaken into a collecting chamber and remelted. The proportion of the gold melted that is driven off in the vapour is very small, but the results show that it is well worth recovery.

Fashioned by Wind and Water

The great deserts of Southern California, the scientists say, were at one time the bed of an ocean, and in places they are strewn thickly with loose stones, which the action of water and subsequent exposure for ages to the disintegrating effects of the atmosphere have wrought into many strange, fantastic shapes.

The accompanying photograph shows a heap of these curious stones, collected almost haphazard in the desert. There are stones of every imaginable shape, the peculiar dumbbell-like formation being a particularly striking feature. Many of these, rounded by the action of water, have been subsequently hollowed out by atmospheric influence till they appear almost as though they were the work of man.



Desert Sculpture : Stones worn by the elements into strange shapes

* * * *

The Greatest Sea Depth

The bottom of the sea seems to be still further down than was indicated on page 119 of the February "*M.M.*" There the greatest sea depth was stated to be 32,636 ft., off the east coast of Japan, but the German cruiser "*Emden*" has now sounded a depth of 34,120 ft. in the same neighbourhood in the western Pacific Ocean. This depth is practically six and a half miles and is an increase of more than a quarter of a mile on the former record.

* * * *

Land in the Unexplored Arctic Ocean !

The efforts of explorers are of greater interest when their journeys are designed to settle disputed questions. One such question concerns the possibility of land in the unexplored portion of the Arctic north of the Bering Straits.

The first suggestion of the existence of land to the west of Grant Land came from the early explorers, who thought they sighted mountains and gave the name of Crocker Land to the country they imagined they saw. Some likelihood of further discoveries in this direction was suggested when Stefansson reported the existence of a new island north west from Prince Patrick Island. Stefansson's new island was authentic, for he not only saw it but landed on it and made a journey right round its coasts. Crocker Land on the other hand seems to have been a delusion, probably of the same kind as that which caused Ross to turn back from Lancaster Sound as related on page 104 in the February "*M.M.*" At any rate recent explorations, particularly by the American McMillan, have failed to verify its existence, while Amundsen saw no trace of land on his air journey from the Pole to Alaska.

The latest opinions are very interesting and are derived from a study of the flow of tides over the Polar circle. The tide flows from the Atlantic Ocean through the space between Greenland and Spitzbergen and thence in the direction of the Siberian coast, and the general evenness of this flow seems to indicate that there are no obstructing land masses in its path. An important circumstance, however, is that the high tide at Point Barrow on the coast of Alaska is five hours later than at De Long's Island off the coast of Siberia, although the distances of these two points from the Spitzbergen opening are practically equal. The suggested explanation of this is that the sea north of the Bering Straits is so shallow that it retards the tide and it is possible that there are a few islands in this area. The results of further exploration will be awaited with interest to see if these deductions are confirmed.

* * * *

The Danger of Burning Steel

Steel is not usually regarded as a dangerous substance in a fire, but when it is in the form of exceedingly fine wire, as in steel wool, it is capable of burning easily. The cause of burning, with the production of heat and usually light also, is, of course, a chemical change in which the oxygen of the air unites with the material burning. This change takes place more rapidly when the material is finely divided, for the oxygen is then able to attack it over a large surface. No doubt many readers have seen ordinary iron wire burn when heated in oxygen, and therefore will be able to realise that steel wool is liable to burn in air.

The extraordinary effect of an increased surface is shown by the fact that very finely divided iron ignites spontaneously in the air.

Burning steel wire gives no easily noticeable flame or smoke and its dangerous nature is still further increased by the fact that some chemical fire extinguishers are not only useless but actually harmful. One liquid that is often used in extinguishers is carbon tetrachloride, and this actually acts upon hot iron with the formation of a poisonous gas known as phosgene. Water, fortunately, is a safe extinguisher.

Ocean Current at a Depth of Three Miles

The investigations of a German scientific expedition have brought to light some interesting facts with regard to the currents in the Atlantic Ocean. The most striking is probably the revelation of the existence of a current of cold water that travels a distance of several thousand miles at a depth of three miles below the surface.

The expedition sailed in the "*Meteor*" and crossed the south Atlantic Ocean no fewer than 10 times. Soundings were taken continually, and in addition the temperature at various depths was determined. This led to the discovery of the current of cold water already mentioned, flowing south at a depth of from two to three miles. It originates in the Arctic Ocean, where the cold sea water under the ice sinks owing to its greater density, and then moves slowly south for thousands of miles. It gets nearer the surface on approaching Antarctic regions and at a depth of half a mile flows slowly northward again, after which it is lost by slow mingling with the surface waters. The manner in which this stream curls upward to flow towards the Equator once more is really remarkable.

At first glance it would be expected that the current would rise to the surface at the Equator while travelling south and that a similar current would flow northward from the Antarctic regions. The latter comprises a large land mass covered with an ice-cap, however, whereas in the Arctic regions there are large expanses of frozen sea. It is only to be expected, therefore, that far more influence will be exerted on ocean currents by Arctic conditions.

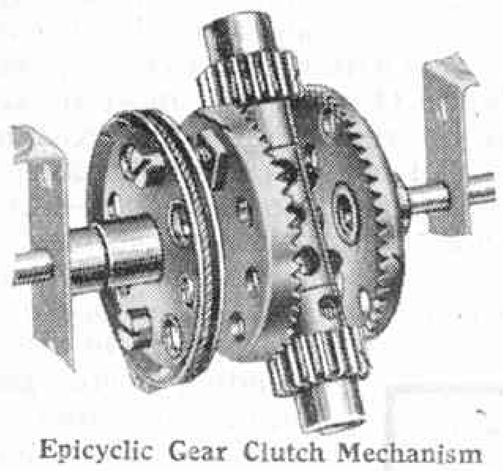
* * * *

Chocolates that Explode

The "explosive" chocolate costs American manufacturers many thousands of pounds yearly, and has become so common that a Government scientific department there is investigating the subject.

The explosion is not a true one, of course, the chocolate cover being merely split open. Its cause has been found in the action of a kind of yeast derived from the fruit used in making chocolates with fruit centres. This ferments the sugar, with the production of minute quantities of gas, and it is the increasing pressure due to the accumulation of the gas that causes the chocolate to burst. For its prevention the use of a special artificially-made sugar is recommended, together with heating to destroy the fermenting agent.

The presence of microscopic organisms on the skin of fruit has been known for many years. An instance is the yeast that occurs on the berries of the grape and is responsible for the chemical changes that produce alcohol in wine making.



Epicyclic Gear Clutch Mechanism

Suggestions Section

Edited by "Spanner"

(94)—Intermittent Rotary Motion

(G. C. Cunliffe, Fortis Green, London, N. 2)

FIG. 94 shows an ingenious Meccano device by means of which intermittent rotary motion may be produced from a driving shaft that revolves continuously. Intermittent drive of this kind is required frequently in connection with all kinds of machine tools, conveying machinery, etc., and the advantages of such a device when fitted to Meccano models will be obvious. Meccano Club members, in particular, should find it extremely useful when building models for Club exhibitions, etc., for a display model in which it is incorporated may be caused to stop and start at regular intervals, thereby adding considerably to the attractiveness of the exhibit. For example, if the device is fitted to the Big Wheel (No. 606 in the Complete Manual) the model may be arranged to turn for two or three minutes, remain stationary for a like period, and again revolve, just as its prototype in actual practice pauses every now and then to allow passengers to embark or disembark.

Variable number of Revolutions at each Impulse

In Standard Mechanism No. 265 (Intermittent Rotary Motion) the driven rod is moved through a fraction of a revolution only at each impulse of the driving mechanism, whereas in the model about to be described the number of revolutions made by the driven rod at each impulse may be varied to a large extent. The device is simple and very reliable in action and can be relied upon to work continuously without supervision.

The photograph shows a convenient arrangement of the gearing, although of course the layout and general assembly of the necessary apparatus may be altered as desired to suit individual requirements. The Rod 1 forms the driven shaft, which conveys intermittent motion to the model that it is required to operate. The drive from the Motor or other source of power is led by any suitable means to a Worm Wheel 2 that meshes with a 57-teeth Gear Wheel 3, in the face of which two Threaded Pins 4 are secured as shown. In the illustration the Gear Wheel 3 is secured to a short Rod journalled in a footstep bearing consisting of a Double Bent Strip bolted to the base plate.

Automatic Operation of the Clutch Mechanism

As the 57-teeth Gear Wheel slowly rotates the Threaded Pins 4 alternately press against the end of a $3\frac{1}{2}$" Rod 5, which is secured in a Coupling mounted on any suitable Pivot 6. On this Rod 5, about $\frac{1}{4}$" from the Coupling, is mounted the centre boss, or "spider," of a Universal Coupling, one fork of which forms a pivotal connection between the Rod 5 and a $2\frac{1}{2}$" Rod 7. This Rod 7 carries a Crank 8, through the end hole of which is journalled the driven shaft 1. The latter slides in its bearings and carries on its inner end one section of a Dog Clutch 9, the corresponding clutch section being secured next to the Worm Wheel 2 on the driving Rod 2a. The Clutch is normally held in engagement by means of a small compression spring (extracted from a Spring Buffer, part No. 120a) mounted on the driven shaft and pressing against a Collar 10. This spring, while retaining the Clutch in engagement, also tends to hold the lever 5 against the boss of the 57-teeth Gear Wheel 3.

When one of the Pins 4 strikes the lever 5, the Rod 7 is pushed back in its bearings. This movement is conveyed by means of the Crank 8 to the Rod 1, the Spring thereon is compressed and the Clutch members 8 disengaged. The model is thus thrown out of gear and the Motor is free to rotate independently. It continues to do so until the movement of the Gear Wheel 3 has carried the Threaded Pin far enough to allow the Rod 5, through the action of the spring on the Rod 1, to slip back into its normal position, when the Clutch is re-engaged. The Motor is now connected to the model and the latter is operated until the second Threaded Pin presses against the Rod 5. The cycle of operations is then repeated, the second Threaded Pin disengaging the clutch in the same way as did the first Pin.

Since the Threaded Pins are fixed 180 degrees apart on the Gear Wheel 3 the cycle of operations is completed twice in each revolution of this Wheel. If the Pins are placed in any other position the time between each cycle of operations would become irregular, of course, and no doubt the irregular motion so obtained would prove useful in certain models, particularly in displays and advertising novelties.

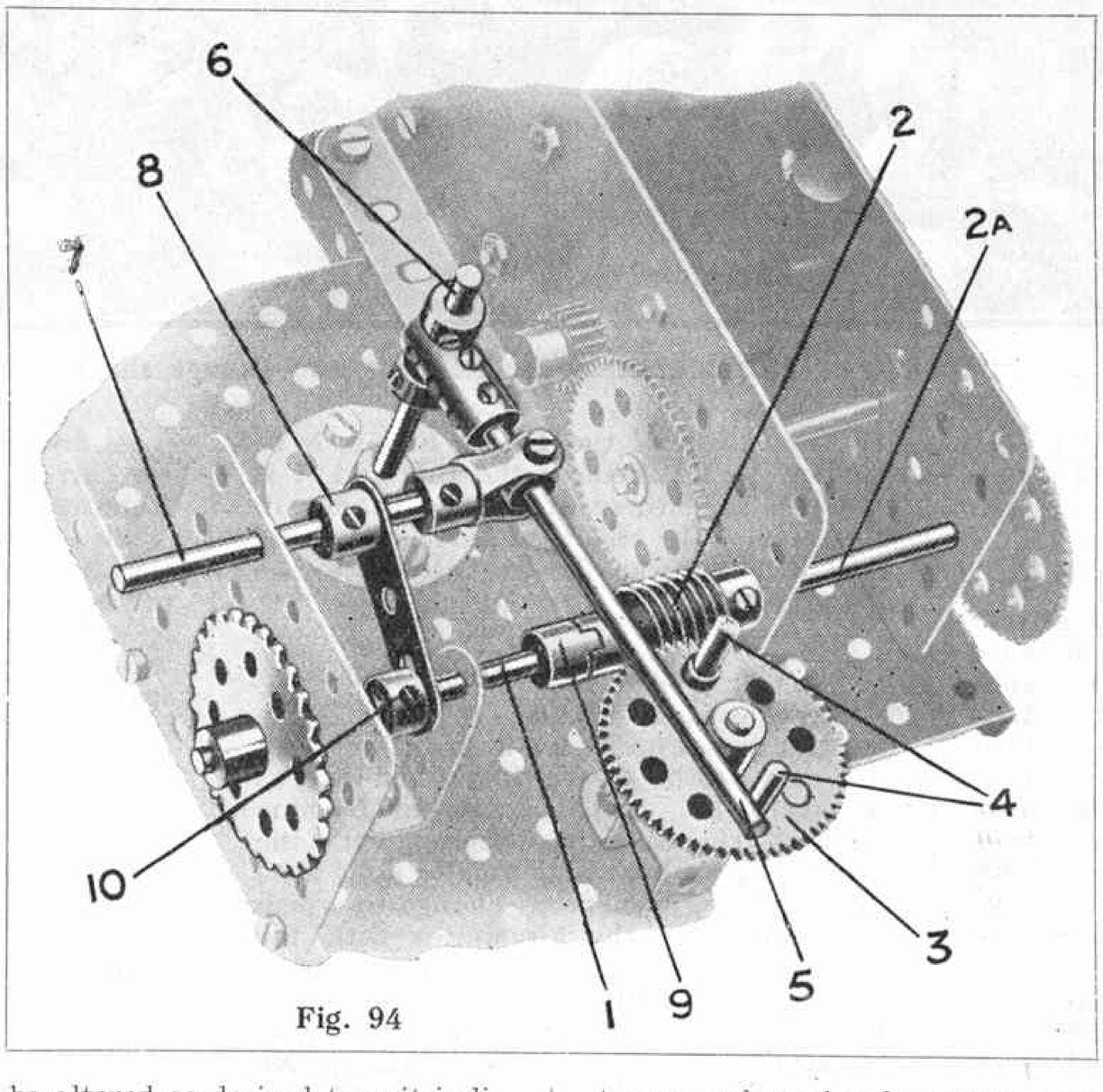


Fig. 94

Adjusting the Frequency of Operation

The speed ratio between the Motor and the Gear Wheel carrying the Threaded Pins has a direct bearing on the rapidity with which the cycles of operations take place. An increase in the ratio will result in a corresponding increase in the time taken to complete each cycle, and vice versa. Hence, by altering the gear train attached to the Motor, it is a simple matter to vary the length of the periods during which the Model is at rest or in motion.

Readers will observe in the above model a resemblance to the automatic reversing gear described under Suggestion No. 86 in the June "*M.M.*" Some remarkable results will be obtained by using these two movements in conjunction with each other; that is to say, by coupling the driving shaft 2 of the reversing gear (see illustration in June "*M.M.*") to the driven shaft 1 of the intermittent gear.

(95)—Meccano Heald-Making Machine

(H. C. van Doorn, Utrecht, Holland)

Most Meccano boys like to build models that can be put to practical use, and if a Meccano structure can be employed to actually manufacture some small object, its fascination is increased a hundredfold. There are several well-known models that fulfil extremely practical functions, such as Meccano lathes that turn wooden wheels or chessmen, etc.; drilling and planing machines; looms, clocks, and clay-modelling machines, etc.; and another very interesting addition to the list is provided by the apparatus shown in Fig. 95. This was designed by H. C. van Doorn for converting thin lengths of wire into healds for use in Meccano Looms. It is very simple to construct and easy to operate. Two typical specimens of healds made with the machine are shown in Fig. 95a.

Details of Construction

The model consists principally of two box-like structures each composed of two $3\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plates and two $2\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates bolted to a $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate, which, in turn, is secured to a base consisting of two $12\frac{1}{2}''$ Angle Girders. The $2\frac{1}{2}''$ Flat Plates form bearings for two $4\frac{1}{2}''$ Axle Rods placed longitudinally in the model. One of these Rods is fitted with a handle composed of a Threaded Pin secured to a Bush Wheel; it carries also a $\frac{1}{2}''$ Pinion that engages with a 57-teeth Gear Wheel secured to an 8″ Rod 3.

The other $4\frac{1}{2}''$ Rod 2 is actuated on rotation of the operating handle 1, but it is arranged to revolve in the opposite direction, the reverse motion being obtained in the following manner. The inner end of the 8″ Rod 3 is journalled in one end of a Coupling, through the centre hole of which passes the vertical $2\frac{1}{2}''$ Rod 7. The latter carries a $\frac{3}{4}''$ Pinion and is journalled in the centre holes of two $2\frac{1}{2}'' \times 1''$ Double Angle Strips bolted to the $12\frac{1}{2}''$ Angle Girders. Another 8″ Rod 4 is journalled in the opposite end of the Coupling, and this Rod is fitted with a 57-teeth Gear Wheel meshing with a $\frac{1}{2}''$ Pinion on the Rod 2, thus corresponding with the gearing at the opposite end of the machine.

The Rods 3 and 4 are both free to revolve in the ends of the Coupling, but the drive is transmitted from Rod 3 to Rod 4 via two $\frac{3}{4}''$ Contrate Wheels 5 and 6 and the Pinion on Rod 7; hence the direction of rotation of Rod 4 is reversed and consequently the Rod 2 rotates in an opposite direction to the $4\frac{1}{2}''$ Rod carrying the operating handle. It will be seen that the Pinion and Contrate Wheel drive is a simple application of Standard Mechanism No. 66 (Reversing Gear).

Each of the two $4\frac{1}{2}''$ Rods is fitted with a Coupling carrying a Threaded Pin 8, 9 secured at right-angles to its end; these Pins form hooks over which is slipped the loop of wire from which the heald is formed. Each Rod is also equipped with a small compression spring (extracted from a Spring Buffer, part No. 120a). The springs are mounted between the inner $2\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates and Collars and set-screws on the Rods in such a way that they normally tend to hold the Couplings carrying the Threaded Pins against the Plates.

Two Threaded Pins 10 and 11 are bolted to the side of the machine to form a gauge by which the correct length of wire may be ascertained.

The healds are manufactured as follows: A piece of suitable wire, about 13″ in length, is passed round the Pins 10 and 11 and the ends twisted together with a pair of pliers to form a loop. A convenient size of wire is 26 S.W.G. (.018″ in diameter).

Next the loop of wire is removed and passed over the Rod 7, and its ends slipped over the Pins 8 and 9. The hand wheel is now rotated and the loop of wire is twisted into the form of a heald, the Rod 7 forming the hole through which will pass the warp threads of the loom. As the loop of wire is twisted the $4\frac{1}{2}''$ Rods carrying the Threaded Pins 8 and 9 are drawn slightly towards the Rod 7. This movement is allowed for by the small compression springs already mentioned, and as soon as the completed heald is removed the Rods slip back into their normal positions. The whole operation occupies a few seconds only.

Parts required:

2	of No.	8	2	of No.	26	4	of No.	53
2	„ „	9f	2	„ „	27a	4	„ „	59
2	„ „	13a	2	„ „	29	3	„ „	63
2	„ „	15	40	„ „	37	4	„ „	72
1	„ „	17	8	„ „	38	5	„ „	115
1	„ „	24	2	„ „	46	2	„ „	120a
1	„ „	25	2	„ „	52			

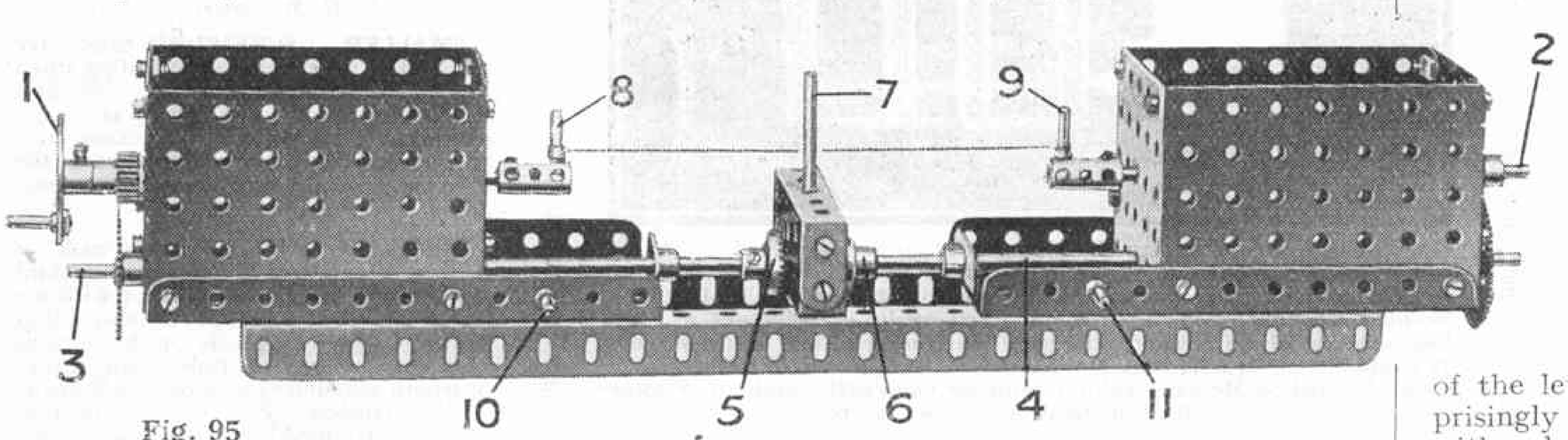


Fig. 95

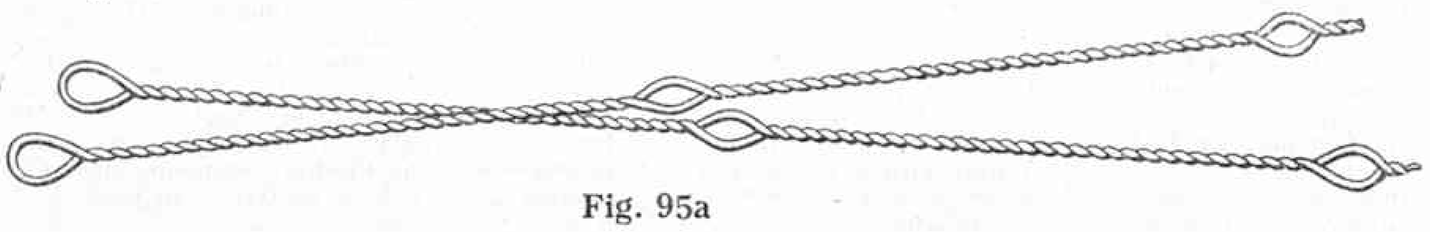


Fig. 95a

(96)—Push-Button Brake Control

(G. Boedeker, Croydon)

By means of the device shown in Fig. 96 it is possible to control the movements of a Meccano model merely by pressing a button! This new brake is particularly suitable for regulating the speed of the Clockwork Motor.

A Collar and set-screw secured to the 1″ Rod 1 forms the operating button. The 1″ Rod is secured beneath the plate in a Strip Coupling 2, in the slot of which a Strip 3 pivots upon the shank of a grub screw or an ordinary bolt inserted in the threaded bore of the Coupling. The

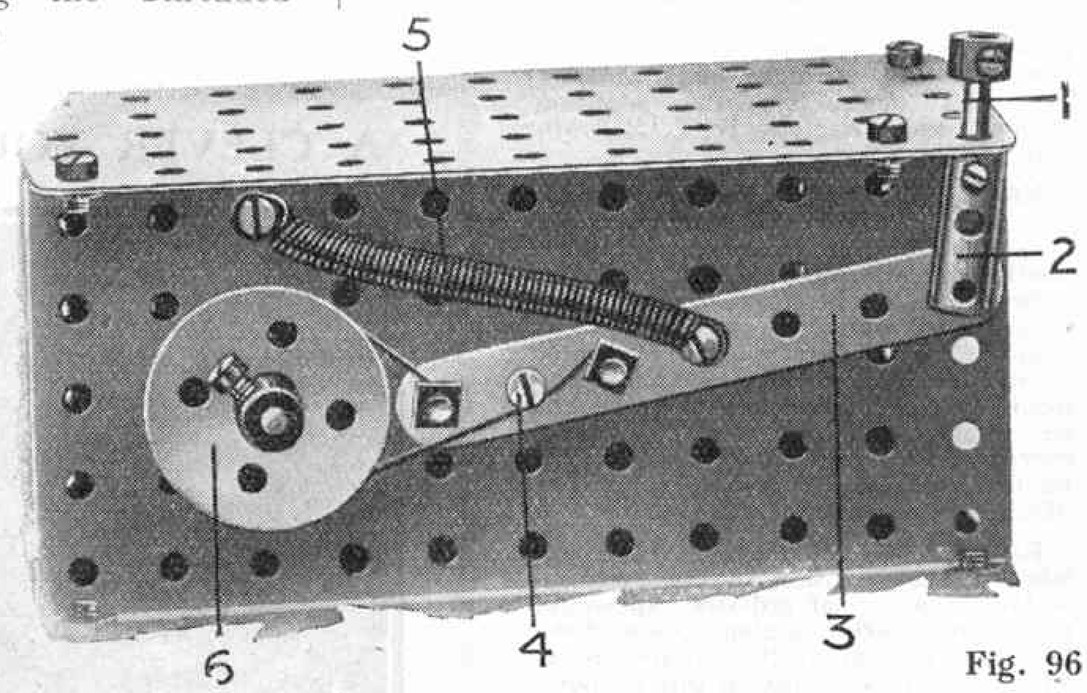


Fig. 96

Strip 3 is also mounted pivotally on a $\frac{3}{8}''$ Bolt 4 secured to the frame by means of two nuts arranged one on each side of the Flanged Plate (see Standard Mechanism No. 262).

A short piece of Cord tied to the end of Strip 3 is passed round a Flanged Wheel 6 secured to the shaft that is to be controlled, and the other end of the cord is secured by a nut and bolt on the opposite side of the pivot 4. The Spring 5 normally keeps the button 1 raised, and in this position of the mechanism the cord grips the Flanged Wheel 6 and thereby stops the rotation of the Rod on which the wheel is mounted. The braking effect may be diminished by gently depressing the Rod 1. When the latter is pushed down as far as it will go the cord should be comparatively slack and the wheel 6 free to revolve.

In some models it may be desirable to adjust the brake so that only a slight retarding effect is applied to the Flanged Wheel when the button is fully raised. This arrangement might be useful, for example, in a model motor car that is driven by a clockwork motor; in such a case the lever 1 should protrude through the floor of the car to correspond with the accelerator pedal. The car would travel at maximum speed when the Rod 1 is pressed hard down.

Although the movement of the lever 3 is small, the brake is surprisingly effective and it may be used with advantage in the heaviest models.

Contributions for the "Suggestions Section" are invited. If possible they should be accompanied by clear drawings or photographs, and the envelopes should be addressed to "Spanner." Special awards are given each month for all suggestions published in the Section.

In Reply

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

Suggested New Meccano Parts

LARGER HINGES.—We are at present working on designs for a Meccano hinge having longer arms than the existing part. We hope to make an announcement concerning this in the near future. (*Reply to L. Ison, Northcote, Victoria, and H. R. Dobbie, Christchurch, N.Z.*)

IMPROVED WORM WHEEL.—We note your remarks regarding an alteration to the pitch of the present Worm Wheels. We fear, however, that there are many manufacturing difficulties obstructing the adoption of your idea. (*Reply to W. L. Holcroft, East London, S.A.*)

NARROWER PERFORATED STRIPS.—We shall give further consideration to your suggestion regarding the introduction of Perforated Strips ½" in width, although we doubt whether these parts would fulfil many important functions that are not already covered efficiently by existing parts. We agree that they would be useful as tie-rods, etc., but we would point out that in almost every case Meccano Rods can be used for this purpose. (*Reply to R. E. Fysh, Moose Jaw, Sask.*)

RADIATOR CAP.—It is doubtful whether the inclusion in the Meccano system of a special radiator cap would prove particularly popular in view of the fact that several of the existing parts lend themselves readily to this purpose. The Buffer (part No. 120), Handrail Support, and Threaded Boss fitted with two bolts are good examples. However, we are experimenting with a model car radiator and bonnet, as stated in last month's issue, and additions of the type you mention will receive careful attention. (*Reply to R. E. Fysh, Moose Jaw, Sask.*)

IMPROVED METHOD FOR CONNECTING RODS.—We note your proposal that one end of each Axle Rod should be tapped and the other end threaded in order that the Rods could be screwed end to end in preference to using an ordinary Coupling. Your idea is very interesting but we fear that the diameter of the Rods is too small to permit the end being bored as you suggest. (*Reply to A. England, Swansea, and L. P. Star, Watford*).

IMPROVED CHANNEL SEGMENTS.—We are interested in your remarks concerning the provision of lugs on the outer diameter of the Channel Segments. The question of altering the design of the Channel Segments has already received attention in these columns, however, and we intend at the earliest opportunity to alter these parts so that the existing lugs shall have two holes instead of one. This should enable the Segments to be bolted together more rigidly, and should produce a smoother track for use in roller bearings, etc. (*Reply to E. A. Rawlings, Westmount, Quebec*).

THINNER WASHERS.—We note that you consider the Washers are a little too thick. The Washers are approximately the same thickness as the longer Meccano Strips, but we shall consider your proposal that they should be made of the same thickness as the shorter Strips, Plates, etc. (*Reply to D. H. Williams, Ipswich*).

SMALLER FLANGED WHEELS.—The introduction of ½" diameter Flanged Wheels has been suggested before, but at present there appears to be little demand for these parts. The present Flanged Wheel is quite satisfactory for ordinary locomotive construction, but we agree that the smaller size would be useful for a number of models in which bogie trucks are incorporated. Further attention will be given to this idea. (*Reply to A. Ross, Glasgow*).

¼" DIAMETER PINION.—We regret we are unable to introduce this part, as it would not conform to the Meccano standard. (*Reply to J. Genny, S. Australia*).

1¼" BOLT.—There is little demand for a 1¼" bolt. We find that in most cases where a bolt longer than the ¾" size (part No. 111) is required, it may usually be substituted by the 1" or 2" Threaded Rods. (*Reply to W. E. O'Neary, Forestville, S. Australia*).

2½" GEAR WHEEL.—We note your suggestion regarding a 2½" diameter gear wheel and agree that this would be a useful part if it could be arranged to mesh with a ½" Pinion, giving a ratio of 5 : 1. At present it is difficult to apply the decimal system to Meccano gear ratios, but we would draw attention to the fact that a reduction gear of 50 : 1 can be obtained by driving a 57-teeth Gear Wheel with a Worm and meshing the former with a 50-teeth Gear Wheel. (*Reply to E. G. B. Bosch, Delft, Holland*).

MECCANO FLAG.—We note your suggestion that a miniature Flag should be available for use on Meccano models. We do not consider this part would serve any useful purpose, however. (*Reply to J. Phillips, Emsworth*).

LARGE GEAR WHEELS.—The occasions on which a 5½" or 6½" diameter Gear Wheel could be used would be extremely rare. When a very large gear ratio is required it is quite a simple matter to arrange a gear train using two or three of the existing wheels. In addition, your proposed part would prove extremely costly to manufacture. (*Reply to C. L. Hordern, Mt. Evelyn, Victoria*).

RACK ROD.—We note your suggestion regarding an Axle Rod serrated along half its length, but we are unable to discover any purpose to which this part would be put that is not already covered by the existing Rack Strip. As you point out, your proposed part could be used in conjunction with a Pinion to transform rotary motion into to and fro motion, but this result can be obtained equally well by means of the Rack Strip already mentioned. See Standard Mechanisms Nos. 166 and 280. (*Reply to J. Jones, Ascot Vale, Victoria*).

IMPROVED THREADED PIN.—We note your proposal concerning the provision of a slot in the Threaded Pin so that a screwdriver could be used to fix this part more firmly to Plates, Strips, etc. Many readers have suggested, with the same object in view, that a squared shoulder should be fitted to the Pin, as we have stated previously in these columns, and we hope to adopt the latter improvement in the near future. It will be possible to secure the improved part very rigidly by means of a spanner. (*Reply to R. Sligho, Southampton*)

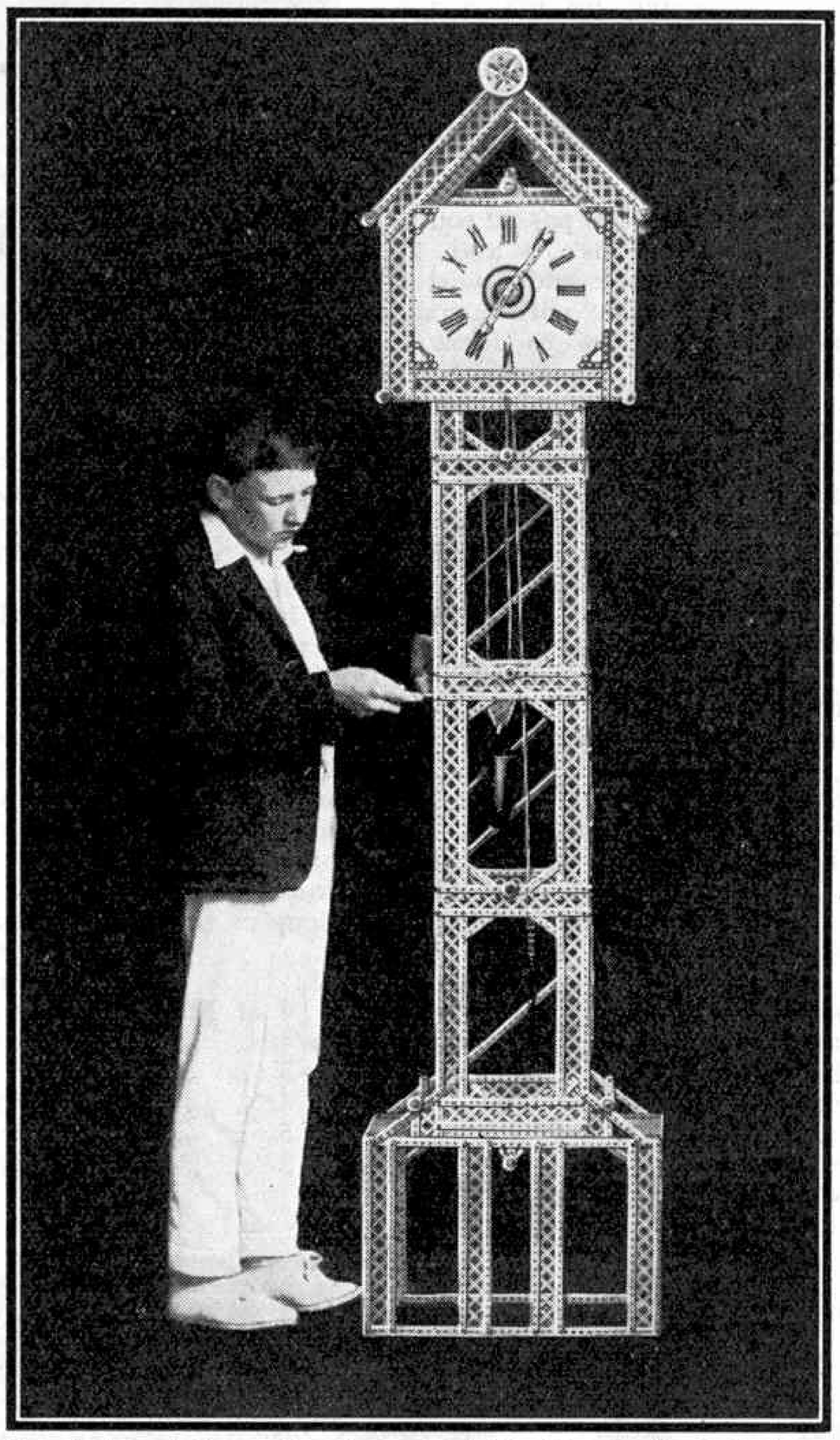
IMPROVED HANDRAIL SUPPORTS.—The addition of a boss and setscrew to the Handrail Support would prove advantageous in certain constructional work, without doubt, and we shall give your suggestion further consideration. We would point out, however, that the threaded shanks at present fitted are extremely useful when it is required to secure the handrail to Meccano Strips, etc. (*Reply to D. Theedom, S. Farnborough, Hants.*)

IMPROVED WHEEL BOSSES.—Many readers have suggested from time to time that Couplings, bosses of wheels, etc., should be tapped right through in order that two set-screws may be used and a more powerful grip on the axle thereby obtained. We hope to adopt this suggestion in the near future. (*Reply to D. H. Williams, Ipswich*).

SMALLER SCREWDRIVERS.—We regret that your proposal regarding small screwdrivers is not quite clear. We find that the present screwdrivers are quite satisfactory for use in connection with the various bolts and grub screws in the Meccano system. (*Reply to H. Hosegood, South Norwood*).

MECCANO RAILS.—Meccano rails of a larger gauge than the Hornby standard might prove useful in connection with the construction of locomotives and other railway vehicles. It is quite simple, however, to build up rails of any gauge or length as required by means of Meccano Angle Girders. For heavy models, 12½" Strips should be bolted along the up-turned flanges of the Girders, thus providing a wider contact surface on which the travelling wheels may rest. Where small circular tracks are required, such as in swivelling cranes, swing bridges, etc., the Hub Disc or Circular Girder will be found quite satisfactory; the Channel Segments are suitable for a larger track (11½" diameter). (*Reply to N. S. Dunn, Kingstone, Surrey*).

A CLEVER YOUNG CLOCK-MAKER



Our photograph shows Alan Young, aged 12, of Semley Road, Norbury, S.W.16, with his Meccano model of a Grandfather Clock with which he secured Second Prize in the Hobby Exhibition recently held at the Selhurst Grammar School, Croydon. The model is well built and we feel sure that all our readers will agree that the prize was well deserved. It is interesting to note that the Selhurst Grammar School has a special room devoted to Meccano exhibits and we have little doubt that some excellent work is to be seen there.

Suggested Hornby Train Improvements

OPERATING TWO ELECTRIC LOCOMOTIVES.—As you point out, it is indeed difficult to control independently of each other two electric locomotives running on the same layout. It is possible, of course, to obtain the desired result by dividing the track into two sections, each section being insulated from the other and provided with a separate Resistance Controller. An alternative method is the provision of an adjustable resistance on each locomotive, but here the old difficulty again arises regarding the possibility of short circuits or an unequal supply of current to the locomotives. (*Reply to D. H. Morgan, Penarth*).

THEATRICAL PROPERTIES VAN.—We are interested in your suggestion concerning a special van designed for the transport of stage scenery, etc., but as rolling stock of this description is comparatively uncommon, we doubt whether the vehicle would prove particularly popular. (*Reply to L. H. Porter, Stoke-on-Trent*).

BANANA VANS.—The addition of a banana van to the Hornby system would not fulfil any specially useful purpose, but we are keeping a note of all suggestions received on the subject. (*Reply to I. Bryant, Bristol; R. Porter, Southsea; B. Morris, Whitchurch; F. Reynolds, Wandsworth, S.W.11; L. Bartlett, Rochester; and H. Croome, Sutton, Surrey*).

CAST WHEELS. — As we have stated previously, we are unable to adopt at present the suggestion concerning the introduction of cast wheels on all rolling stock. This innovation would result in a considerable increase in the cost of the accessories and, owing to the extra weight of the wheels, etc., it would also tend to decrease the number of vehicles that each locomotive is able to pull. These disadvantages outweigh the few advantages that are to be obtained from the use of cast wheels. (*Reply to A. Hodgkinson, Fleetwood; T. Leather, London, N.W.18; H. A. Vlies, Manchester; J. Orr, Haddington; V. Eckersall, Manchester; and E. G. Hobson, The Valch, near Stroud*).

LARGER RADIUS CURVED RAILS.—As announced in the "*M.M.*" for December 1926, we are unable to give further consideration at present to the question of introducing curved rails of 4 ft. radius. This also applies of course to the proposal for 6 ft radius rails. (*Reply to J. Orr, Haddington; J. Masters, Cheltenham; O. Williams, Windermere; F. J. Wilcox, Stone; S. Bruce, York; E. C. Marsden, Blackburn; and F. Auld, London, E.12*).

WATER TANKS FOR LOCOMOTIVES.—We are interested in your proposal that locomotive tenders should be fitted with miniature water tanks provided with filling holes and taps, but we fear that an addition of this kind, whilst increasing the cost of the tenders, would serve no useful purpose. The same objections apply to the question of fitting side tanks to the tank engines. (*Reply to D. Miller, Higher Tranmere, Birkenhead*).

HEAVY BASES FOR SIGNALS, Etc.—We note that you suggest the addition of heavy bases to the Signals, Lamp Standards and similar accessories. The present form of base consists of heavy sheet metal and we do not consider that it can be improved upon without greatly increasing the cost of the accessories. Hornby Control Signals are clamped to the rails and therefore they are always quite rigid when in use. (*Reply to R. Slight, Southampton*).

THINNER HANDRAILS FOR LOCOMOTIVES.—A decrease in the diameter of the handrails in the No. 1 and No. 2 engines would decrease the general strength of the locomotives and we do not consider that the advantages offered justify this alteration. The boilers and fittings of all Hornby engines are designed primarily for long and hard wear. (*Reply to W. F. Parker, Carlisle*).

RAIL WATER TROUGHS.—Your suggestion regarding miniature water troughs to lie between Hornby rails is very interesting. We do not consider that the introduction of an accessory of this kind is desirable, however, since it would serve only ornamental purposes. If it is desired particularly to include water troughs in a layout, the best plan is to place between the rails a strip of glass, coloured blue to represent water. Actual water should not be used, of course, for fear the mechanisms of the locomotives are damaged by damp or rust. (*Reply to A. Hodgkinson, Fleetwood*).

MAIL TRAIN OPERATION.—As stated in previous issues, the introduction of mail vans, wayside nets, and similar accessories has been under consideration for some time. We are keeping careful note of all suggestions received upon the subject. (*Reply to F. J. Wilcox, Stone; S. Ellins, Kensworth, Dunstable; A. H. Handley, Manor Park, E.12; A. Hodgkinson, Fleetwood; A. Herbert, Penarth; J. West, Bury St. Edmunds; H. W. Jacombs, Godalming; M. Rowlett and C. Wood, Gillingham; G. Innes, Winchester; J. Thorburn, Kilmacolm; J. Miller, J. Robbins and L. F. Hall, London, N.W.2; K. Nelson, Montreal; D. C. Young, Sheffield; P. Slade, London, S.E.5; R. W. King, Nottingham; and T. Johnson, Talywain, Mon.*)

HORNBY CONTROL FOR ELECTRIC LAYOUTS.—We are carrying out experiments regarding the application of the Hornby Control System to model electric layouts and we hope to make an announcement on the subject in the near future. (*Reply to G. Innes, Winchester; D. Schofield, Tiverton, Devon; J. D. Macintosh, Redhill, Surrey; R. G. Slade, London, S.E.23; and others*).

SIGNAL GANTRIES.—A number of suggestions have been received regarding the introduction of signal gantries, but we are unable to make any definite announcement on this point. We continue to keep a careful record of all readers supporting the proposal. (*Reply to A. Malkin, Leek; J. V. H. Cookson, Bucks.; A. G. Houstoun, Dunbar; J. Thorburn, Kilmacolm; F. J. Wilcox Stone; and P. Rose, Hindhead*).

AUTOMATIC TURNTABLES.—The possibility of designing an electric or hand-driven control for the Turntable has been carefully considered and we regret that, at least for the present, we are unable to proceed further in the matter. Either type of control would increase the costs of production by a large amount and we fear that the demand for these accessories would be insufficient. (*Reply to T. Urben, Southampton; I. Header, Ilkley, Yorks.; C. Outtrim, Melbourne; and E. Mackintosh, Redhill, Surrey*).

MODEL CRANES.—We do not favour the idea of introducing model cranes, other than those already fitted to the Goods Platforms, for use in connection with Hornby railways. It is a simple matter to construct any desired type of crane from Meccano parts. (*Reply to J. Gwinn, Guildford, Surrey*).

SPECIAL STATIONS.—We do not consider that a curved platform would meet with any great demand. As we have stated in a previous issue, it is a simple matter to insert two or three straight rails in the track at the point where it is required to introduce the station. (*Reply to F. Whyte, Sydney, N.S.W.*)

MINIATURE FOG SIGNALS.—We doubt whether fog signals on so small a scale would prove satisfactory. We are experimenting with a Meccano apparatus, however, by means of which Hornby locomotives may be caused to explode small gunpowder "caps" at some pre-arranged point in the layout. (*Reply to E. B. Moss, Bromley, Kent*).

ELECTRIC FREIGHT LOCOMOTIVES.—We are giving attention to the possibilities of introducing several new electric locomotives, and freight engines are receiving consideration. (*Reply to E. Lansdell, London, S.W.10*).

SPRING-CONTROLLED POINTS. — The introduction of spring-controlled points to facilitate operation from a distance has been suggested by several readers and will receive further consideration. We believe, however, that the Hornby Control System renders this innovation unnecessary. (*Reply to G. Fryer, Odiham, Basingstoke, and J. Finley, Miles Platting, Manchester*).

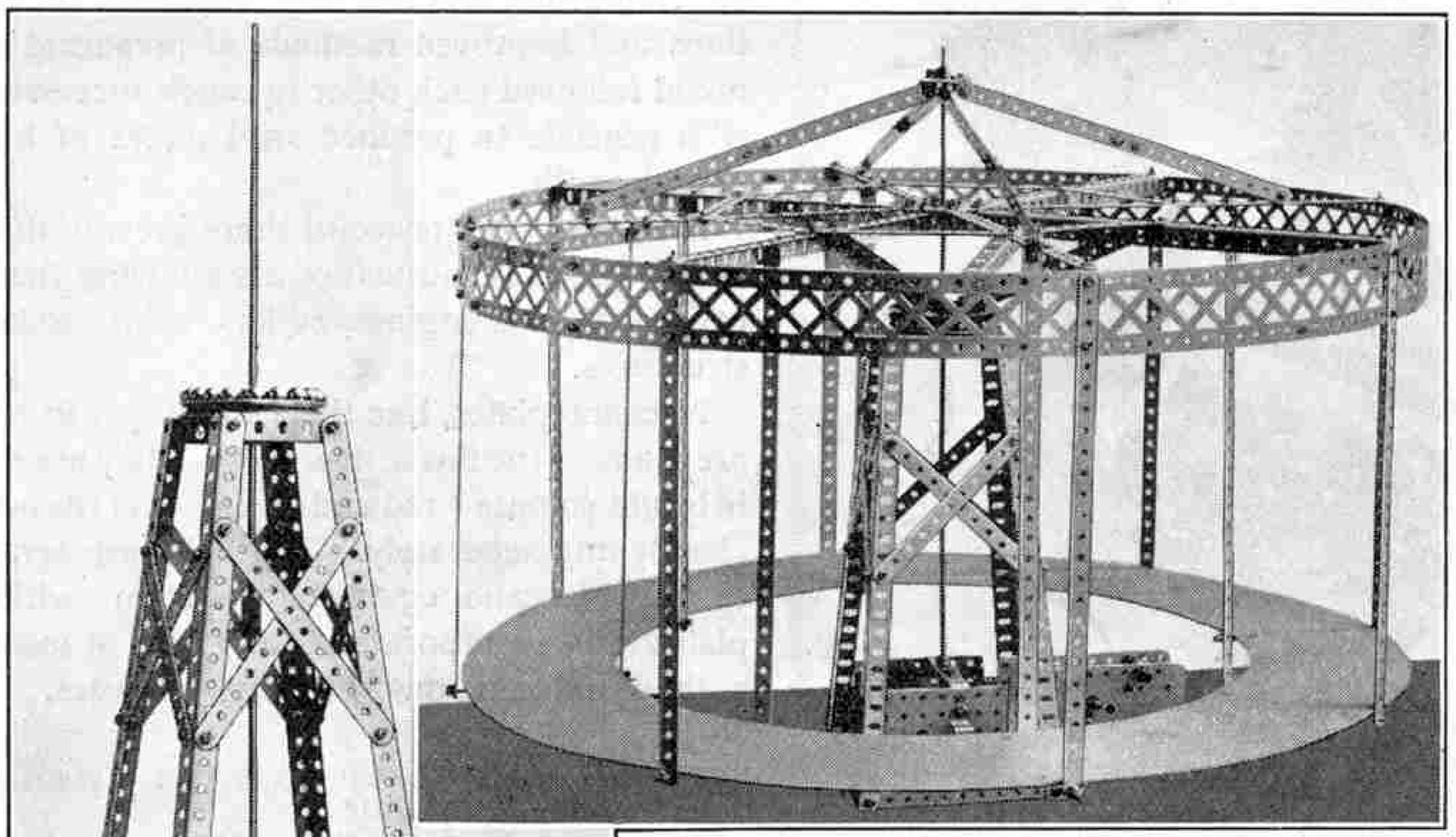
LOWER BUFFER BEAMS.—We note that you consider the buffer beams on Hornby locomotives are too high above the track. It is difficult, of course, to reproduce such details accurately to scale but we shall give careful attention to the matter. (*Reply to W. F. G. Gadsby and T. M. Hoskinson, Brierley Hill*).

FOOTPLATE ON RIVIERA "BLUE" LOCOMOTIVE.—We do not consider that it is necessary to fit a hinged footplate to the Hornby Riviera "Blue" locomotive, for a special coupling arrangement has been adopted to bring the engine and tender closer together than is the case with other Hornby trains. (*Reply to G. F. Roberts, Newland, Hull*).

OBSERVATION CARS.—An open-end observation car, although in keeping with a Dominion or American train set, is hardly suitable for the Hornby System in view of the fact that this type of rolling stock is comparatively rare on British Railways. (*Reply to R. A. Shone, Seaford*).

FISH VAN.—We doubt whether the introduction of a Fish Van would prove very popular, for it would resemble very closely the existing No. 1 Cattle Truck and Milk Traffic Van. (*Reply to R. Porter, Southsea; F. J Wilcox, Stone, Staffs.; F. Illingworth, Haslingden; and E. Lansdell, London, S.W.10*).

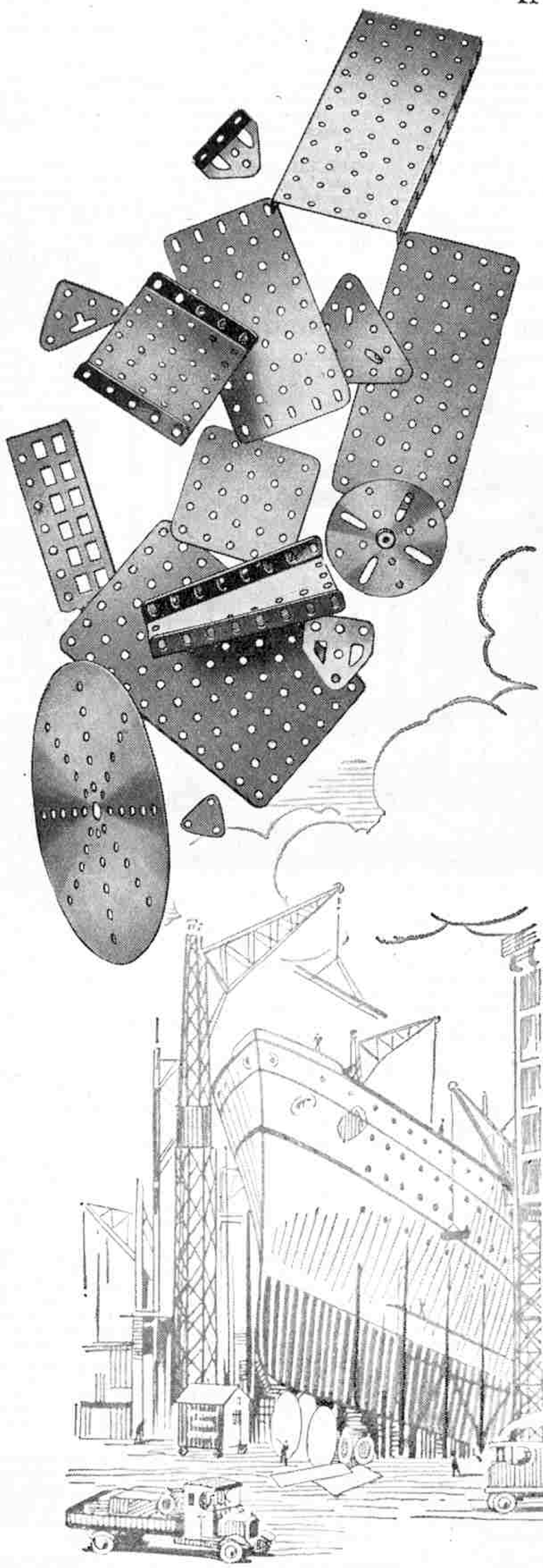
How Would *You* Complete This Fine Meccano Roundabout?



This model Roundabout was built by Richard Boom (aged 10 years) of Hengels, Holland, from a No. 5 Meccano Outfit with one or two additional parts. No doubt Richard has plenty of ideas as to the fitting of suitable seats, etc., for the passengers, but the illustration shows the framework of the model only and we invite readers to send in their own suggestions regarding the completion of the model. Remember that nowadays roundabouts are fitted with all kinds of ingenious mechanical devices, such as galloping horses, dragons, motor cars, etc. We shall give a prize to the value of 10/6 and other awards to readers who suggest the best additions or improvements for the model.

MECCANO ACCESSORY PARTS

IN COLOURS



Plates

THE manufacture of steel plates in actual practice has been brought to a wonderful pitch of perfection.

This is due chiefly to the fact that the amazing evolution of armaments—which reached its climax during the Great War—necessitated the constant production of plates of sufficient toughness to afford some measure of protection for warships, forts, tanks, etc., against the terrible and ever increasing power of enemy armour-piercing projectiles and high-explosive shells. New inventions and improved methods of preparing and rolling the metal followed each other in quick succession, until to-day it is possible to produce steel plates of huge dimensions and strength.

Now that more peaceful times prevail, the improvements in steel plate manufacture are showing their merits in the construction of engines, boilers, ships, bridges, and similar structures.

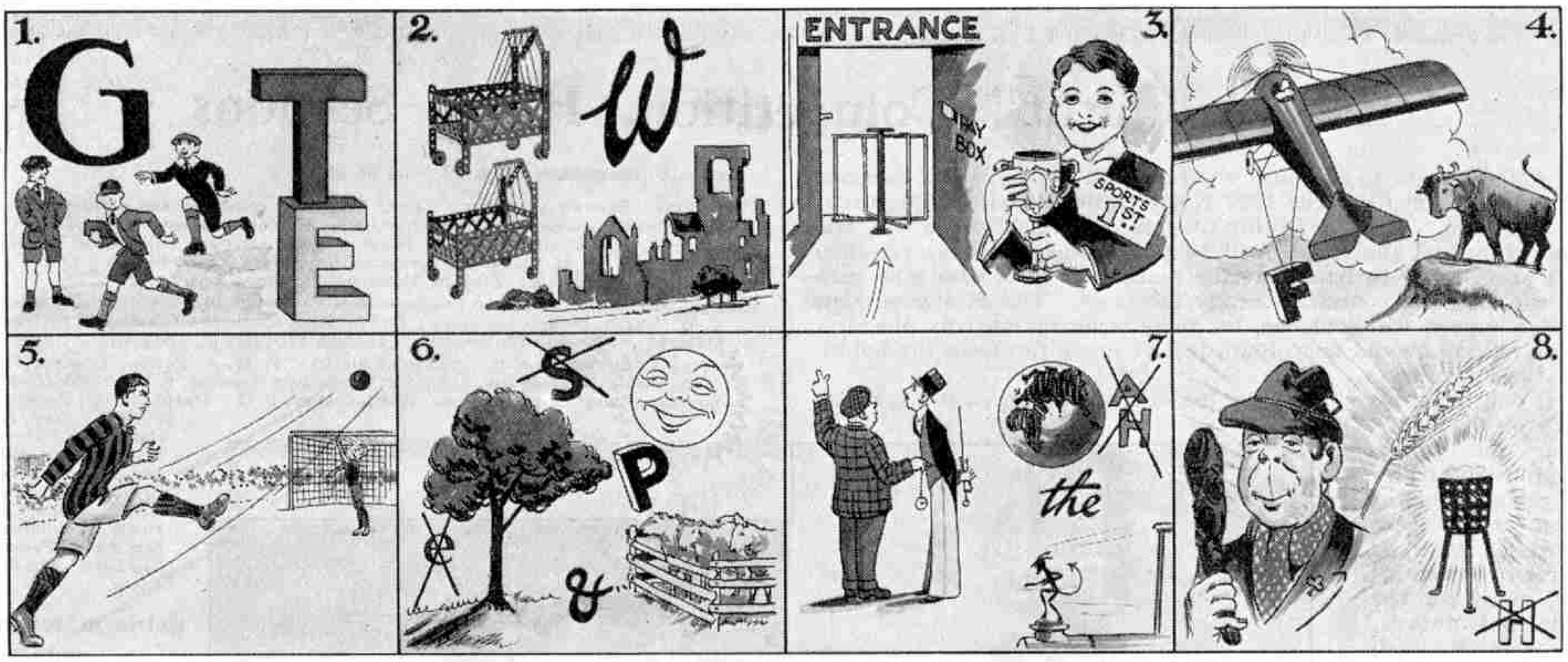
Meccano plates, like their prototypes in real engineering, are made of the finest steel only. They are richly enamelled in bright colours—red and green—and the holes are punched cleanly and accurately. The holes are arranged according to the Meccano equidistant system, which enables the plates to be incorporated in any kind of model and used for a thousand and one different purposes.

			s.	d.
52.	Perforated Flanged Plates, $5\frac{1}{2}'' \times 2\frac{1}{2}''$, $\frac{1}{2}''$ Flanges	each	0	5
52a.	Flat Plates, $5\frac{1}{2}'' \times 3\frac{1}{2}''$	,,	0	5
53.	Perforated Flanged Plates, $3\frac{1}{2}'' \times 2\frac{1}{2}''$, $\frac{1}{2}''$ Flanges	,,	0	3
53a.	Flat Plates, $4\frac{1}{2}'' \times 2\frac{1}{2}''$	,,	0	3
54.	Perforated Flanged Sector Plates	,,	0	3
61.	Windmill Sails	,,	0	2
70.	Flat Plates, $5\frac{1}{2}'' \times 2\frac{1}{2}''$	,,	0	3
72.	,, ,, $2\frac{1}{2}'' \times 2\frac{1}{2}''$	,,	0	2
76.	Triangular Plates, $2\frac{1}{2}''$	,,	0	2
77.	,, ,, $1''$	,,	0	1
109.	Face Plates, $2\frac{1}{2}''$ diam., with centre boss and set screw	,,	0	4
118.	Hub Discs, $5\frac{1}{2}''$ diam.	,,	1	3
126.	Trunnions, $1''$ deep, $\frac{1}{2}''$ flange	,,	0	3
126a.	Flat Trunnions, $1\frac{1}{2}'' \times 1\frac{1}{2}''$	,,	0	2
133.	Corner Brackets	,,	0	3
145.	Circular Strips, $7''$ diam. over all	,,	1	0
146.	,, Plates, $6''$,, ...	,,	1	3

Your dealer will be pleased to show you all the Meccano Parts. Ask him for a complete list.

MECCANO LTD., BINNS ROAD, LIVERPOOL

Competition Page



What Locomotives Are Represented By These Pictures?

The names of eight well-known English locomotives are hidden in the pictures above. What are they ?

This form of puzzle has long been popular in this country and all over the world. It has never previously appeared in the "*M.M.*" but most of our readers will be familiar with the principle on which the pictures are constructed. For the guidance of those who are doubtful we give an example. The picture in the upper left hand corner represents the famous old locomotive "*Gladstone,*" which was mentioned in a recent issue of the "*M.M.*" With the name before us it is easy to trace the solution. The initial letter, *G*, is given. Several boys are shown at play ; they are *lads*. The next portion of the picture shows the letter *E* surmounted by the letter *T*, in other words *T on E*. There we have the solution, *G-LADS-T-ON-E :* Gladstone.

Prizes of Meccano products or Hornby Train Goods to the value of £1-1s., 15/–, 10/6 and 5/- respectively will be awarded to the senders of the four most accurate lists of names, and in addition there will be a number of consolation prizes. In the event of a tie for any of the awards, the entry displaying the neatest or most novel presentation will be given the preference.

Entries must be on postcards and the locomotive names must be numbered to correspond with the numbers given with the pictures. Competitors should not hesitate to send in an incomplete list for we are desirous of knowing how many readers like this form of competition. Postcards must be addressed to "Loco Puzzles, Meccano Magazine, Binns Road, Liverpool," and sent to reach this office not later than 31st August. Overseas closing date : 30th November.

32nd Photo Contest

Water seems to exercise a peculiar fascination for amateur photographers and, were it possible to take a census, probably it would be found that nine out of every ten camera enthusiasts included a water scene in one of the first half-dozen photographs they took.

It is because of this wide appeal that we have chosen "*A Waterside Scene*" as the subject of the August photographic contest. During this month the majority of our readers will be enjoying the freedom of the annual holiday and with beautiful waterside scenes to be found everywhere, each reader will have a chance to secure suitable photographs whether his holiday takes him to the seaside, country or mountains.

Photographs need not have been developed and printed by the entrant provided that he (or she) made the exposure. Competitors will be divided into two sections, A for those aged 16 and over and B for those under 16, and prizes of photographic materials or Meccano products (to be chosen by the winners) to the value of £1-1s. and 10/6 respectively will be awarded to the best two photographs in each section. The closing date will be 31st August, and competitors must remember to put their name, age and address on the back of each print submitted. Overseas closing date, 30th November.

No photograph can be returned unless a stamped and addressed wrapper, of adequate size, is forwarded with the entry.

Results

Slogans Competition

The interest taken in advertising by boys to-day was splendidly demonstrated by the exceptionally large entry to this competition and the keen knowledge shown of the proprietorship of the slogans that competitors were asked to identify. No competitor, however, succeeded in giving a completely accurate list but several entries gave only three or four incorrectly.

To enable competitors to check their solutions we give below the list of firms whose slogans were used. For reasons of space the names of the firms are omitted in those cases in which the trade name of the article is the better known.

No. 1. Pear's Soap. **2.** Johnny Walker Whisky. **3.** Anzora Hair Cream. **4.** Wrigley's Chewing Gum. **5.** Jenners. **6.** Players Medium Navy Cut Tobacco. **7.** Musterole. **8.** Monkey Brand Soap Powder. **9.** Dunlop Tyres. **10.** Stone's Ginger Wine. **11.** Palmolive Soap. **12.** Bovril. **13.** "Yorkshire Post." **14.** "John Bull." **15.** The Pickwick, the Owl and the Waverley Pen. **16.** Lux. **17.** Tiz Foot Powders. **18.** Wolsey Underwear. **19.** Rudge Cycles. **20.** Hovis Flour. **21.** Krüschen Salts. **22.** Phosferine. **23.** Rinso. **24.** Cadbury's Chocolate. **25.** Chivers' Jellies. **26.** The Grand Hotel, Llandudno. **27.** Colman's Mustard. **28.** Oxo Cubes (this slogan has been used for other articles, including a wireless crystal, and alternative proprietorships have been admitted). **29.** Hoover Vacuum Sweeper. **30.** B.P. Petrol. **31.** Pepsodent Tooth Paste. **32.** Zam-Buk. **33.** Three Castles Tobacco. **34.** Underwood Typewriter. **35.** Glaxo. **36.** Three Nuns Tobacco.

A number of quite good new Meccano slogans were submitted but there has been insufficient time yet in which to examine their possibilities and we cannot, therefore, offer any comment upon them.

The prizes were awarded to the following competitors. 1. J. ANGUS (Selby, Yorks.) ; 2. T. G. TANFIELD (Newcastle-on-Tyne) ; 3. B. and A. BURNE (Harefield, Middlesex) ; 4. D. H. LEALE (Grove Park, S.E.12). Consolation Prizes : R. BUTTERFANT (Withington, Lancs.) ; P. HARRISON (Sleaford, Lincs.) ; W. SHEPPARD (Gateshead, Co. Durham) ; A. D. WATSON (Driffield, E. Yorks.) ; J. D. K. WATSON (King's Heath).

Overseas Result

My Hornby Layout

First Prizes : Section A : R. S. SMITH (Paris) ; Section B : J. WHITEHEAD (Waikato, N.Z.) Second Prizes : Section A : F. Ross (Cape Town) ; Section B ; G. MACKAY (Southland, N.Z.)

(*Continued on page* 717)

Results of

Meccano Model-Building Contests

By Frank Hornby

"No. 1 Outfit" Competition, Home Sections

I AM able now to announce the results in the "Home" Sections (A, B, and C) of the 1927 No. 1 Outfit Model-building Competition. Section D (for overseas readers) closed on the 30th July and the results will be published as soon as possible.

I am pleased to note that the number of girls who take part in the Meccano contests steadily increases. This is a good sign and I hope it will continue, for there is no reason why Meccano boys' sisters should not obtain just as much fun from the hobby as their brothers.

It will be gathered from the list of awards that in two sections of this competition the judges again found it impossible to select from many good entries two or three of outstanding merit for the principal awards. It was decided, therefore, to combine the three chief prizes and to distribute the total value evenly amongst the senders of a few carefully selected entries.

Section A (Competitors over 16 years of age) :

FIRST PRIZE (Meccano products to value £3-3s.) : R. G. Branstone, Portsmouth.

SECOND PRIZE (Meccano products to value £2-2s.) : S. H. McLeod, Walthamstow, London, E.

THIRD PRIZE (Meccano products to value £1-1s.) : W. J. Hendry, Dunipace, by Denny, Stirlingshire.

SIX PRIZES, each of Meccano products to value 10/6 : W. Lambert, Leeds ; J. Wilson, Aberdeen ; O. S. Bates, London, N.W.1 ; G. Lampson, Dover ; P. T. Harrop, Torquay ; K. Thompson, Bristol.

SPECIAL COMMENDATION (Certificates of Merit) : J. Wardle, Burton-on-Trent ; George Hitchcock, Catford, London, S.E.6 ; F. Ottaway, Surbiton Hill, Surrey ; G. P. Brown, Scarborough.

Section B (Competitors over 12 and under 16 years of age) :—

THE FIRST, SECOND AND THIRD PRIZES have been combined and divided amongst the following four competitors, each receiving Meccano products to the value of one and a half guineas : G. D. Coxhead, Wanstead, E.11 Alfred G. Barthram, Crouch End, N.8 ; C. Wilson, Southtown, Great Yarmouth ; D. C. Young, Nether Edge, Sheffield.

SIX PRIZES, each of Meccano products to the value of 10/6 : R. G. Parker, Stokes Croft, Bristol ; James McGinn, Glasgow ; R. M. Coverdale, Hornsea ; Edwin B. Chadwick, Charlesworth, near Manchester ; Arthur M. Johnston, Dunstable ; J. R. Sinden, Marlborough, Wilts.

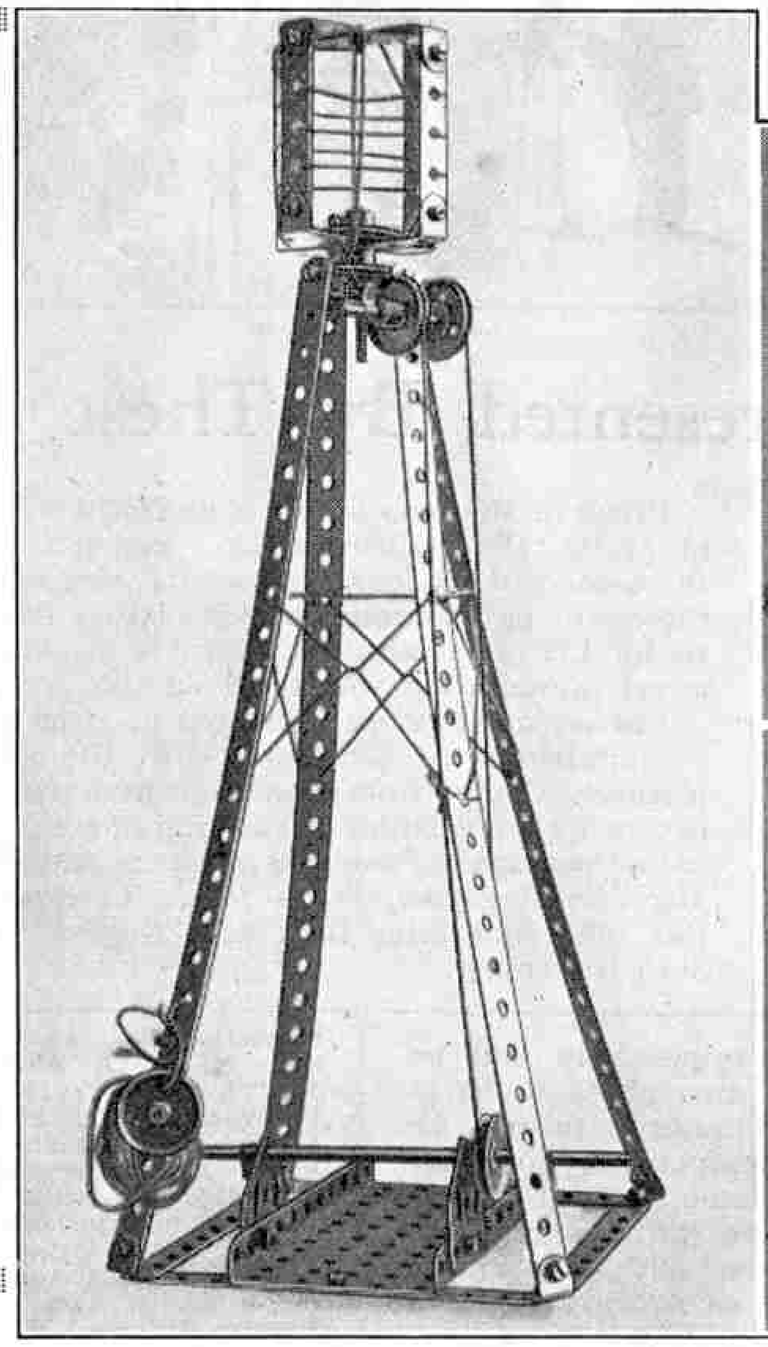
SPECIAL COMMENDATION (Certificates of Merit) : Leonard Alexander, Bournemouth ; Fred A. Dunkley, Earls Barton, Northampton ; F. I. Gillson, London, E.13 ; John W. Hendry, Dunipace, by Denny ; George Mullis, Eastbourne ; Jack Fox, Bradford ; A. Rand, Rayleigh, Essex ; L. Todd, Parham, near Wickham Market ; Arthur Cheale, Lewes ; Frank Hoddell, Ganarew, near Monmouth ; Ivor Cheesman, Shoreham-by-Sea ; R. Hermon, Wallasey S. Joint, Leighton Buzzard ; S. R. Macaree, London, N.8.

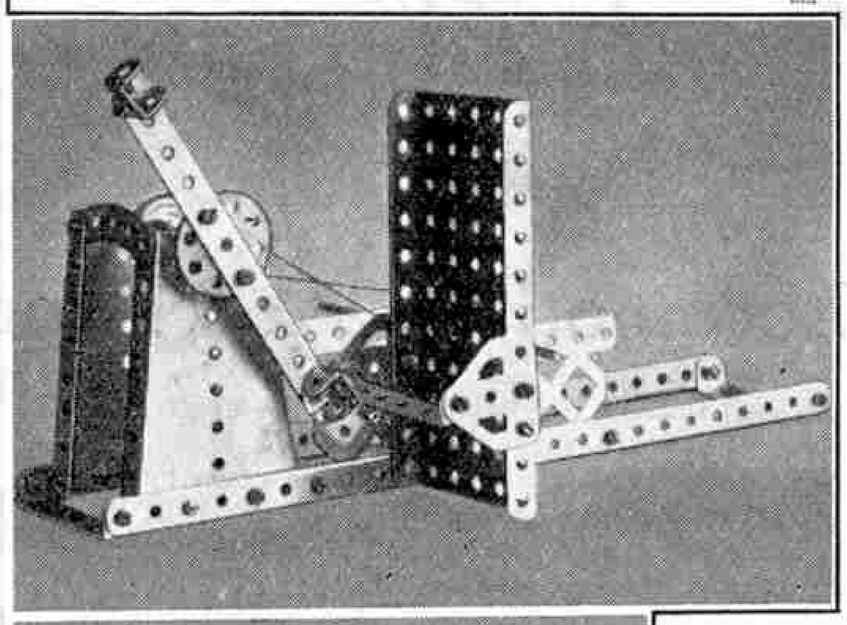
Section C (Competitors under 12 years of age) :—

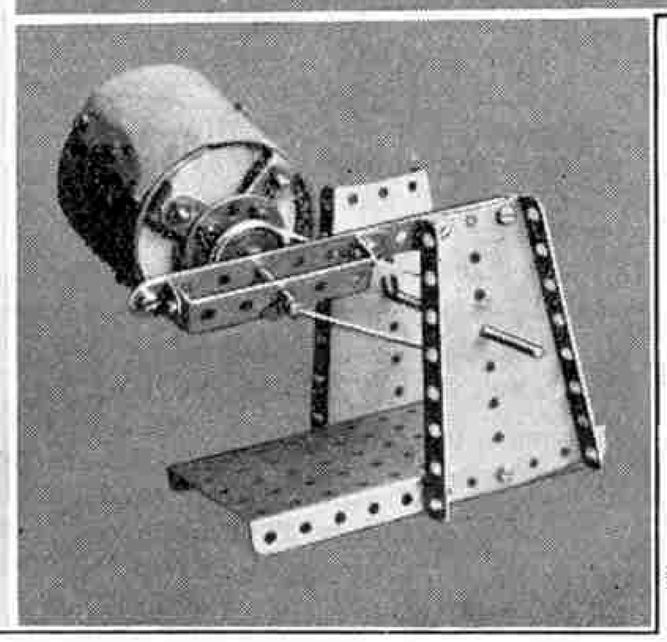
THE FIRST, SECOND AND THIRD PRIZES have been combined and divided amongst the following six competitors, each receiving Meccano products to the value of one guinea : Gladys Sellers, Chorley, Lancs. ; Leslie Atkinson, Cullercoats, Northumberland ; R. A. H. Davies, Worcester ; B. Gertrude Yates, Belfast ; Cecil Chapman, London, S.E.8 ; Edward Handscombe, Stow, London, E.17.

SIX PRIZES, each of Meccano products to the value of 10/6 : C. Davis, Bedford ; C. W. Arnold, Ballino, Co. Mayo ; H. Wardlow, Sherborne, Dorset ; B. E. Timms, Oxford ; A. Rosenberg, Swansea ; Thomas Fitzpatrick, Glasgow.

SPECIAL COMMENDATION (Certificate of Merit) : P. H. A. Barnes, London, W.5 ; Harold Bates, Oakengates, Salop ; P. Ronaldson, London, W.8 ; Frank Hoskins, Southampton ; Lawrence Bone, Walthamstow, E.17 ; David Martin, Barrow-in-Furness ; Percy Hutchinson, Dyserth ; K. C. Smart, Kingston-on-Thames ; Eric Skelton, Oldham ; George Zappa, Cranford, Middlesex ; Stanley Patience, Chadwell Heath, Essex.







Three interesting prize-winning models from Section C : (left) Flashing Harbour Light, by Gladys Sellers ; (top, right) Watermill, by Leslie Atkinson ; (bottom, right) Cement Mixer, by R. A. H. Davies

Entries in Section A

The First Prize-winning model in Section A takes the form of a lathe. In view of the limited number of parts available the various details in this model are reproduced in a surprisingly realistic manner. R. G. Branstone, its designer, tells me that a piece of plasticine may be moulded into numerous shapes within a few minutes with the aid of the machine. The mandrel shaft is driven by means of pulleys and Meccano cord, the driving belt being duplicated in order to secure a better grip about the pulleys.

S. H. McLeod submitted a model of a swivelling crane, the clean-cut design of which combined with a careful attention to the proper arrangement of struts and ties secured for its designer one of the principal awards. Several models submitted in recent competitions are braced inefficiently. Of course, this cannot always be avoided when building models with the smaller Outfits, but in one or two cases more care might have been taken in arranging the ties and struts with which the models were fitted. In a hurriedly-assembled model, for example, it is not uncommon to find a massive tie inserted in some part of the model that is not subjected to the slightest tensional forces, while at a point where the model is expected to withstand a considerable weight or other compressive force an all-important strut has been omitted by reason of the lack of parts. The pieces used in building the unnecessary tie might easily have been used to form a suitable strut, and the whole structure would have been improved thereby without using any extra parts.

(*Continued on page* 733)

"No. 2 Outfit" Competition, Home Sections

AS in the "No. 1 Outfit" Contest, the three principal prizes in Sections B and C of this Competition have been combined and distributed equally amongst several competitors. Each of the entries concerned is specially good and the judges were unable to give preference to any particular one.

Section A (Competitors over 16 years of age) :—

FIRST PRIZE (Meccano products to value £3-3s.) : J. B. Dunstable, West Hartlepool. SECOND PRIZE (Meccano products to value £2-2s.) : A. F. Williams, Newport. THIRD PRIZE (Meccano products to value £1-1s.) : Henry C. Thompson, Scotstoun, Glasgow.

SIX PRIZES, each of Meccano products to value 10/6 : H. G. Moon, Northampton ; T. N. Blackthorne, Grimsby ; S. L. Grave, Bournemouth ; J. Findley, Aberdeen ; R. K. Blythe, Cardiff ; Ralph Sewell, St. Ives.

SPECIAL COMMENDATION (Certificates of Merit) : S. Oakley, London, N.2 ; F. Ottaway, Surbiton Hill, Surrey ; V. J. Ruxton, Kirkcaldy ; K. F. Jennings, Lingfield ; W. S. Purves, Carlisle ; B. S. Ronaldson, London, N.W.1 ; T. Smith, Newcastle.

Section B (Competitors over 12 and under 16 years of age) :—

The First, Second and Third Prizes have been combined and divided amongst the following six competitors, each receiving Meccano products to the value of one guinea : Margaret Adams, West Hallam, near Derby ; James Henderson, Girvan, Ayrshire ; Celia Fremlin, Berkhamsted ; R. Johnston, Manchester ; J. Sharp, Haywards Heath ; W. Dobson, Ibrox, Glasgow.

SIX PRIZES, each of Meccano products to value 10/6 : Aline B. Dawson, Leigh-on-Sea ; W. Jacks, Aberdeen ; H. A. Tippetts, Birmingham ; G. Campbell, Alloa ; T. J. Hobbs, Birmingham ; Edgar Cousins, Swansea.

SPECIAL COMMENDATION (Certificates of Merit) : Alan Thomas, Amersham ; Portia Hobbs, Birmingham ; R. H. Sheppard, London, S.E.23 ; John Gordon, Newport ; L. J. Wells, Gerrards Cross ; C. G. Walton, Harborne, Birmingham ; K. H. Turnbull, Southend-on-Sea ; R. Wootton, Westcott Green, near Dorking ; C. R. W. Hancock, London, S.W.4 ; Alex. Todd, Coatbridge ; H. Leed, Downpatrick, Co. Down ; P. Aspinall, Bampton ; L. W. Entwistle, Rossendale ; T. E. Whittle, Charnock Richard, near Chorley ; Malcolm Gray, East Ham ; John Longridge, Mobberley ; H. Cash, Walthamstow, E. ; W. Hough, Edgeworth, near Bolton ; Alfred Pope, Grimsby ; John Petch, Bangor ; R. Clare, Doncaster ; Hugh B. Jones, Maybole, Ayrshire.

Section C (Competitors under 12 years of age) :—

The First, Second and Third Prizes have been combined and divided amongst the following six competitors : each receiving Meccano products to the value of one guinea : P. H. Drake, Newquay ; D. B. Hewitt, Manchester ; Clifford Turnbull, Eastwood ; H. F. Bowen, London, S.E.4 ; Norman Quinn, Belfast ; E. Coushin, London, N.12.

SIX PRIZES, each of Meccano products to value 10/6 : D. Brough, Worcester Park, Surrey ; J. Rosser, Newport, Mon. ; H. D. Hosegood, S. Norwood ; H. Hartley, Leeds ; F. Dalloway, Bexhill-on-Sea ; W. Levie, Aberdeen.

SPECIAL COMMENDATION (Certificates of Merit) : Norris Robinson, Stockton-on-Tees ; Terence Stow, London, N.3 ; William Kent, Brighton ; C. Goddard, Norfolk ; Cyril Slater, Warley ; Burton Hall, The Cape, Warwick ; J. Rochester, Kettering ; John Stebbings, Kingsbridge ; Jack White, Kenilworth ; Thomas Hall, Edinburgh.

Entries in Section A

The First Prize-winning model in this Section is an excellently-designed Meccano monoplane. The fuselage is constructed principally from 5½" Strips, the rounded nose being obtained by means of 2½" Curved Strips. The wings consists of 5½" Braced Girders and a four-bladed propeller is represented by Strips bolted to a Bush Wheel.

A swing bridge formed the subject of A. F. Williams' entry. The moving section in this model is mounted on a central pivot and is rotated on operation of a Crank Handle conveniently situated at a distance and connected to the bridge pivot by means of cord.

H. C. Thompson submitted a "penny-in-the-slot" machine, the mechanism of which is simple and ingenious. The insertion of a penny in the machine releases a catch and allows a drawer to be withdrawn, thereby bringing into view a box of matches. A stack of boxes is placed inside the machine and on pushing the drawer back the next box of matches automatically falls into place ready for withdrawal on payment of another penny. This makes a very effective model, especially if the framework is covered with cardboard, and the machine is ideal for Meccano Club exhibitions, etc.

Entries in Section B

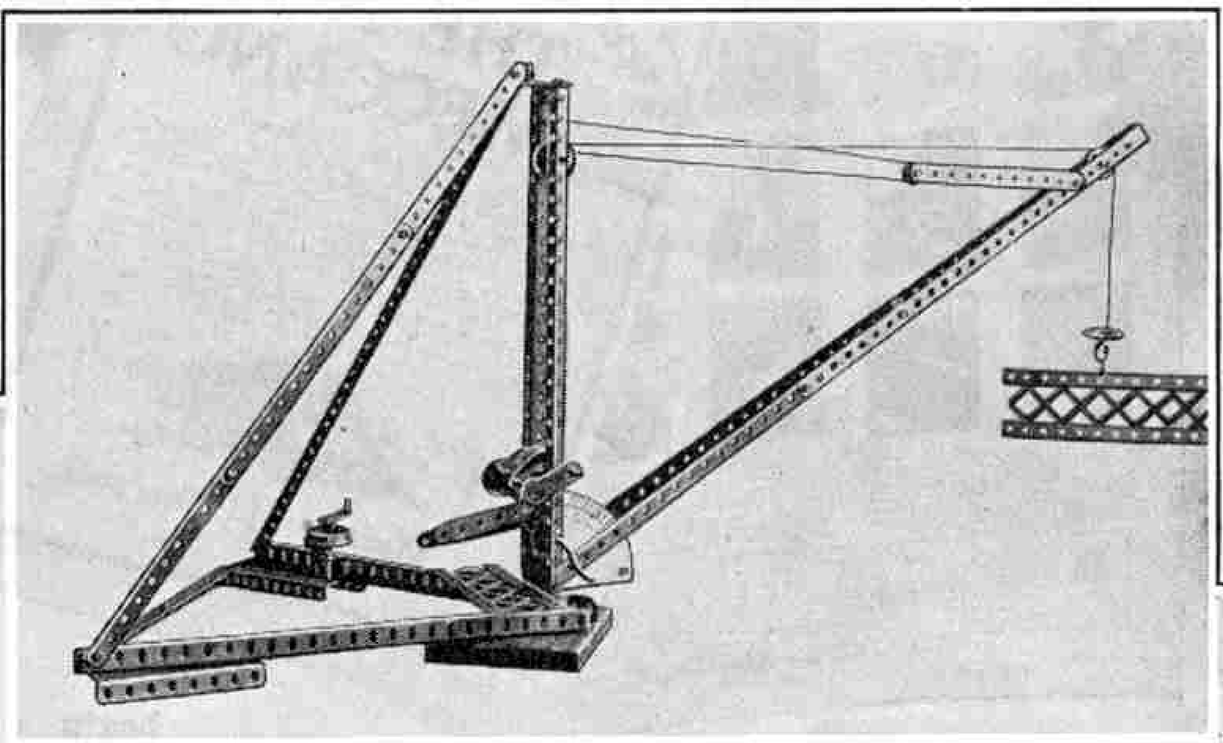
Margaret Adams' prize-winning entry in Section B is included in the accompanying illustration. As will be seen, it represents a four-seater touring car, and is equipped with steering gear, head and tail lamps (the latter consisting of a Threaded Pin), seat, hood, and even a radiator cap. The steering gear is similar to Standard Mechanism No. 119. An excellent finish is given to the bodywork by the use of the 2½" Curved Strips at the rear, and the addition of a Double Angle Strip to represent the hood shows ingenuity.

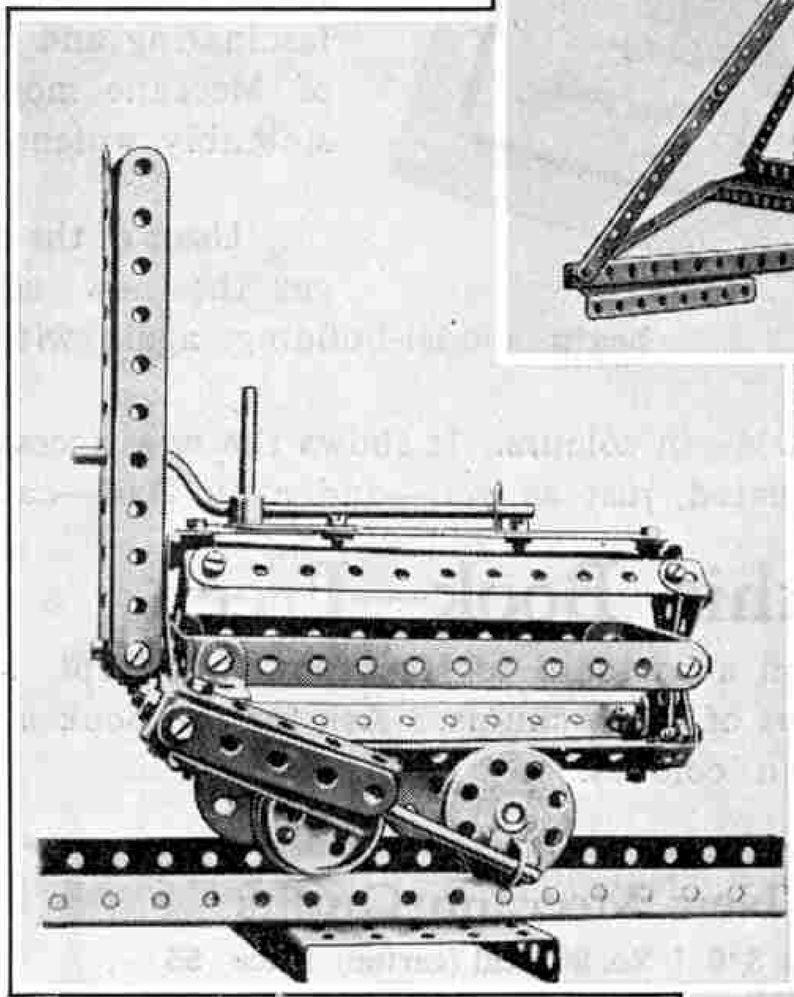
W. Dobson's derrick crane is also included in the illustration. As will be seen, it is fitted with an indicator placed at the foot of the jib to mark the radius of the working area at any particular angle of the jib.

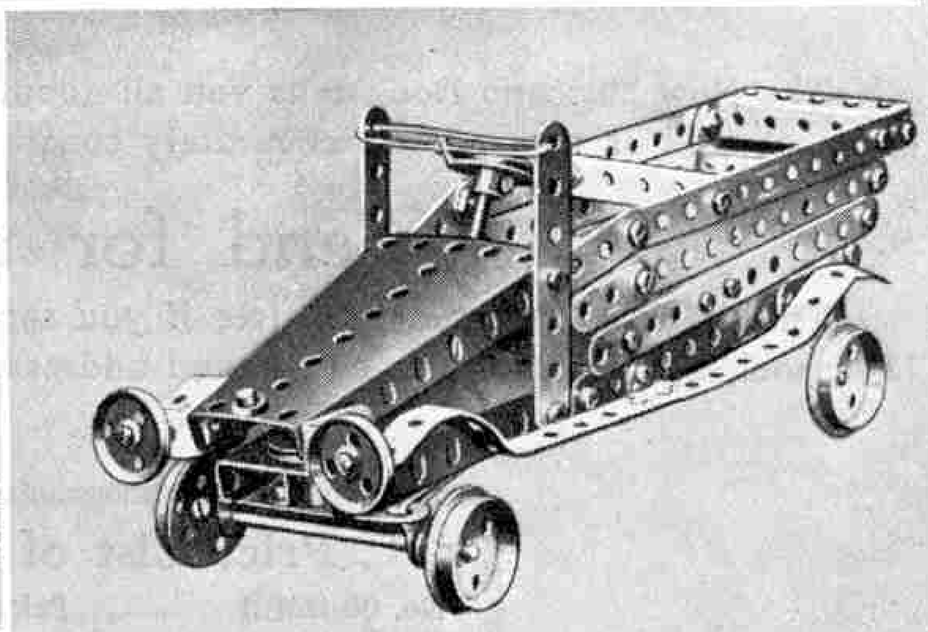
Incorporated in a fine steam shovel sent in by J. Sharp is an interesting invention recently patented by W. Savage and Ruston and Hornsby Limited. This invention is intended particularly for use in connection with non-reversible engines. A secondary winding drum is included in the mechanism and by stopping the motion of this drum the racking gear controlling the shovel arm is kept inoperative ; if the brake is slacked off the pull of the bucket-hoisting rope works the racking gear to increase the bite of the bucket, the secondary drum meanwhile paying out ; and if power is applied to the latter the racking gear is so worked as to retract the bucket arm.

"Man and Allosaurus"

Celia Fremlin's entry takes a most original form. It is entitled "Man and Allosaurus." The (*Continued on page 733*)







Three prize-winning entries in the "No. 2 Outfit" Contest. Top : Derrick Crane, by W. Dobson. Below (on left) : Early Locomotive, by Paul Drake and (right) : Motor Car, by Margaret Adams

Good News!

"Look, Dad, it's in Colours Now!"

All the steel Meccano parts are now enamelled in red or green, and these, in combination with the bright brass Wheels and Gears produce an exquisite effect.

Splendid new models are now made possible and the scope of the fascinating and instructive pastime of Meccano model-building is considerably widened.

Users of the old Meccano should get the new coloured parts and begin model-building again with a new interest.

The New Meccano Book tells you all about it—in colours. It shows the new accessories and Outfits, etc.; as well as new models accurately constructed, just as you—and even Dad—can construct them.

Send for this Book—Free

This book will be sent you free if you send a postcard to Meccano Ltd., Dept M.B., Binns Road, Liverpool, and mention the names and addresses of three chums. Ask for the book about New Meccano in colours.

Price List of New Meccano Outfits

No. 00 Outfit	...	Price 3/6	No. 5 Outfit	(carton)	Price	55/–
No. 0 ,,	...	,, 5/–	No. 5 ,,	(cabinet)	,,	85/–
No. 1 ,,	...	,, 8/6	No. 6 ,,	(carton)	,,	105/–
No. 2 ,,	...	,, 15/–	No. 6 ,,	(cabinet)	,,	140/–
No. 3 ,,	...	,, 22/6	No. 7 ,,	,,	,,	370/–
No. 4 ,,	...	,, 40/–				

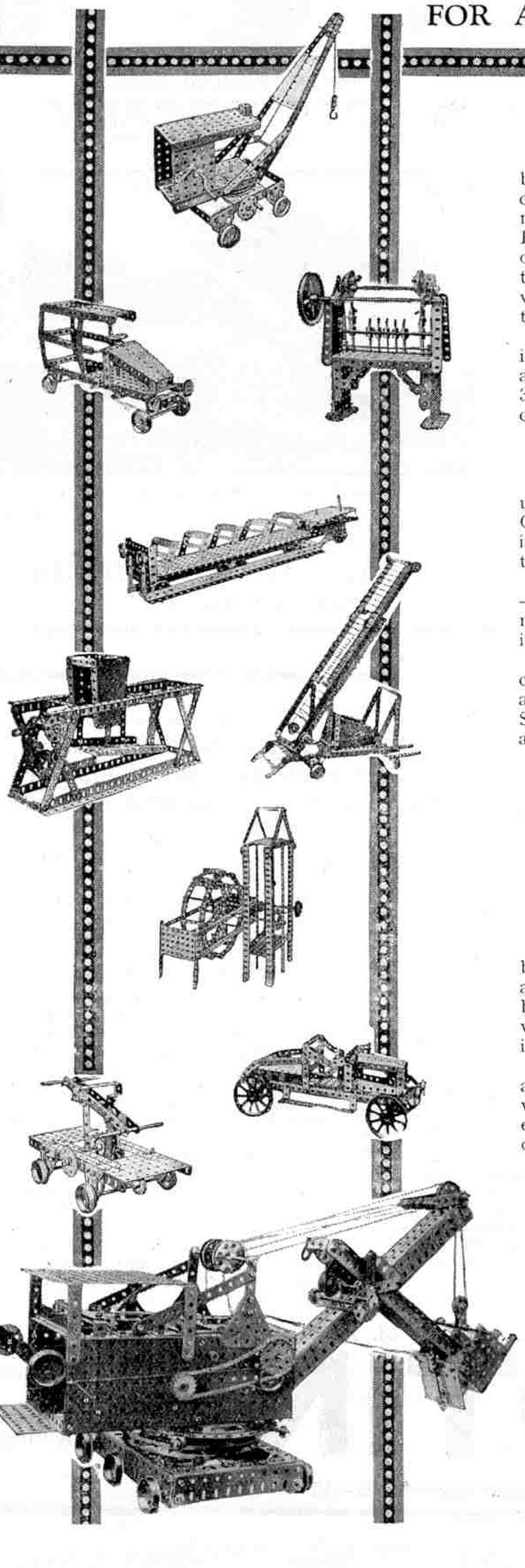
THE NEW MECCANO

MECCANO LTD. : BINNS ROAD : LIVERPOOL

Another Special Summer

Model-Building Competition

FOR ANY TYPE OF MODEL



About the "Summer" Competitions

As explained in last month's "*M.M.*," the "Special Summer" Model-building Competitions are based on somewhat different lines to our usual contests in that no restrictions are laid down as to the type of model that may be submitted or the number of parts that each competitor may use. Hence the amount of time that competitors need spend at home working out their entries is reduced to a minimum. A walk in the country or a trip to the seaside should provide a Meccano boy with innumerable ideas from which he can evolve interesting models, while at the same time he is making the best possible use of our brief English summer.

The first "Summer" Model-building Competition, which was announced in our July issue, closes for "home" entries on the 31st of this month, and entries from readers residing overseas must be received not later than 30th November next. Every reader is at liberty to participate in both competitions.

Second "Summer" Contest

All models submitted in this competition must be the competitors' own unaided work, both in design and construction. Although any size of Outfit or quantity of parts may be used, it is important to remember that it is not necessarily the most intricate or elaborately-constructed models that will carry off the prizes.

As in every previous contest the most telling point will be originality—either with regard to the type of apparatus selected as the subject of the model, or to the novel uses of Meccano parts or movements employed in its construction.

Entries will be divided into the following Sections: Section A, for competitors over 14 years of age. Section B, for competitors under 14 and over 12 years of age. Section C, for competitors under 12 years of age. Section D, for competitors residing outside Great Britain. The ages of all competitors in this Section will be taken into careful consideration.

List of Prizes

Prizes will be awarded for the best entries FROM EACH SECTION as follows:

FIRST PRIZE: Meccano products to the value of two guineas.

SECOND PRIZE: Meccano products to the value of one guinea.

THIRD PRIZE: Meccano products to the value of half-a-guinea.

SIX PRIZES, each consisting of Meccano products to the value of 5/–.

A LIMITED NUMBER of Certificates of Merit.

The first prize in each section will be awarded to the competitor who builds the model that the judges decide to be the best entered in that section, and the second and third prizes will be awarded to the second and third best models, and so on. Models possessing points of exceptional interest will be described in the Magazine and if suitable they will also be included in forthcoming Instruction Manuals.

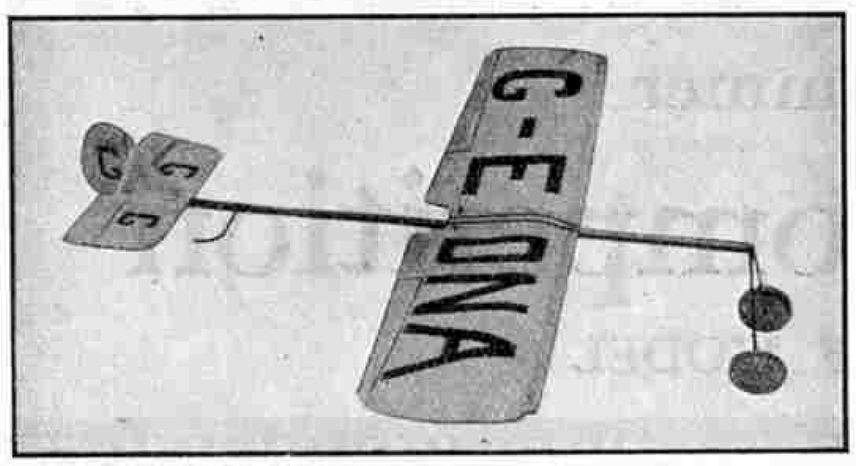
Actual models should not be sent. A clear photograph or drawing is all that is necessary. Photographs or drawings of unsuccessful entries will be returned if a stamped addressed envelope of the necessary size is enclosed with the entry. It should be noted, however, that photographs of prize-winning models become the property of Meccano Limited.

Closing Dates

Entries for Sections A, B and C must be received not later than 30th September. Closing date for Section D; 31st December, 1927.

Important Instructions

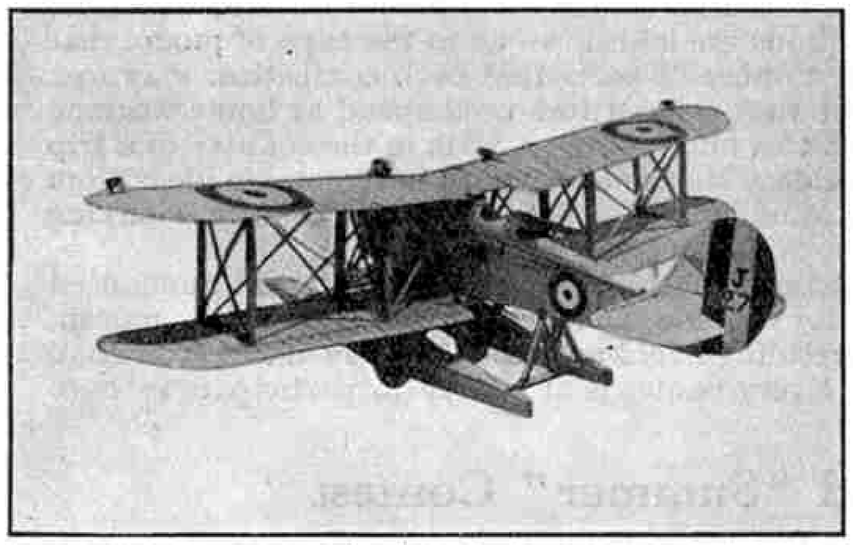
Readers should send in clear photographs or good drawings of their models together with any explanations that may be necessary. The following instructions must be followed closely:—The competitor's name and address must appear on the back of each photograph or sheet of paper used, together with his age, name of the competition (Second Summer Model-building Competition) and the Section in which the model is entered. Envelopes should be addressed "Second Summer Model-building Competition," Meccano Ltd., Binns Road, Liverpool.



MODEL GLIDER "G-EDNA"

These models will soar to a height of 30 ft.

G-EDNA 24"	Model, set of parts	...	...	...	**2/6**	Post 6d.
G-EDNB 18"	,,	,,	...	...	**1/9**	,, 6d.
G-EDNC 12"	,,	,,	...	...	**1/–**	,, 4d.



BLACKBURN "VELOS" SEAPLANE

A 24" model with elastic motor inside the fuselage, four aluminium disc wheels, two floats and finished torpedo.
Set of parts and instructions ... **3/6** Post Paid.

APPLEBY'S FAMOUS MODEL AEROPLANES

These models are wonderfully realistic, having all the parts and fittings of the originals faithfully reproduced in miniature.

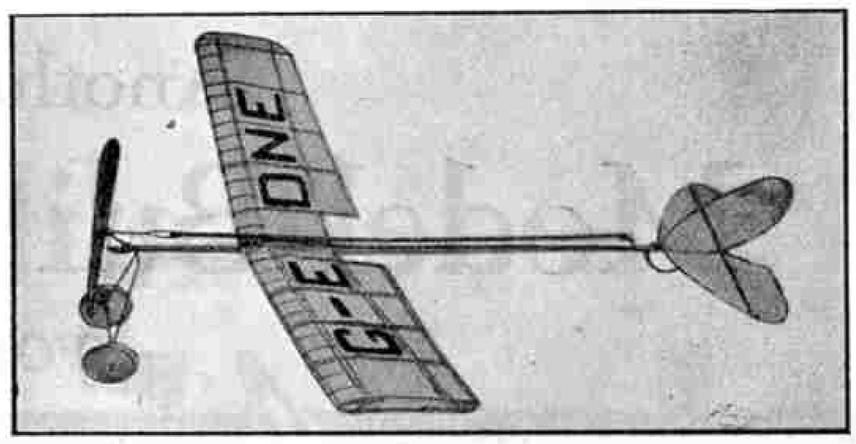
The illustrations are actual photographs of the finished models, and the sets which you buy will make up exactly similar without any further parts being required.

The model Gliders (types G-EDNA/B/C) are our latest productions. They have a new type of double surfaced mainplane, aluminium disc wheels and will soar to a height of 20 or 30 feet. The largest model G-EDNA if launched in an upward direction will climb to a great height, flatten out and then gracefully glide down to the ground in either a straight or circular course.

ORDERS OVER 3/– Post Paid.

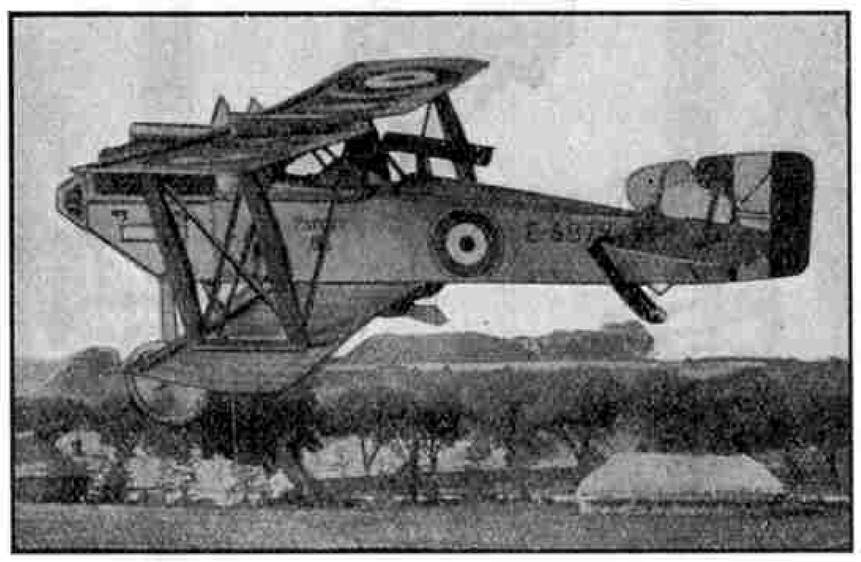
Colonial customers should remit 9d. per model extra to cover extra postage.

SEND YOUR ORDER NOW



TRACTOR MONOPLANE G-EDNE

This model will rise off the ground and fly for 20 seconds. Span 20". Length 21". Propeller 6". Weight 18 drams.
Set of parts and blue print, **3/9** post free.



MILITARY BIPLANE, TYPE E-6879

A model Glider complete in all detail. Will perform almost any evolution of the original.
Set of Parts and Instructions 1/–. Post 4d.

William E. Appleby (N/C) & Co.,

(Dept. K) 217, 219, JESMOND ROAD, NEWCASTLE-ON-TYNE

Gwen—"What is he saying, Tom ?—I can't make it out."
Tom—"He says, 'S-E-C-C-O-T-I-N-E—S-T-I-C-K-S—E-V-E-R-Y-T-H-I-N-G.'"
Gwen—"Oh, the silly !—sure everybody knows that."

OF COURSE every Meccano boy who can use his hands knows all about Seccotine and what it can do but, beginning with the children, it is interesting to learn what faith other people have in the great Adhesive.

Two ladies occupied a seat on a Cambridge lawn, in sight of the great Chapel of King's College. One told to the other how she had taken a little boy into the Chapel, and as she pointed out to him the great height of the building—its walls so old, so high, and yet so strong,—the little fellow, impressed, said, "I wonder did they use Seccotine."

This is not an invented story. A third adult, stranger to the others, sitting on the same seat, knew something about Seccotine and its home, and reported the incident. It is an example of the grip that Seccotine has on the national mind, that, when a child is shown something remarkable for firmness of jointing, it associates Seccotine with the good work.

King's College Chapel, Cambridge, was not built with Seccotine, but its proved reliability in a wonderful variety of uses is sufficiently remarkable. It is not possible here to enumerate these uses,—mention can be made of only a few, widely differing.

Lord Kelvin, the great scientist, wrote of Seccotine: "I am glad to say I find it very useful for many ordinary purposes and for scientific models."

Messrs. Yarrow & Co. Ltd., Scotstoun, Glasgow, wrote: "We are pleased to say that we have used your Seccotine for lining steel lockers with canvas . . and find it very satisfactory."

In yacht-building, also, Seccotine has been used successfully. Many will remember that, years ago, in one of the earlier races for the America Cup, Shamrock III. had her spinnaker boom broken in a severe gale. Seccotine was used to repair the damage. We give here a copy of letter sent us on the subject by Messrs. Cosens & Co. Ltd., Weymouth: "We are in receipt of your letter of 22nd inst. . . . We used Seccotine in the repairs to spinnaker boom of Shamrock III., the results being, as far as we can judge, quite satisfactory."

Here is the testimony of a well-known firm of opticians in Bristol: "We find Seccotine one of the most excellent adhesives we have ever tried."

Sold everywhere in pin-stoppered tubes at 4½d. (vest pocket size) 6d. and 9d. per tube

Sticks Everything

SECCOTINE

Requires no heating

Regd. Trade Mark

In the Workshop—in the Laboratory—in the Home—Seccotine is—AT HOME

"No. 1 Outfit" Model-Building Contest—

(*Continued from page* 728)

W. Hendry secured Third Prize with a miniature railway breakdown crane. This is an excellent model and very good use is made in its construction of the contents of the No. 1 Outfit.

Section B

In this Section, G. D. Coxhead submitted a very interesting representation of a "ballista." This is an ancient Roman weapon, as I suppose most Meccano boys already know, and in principle is not unlike the crossbow or arbalest. In the Meccano model the projectiles are represented by matches and these are discharged by releasing a Meccano Strip that is bent back when loading by turning a Crank Handle. The whole apparatus is mounted on wheels.

Very different from this rather gruesome relic of olden days is the subject of C. Wilson's model. He describes it as a cake mixer and I have no doubt that, providing one is blessed with a little patience, it should prove quite a practical machine. It consists principally of a 3½" Axle Rod threaded at its centre through the middle hole of a Double Bracket. The upper end of the Rod is inserted in one of the holes in the face of a Bush Wheel secured to the lower end of a vertical Rod. The latter is rotated by means of belt gearing from the operating shaft, and its movement imparts an eccentric motion to the 3½" Rod, the lower end of which serves to stir the mixture.

Section C

Gladys Sellar's model of a flashing harbour light is illustrated on page 728 and, as will be seen, it is of simple yet very effective construction. Another model included in the illustration is that of a concrete mixer built by R. A. H. Davies. This is a very original model and the addition of cardboard round the sides and on the floor of the container allows practical use to be made of the apparatus.

The third model included in the illustration was built by Leslie Atkinson, and represents a water mill.

A very interesting model of the late Mr. Parry Thomas's ill-fated racing car "Babs" secured an award for Cecil Chapman. The chassis, steering gear and seats in this model are constructed entirely from Meccano parts, and the body is fashioned from a thin sheet of cardboard. The bonnet is represented by a 5½"×2½" Flanged Plate and a Sector Plate, and the "radiator" consists of a Flat Trunnion bolted to the Sector Plate in the front of the car.

"No. 2 Outfit" Model-Building Contest—

(*Continued from page* 729)

allosaurus, apparently, is a fearsome monster of prehistoric times, and after inspecting Celia's model it is indeed comforting to know that one is not likely to meet such monsters on the earth nowadays. The Meccano allosaurus, which consists principally of a pair of Sector Plates to represent the body with 5½" Strips for a tail, appears to be in the act of chasing the man up a tree trunk (two 12½" Angle Girders bolted together). On operation of a Crank Handle, the arms and jaws of the creature waggle alarmingly, whilst the man performs remarkable contortions in attempting to climb the tree.

J. Henderson won his prize with a hand loom, one of the heald frames of which is suspended by means of pieces of elastic so that it may more easily be moved up and down whilst weaving.

Section C

Paul H. Drake's model of an early locomotive, which is illustrated on page 729, is exceptionally good. The cylinder is formed from 2½" Strips connected together at one end by means of two Angle Brackets and two Double Brackets. An Angle Bracket secured inside the cylinder about midway along its length acts as a guide for the 3½" Axle Rod representing the piston, and the latter is pivoted by means of two Spring Clips to an Angle Bracket bolted to a Bush Wheel that, in turn, is secured to the driving axle.

C. Turnbull and H. Bowen both submitted models of electric tramway cars, while Eric Coushion's entry is in the form of an adjustable book rest, which, he tells us, proves very useful for holding the Meccano Instruction Manual in position while one is building models.

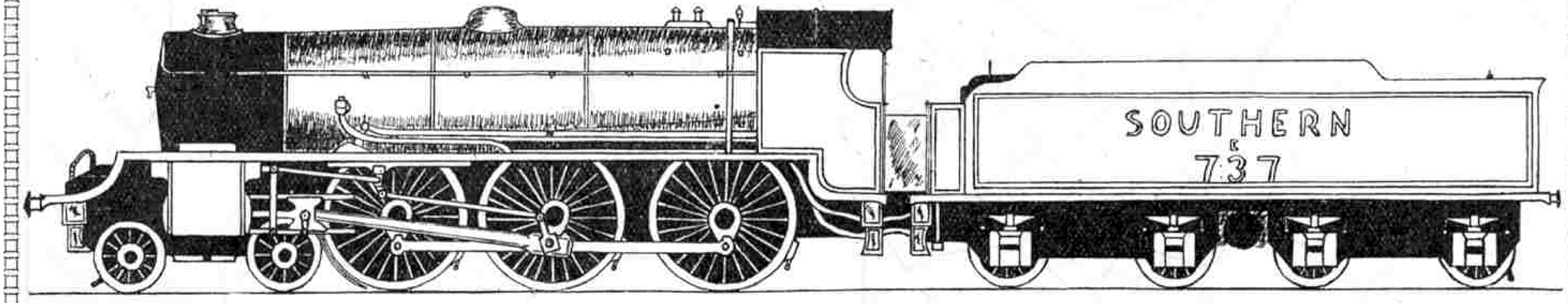
Chemical Gardens—

(*continued from page* 716)

each other. The result will be, therefore, to spread out the particles as widely as possible throughout the liquid. It should be noted also that the deposition of the solids suspended in water in forming deltas at the mouths of muddy rivers depends largely upon removing this electrical charge. When salt is dissolved in water some of it is split up with the formation of chlorine ions, a name that has been used already for negatively charged chlorine atoms, and the negative charges of these neutralise the positive electrical charges of the suspended solids. The small particles of the latter will no longer repel each other and their tendency then to come together to form larger particles results in an increase in the rate of settling.

Drawing Contest Result

Some excellent drawings of the rotor ship "*Barbara*" and some highly imaginative types of other rotor driven vessels were submitted to this contest. The standard fell only very slightly below that of the equivalent Home Section which, we recall, was considerably above the average contest in merit. The winners, whose names appear below, may, therefore, be highly complimented. First prizes, Section A: E. Bennici (Malta); Section B: D. Shores (Winnipeg). Second prizes, Section A: A. M. Flanderka (Ceylon); Section B: T. Abendein (Claremont, S.A.)



The above interesting drawing of a Southern Railway 4–6–0 locomotive has been submitted by one of our readers, A. E. Hedges of Eastleigh, Hants.

Some Notes on Permanent Way—

(*Continued from page* 735)

nose, or point of the crossing, is the "lead." This varies with the radius of the curve and determines the angle of the crossing. Variations are introduced when the turn-out is from a curve instead of from the straight.

In the foreground on the right-hand side of the photograph is a short rail called the "guard rail." There would be one also on the left-hand side if there were not a check rail there already. The guard rail is to hold the wheels on that side hard over to the running rail in order to prevent any possibility of the wheels on the other side striking the nose of the crossing.

Various methods of holding down the chairs are in use on different railways. In our example galvanised wrought iron coach screws are used, having a square head on to which the spanner fits.

Round the curve at the top of the photograph the rails are carried on ordinary sleepers, which used to be 9 ft. in length, 10 in. in width and 5 in. in thickness, but are now, in the interests of economy, 8 ft. 6 in. long. When we come to the switches and on towards the crossing, the sleepers have to be longer and are then known as "timbers." At the crossings, in order to accommodate the extra chairs, timbers 12 in. in width are sometimes used. As soon as we get clear of the crossing we get back to ordinary sleepers, as the timbers are, of course, more expensive in proportion and therefore as few of them as possible are used.

At one time independent timbering of turn-outs was resorted to, each track being carried on its own sleepers, which therefore had to be interlaced. This meant that there was so much timber in the job that the platelayers could not pack the ballast properly, and it is now never done except on temporary work. The long through timbers also hold the two roads in their correct relative position much more accurately.

A later article in this series will describe the layout and construction of double junctions, which present many features of great interest, particularly when electrical equipment is incorporated.

THERE'S "FORCE" BEHIND THAT!

Ssss-swish. Crack! Straight down the fairway. "Betcha can't drive like that!"

Jim excels himself on his dad's golf course. Same old Jim; same old "Force" behind everything he does.

Put a drive into your work and play. Make the other chaps look when you're coming. Get some of this *energy* food into you. "Force" is the power of wheat made so you can *use* it. Strong stuff! and the taste—scrumptious.

You can have "Force" every day of the week if you really want it. Ask, and keep on asking till you get it. Eat it any time with milk or fruit.

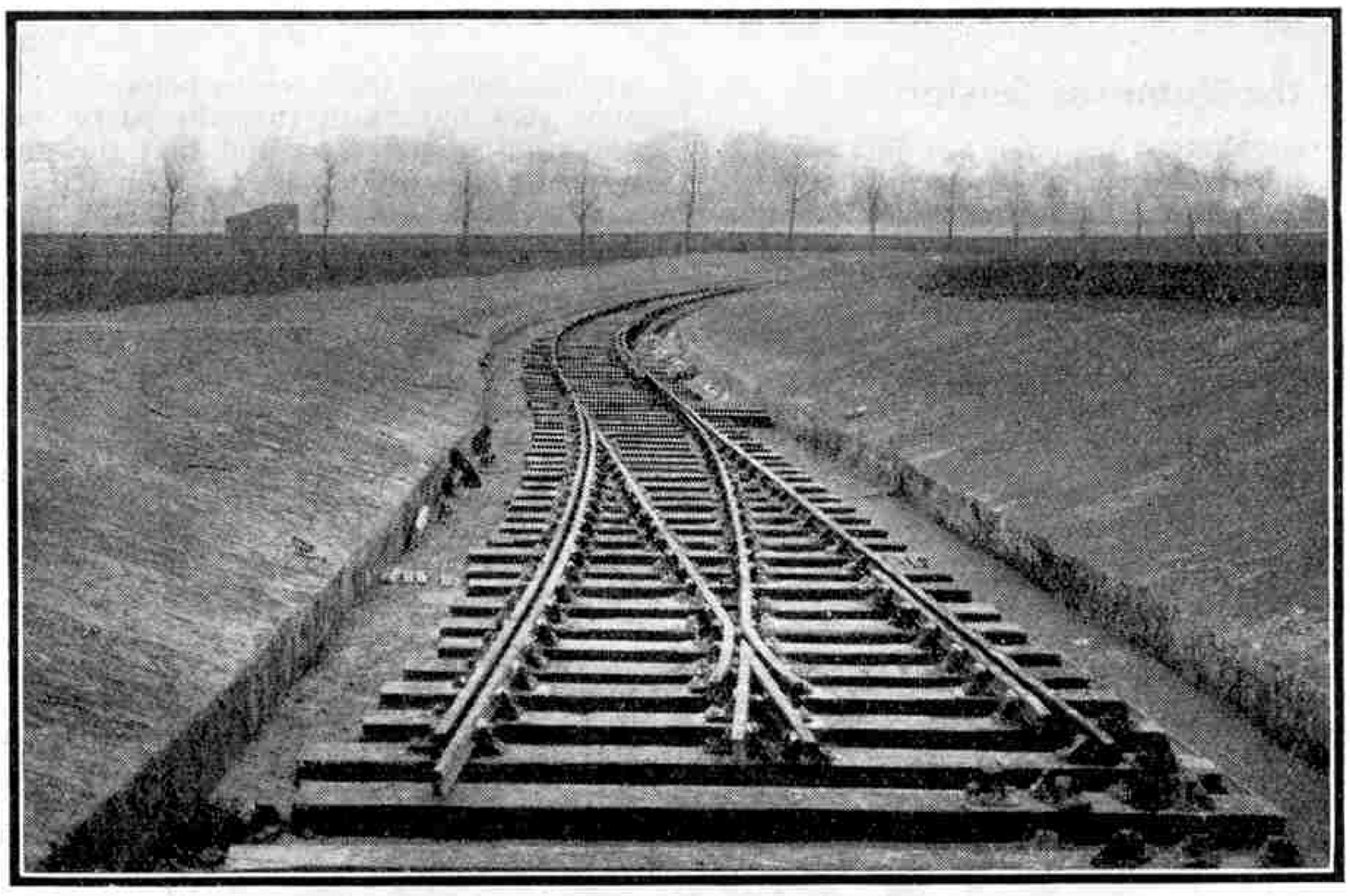
TRY "HOLFORCE" MADE FROM "FORCE," BUTTER, EGGS, MILK, SUGAR AND FLOUR—**6d.** PER PACKET.

Some Notes on Permanent Way

I.—Laying a Siding into a Factory

By R. D. Gauld, M.Eng., A.M.Inst.C.E.

THE accompanying photograph illustrates the laying-in of a siding into a factory. The arrangement of the rails and other components is just the same as it would be on a main line, except that in this particular instance second-hand rails and chairs were used. This is often done in sidings for economy, as the rails are quite good enough for the slow running that one gets in such places although they would not be safe on a main line. The chairs are, of course, the cast-iron castings in which the rail rests, and a few loose chairs are to be seen in the bottom right-hand corner of the picture.



A Siding into a Factory

It will be noticed that the track seems to be sunk into the ground. This is only temporary, however, as ashes will afterwards be packed under the sleepers, lifting them up about 1 ft. Ashes are often used to carry permanent way over clayey ground for it has been found by experience that they are the only kind of ballast that will keep the clay down. If broken stone is used, the clay works its way through it, making the track water-logged in wet weather. In main line work broken stone is sometimes placed on the top of a good bed of ashes, the latter resting on the clay.

The curve in the distance in the photograph is a fairly sharp one. Railway engineers measure curves by their radius in chains, a chain being 66 ft. By Ministry of Transport rules all curves on a railway over which passenger trains may run, and which are sharper than 10 chains, that is 660 ft. radius, have to be "checked." This does not apply to sidings, but in our example it was thought advisable to check the curve.

It will be seen that there are two rails on the inner side of the curve. The one on the right is the "running rail," on which the wheel rides; the one on the left is the "check rail," and the opening between the two is $1\frac{3}{4}$ in. The check rail shown in the photograph is not quite finished; another short piece has to go in, finishing just in front of the points. There is another check rail on the left of the picture, and this clearly shows the double or check chair required, and also the oak or teak key holding the rail in position. The running rails are similarly held by keys on the outside.

The idea of the check rail is to hold the wheels over and prevent them from climbing the outside of the curve.

The photograph shows also what is called a single turn-out, which consists of one set of points or switches and a common crossing. Taking the switches first, these are very often 9 ft. in length for siding work, the length varying with the radius of the turn-out, which for sidings is usually fairly sharp in order to save space. On the main line where speeds are high, curves have to be made flatter and the switches are longer, 21 ft. being quite a common length.

The fixed end of the switch is called the "heel"; the pointed end is called the "toe" or "nose." Switches are always in pairs and are coupled together by one or more stretcher bars, so that they work exactly together. The opening between the toe and the other rail, called the "stock rail," is usually $4\frac{1}{2}$ in. In sidings the switches are worked by a hand-operated lever or "tumbler," and in the photograph will be noticed the two extra long sleepers on which the tumbler will be fixed. At the heel, the fishplates that form the joint are left free by not screwing up the fishbolts too tightly. This allows the switches to move freely.

The check rail on the left-hand side is here shown spliced into the straight running rail. This means a little more work in the machine shop, but it is better than the alternative, which is to stop off the check rail short of the switch heel.

In the middle of the foreground of the picture is the crossing, the middle portion of which is the "V" or nose, while the two side portions are the "wings." The ends of the wings are bent outward to avoid any danger of a wheel striking them. The amount of opening for the wheels, called the "flangeway," is usually $1\frac{3}{4}$ in. The crossing entails several special chairs called crossing chairs and, as there are many different angles of crossing, the number of crossing chairs is quite large.

The rail that curves over from the heel of the switch to the crossing is called the "lead rail," and the distance from the toe of the switches to the (*Continued on page 733*)

With the Secretary

Winding Up the Summer Session

The most fitting climax to the summer session is a well-organised outdoor function, such as a sports meeting or a garden fete. An event of this kind provides a splendid opportunity for parents and friends of members to assemble and also it may be made a source of revenue. At this period of the year club funds as a rule are not very strong and even a small addition is welcome to help to place the club in a sound position to commence the first winter session. Outdoor functions of this nature naturally present less difficulty to a large club than to a small one, but almost every club should be able to carry out something of the kind provided the necessary enthusiasm is brought to bear.

Once the nature of the event has been decided, the first essential is careful preparation, and it is often a good idea to appoint an organising committee. Last year one of the most successful outdoor events was a semi-humorous historic pageant produced by a south-country club as the main feature of a garden fete. Six episodes were arranged, depicting such scenes as the landing of the Romans in Britain, King John signing the great Charta and the murdering of Thomas à Becket. Some of the costumes devised were truly wonderful, considering their component parts. The attire of the ancient Britons, for instance, consisted of a few rugs and sacks aided by plenty of grease paint on legs and faces. These warriors fought hard but were overcome by a solid phalanx of Romans in shining armour made from cardboard or old football jerseys covered with aluminium paint. Thomas à Becket was an imposing figure in a magnificent red gown, and I hear rumours that this was scarcely in a condition to revert to its normal use as a dressing gown after the wooden daggers had done their work! King John's crown was made of cardboard and red velvet and was thickly encrusted with gems—from Woolworths! I have mentioned these details to show that quite an elaborate scheme can be carried out with materials that cost practically nothing.

All Smiles! A cheery group of members of the Weston Meccano Club snapped by the leader, Mr. H. G. Peckham

Visits to Places of Interest

This year the majority of clubs are arranging visits to places of interest, but I am sorry to note that several clubs still make no efforts in this direction. There can be no doubt as to the interest and pleasure to be derived from such visits and as a rule there is little difficulty in making the necessary arrangements. In regard to big engineering undertakings such as electric power stations, gasworks, etc., it is my experience that the officials are almost invariably glad to welcome a party of Meccano boys for they know that these boys take a genuine interest in the various things they are shown. It is very necessary to treat such visits seriously and to make courteous application by letter at least two or three weeks beforehand. On the day of the visit it is very important that the party should arrive punctually at the time agreed upon and that the number of members should be no greater than was stated in the letter of request. Finally, a courteous letter of thanks should be sent next day from the club Leader or secretary to the officials concerned.

Two visits paid recently by Meccano clubs will serve to illustrate the immense amount of interest that may be obtained in this manner. In the first case the Ashburton School (London) M.C. asked Imperial Airways Ltd. to permit a party to visit Croydon Aerodrome. Not only was permission given with great readiness, but the various officials exerted themselves to the utmost to make the visit thoroughly enjoyable and instructive. Among other items the party were shown the lookout tower from which direct wireless communication is maintained with all Continental aeroplanes throughout the journey, and subsequently they inspected thoroughly a giant air liner that was ready to start on its Continental trip. In the other case the Blantyre (Scotland) M.C. obtained permission to visit the huge factories of the Scottish Co-operative Wholesale Society at Shieldhall, Glasgow. In this case also every effort was made by the conducting official to show the various features of interest and to explain them thoroughly. The Leader winds up his account of the visit by saying: "The effect on the boys was incalculable and I am sure the memory of it will live with them for many years."

Summer Camp

Any club Leader who is thinking of taking his boys to camp about the third week in August, might be interested to learn that Mr. G. A. Grant, Leader of The Royal Grammar School M.C., has a suitable camping ground and camp all complete, ready to walk into on August 19th or 20th. The site is "Waterside," Goddrington, Nr. Paignton, South Devon, and would be admirable for a party of about 40. The camp is three hundred yards from the sands. Those interested should write to Mr. Grant at Royal Grammar School, High Wycombe, Buck., for further particulars.

Proposed Clubs

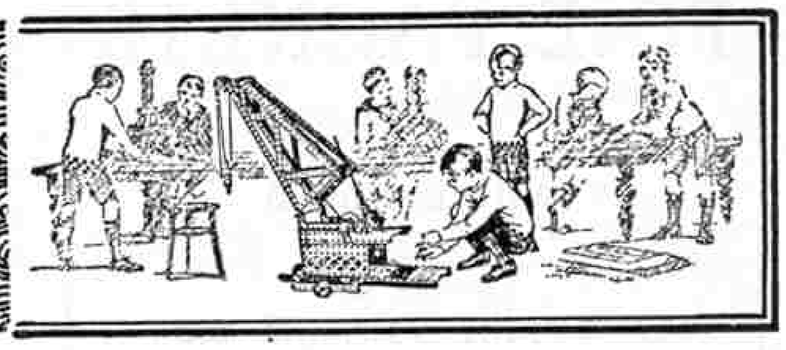
Attempts are being made to form Meccano Clubs in the following places, and boys interested should communicate with the promoters, whose names and addresses are given below:—

SOUTH AFRICA (PRETORIA).—John F. Wood, 723, 5th Street, Villieria, Pretoria, Transvaal, South Africa.

LONDON, S.E.4.—C. Morgan, 46, Brightling Road, Crofton Park, London.

GOODWOOD (AUSTRALIA) M.C.—Mr. W. R. Ferguson, Ormond Grove, Dulwich, Adelaide, S. Australia.

CLUB NOTES



Herne Bay M.C.—A most enjoyable picnic was held at Bishopstone Glen. Unfortunately the Leader was unable to be present, but Mr. Rogers, Leader of Reading M.C., was staying at Herne Bay at the time and was made very welcome. The party started out at 10 a.m. and during the morning cliff climbing, rambling up the glen and excursions to the "pop" shop were enjoyed. An exciting Paper Chase was arranged for the commencement of the summer session. The "hares" took a course of about 11 miles through fields and footpaths and across the railway. Club roll: 28. *Secretary*: C. W. Russell, 4, Clifton Villas, Herne Bay.

Crowle M.C.—About a dozen of the members are going to camp and are looking forward to an enjoyable time. A playing field has been placed at the disposal of the club through the kindness of a local gentleman and this is greatly appreciated. The membership shows a steady increase. Club roll: 22. *Secretary*: Maurice Boardman, North Street, Crowle, Scunthorpe, Lincs.

Winchmore Hill Collegiate Schools M.C.—Visits to the Greenwich Inlaid Linoleum Works and to a Stocking Factory were made by parties of members and were thoroughly enjoyed. Several interesting lectures have been given, including one by the Leader on "*Guns*" and one by the secretary on "*The Conquest of the Air*." Good results were obtained in a Model-building Competition, the subject being "A Motor Bus." Club roll: 40. *Secretary*: K. Walden, 18, Old Park Road, Palmers Green, London.

Derby M.C.—Lectures are very popular and keen interest is taken in them. A recent Exhibition proved very successful and was well attended. The models exhibited were of good quality and a Workshop Model loaned from Headquarters aroused great interest. Visits to local places of interest are being arranged. Club roll: 41. *Secretary*: W. P. Smith, 435, Uttoxeter Road, Derby.

Castle Douglas M.C.—The attendance at meetings continues to be particularly good. The main features of the programme are Model-building, Bridge-building, Dart Rifle Shooting, and Indoor and Outdoor Games. The railway layout has been increased still further. It is hoped to arrange a trip to the seaside shortly. Club roll: 35. Leader: Mr. Peter Thomson, 106, Queen Street, Castle Douglas.

Wallaseyan M.C.—Many interesting evenings have been held recently. A lecture by the secretary on "*The Mersey Ferries*" was greatly appreciated; it described the development of the ferries from rowing-boats to the fine steamboats of to-day. Meetings are held fortnightly on Monday evenings and new members will be very welcome. Club roll: 36. *Secretary*: G. M. Gaynor, 20, Valkyrie Road, Wallasey, Cheshire.

Upwey and Broadwey M.C.—Among the most popular features are Mock Trials and Charades, which are arranged frequently. Mr. Ravenscroft, the engineer of the Waterworks, gave a lecture on "*Pumps and Their Working*," which was keenly enjoyed. Model-building is carried on with enthusiasm and members bring their models to meetings. Two exhibitions are proposed and the programme includes visits to many interesting works including the Portland Waterworks and the Whitehead Torpedo Works. Club roll: 16. *Secretary*: W. Ravenscroft, The Waterworks, Upwey.

Chalmers Church (Alloa) M.C.—A Social recently held was very successful. The programme included Recitations, Dialogues and a Sketch by the Girls' Auxiliary, and every item was greatly enjoyed. Members are very grateful to Miss MacGillivray for providing tea and to Mr. John Mein who prepared the stage. The club is closing down until October. *Secretary*: J. Campbell, Grange Manse, Alloa, Scotland.

Teignmouth Congregational M.C.—The club entered for the Devon and Exeter Music Competition at Exeter and secured a first-class certificate and a second place. The test was a sea shanty entitled "The High Coast of Barbary." Members are very grateful to Mr. Smith, B.Sc., for training them so skilfully. The cricket team is doing well. Club roll: 33. *Secretary*: Donald Ford, 16, Higher Brook Street, Teignmouth.

Haslingden Secondary School M.C.—Lectures continue to be a popular feature. The President gave a most interesting address on "*Pioneer Work in Electrical Research*" and outlined the principles of wireless. A talk on the manufacture of Coal Gas was given by the Leader, who fitted up in the club room for the occasion a miniature gasworks and actually prepared gas and burned it at a jet. "Five-Minute Talks" are very popular. Club roll: 36. *Secretary*: Kenneth K. Tupling, 16, Alexandra Terrace, Haslingden, Rossendale, Lancs.

Middlesbrough M.C.—The President, Mr. Spiers, has inaugurated a Competition in which entrants will be required to describe the working of either a Petrol Motor or a Steam Engine without any reference to notes. There will be prizes of a Meccano Electric Motor and 5/- worth of Meccano goods. A Savings Bank has been opened and a Visiting Committee elected. The club song is very popular and is sung regularly at meetings. The secretary gave an address on "*The Most Wonderful Thing in the World*," this being the wheel. Summer activities include picnics, rambles, cricket, cycle runs and charabanc rides. Club roll: 47. *Secretary*: A. Bradley, 95, Deepdale Avenue, Marton Grove, Middlesbrough.

Meccano Club Leaders

No. 33. Mr. M. H. Bali

The Cleopatra Meccano Club, Cairo, has the honour of being the first club in Egypt to become affiliated with the Guild. Mr. M. H. Bali has held the Leadership from the establishment of the club and under his enthusiastic encouragement it has developed from a very small beginning to its present flourishing condition. The membership has already reached 30 and is still increasing, and meetings are well attended.

The club was affiliated in February of this year under the name of the Cairo M.C., but since that time the name has been changed to Cleopatra Meccano Club.

Withington M.C.—First-Aid practices are held frequently and members find them very interesting and instructive. A "Do-As-You-Like" Evening was greatly enjoyed, some of the boys reading while others exchanged stamps, etc. Members recently paid a visit to Liverpool and were shown round the Meccano Works, which interested them keenly. Later in the same day the members were allowed to look over the Cunard liner "*Laconia*." Cricket is popular and Kite Flying has found a place in the syllabus. Club roll: 11. *Secretary*: K. Cradduck, 36, Mauldeth Road West, Withington, Manchester.

Memorial (Hull) M.C.—A Social Evening was an outstanding success. Games were played with great enthusiasm, and much excitement and amusement was created by two parties of boys endeavouring to drive balloons along a line down the centre of the room. On this occasion prizes were awarded for an Essay Competition, the subject being Wireless. The evening concluded with supper, to which all members contributed. A visit was paid to a disused chalk works at Skidby, an attractive feature of the outing being an "al fresco" tea. *Secretary*: Philip Gambie, 53, Albany Street, Hull.

St. Peter Mancroft M.C.—Mr. Sercombe, the Leader, has unfortunately been obliged to resign, but Mr. Eagle has kindly undertaken the position. An interesting lecture on "*China*" was given by the Rev. Callon, who was a missionary in that country for over 20 years. Cycling runs are enjoyed and it is hoped shortly to visit the power station at Thorpe Norwich. Club roll: 50. *Secretary*: Lionel H. Oates, 18, Civic Gardens, Mile Cross, Norwich.

Rotherham M.C.—Model-building Contests are held frequently and the models produced are of a high standard. An Indoor Games Championship has been arranged and is likely to be a great success. A Draughts Section is to be introduced and a set of draughts has been bought out of club funds. Club roll: 27. *Secretary*: A. E. Wood, 26, Norfolk Street, Rotherham.

Southport M.C.—The Exhibition was a great success and was attended by a large number of visitors. A model of a High-Speed Ship Coaler built by R. Westerman attracted a great deal of attention and visitors were much interested also in a Marine Engine loaned from Headquarters. The Hornby layout as usual was greatly admired. Lectures are a prominent feature and among them was one by K. Lancaster on the Eclipse. Club roll: 24. *Secretary*: W. E. Williamson, Delamere Road, Ainsdale.

Italy

Siena M.C.—A Shooting Section has been commenced and the first contest produced very good results. This section is extremely popular and is likely to develop. Cesare Lunghetti has been appointed Assistant Secretary. The attendance at meetings continues to be good. *Secretary*: Valentino Bruchi, 39, Via Ricasoli, Siena, Italy.

Egypt

Cleopatra (Cairo) M.C.—A cycle run in the moonlight to the great Pyramids was greatly enjoyed and members spent three hours in looking over these wonderful monuments. A trip up the Nile to El Maādi proved very enjoyable. Stamp and Correspondence Sections are making good headway and Games Evenings form a regular feature. The club now has its own library and books are in great demand. A recent lecture on "*Aviation*" was greatly appreciated. The membership is increasing and meetings are well attended. Club roll: 30. *Secretary*: Abdel Hamid Amin Abdel Monem, 2, Haret El Ismaily, Nasria, Cairo, Egypt.

South Africa

Clifton (Johannesburg) M.C.—Model-building continues to be a popular feature. On a recent club night members were divided into three sections, each of which was required to build a railway bridge. The standard of models produced was very high and showed considerable knowledge of the principles of bridge construction. An Essay Competition produced many excellent efforts. Club roll: 26. *Secretary*: Hermann Jacobsen, 169, Loveday Street, Clifton, Johannesburg, Transvaal, S.A.

New Zealand

Takapuna (Auckland) M.C.—An enjoyable Sports meeting was held at Takapuna Beach, Mr. W. Henwood being in charge. There were races of every description into which members entered with enthusiasm and sportsmanship. Mrs. Henwood kindly provided refreshments on the beach and it was announced that Mr. Oborn, father of the Leader, had presented to the club a Rugby Football. Further meetings of this nature are planned. *Secretary*: G. P. Henwood, 56, Lake Road, Takapuna, Auckland.

Clubs not yet Affiliated

Carlisle M.C.—Good progress is being made although a club room has not yet been secured. Open air meetings are being held when the weather is suitable. Members are very enthusiastic and are anxious to hear of a gentleman who will undertake Leadership. *Secretary*: W. S. Purves, "Tynedale," Warwick Terrace, Warwick Road, Carlisle.

Penarth M.C.—A recent Exhibition was very successful. Many of the models exhibited were of outstanding interest and a Hornby Train Layout, both clockwork and electric, proved a great attraction. It is hoped to obtain affiliation very soon. *Secretary*: Allen Moon, "Wenvoe," Grove Villas, Penarth.

Rothesay M.C.—A Meccano Stall was incorporated in the Church Sale of Work and was very successful. Several enjoyable outings have been held and in particular a Cycling Picnic to Ettrick Bay was greatly enjoyed. The membership is increasing and it is hoped shortly to secure a Leader. *Secretary*: T. Maitland, 1, Ladeside Street, Rothesay.

Singapore M.C.—A club has been successfully started and a Leader secured. New members are desired and will be made very welcome. Boys who are interested should communicate with the *Secretary*: Kwa Soon Hock, 236, Pasir Panjang Road, Singapore, S.S.

FINE PACKETS

The best way of adding to your collection is to BUY GOOD PACKETS.

Gibbons Packets are best of all.

WHOLE WORLD

100 diff. 6d.	300 diff. 1/6	600 diff. 4/6
200 diff. 1/-	500 diff. 3/6	750 diff. 7/-
	1,000 diff. 10/6	

BR. EMPIRE ONLY (No. G.B.)

100 diff. 1/3	300 diff. 8/6	600 diff. 30/-
200 diff. 3/6	400 diff. 14/-	750 diff. 45/-
250 diff. 6/-	500 diff. 21/-	1000 diff. 80/-

Ask for a Gibbons Approval Sheet—THE BEST.

STANLEY GIBBONS LTD.

DEPT. S.15., 391 STRAND, LONDON, W.C. 2.

2 Gambia Elephants Free

For 30 days (Colonies 60 days) we present this gift **Gratis** to every Stamp Collector sending **2d.** (for cost of postage), Abroad **3d.** Only one gift allowed to each applicant and cost of postage must be sent.

☞ **Important. Now Ready. 43rd Edition, 1927. Illustrated Catalogue and Guide to Stamp Collecting.**

Over 100 pages. Full of information and bargains.

Post Free, 6d. We present free with our Catalogue a set of 10 new Mozambique stamps (all pictorial).

ESTABLISHED 1880.

ERRINGTON & MARTIN LTD.
LONDON, E. 9

PACKETS (Postage extra)

25	N. America	3d.	100	S. America	1/6
50	,,	7d.	125	,,	2/6
75	,,	1/-	150	,,	4/-
100	,,	1/6	25	W. Indies	6d.
125	,,	2/6	50	,,	1/2
150	,,	4/-	75	,,	2/-
25	C. America	1/3	100	,,	3/-
50	,,	2/3	125	,,	4/6
75	,,	2/3	150	,,	7/-
100	,,	3/6	14	French Col.	2d.
125	,,	5/-	20	,,	3d.
150	,,	7/-	25	,,	4d.
25	S. America	3d.	30	,,	5d.
50	,,	7d.	35	,,	6d.
75	,,	1/-	50	,,	9d.

Sheets of Postage or Fiscal in separate countries.

J. RUSSELL

Chetwynd, Shanklin Drive, Westcliff-on-Sea.

13 Mozambique Company Free.

To all sending 2d. (Overseas 3d.) for postage of my new 64-page Price List of Packets and Sets from 1d. up, Albums from 1/- to £4, Books about stamps from 6d. up, Outfits and Accessories of all kinds, fully illustrated, will be sent the above 13 different Mozambique Company stamps. This is a beautiful set, mostly in two colours, and depicts East African Natives, Ivory, Tobacco, Cotton, Coffee and Maize crops, View of the Port of Beira, Native Village, Coat of Arms with Elephant Supporters, etc. Ask for the No. 2 Packet, and don't forget the Postage. In addition, for RESPONSIBLE approval applicants only, 2 TRINIDAD (large stamps) FREE.

THIS IS A SNIP—ONLY ONE PACKET TO EACH APPLICANT.

If you don't want the Packet, send a postcard for the Price List.—You want that.

EDWARD SANDELL, 10-11, FETTER LANE, LONDON, E.C.4.

FREE! THE "CLASSIC" PARCEL of Stamps and Fine Accessories. FREE!

An extraordinary offer includes 250 of the finest "Liver" Stamp Mounts, a splendid and indispensable aluminium Watermark Finder, 56 all different stamps from French Morocco, Lettland, fine set of 10 interesting overprinted stamps, United States of America, Bohemia, Poland, Laibach (Jugo Slavia), Irish Free State, 25 all different unused, British Colonials. To secure this splendid parcel, just send postcard only, and request our famous approval sheets. *(Collections Purchased).*

LISBURN & TOWNSEND, LONDON ROAD. LIVERPOOL

Free! 50 Different British Colonials

This wonderful gift packet contains 2 Jamaica (pictorial), 5 Australia, 1 Malay (tiger), 10 Canada, 1 Cochin (rajah), 1 Deccan, 4 Ceylon, 1 Gold Coast, 1 Nigeria, 1 Travencore, 4 New Zealand, 1 Queensland, 1 Straits, 5 Union South Africa (including new issue), 9 Irish (set with high values). ABSOLUTELY FREE TO GENUINE COLLECTORS REQUESTING APPROVALS. Also those sending 3d. for postage, etc., receive fine set of 100 unused German, all different.

SPECIAL OFFERS.—50 diff. French Colonials, 7d.; 100 diff. 1/6; 50 diff. Portuguese Colonials, 7d.

J. BURTON, 31, Onslow Road, Fairfield, LIVERPOOL

"1000 PACKET" A Wonderful Offer for 4½D.

The "1000 Packet" contains 500 excellently assorted stamps, a **COMPLETE SHEET OF 100 UNUSED** (very useful for exchanging), a neat booklet (12 pages) for holding duplicates, **25 British Colonials,** usually sold at ½d.—1d. each, including new and obsolete issues, 375 Magic "Strip" Mounts which are three times as quick as the old-fashioned single ones, and my price list of stamp bargains. In addition FREE Sets will be sent to those who send names and addresses of stamp collecting friends.

Postage 2½d. extra. Abroad 6d. ex.

WATKINS (M. Dept.), GRANVILLE ROAD, BARNET, HERTS.

POUND in a "DIAMOND" PACKET: FRANCE 1870, 80c., catalogued by Stanley Gibbons at £2

Many Rare Stamps have been found by purchasers of **THE "DIAMOND" PACKET** which is guaranteed to contain **1,000 Unsorted Stamps** from Convents abroad. 1 packet 1/3, 2 packets 2/5, 3 packets 3/6, 4 packets 4/6, 5 packets 5/6. All post free. (Abroad 3d. per packet extra.)

O. NERUSH, IMPORTER (DEPT. E), 2-22, CATHCART HILL, LONDON, N.19

1,111 Try the Cheapest and Best 1,111

Method of adding to your collection. When you buy PACKETS you buy DUPLICATES. I will send you a book of 1,111 different stamps from which you may select any 100 for 3/-. BUY ONLY THOSE YOU REQUIRE.

H. HARDY,
1,111 285, Archway Road, London, N.6. 1,111

USED Syria and Grand Lebanon.

FREE OFFER. I will give two of the above FINE USED PICTORIAL stamps to genuine collectors applying for my **outstanding** approval books and sets. **8 different of above used pictorials,** 10d.

REMEMBER—THE EARLY BIRD CATCHES THE WORM. I cater especially for **Overseas collectors** who are requested to favour me with a good English reference, **or** deposit by Postal Order or M.O. (not stamps).

H. LINDSEY (Dept. M),
27a, The Square, P.O. Box 10, St. Annes-on-Sea.

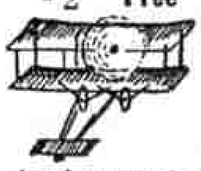
MY RECORD SELECTIONS OF BRITISH COLONIALS and Foreign Stamps at the huge discount of 8d. and 9d. in 1/- off Catalogue Price. These are indeed a record of quality and cheapness and I have many unsolicited testimonials to that effect. These contain stamps of very good quality and not the rubbish that is sometimes put on approvals and only **6d. in 1/- discount** allowed. This is why I give no **free gifts.** Kindly state whether cheap, medium or rare stamps are desired, cheap selection stamps up to 3/- catalogue, medium up to 10/-, rare 10/- cat. and upwards.

Record House, 23, Canning Road, East Croydon, Surrey.

Free "QUEEN'S HEAD" PKT. containing 54 beautiful stamps incl. scarce mint **Costa Rica 1c. and rare Luxemburg** (Queen's Head), fine set of Spain, Brazil, etc. Request **cheap high-class approvals.** 1½d. postage please.

PORTER, 20, Sydner Rd., Stoke Newington, N.16.

The "AERO" PACKET 4½d. Post Free



18 Airpost and Triangular Stamps FREE to purchasers of the Aero Packet who ask to see approval sheets. Packet contains good class stamps only. New issues of **Liban, Syria, Niger, Poland, China** (famine stamp), Pictorials of **Newfoundland, Ecuador and Mozambique, etc.** FREE with each packet 18 AIRPOST aeroplane design and triangular stamps. Satisfaction guaranteed or money returned. Send names of stamp collecting friends and receive an extra set free.

H. C. WATKINS, M. Dept., Granville Road, BARNET.

100 DIFFERENT. Free. Send for ½d. approvals.—Cox, 135, Cambridge Road, Seven Kings.

ASTOUNDING OFFER! Breaking Stamp Collection. 500, 6d.; 100 Mounts Free.—Rendall, "Endsleigh," Higher Compton, Plymouth.

75 FREE. Offered only during August. Private Collection.—J. Taylor, Montfort, Borth, Cardiganshire.

FREE. 150 diff. stamps, from Africa and Port. Cols., to approval applicants.—W.S.C., 42, Alma Rd., Windsor.

FREE. 200 Stamps to approval applicants. Send Postage.—J. A. Warnock, Polton Rd., Loanhead, Midlothian.

STAMPS. Send 1½d. stamp for Approval Books and Packets. Presents given away. Brownlow Series, 68, Queen's Road, Wimbledon.

JAPAN EARTHQUAKE SET FREE with my ½d. approvals.—S. R. Catt, 20, Brunswick Rd., Ipswich.

50 CLEANED STAMPS FREE. Send for 1d. and ½d. approvals.—Miss Williamson, 18, Victoria Park, Dover.

FREE. 25 stamps, including Guatemala, Venezuela and Kenya, to applicants for approvals, enclosing 1½d. postage. Charlesworth and Hall, 34, Alexandra Road, Ansdell, Lytham.

100 DIFFERENT STAMPS FREE
to applicants for approvals who enclose 1½d. postage. Many Stamps at 1/12th Catalogue Price.
E. J. DAVIES,
3, Glapton Road, Meadows, Nottingham.

FREE **3d., 6d., 1/-, 2/-, 5/- JAMAICA**
Free and Post Free to all genuine applicants for Half price approvals (Abroad 6d.) Mention Jamaica.
Horace Miller & Co., Whitstable

SHANGHAI PACKET FREE

A grand packet of **25 Different Stamps** containing **Shanghai** 1893, 5c unused, a very fine stamp, **Soruth** Indian Native State, 1923, 3 pies unused, **Morocco** King George 5c unused, **Albania** 1926, 1 qind, **Japan Earthquake** 1924, **Ruanda-Urundi** surcharged on **Belgian Congo,** a fine **set of 4 French Equatorial Africa** surcharged on **Gaboon, Middle Congo, Oubangui** and **Tchad, Monaco** 1925, **Angola** 1914 unused, **New Caledonia** pictorial, **Madagascar** pictorial, **Niger Territory,** pictorial, etc., etc., free to all asking to see my famous approval sheets and enclosing **2d. for postage and packing** (abroad 3d).

S. HAMMOND, 2, Chesham Fields, BURY.
Stamp Collections Purchased.

Stamp Collecting

SOME CURIOUS BIRDS OF AUSTRALASIA

THOSE readers who combine a love of natural history with a taste for stamp collecting will already have discovered how vast is the scope for the pursuit of the two hobbies in close conjunction. It would perhaps be true to say that nowhere, outside heavy encyclopædias or comparatively technical works, can so excellent an idea of the fauna and flora of many countries be obtained than through the medium of their postage stamps. There is scarcely a single stamp-issuing country that at some time or another has not depicted some bird, beast or plant connected closely with its national life. Obviously therefore the field for research is very wide and the task of the collector who set out to secure a complete collection would be enormous. By confining himself to a group of countries and to one section of the natural kingdom his quest would be greatly simplified, and the special knowledge gained by the more limited study would render the collection infinitely more interesting.

In this article we deal solely with the birds that are illustrated on the stamps of Australasia—that portion of the world that includes Australia, New Zealand, Borneo, New Guinea and the neighbouring archipelagoes. Many curious, quaint, and we might almost say comical-looking birds are to be found in this part of the globe and our illustrations show a number of the more interesting.

New Zealand, although it lies within the temperate zone of the Southern Hemisphere, is really a portion of the Northern Hemisphere in most matters affecting its birds, if not its plants. Until a few hundred years ago it possessed probably the most gigantic birds that have ever lived. These birds are classed generally as Moas and originally came from the North; probably they existed also in North Queensland and New Guinea. The wide distribution of these birds, by the way, is one of the main planks of the theory that New Zealand is the surviving piece of a great semicircle of land stretching out in the Pacific from New Zealand to North Queensland and from the Australian Continent to New Guinea. Included in the Moas group of birds, the majority of which are extinct, were the Great Auk, Moho, Black Emu, Grey Kiwi and the Dodo, the last-named possessing a decided sense of humour if its pictures reflect its temperament! It was ducklike in appearance, but its bill was broad and long with a parrot-like beak. Its feet had no webs and it possessed a tail with plumes.

The Kiwi is shown on the 6d. stamps of the New Zealand 1907/8 issues. Its generic name, *apteryx*, gives a clue to its peculiarities; *a*, without, *pteryx*, wing. In fact, it has neither wings nor tail. The present day Kiwi is a much smaller bird than its ancestors; its feathers are hair-like in appearance, and its beak is long and curved with the nostrils nearly at its extremity. The bird is now protected very closely but it is to be feared that its complete extinction is merely a matter of time. The Sacred Huia birds, and the Kea and Kaka, two species of the hawk-billed parrot, also appear in the same issue, on the 3d. and 1/– values. The latter two birds are of the genus *Nestor*, the Kea being found only in the South Island. The Kaka inhabits woods and feeds on soft fruits and insects, but it is said that the Kea is carnivorous and when hungry attacks live sheep, tearing through the wool and flesh until it reaches the fat around the kidneys. The Huia is one of the most remarkable birds existing, for the reason that the male bird has a short stout bill while the female's is long and curved! This characteristic is excellently portrayed by the stamp. Actually the bird should be classed as a rook. Its plumage is greenish black in colour, the tail being tipped with white.

Passing now to Australia we find that birds figure prominently on the stamps of the various State pre-Commonwealth issues and on the Commonwealth issues. The Western Australian Swan is famous and no extensive reference to this bird is needed. The Emu is probably the best known of the larger Australian birds and is depicted on the twopenny stamp of the New South Wales 1888 issue. It is also a prominent feature in the Commonwealth "King's Head" stamps, figuring with the Kangaroo as one of the "supporters." The Emu stands approximately five feet in height and is an ostrich-like bird, although differing from the ostrich in that its head and neck are completely feathered. It is easily tamed but is not a good pet owing to its highly mischievous disposition. The hen is pugnacious and its general demeanour resembles very closely that of the male birds of other species. The Emu once was to be found in large numbers throughout the Australian Continent but the large quantity of grass it consumes has rendered it extremely unpopular with the settlers and its numbers now are steadily diminishing.

The Kookaburra, or Laughing Jackass, is another curious bird and this is to be seen on the 6d. stamps of the Australian Commonwealth 1913 issue. This bird is also nicknamed the "Settlers' Clock," owing to the regularity of the peculiar gurgling cry that it utters at dawn and dusk. Its colouring, unlike that of most Australian birds, is not of brilliant hue but consists of a mixture of brown, black and white. The male bird, however, sports a bright green-blue patch on the lower part of its back. The Kookaburra belongs to the Kingfisher family but, unlike our English Kingfisher, which feeds on fish and water insects, feeds principally on tree insects, reptiles and even small animals. The New South Wales 1888 and subsequent issues also show the Lyre bird on the 8d. and 2/6 stamps. This is the most interesting of all the Australian "stamp birds." The head and body are extremely like those of the English pheasant but its tail is the most distinguished in the whole realm of feathered creatures. The peacock may display more gorgeous colouring, but for sheer beauty of design the tail of the male Lyre bird surpasses all. It possesses two great lyrate plumes from the base of which 12 tail plumes without barbules and with widely-separated barbs are spread. There are two other plumes with very narrow webs. The tail plumes often reach a length of 33 inches.

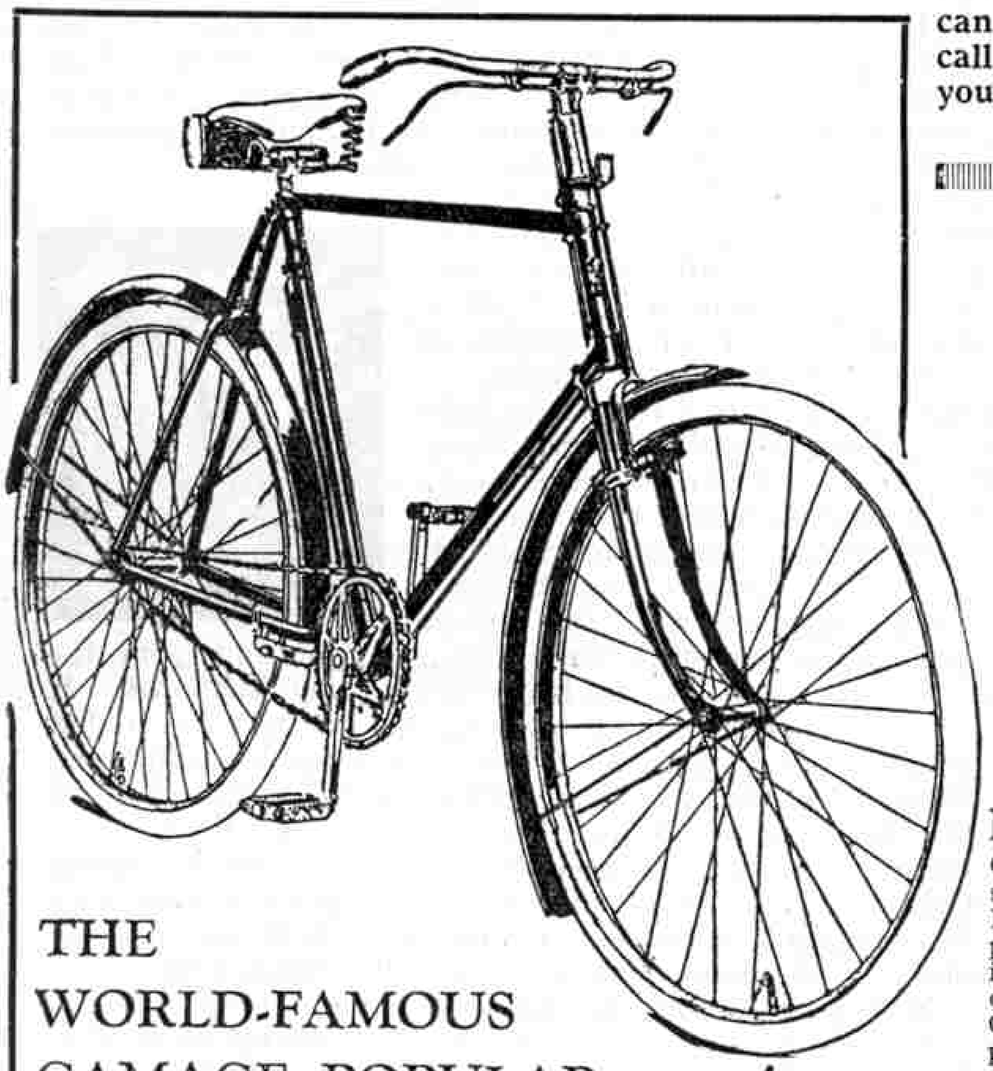
The Wryneck, or Torea, illustrated on the Cook Islands issues of 1893/1909 is another interesting bird. It is not unlike a Woodpecker in appearance and, in fact, is related to that family. Its plumage is curiously mottled with black, brown, grey and white. It lives principally upon insects but seeks these in the ground. It differs from the woodpecker principally in the absence of the spiny shafts that are so prominent a feature of the latter's tail. These spines are, of course, an important feature of the woodpecker's equipment and close observation of this bird at work on a tree will reveal the fact that its tail plays as large a part as its claws in holding it to the trunk.

(*Continued on page* 741

GAMAGES

SUGGESTIONS FOR HOLIDAYS 1927

August has entered. The old school gate shuts with an ancient click—you are Free—and the Open Road and holidays are calling. If you are "Cycling"—or "Hiking"—Gamages will supply your New Bike or Tent at prices that you can easily afford. If it is impossible to call at Gamages, write and tell us about your requirements and we will send you full particulars of your wants.



THE WORLD-FAMOUS GAMAGE POPULAR

is the bike that "won't let you down," but will enable you to enjoy a "care-free" holiday awheel, a mount that embodies those essential qualities—built and constructed by the finest workmanship, strong, silent, and easy running. Every boy should be the proud possessor of one. The price cash down is **85/-**

Get Dad to purchase you one on our special easy payments. 7/11 down and 11 monthly payments of 7/11.

THIS SOLVES THE LUGGAGE PROBLEM

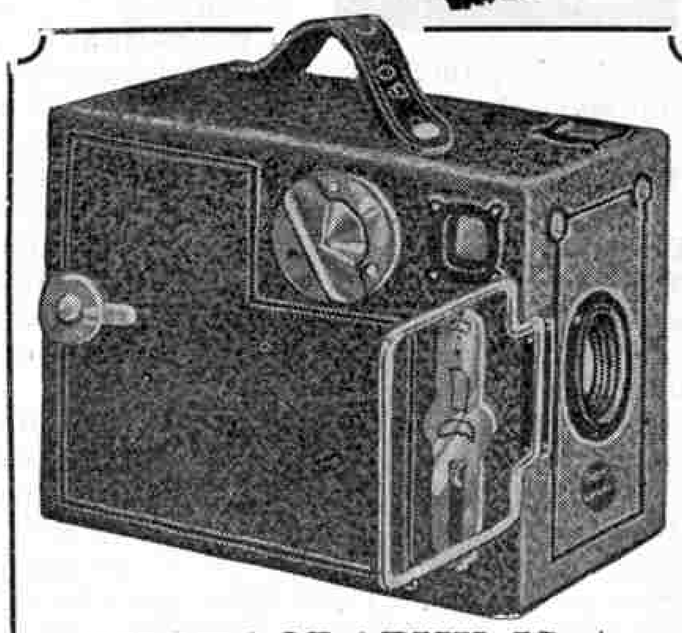
Our New Super Touring Bag, made with strong double texture motor twill cloth. Rubber proofed, with steel bar at back to prevent sagging and two side pockets. Bound in Sheepskin, and straps for carrying capes and overalls. Capes are not included in the price. Post 6d. Price **9/6**

TRY A CAMPING HOLIDAY THIS YEAR

Think of the fine Healthy Sport you enjoy—the delights of an Open-air Life for a few weeks, but only with the correct Camping Gear. Well, of course, **"GAMAGES ARE THE PEOPLE,"** you say. Then order this Splendid Tent right now. Made of Green Rotproof Special Lightweight Material, absolutely waterproof, Jointed Poles, Packed complete in valise including ropes, pegs, mallet, etc. Size 6×5×4. Will sleep 2 adults or 3 to 4 boys. Price **30/-**

Now for Football!

Make up your mind NOW to do better this season than you've *ever* done. Get ALL your Kit from Gamages and play WELL—safe in the knowledge that your Outfit will never let you down. . it's the BEST that money can buy!



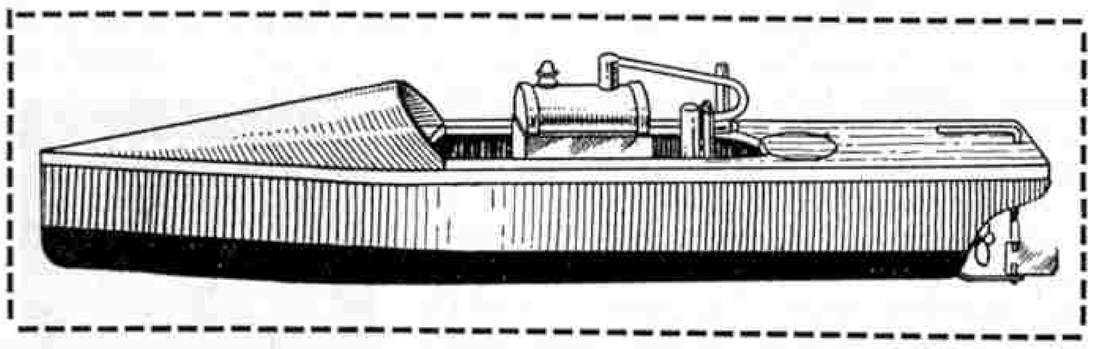
PHOTOGRAPHY IS A SPLENDID HOBBY

This is the most popular of all Roll Film Cameras. Simple in operation and certain in results. These cameras are fitted with the direct vision wire view-finder, which very greatly simplifies accurate picture making.

CONSTRUCTIONAL DETAILS.

Solid constructed body, covered with black leatherette, fixed focus, nickel-plated and black fittings, silent winder, easy loading, Reflex and direct view-finders. Real Periscopic lens, 3 stops. Everset Time and Instantaneous shutter, leather handle. Instruction book. No. 2¼B, for pictures 2¼×3¼ (6×9 cm.) Price **12/6**

Films **1/2** each. Any make. Post free.



Boys! Get This Splendid Racing Launch "Miss AMERICA"

A splendid boat of improved design and speed. It is beautifully shaped, with a hull finished in two colours and the deck lined for planking. The engine unit is of improved pattern with lamp that raises a big head of steam in a very few minutes. A new automatic greaser is fitted as a lubricator, and gives greatly increased speed. 22½ ins. long. 4⅛ ins. beam. Price **12/6**

A non-spill lamp, filler and full instructions are sent with the boat in a strong cardboard box.

A. W. GAMAGE LTD., HOLBORN, LONDON, E.C. 1

CITY BRANCH:—107, CHEAPSIDE, LONDON, E.C. 2

Stamp Collecting—*(continued from page 739)*

We also illustrate the Argust Pheasant of North Borneo, which appears on the 5c. stamps of this country's 1894 and 1897 issues. The stamp depicted is from the latter. This bird, strictly, is not a pheasant, but, we suspect, a remote descendant from the Guinea-fowl with a strain of Peacock also. The name is derived from the presence of "eye-like" spots, akin to those of the Peacock, that appear in the tail of the male bird. Argus was one of the mythical gods of early Grecian days, and possessed 100 eyes, of which only two were closed at a time. His wakefulness caused Juno, the wife of Jupiter, the mightiest of the gods, to set him as watchman over the unfortunate Io whom Jupiter had changed to a heifer. Mercury, who had been sent to rescue Io, managed to surprise and kill Argus, and Juno, in her grief, transferred his eyes to the tail of her favourite bird, the Peacock.

The Hornbill, to be seen in the 16c. stamp of the North Borneo 1909 issue, is one of the most remarkable birds known to ornithologists. Its name is derived from its highly developed bill which is surmounted by a helmet-like piece of horn. There are many species in the hornbill family and their sizes range from that of a pigeon up to that of a small eagle. The most common variety is not unlike the raven, both in size and colour of plumage.

When the discovery of the bird was first reported, naturalists declined to believe its existence and declared the reports to be mere figments of imagination. There is certainly some excuse for their attitude for the description read "greater than the Eagle; having hornes like a Ram on either side of the head, of the colour of yron, and the head onely read." Yet this report was only slightly exaggerated. Later reports authenticated the earlier stories and the Hornbill was generally described as the "rhinoceros bird."

The bird feeds principally on fruit and insects but the larger varieties are rather more liberal in their diet and are very partial to small animals and snakes.

Next to the peculiarity from which it derives its name, the Hornbill's claim to interest is its nesting habits. The nest usually is a rudely constructed affair placed in a hole in a tree. When it is complete, the female bird takes up her residence and proceeds to block up the entrance until only a very small opening is left. Through this the male bird feeds his mate until their progeny is hatched.

It would be possible to fill a volume with details of other "bird stamps," but in the space of an article such as this it is impossible to do more than merely scratch

(Continued at foot of next column)

Stamp Gossip

EGYPT

What may well be regarded as companion sets to the Geographical Congress Stamp, illustrated in these notes in our January issue, have recently been issued by the Egyptian Government in connection with the International Congresses of Shipping and Cotton respectively, the 5 mil. values of each of which are illustrated below.

Each of the stamps is perforated 13½ and is watermarked with the multiple crown star and crescent. The stamps were printed by the Survey Department, Cairo, and three values have been issued in each set, 5, 10 and 15 milliemes.

The Navigation stamps are coloured black and brown, black and carmine, and black and blue for the respective values. The design is from a sculpture from the Temple of Dierel Bahari, and represents an ancient slave galley.

A feature of special interest in connection with the Navigation set is that it was used as a commemorative for the opening of the new Egyptian town, Port Fuad, by H.M. The King of Egypt, the stamps being overprinted with the words "Port Fuad" and placed on sale for one day only. The demand for this overprinted set was so enormous that the post office was literally stormed, men swarming over housetops in their efforts to get into the building. Fifty policemen were insufficient to stem the rush which resulted in many people being seriously hurt, one man dying from his injuries!

The Cotton Congress issue is, by contrast, a peaceful affair. The colourings for the values mentioned are green and brown, green and carmine, and green and blue respectively. The design needs no explanation.

(Continued from previous column)

the surface of this fascinating side to stamp collecting. Enough has been written, however, to reveal the possibilities of the subject.

We take this opportunity of acknowledging the courtesy of Messrs. Lisburn & Townsend in loaning the stamp from which the illustration of the North Borneo 5c. "Argus Pheasant" stamp was prepared.

The remaining illustrations used with this article and the stamp gossip are from stamps loaned by Stanley Gibbons Ltd.

JAPAN

W. E. Broadbridge, of Formosa, informs us that Japan has issued a new set of four stamps in commemoration of the 50th anniversary of the country's entry to the Universal Postal Union. The values will be 1½, 3, 4 and 10 sen respectively, the designs showing a portrait of Baron Mayeshima, the first Japanese Post-Master General, and an international map.

* * * *

AN AUSTRALIAN COMMEMORATIVE

Readers will be interested to see the illustration herewith of the new Australian 1½d. stamp issued to commemorate the opening of the Federal Parliament Buildings at Canberra, the new capital of Australia. The opening ceremony was performed on Monday, 9th May, by their Royal Highnesses the Duke and Duchess of York. The stamp is red brown in colour and the design, a plaque showing the front elevation of the new Parliament Buildings, flanked by a portrait of a woman, supporting with her right hand a shield on which are depicted the stars of the Southern Cross, is allegorical, representing Australia greeting the opening of Parliament House.

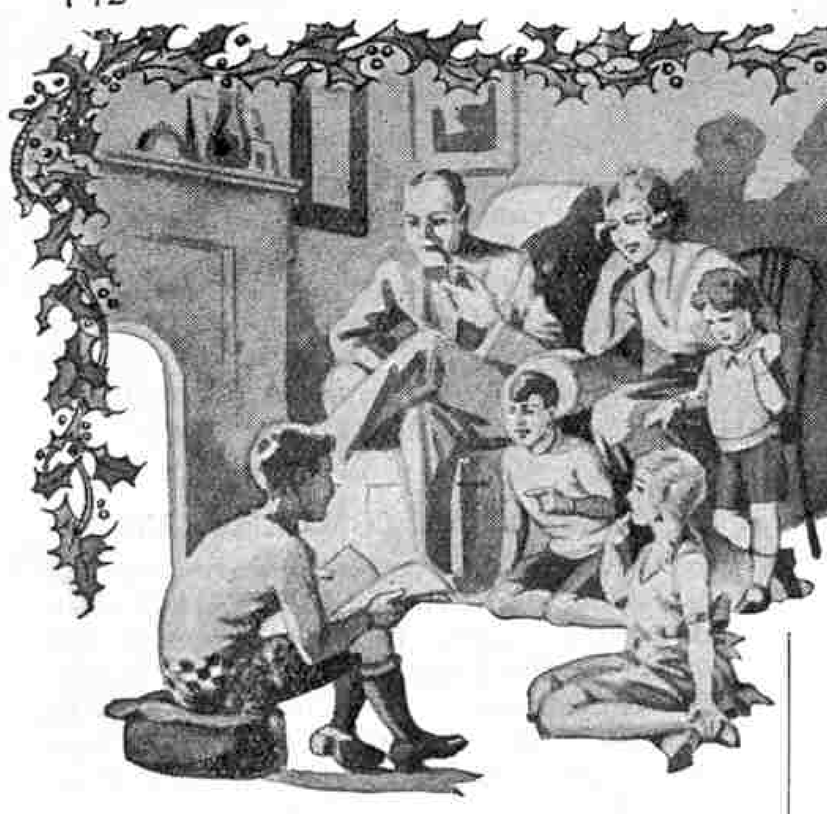
The official proclaiming of Canberra as the new capital of Australia marks a great step forward in the development of the Commonwealth. Since 1901 when the first Federal Parliament was opened, the capital has been located at Melbourne, Victoria, a situation that has caused some small though friendly jealousy among the remaining States. For several years subsequent to 1901 the search for a suitable site for the new Capitol was continued until in 1911, the Canberra site was selected and formally constituted the Federal Capital Territory. Steadily the work of development has been pushed forward and in 1920 H.R.H. the Prince of Wales laid the foundation stone of the Capitol.

To-day the Commonwealth Parliament possess its own home. Canberra now means Australia and there is a new name on the political map of the world. The Federation of Australian States is complete.

* * * *

DENMARK

It is perhaps rare for two such notable additions to the collection of stamps depicting ships at sea to come to hand at once, but following the announcement above of the Egyptian Navigation Congress stamp depicting a slave galley, we find Denmark issuing a new set of stamps showing a fine representation of an old Viking Ship in full sail. The series consists at present of 15, 20, 25, 30, 35, 40 ore values, coloured respectively red, grey, blue, brown, red-brown and green. The stamps are watermarked with multiple crosses and perforated 14 × 14½.



Fireside Fun

THE WHY AND THE WHEREFORE

Paddy, on joining the village pipe band, was given the bass drum to play. One hot day during practice Paddy was observed to remove his coat and waistcoat. Thereupon one of the pipers said to him, "Say, Pat, why do you take off your coat and waistcoat to play the drum?"

"For the same reason that you Scotchmen take off your trousers to play the pipes," retorted Paddy.

* * * *

Tommy's first school report, which was promising, read "Trying."

The second term's report raised his parent's hopes by stating "still trying."

The next report, however, dashed all hopes to the ground. It read, "Still very trying."

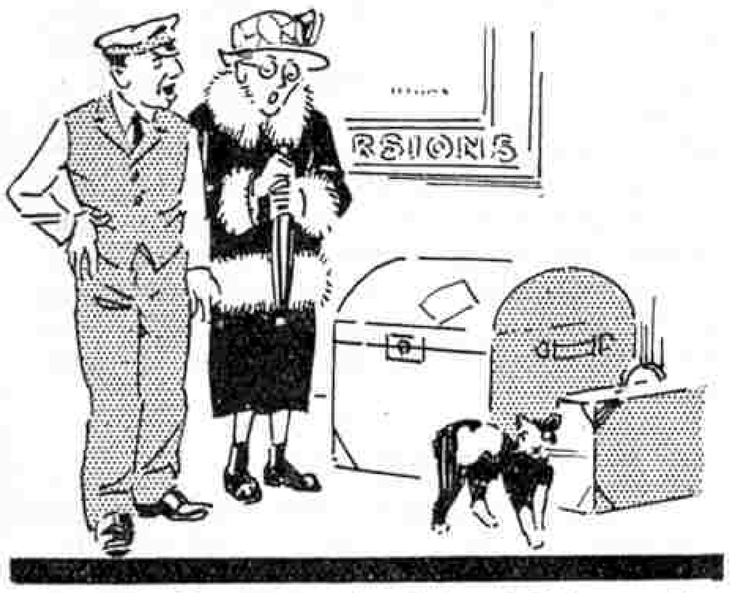
* * * *

Farmer Jones: "Why, I scarcely knew you. That's the third time in six months you've gone an' cut off your whiskers!"

Farmer Brown: "Yes; the wife be stuffin' the sofa!"

* * * *

MERELY RE-MODELLED



Kindly Passenger (noticing tail-less cat): "A Manx cat, Porter?"

Porter: "No, lady—the eleven fifty-nine express did that!"

* * * *

THE NEW MECCANO

Hori the Maori, was gazing in a mystified manner at a gang of Hawke's Bay Power Board workmen at Redclyffe, erecting one of the towers which are an important feature of the hydro-electric installation. After staring for some time in a vain endeavour to arrive at an explanation of their use, he finally had a brain-wave and blurted out delightedly, "Py korry, dat te fine Meccano!"

FROM THE LIMERICKS COMPETITION

A young man of the seventeenth corps,
Said "I don't want to fight any morps;"
So he flung down his gun,
When up rose a Hun,
Who shot him, and said, "That makes forps!"

* * * *

THE MIGHTY GERM

Agitated Jones (to footpad): "Now look here, I've got the influenza, and if you follow me another step, I'll jolly well turn round and breathe all over you!"

* * * *

Senator Money of Mississippi once asked an old coloured man what breed of chickens he considered best, and he replied: "All kinds has merits, sah. De white ones is de easiest to find; but de black ones is de easiest to hide artah you gits 'em."

* * * *

Guard: "Hi, Mike, why have you slowed down?"

Driver: "The signals are agin us."

Guard: "You're gettin' mighty particular all of a sudden, arn't yer?"

* * * *

A BIG ORDER

A motor-'bus stopped, and the conductor looked up the steps expectantly. But no one descended, and at length he ran up impatiently. "Here you!" he said to the man on top, "don't you want the Houses of Parliament?"

"Yes," was the reply.

"Well," retorted the conductor, "come down for them. I can't bring them up to you."

* * * *

"My friend," said the solemn-looking individual, "what are you doing for those who come after you?"

"Doing for them? I am trying to dodge the pests," replied the man, who was harassed by bill collectors.

* * * *

Q. What is the end of doom?
A. The letter M.

HOLED IN ONE

A golfer was considerably handicapped by the actions of a very slow player in front. As it happened the latter was the owner of a perfect pair of bow legs.

All through the afternoon the first player found himself hindered at every hole, but he managed to control his temper, although once or twice it cost him a great effort. But this could not go on for ever. Finally, his patience exhausted, the victim drove clean through the player in front, and his ball passed through the widely spread bow legs.

Mad with rage, the slow player marched back to the following player. "Do you call that golf, sir?" he stormed.

"No," answered the other suavely, "but it was pretty hot croquet—what?"

* * * *

Grocer: "What was that woman complaining about?"

Assistant: "The long wait———."

Grocer: "And yesterday it was the short weight. You can't please some people."

* * * *

Teacher: "An anonymous person is one who does not wish to be known. Now, who is that laughing in class?"

Voice (from rear): "An anonymous person, miss!"

* * * *

COULDN'T BE NEARER

The rather jolly-looking coster was wandering round the pig section at the cattle show, and, pointing to one of the animals, he remarked to a farmer standing near:—

"Nice pig, that!"

The farmer looked at him scornfully.

"Much you know about pigs!" he commented.

"Garn!" retorted the coster. "Bet yer five bob I can guess 'is weight as near as you can."

"Done," said the farmer promptly.

"Well, what do you say 'e weighs?" the coster asked.

"Twenty stone," replied the farmer with confidence.

The coster grinned. "I say twenty stone, too, an' that's as near as you, so I win!"

HIS ONLY CHANCE

An old gentleman saw a little boy carrying an open umbrella in the street, and said to him:

"Why are you carrying that umbrella, my boy? It is not raining and the sun is not shining."

"Well," replied the boy, "when it is raining, father takes it to business with him, and when it is sunny, mother has it, so this is the only sort of weather when I can use it."

* *

Customer: "Yes. I'll take the ring for twenty-one pounds. Put it to my account."

Shopkeeper: "But you owe fifteen pounds already."

Customer: "Well! Can't you add up?"

* *

"How did the Queen of Sheba travel when she went to see Solomon?" asked the teacher. "Could she have gone by railway?"

"Yes," said a bright little maid.

"Indeed, how did you find out?"

"In the second verse," responded the child. "It says she came with a great train."

* *

Pat had bought a flannel shirt on the recommendation of a friend and had found it so comfortable that he disclosed his secret to Mike.

"Sure, Mike, them flannel shirts are good. When ye're cold and wet ye're warm and dry!"

* *

First Sailor: "How do you like life in the Navy? Quite a few turns for a fellow to get to, aren't there?"

Second Sailor: "I should say so. At night you turn in, and just as you are about to turn over somebody turns up and shouts, 'Turn out!'"

* *

Customer: "I would like to see a pair of shoes that would fit my feet."

Salesman (thoughtlessly): "So would I!"

* * * *

A group of lads were seated in a ring round a pile of cigarette cards when an old gentleman passed.

"What are you boys doing?" he asked.

"We're having a competition," said one of the lads. "Whoever tells the biggest lie gets the——"

"What!" said the old gentleman. "Why, when I was a boy I never told a lie!"

"Give him the lot," said the eldest lad.

MIST—IFIED

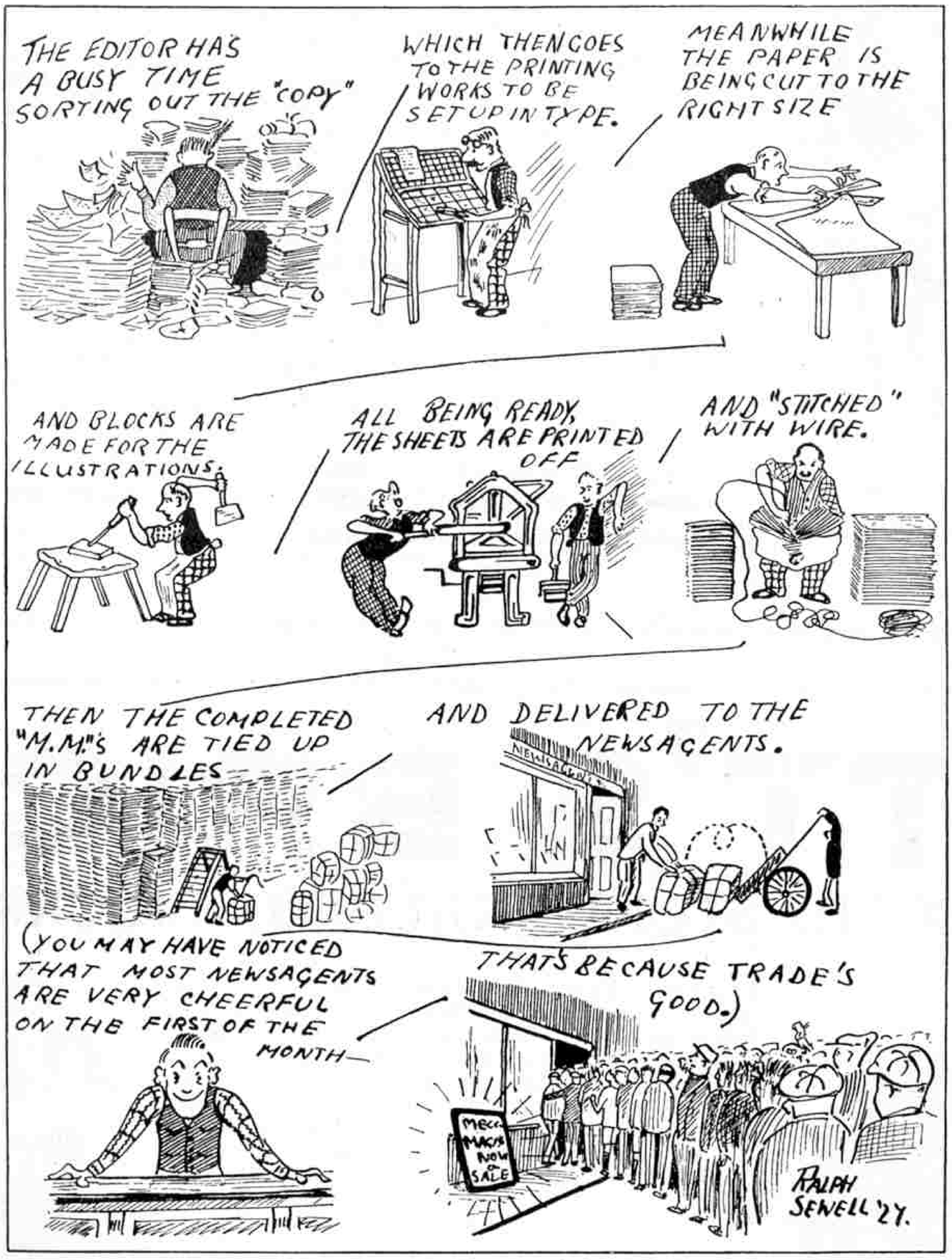
Two men who had travelled considerably were comparing their ideas about various cities.

"London," said one, "is certainly the foggiest place in the world."

"Oh, no it's not," said the other. "I've been in a place much foggier than London."

"Where was that?" asked his interested friend.

"I don't know where it was," replied the second man, "it was too foggy."



How the "*M.M.*" is *not* prepared

A stockbroker, whose good luck was proverbial, went to dinner with some friends. Nearly everybody there was rather tired of his good luck, and one man said to him maliciously: "I suppose, with your usual luck, you've pulled off any amount of good things lately?"

With a twinkle in his eye, the stockbroker replied: "I picked up a good thing recently. It stood at 44 when I discovered it, and last week it touched 78."

"Good heavens!" What was it?" somebody shouted.

"A thermometer," said the stockbroker.

RESOURCEFUL

"When I was only a lad," continued the millionaire, who was telling his fellow club members at their annual dinner some of the troubles of his earlier life, "I walked to Devonshire. I found a job and, after five years' hard work, managed to save enough to buy a bicycle."

There was a gasp of astonishment from the listeners.

"Not long after this," began the other afresh, "I got a letter from home. Mother was very ill. So I jumped on the bike and rode into London just in time to hear the doctor say that the fresh air of Devon was the only thing that would save mother."

His audience gasped.

"You didn't take her back?" they said.

"No," said the millionaire: "I dragged the old bike in, let the wind out of the tyres, and mother's alive to-day!"

* *

Patrick O'Casey was visiting a friend who possessed a very clever parrot. Now this parrot had picked up quite a number of phrases and was wont to bring them out with almost human distinctness.

"Hallo, there!" cried the bird, as Patrick passed in front of the cage. The Irishman turned and, after staring at the cage and its inmate for a moment or two, he raised his hat. "Good morning to you," he said politely. "At first sight I took ye for a bird, to be sure."

* *

Father: "I'm sorry, my boy, but I only punish you because I love you."

Son: "I'm only sorry, dad, that I'm not b-big enough to return your love."

* *

Friend (sceptically): "Do you mean to tell me that you cycled across a ploughed field at 50 miles an hour?"

Motor Cyclist (significantly): "If you don't believe me, ask my wife's mother—she was on the carrier!"

* * * *

Visitor (at country church): "The parson seems a very dogmatic sort of man, Mr. Verger."

Verger: "Bless your life, no, sir! He's only got two and them's both mongrels!"

* * * *

Editor: "I'm sorry I cannot use your poem, but leave your address."

Poet: "If you don't take the poem, I shan't have an address!"

The New "Meccano" Jersey

JAEGER
Pure Wool

The New "Meccano" Jersey

This Jaeger "Meccano" Jersey is made in the special "Meccano" pattern. It wears splendidly and prevents chill when a boy gets hot, as every boy will sooner or later. The "Meccano" Jersey appeals to every boy at once as well as to the "grown-ups" who study the health, happiness and appearance of children.

22″	24″	26″	28″	30″ Chest
7/-	7/9	8/6	9/3	10/-

Colours :—Navy body with Light and Dark Saxe dice effect.
Mid Grey body with Black and White ,,
Fawn body with Brown and Saxe ,,
Brown body with Fawn and Red ,,
Saxe body with Navy and Dark Saxe ,,
French Grey body with Lt. and Dk. Saxe ,,

Three-quarter Hose, Turnover Tops to match

3, 4	5, 6, 7	8, 9, 10
2/9	3/3	3/9

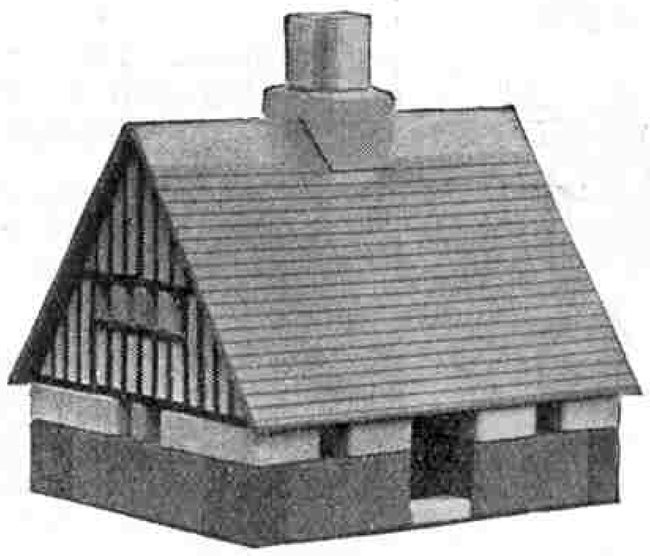
Obtainable only from Jaeger Depots and Agents.
(*Write for the address of your Local Agent*).

JAEGER HEAD RETAIL DEPOT : 352/54, OXFORD ST., LONDON, W.1.
WHOLESALE & SHIPPING : 95, MILTON ST., LONDON, E.C.2.

BRANCHES : AUSTRALIA—Melbourne, 234/236, Flinders Lane. Sydney, 38/44, York Street.
CANADA—Montreal, 1187, Bleury Street.

LOTT'S BRICKS

SOLID STONE BUILDING BRICKS



COTTAGE. Built with Box 1 Tudor Blocks, Price 3/6

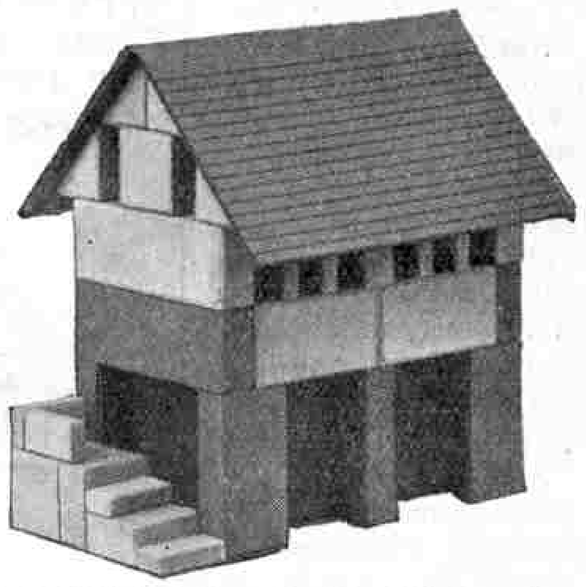
Every boy can build Houses, Bridges, Railway Stations, Signal Boxes, Farm Buildings, etc., with a box of Lott's Bricks or Tudor Blocks. Buildings made with these bricks are ideal for use in every kind of model display. The cost too is moderate when compared with that of other methods of model building, and like real structures they are built in solid stone. Ask your dealer for particulars to-day or write for illustrated list to Lott's Bricks Ltd., Watford.

PRICES :

LOTT'S BRICKS. 30 models, 5/- ; 48 models, 10/- ; 70 models, 17/6 ; 100 models, 42/-

TUDOR BLOCKS at 3/6, 7/6, 21/- and 42/- per box.

Stockists are invited to advise us when they are making special window displays, that their name may be included in our lists.



SIGNAL BOX. Built with Box Oa, Price 3/3

SOME PROVINCIAL STOCKISTS :

Andover	– F. Pearse.
Bromley	– F. Medhurst Ltd.
Broadstairs	– J. Hill.
Canterbury	– R. G. Dashwood.
Carlisle	– Robinson Bros. Ltd.
Chatham	– F. A. Rogers.
Dover	– Dawson's.
Eastbourne	– J. E. Beale Ltd.
Gerrards Cross	R. Binder.
Gillingham	– C. Hawkins.
Hastings	– H. A. Jepson Ltd.
Hove	– M. & E. Dench.
Hyde, Cheshire	Cartwright & Rattery Ltd.
Haverfordwest	Stephen Green.

SOME LONDON STOCKISTS :

T. G. Balmforth	– East Sheen.	Hamleys Ltd.	– All Branches.
Leonard Cave & Co.	Harrow.	Morgans Library	– Purley.
W. F. Chapman	– Balham.	W. J. Playll	– Walthamstow.
Alfred Denny	– Shepherds Bush.	A. B. Sanderson	– Streatham.
Durbins Drug Stores	Wimbledon.	Stanbridges'	– Fulham.
Dales Stores	– Croydon.	A. H. Viall	– Golders Green.
Cyril Gardner	– Holloway Rd.	P. N. Williams	– Ealing.

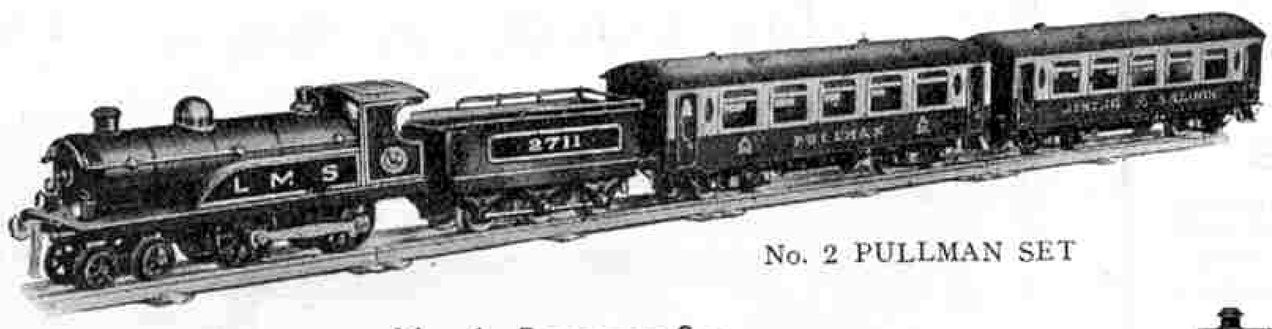
LOTT'S BRICKS LTD., WATFORD, ENGLAND

HORNBY CLOCK WORK TRAINS

THE TRAINS WITH THE GUARANTEE

YOU can have any amount of fun playing with a Hornby Train. Shunting, coupling-up the rolling stock and making up trains will give you hours of pleasure. Hornby Trains are beautifully finished, strongly made, and will last for ever. One of their most valuable features is that all the parts are standardised, and any lost or damaged part may be replaced with a new one.

Every train is guaranteed, and you are therefore sure of satisfaction if you buy a Hornby.

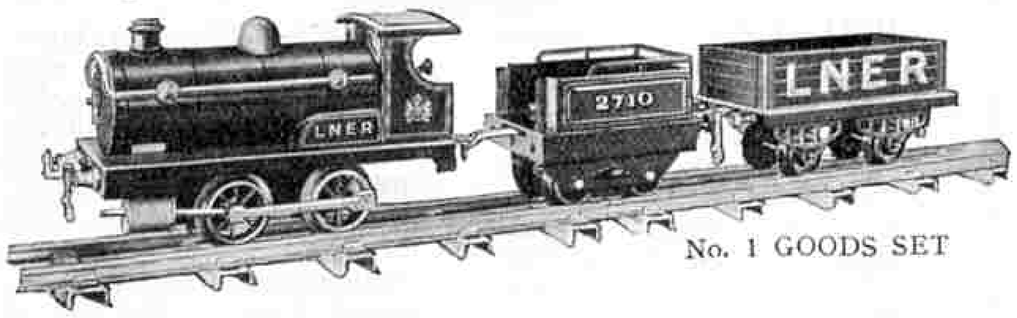


No. 2 PULLMAN SET

No. 1. Passenger Set

The Loco is fitted with reversing gear, brake and governor. Loco, Tender and Coaches are superb in appearance and finish, enamelled in colour and stoved at a high temperature to ensure durability. The doors of the Coaches open.

Gauge 0 in colours to represent the L.M.S. or L.N.E.R. Companies' rolling-stock. Each set contains Loco, Tender, two passenger coaches and set of rails consisting of two straights and curves to form a circle of 2 ft. diameter. Price 27/6



No. 1 GOODS SET

No. 2 Goods Set

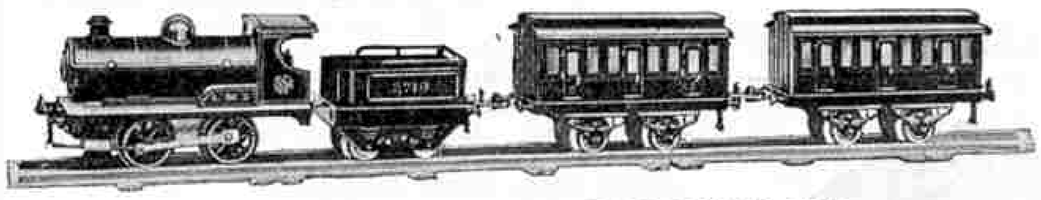
Gauge 0 in colours to represent the L.M.S. or L.N.E.R. Companies' rolling-stock. This set contains Loco, Tender and Rails as in the No. 2 Pullman Set, and two Wagons. Loco fitted with reversing gear, brake and governor. Price 37/6.

No. 2 Hornby Loco ...	Price 22/6	Hornby Pullman or Dining Car ...	Price 15/-
,, ,, Tender	,, 3/6	No. 2 Hornby Wagon	,, 2/6

No. 2 Pullman Set

The No. 2 Loco with Tender measures 17 in. in length. The Loco is fitted with superior mechanism and the accurately-cut gears ensure smooth running. Loco, Tender and Coaches are superb in appearance and finish, enamelled in colours and stoved at a high temperature to ensure durability. The Loco is fitted with reversing gear, brake and governor.

Gauge 0 in colours to represent the L.M.S. or L.N.E.R. Companies' rolling-stock. Each set contains Loco, Tender and two Coaches, with set of rails to form a circle of 4 ft. diameter. Price 60/-.

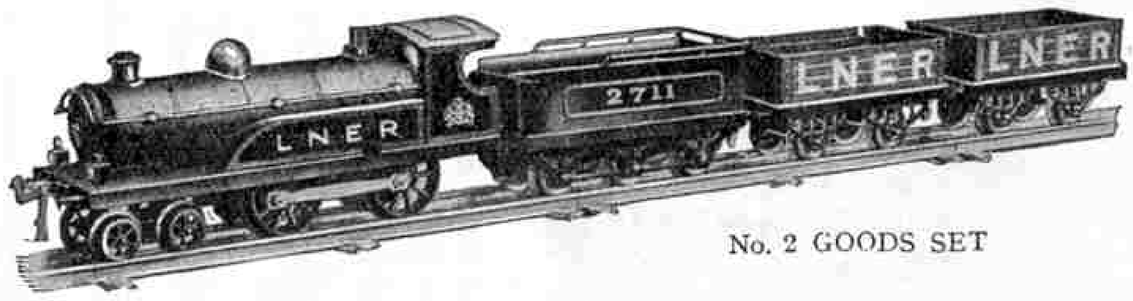


No. 1 PASSENGER SET

No. 1 Goods Set

Gauge 0 in colours to represent the L.M.S. or L.N.E.R. Companies' rolling-stock. Each Loco is fitted with reversing gear, brake and governor. Each set comprises Loco, Tender, one Wagon, and set of rails as in the No. 1 Passenger Set. Price 21/-.

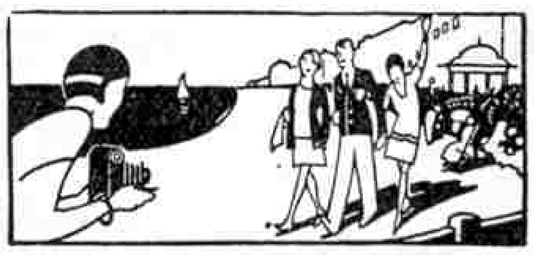
No. 1 Hornby Loco	Price 13/6	Hornby Passenger Coach	Price 3/6
,, ,, Tender	,, 2/6	No. 1 Hornby Wagon	,, 2/6



No. 2 GOODS SET

Ask your Dealer to show you the Hornby Trains

MECCANO LTD., BINNS ROAD, LIVERPOOL



AT "SEASIDE TOWERS"

Many of the girls and fellows at "Seaside Towers" have cameras. Every week there are always two or three who seem to take better snaps than the rest. Perhaps they are experts, or maybe, perhaps not. . . . Anyway, we took the trouble to enquire the reason. Then we discovered a very peculiar thing—practically without exception the best snaps are those taken on a certain type of Roll Film.

It is a very rapid film noted for its perfect accuracy and detail-producing qualities. It shows the correct colour values. It allows for errors in exposure. We can keep the secret no longer—its name is "ILFORD."

The Film that never disappoints!

ILFORD ROLL FILM

The British Made Film in the Red Carton.
In sizes to fit all Roll-Film Cameras.
From Photographic Dealers Everywhere.

*Write for free booklet (illustrated) entitled *"The Lure of the Camera, or Timely Tips for Snapshots"* to Dept. M.M.

ILFORD, Limited, ILFORD, London, England.

NULLI SECUNDUS
PASSE PARTOUT
Picture Framing Outfits

A HOBBY THAT PAYS
Ask for particulars of our Annual Competition. Valuable Prizes.

You can frame your own pictures cheaply and artistically with Passe Partout

—

A picture framed with Passe Partout makes a fine present

—

Complete Outfits at 2/-, 5/-, 10/-, & £1

—

Bindings at 6d. per coil and all accessories from your local stationer or photographic dealer

Send to-day for our free instruction booklet

If your local dealer is out of stock you can obtain Nulli Secundus Passe Partout materials direct post free from us

SAMUEL JONES & CO. LTD.
Passe Partout Makers, Bridewell Place, E.C. 4

Wormar Steam Engines for Meccano

NEW SUPERHEATED MODELS

Specially designed for Meccano, with standard drilled base (by kind permission of Messrs. Meccano Ltd.) the new improved Wormar engines offer the following advantages which are shared completely by no others, *regardless of price.*

BRITISH MADE

1. Meccano drilling. The only engine really suitable for building into any Meccano model.
2. The only seamless *brazed* boiler at the price. The usual soldered boilers leak if water boils dry.
3. Separate engine with solid steel frame—detachable steam union. Can be taken to pieces and re-assembled or run some distance from boiler (by adding extra steam tubing).
4. Superheated steam giving great power and speed. Double power of foreign engines and more than most British ones, even at higher prices.
5. Mods. E & C will take Meccano chain drive.

EXPERIENCE COUNTS

We have concentrated on Meccano steam engines. We know your needs. This unapproachable **5/11** *model is the result.*

Interesting booklet free

Three Models of Solid Brass and Steel only

Mod. D. Single Cyl. as illustrated. With filler. Post 7d. extra. **5/11**

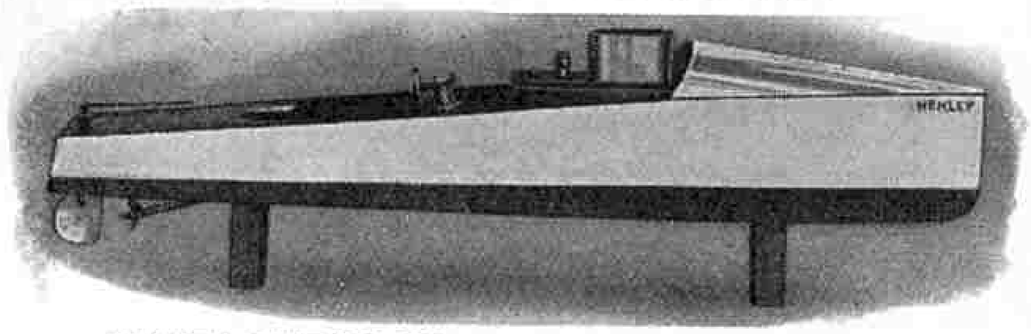
Mod. E. Single Cyl. with geared drive and nickel plated finish. Post 9d. **10/6**

Mod. C. Twin Cyl. with geared drive and super finish. Post 9d. **15/6**

Of all Meccano Dealers or
WORBOYS & SMART
183, King St., LUTON

The "Henley" Steam Launch

An All-British Production



LENGTH OVERALL 24 in. **BEAM 4¼ in.**
Absolutely safe **Practically unsinkable**

A fast and excellent steering craft

SPECIFICATION

HULL—Built of carefully selected mahogany. Strong, light weight, pleasing lines. High freeboard, polished spray hood. Hull enamelled green and white. Adjustable rudder with locking device.

ENGINE—Single cylinder, double acting, oscillating 7/16" ×7/16", solid gunmetal; crankshaft, disc and pin machined from solid steel.

BOILER—Solid copper, **brazed** throughout. **Absolutely safe.** Working pressure 20 lbs., but tested to 100 lbs. Will not damage if allowed to run dry. Efficient safety valve fitted. Non-spill lamp with no wicks to clean.

PROPELLER—Correctly designed 2 bladed propeller of gunmetal.

Price complete with filler, funnel and instructions. Post free **42/-**

Illustrated list of steam, electric and clockwork boats and sailing yachts free on request.

Hamleys Estd 1760
LIMITED

Mail Order Dept. (M),
200/2, REGENT STREET, LONDON, W.1
and branches throughout London

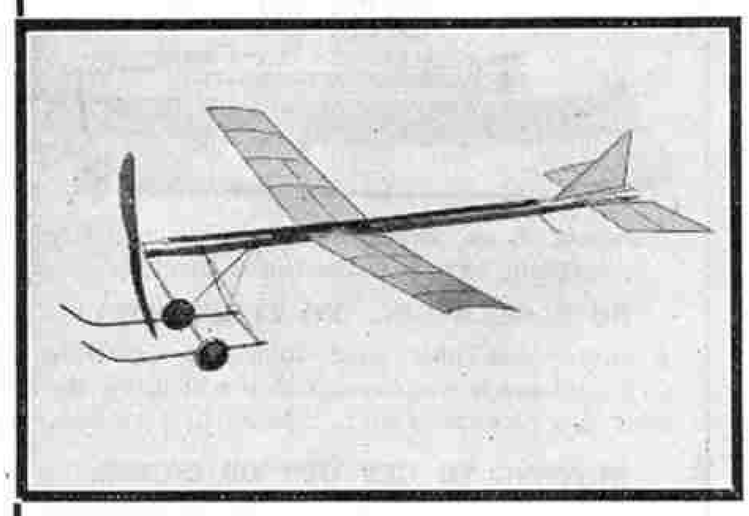
All goods over 10/- sent post free unless otherwise stated.

Hurrah for the Holidays!

No holiday will be complete without a "**SKISAIL**" **MONOPLANE,** as the healthful sport of flying our world-famous Models is most fascinating.

The **1927 "Skisail" Patent Flying Monoplane** stands unrivalled, as no other type can compare for **Price, Design, Performance,** or all those points which make an excellent product.

British Manufacture. Patent No. 138210.



GUARANTEE. — These Models show perfect stability in flight, will rise from ground and will fly 150 to 450 yards, according to size, in straight or circular course.

SPECIFICATION.— Selected Silver Spruce Fuselage, Best Proof Silk-covered Planes, Aluminium Wheels, Polished Propeller. Nos. 0, 1, 2 & 3 fitted with our **Famous Patent Safety Chassis** with **Bamboo Runners.**

No. 0—18/6 No. 3—8/6
No. 1—14/6 No. 4—6/6
No. 2—10/6 No. 5—4/6

Postage 6d. Two sent Carriage Paid.

A Purchaser writes :
"Your 'Skisail' Monoplane showed such excellent flying features that a chum of mine has decided to buy one.—E. P. M. BLACKBURN."

The "Skisail" Monoplane is designed on correct aeronautical lines, constructed with first quality materials (no cardboard parts used), and the holiday season is just the time to get the "Skisail" you have long promised yourself.

Be sure you buy a "Skisail." Insist on a "Skisail." Get none other but a "Skisail."

The "SKISAIL" PATENT MODELS are still the best. Our competitors know it—they TRY to copy them. Purchase direct from the PIONEER INVENTORS.

Send P.O. to:—

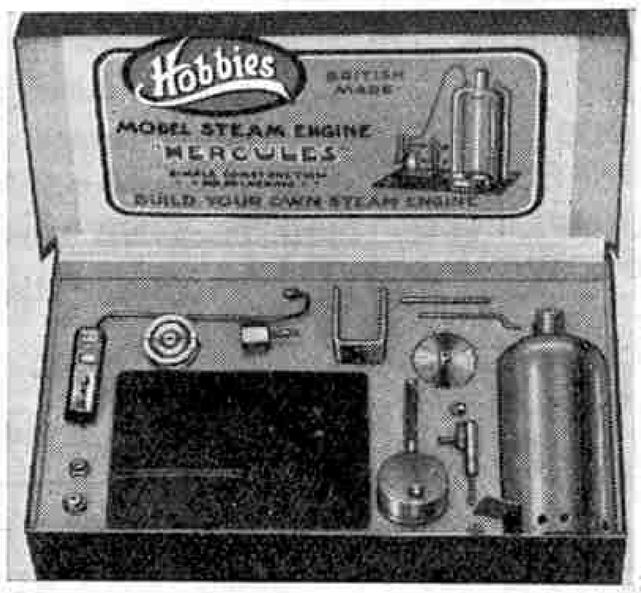
PATENT MODEL MANUFACTURERS,
159, Lymington Avenue, Wood Green, LONDON, N. 22.

Build it yourself!

Never before have you been able actually to construct your own steam engine, but after much experiment Hobbies now offer a box of parts which anyone can put together to make a strong and efficient power plant. The Hercules set is so planned that no soldering is required; simply a screwdriver and a pair of pliers, and the engine is complete within 20 minutes. When built it will drive your Meccano models under steam for a considerable period.

No Soldering or trouble.

HOBBIES "HERCULES" STEAM ENGINE SET



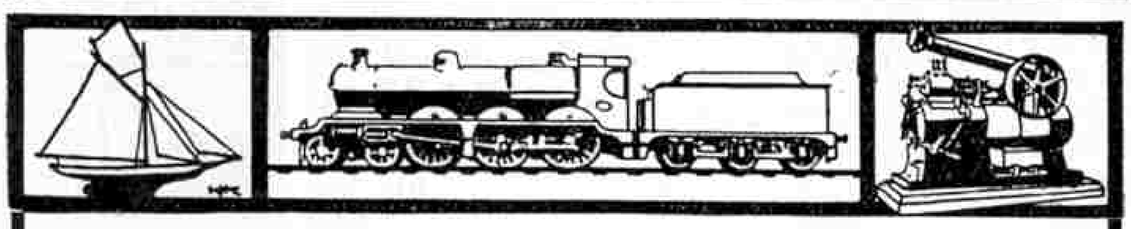
The engine is of brass with large capacity boiler and an enclosed firebox. A safety valve is fitted and a non-spill lamp is supplied. The steam pipe leads to a machined brass cylinder and geared drive, so that two speeds are provided. The whole unit is fitted to a metal base plate.

Complete with fully illustrated instructions **13/6** **Post 9d.**

A SPLENDID PASTIME ANY MECCANO BOY CAN UNDERTAKE

HOBBIES LTD. (Dept. 196), Dereham, Norfolk

Obtainable from Stores and Toyshops or Hobbies Branches in London, Glasgow, Manchester, Birmingham, Sheffield, Leeds, Southampton and Brighton.



Choose your Hobby boys!

Model Railways—Motor Boats, Yachts and Ships—Stationary Engines— Which shall it be?

FIRST make up your mind that nothing but a "Bassett-Lowke" model will do, and then write for catalogue :

RAILWAYS—ENGINES—SHIPS

The Real Thing in Miniature

SECTION A/17.—Model Railways and their equipment. Locomotives, Rolling Stock, Stations, and everything for the complete Model Railway. Over 180 pages. Post free **6d**

SECTION B/17.—Stationary Engines, Boilers, Dynamos, Motors, Boiler and Engine Fittings, Accessories for Stationary and Railway Models. 176 pages. Post free **1/–.**

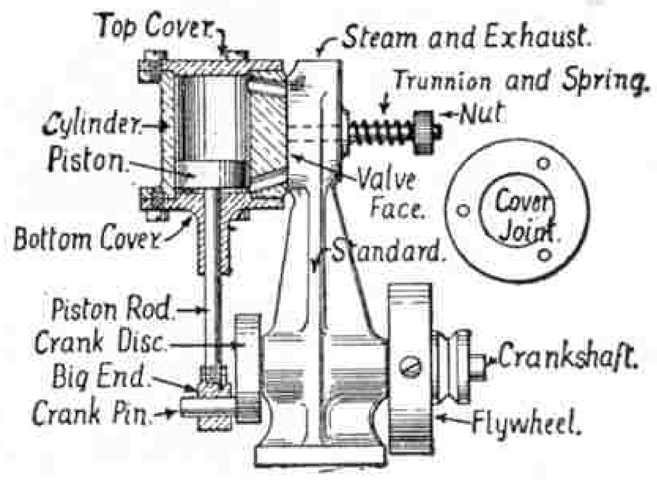
SECTION S/17.— Model Sailing Yachts, Motor Boats, Ships' Fittings and Accessories, Exhibition Ship Models, etc. Over 80 pages. Post free **6d.**

Eighth Edition of the Model Railway Handbook now ready. Price **2/6.** *Postage* **3d.**

BASSETT-LOWKE LTD
NORTHAMPTON
LONDON BRANCH. 112, HIGH HOLBORN, W.C.1.
EDINBURGH BRANCH. 5, FREDERICK STREET

You must have the S.T. ENGINE

to drive your Meccano Models.



This is the drawing which helps you to build the engine.

S.T. Engine Parts	... ...	**5/–**
Finished Boiler	... ...	**8/–**
Finished Plant on Base	...	**17/6**

Post Free.

It is utterly different from the ordinary Toy Shop model engine.

In the first place you have the pleasure of building it yourself.

You need have no fear, we **guarantee** it will work when you have built it.

Secondly, like all Stuart models it is made on correct engineering lines and therefore has **Power.**

The Boiler is of Copper, brazed throughout and tested.

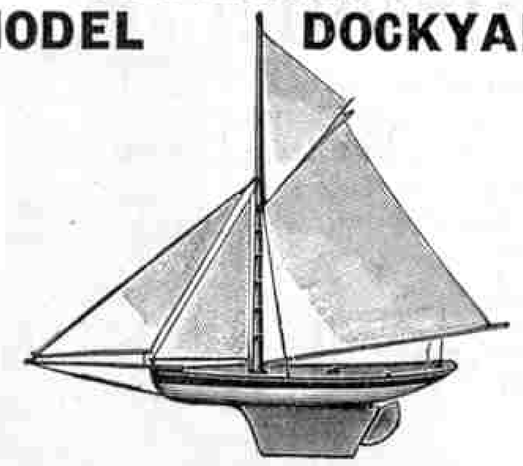
Read what a customer writes :—

"Please send me a trunnion nut for the S.T Engine purchased from you 3 years ago. It is a grand little engine and is running splendidly. I am telling every Meccano boy I see about it. It drives models at an awful speed."

Send a stamp for list 12M which describes this and several other simple models, or better still a Postal Order for 6d. for our new 80 page Engine catalogue, fully illustrated and packed with interest from cover to cover.

Stuart Turner Ltd., Henley-on-Thames

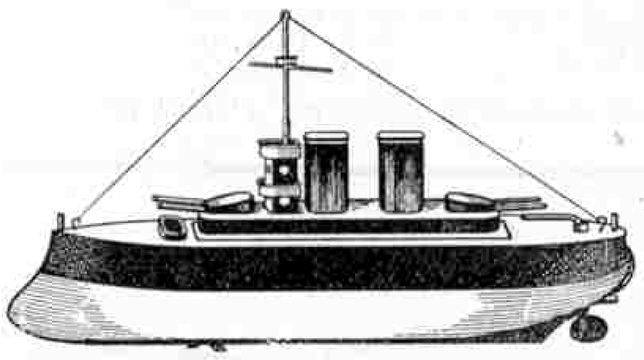
KENSINGTON
MODEL DOCKYARD



Sailing Yachts & Fittings
HOBBIES STEAM LAUNCHES
MOTOR BOATS
HORNBY TRAINS
MECCANO OUTFITS AND PARTS
WORMAR STEAM ENGINES
Requisites for
CRICKET, TENNIS,
FISHING, PHOTOGRAPHY
AIR GUNS AEROPLANES
Electric Motors & Accumulators
Send 1½d. Stamp for List "M"
C. H. LORBERG
185, Kensington High St., London, W.8

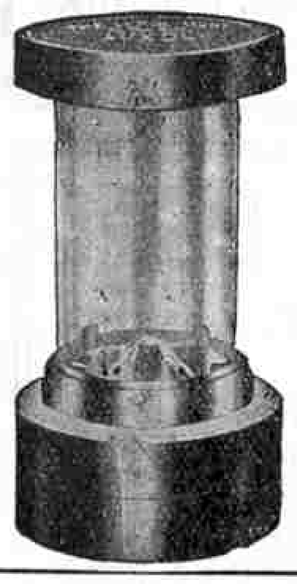
A Windy Day
Hurray! Hurray!
A Lofty Kite for Me
Write for our 1927
KITE LIST
Post Free 1d.
We are Great on
MODEL BOATS
Sailing Boats ... ... 2/6 to 10/6
Racing Yachts ... ... 12/6 to 60/–
Hobbies Steam Boats ... 11/9 to 30/–
Stuart Turner's Henley... ... £2-2s.
Bassett-Lowke's T.B.D. ... 50/–
Clockwork Boats ... 10/6 to 60/–
Boat Fittings in great variety.
C. LUCAS
35, Manchester St., Liverpool

SUTCLIFFE'S
BRITISH MADE
MODEL WARSHIPS



Designed from **British Cruisers,** beautifully finished, and made to last a lifetime.
NO CLOCKWORK. NO ELECTRICITY.
A mysterious and most ingenious principle of propulsion is employed which will drive the boat at a nice speed up to 2 hours at a stretch.
NOTHING TO GET OUT OF ORDER.
Every model is tested to work satisfactorily under its own power, and as there is nothing to get out of order, it will last for years.
12" size **10/6** Postage 9d. extra.
Write for free folder giving full particulars, and for the address of the nearest toy dealer demonstrating these models.
16" size **15/-** Postage 9d. extra.
Sole Manufacturer: J. W. SUTCLIFFE,
ATLAS WORKS, HORSFORTH, near LEEDS.

HOME PHOTOGRAPHY
BUY A
LUXOL"
PATENTED
DARK ROOM
LAMP

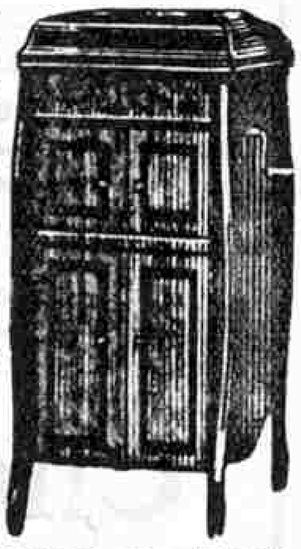


Burns PARAFFIN. No Loose Oil. Special Absorbent Imperishable Wick. No Smoke. Absolute Safety. No Fogging. Ideal when travelling, at School, or on Holidays. Complete in metal case. Always ready. **PRICE 3/–** EXTRA RUBY or YELLOW GLASSES. 1/6 (Post ex.)
From all Dealers or
'Luxol' Safety Light Co. Ltd.
57, SouthwarkSt., London, S.E.

GREAT RECORD BARGAIN !!
THE NEW 1927 IMPROVED MODEL OF THE FAMOUS
"MONARCH" Regd. DE-LUXE LARGE CAMERA
Fitted with genuine GUARANTEED MENISCUS LENS, Reflex Viewfinder, Nickel-plated Spring Lever Shutter, Lever Guard, Flexible Leatherette Handle and absolutely GUARANTEED TO TAKE PERFECT LARGE PHOTOS Size 3½x2½ ins. BRITISH MADE and supplied complete with all Accessories:—Best Quality Plate, Developing & Printing OUTFIT with easy instructions for use. Send P.O. 2/- to-day for complete Camera and Outfit !! Testimonials Galore !!!
SALE PRICE 1/9 ONLY! Post 3d.

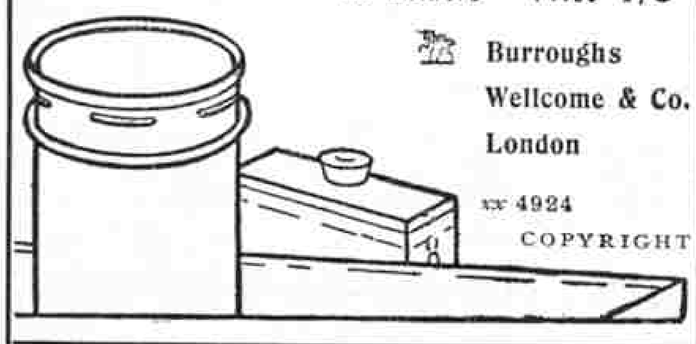
W. J. Thomas, Esq., writes: "Developed and printed photo, think it as good as if taken with a Camera which cost £3." Miss E. Le Cheminent writes: "Astonished to see result of my first effort. The picture is as good as that done by a proper photographer."
Sale Catalogue, 1,000 Big Bargains, Post Free! THE LEEDS BARGAIN Co. (M.), 31, Kendal Lane, LEEDS.

MAKE OR BUY A GRAMOPHONE 100% cheaper than others. Mechanical Parts of a 1st-class RIFANCO-Phone: Double Spring Motor, 12-in. Turntable, Swan Tonearm, Superior Sound Box, Internal Horn as fitted by other firms in £10, £20 Gramophones. All bar the wood. Nett Cash **£1 : 18 : 6**
This set supplied with polished Oak or Mahogany 40 in. high Cabinet as shown, Pedestal **£5** Nett Cash
Carriage paid in U.K. 7 Days' trial. Money back if dissatisfied. Other sets from 18/–. Machines 30 models, Sideboards, Pedestals, Portables, etc., from 19/6. Motors 9/–. 64-page Catalogue of all Accessories FREE. Instructions *How to make Gramophones*, 3d. Est. 23 yrs. 1,000 Testimonials.



Regent Fittings Co., 78D, 120, Old St., London, E.C.1.

Photographers!
Get the best from your snapshots by using
'TANCOL'
TRADE MARK 'TABLOID' BRAND 'TANCOL' TRADE MARK
DEVELOPER
For use in dish or tank.
Gives negatives with the "pyro" quality.
All Dealers *Price* 1/6



Burroughs Wellcome & Co.
London
xx 4924
COPYRIGHT

ROLLER SKATES

Like Meccano and Hornby Trains they are still as popular as ever with all healthy boys and girls.
Many years of wear can be got out of them as they are adjustable to any size.
We sell the best make only, yet our Prices are the lowest in the trade.
No. 3 with Threaded Clamps and Case-hardened Steel Wheels ... 5/– pair
No. 5 with Best Ball-Bearing Wheels 10/– ,,
No. 6 with Best Ball-bearing Wheels and Block Heels, as illustrated 11/– ,,
Postage and Packing 1/–. Colonies and Abroad 5/–
Bateson's Sports Depôt, Blackpool

Photographs
Printed and Developed
24 Hours' Service
V.P.K. - - - - - 1/3
No. 2 Brownie - - 1/3
No. 2a Brownie - 1/6
EXTRA PRINTS
V.P.K. - - - 1d. each
No. 2 Brownie 1½d. ,,
No. 2a Brownie 2d. ,,
POSTAGE FREE
All work carried out by Expert Staff with latest appliances
HIGHEST QUALITY OF GOODS USED
CASH WITH ORDERS
H. H. PARSON (Photo Dept.)
55, NORTHCOTE ROAD - S.W. 11

HARBUTT'S

PLASTICINE

The indispensable adjunct to all users of "Meccano" Construction Sets and Miniature Railways: your little screws and small sections do not roll away and get lost the moment you put them down if you dab them on a slab of Plasticine, that alone is worth all the cost of the "Rainbow" which is only 1/- post free. There are dozens of other things you can use it for too!

Harbutt's Plasticine Ltd.,
99, Bathampton, Bath.

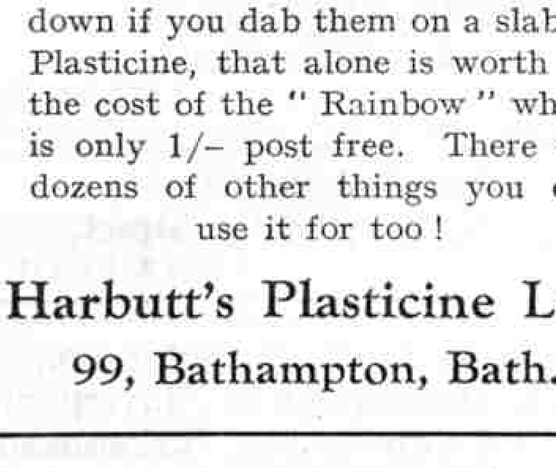
A *Veeder*
CYCLOMETER
FITTED TO
YOUR BICYCLE
TELLS YOU:

How far you have been.
Distance from one place to another.
Service your tyres give you.
Number of miles to destination.
Distance travelled, &c.

Make your riding doubly interesting. Its accuracy has been endorsed by all the best authorities and the experience of your fathers for 30 years.

Insist upon a genuine Veeder—see the name thereon.

Made in Two Models:
Regular 6/6, Trip 15/-.
F. E. DICKINSON, St. Andrew's House, Holborn Circus, LONDON, E.C. 1.



Our Fine Model of the L. & N.E.R. "Director" Class Locomotive.
Gauge 0. Electric or Clockwork.

This is only one of many beautiful Models which we offer. Parts and Fittings for Home Construction a speciality.

The LEEDS MODEL Co. Ltd.,
Dept. M., BALM ROAD, HUNSLET, LEEDS.

OUR PROVED AIR SUPREMACY

THE
D.A.P. MODEL AEROPLANE
SPEAKS FOR ITSELF!

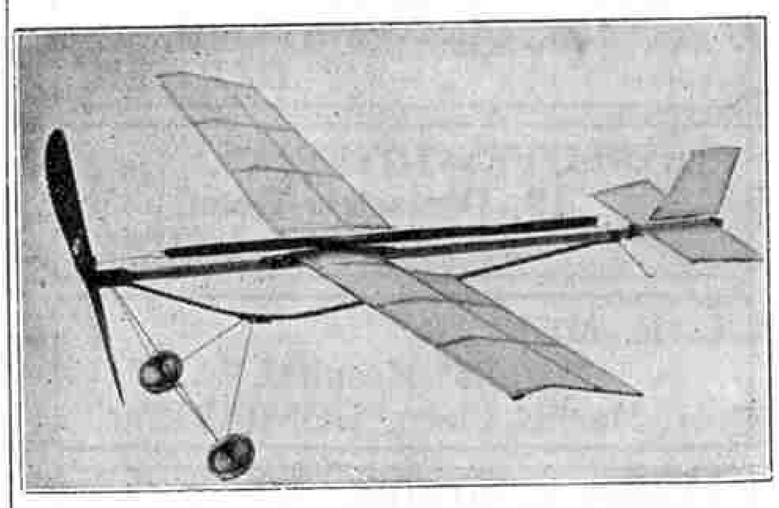
Latest Successes 1927:—

Gamage Cup for Duration, April 9th.
Sir John Shelley Cup, Power Driven, June 4th.
Awarded Medal in Farrow Shield Contest, June 25th.

The only Model Aeroplane on the market which has gained any award in Model Flying Competitions, officially recognised by the Royal Aero Club of Great Britain.

The Firm with over 20 Years' Experience in Model Aeronautics, 1907–1927.

Buy the Aeroplane with the Proved Performance.



This is our No. 6 Tractor Monoplane.
Length 24 ins. Span 22 ins.
which will fly 150 yards.
(Distance doubled under favourable conditions). Fitted with a D.A.P. Hand Carved Propeller (not Bentwood). This Model will rise from the ground. Price **10/6.** Carriage and Packing U.K. **1/-** extra.

Hand Launched Pusher Monoplane. Flies 200 yds. An all round good flyer. Price **5/-**. Carriage and Packing U.K. **9d.** extra.

Set of Materials, including Finished Carved Propeller, Drawing and Instructions to construct a fine Biplane Model. Length 24 in. Span 22 in. Price **8/6.** Post Free U.K.

We supply everything for the construction of Model Aeroplanes. Illustrated Catalogue 4d.

Our Guarantee. Cash refunded on any of our Models that will not fly the distance claimed.

THE D.A.P. MODEL AERO CO. (Dept. M9), 187, Replingham Road, South Fields,
'Phone: Putney 0636. **London, S.W.18.**

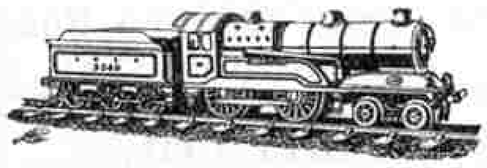
HOLIDAY TIME IS CYCLING TIME

therefore AVOID TYRE TROUBLE

and go care - free on your way. Tubes treated with our IMPERVO increase the joys of your Cycle.

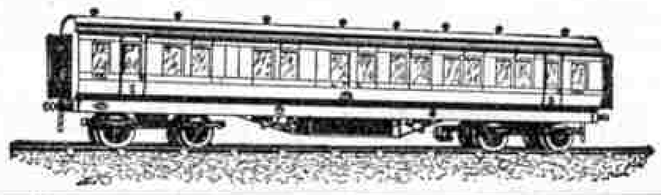
"The Story of IMPERVO"
FREE
to Meccano Readers.
Write NOW for a Copy.

H. COLYER & CO.
(Dept. 31a),
5, Point Hill, Greenwich, S.E.10.



By Hallmark of Quality.
L·M·C
Accurate to Scale
Perfect in Detail

CATALOGUE full of INFORMATION and ACCURATE ILLUSTRATIONS. New Edition, 1/- Post Free. 134 Pages.



JENNERS
PRINCES STREET. EDINBURGH
LIMITED

EDINBURGH
AGENTS
for MECCANO and
Hornby Trains

A complete stock of all Hornby Train Accessories and Meccano Parts

JENNERS PAY CARRIAGE

A YACHT 30" HIGH **12/9**
(Post Free)

Just the thing for the Holidays

"REGATTA" RACING YACHTS

This Yacht is 30" high with an 18" Deck and carries four white sewn sails which can be readily adjusted, like a real Yacht. There is a **Lead Keel** which makes for steady sailing. Mast and Rigging are removable for carrying. The Yacht is beautifully enamelled and lined in attractive colours; it is guaranteed to sail.

SEND for Fine Coloured Catalogue illustrating our series of Model Yachts

PANTOYS LIMITED
7, Promenade : Cheltenham
and 37, Westgate St., Gloucester

Meccano & Hornby Train Supplies

All the dealers whose advertisements appear on this page carry full stocks of Meccano Outfits, Accessory Outfits and Meccano parts, Hornby Trains and Hornby Train Accessories all the year round. The names are arranged in alphabetical order of town.

HARRY BROWN,
1, Moss Lane,
ALTRINCHAM.

J. WOODHALL,
256, Grange Road,
'Phone: B'head 621 BIRKENHEAD.

MERCER'S DOLLS' HOSPITAL,
68, Darwen Street,
BLACKBURN.

BATESON'S SPORTS DEPOT,
Abingdon Street,
BLACKPOOL.

SELLEN'S BAZAAR,
54, Waterloo Road,
BLACKPOOL, S.S.

J. MORRIS, F.C.O.,
70, Knowsley Street,
Tel. 1074 BOLTON.

BROWN, MUFF & CO. LTD.,
BRADFORD.

JOHN TAYLOR,
28, Preston Street,
Tel.: Brighton 957 BRIGHTON.

GYLES BROS. LTD.,
Tel. 2888 24, Bridge Street, BRISTOL.
188, Whiteladies Road, Clifton, BRISTOL.
Tel. 143

JOHN HALL (TOOLS) LTD.,
BRISTOL. NEWPORT.
CARDIFF. SWANSEA.

SALANSON LTD.,
20, High Street, BRISTOL.
4, High Street, CARDIFF.

SAM TAYLOR,
Silver Street,
Tel. 320 BURY.

HAROLD HUNT,
38, Spring Gardens,
Tel. 202 BUXTON.

H. W. GILL,
23 & 24, Pittville Street,
CHELTENHAM SPA.

R. H. JEPSON,
1, Cross Cheaping,
COVENTRY.

PURSEY & MOCKRIDGE,
The Sports Outfitters,
Tel. Dartford 173 DARTFORD.

HENRY WHALLEY,
195, Duckworth Street,
DARWEN.

RATCLIFFES TOYERIES,
19, Osmaston Road,
DERBY.

C. E. MELLER,
"Dolls' Hospital,"
41, Market Place, DONCASTER.

JAMES L. DIXON,
14, Suffolk Street,
(off Grafton St.), DUBLIN.

DIXON'S,
41, High Street,
DUNDEE.

DRAFFEN & JARVIE LTD.,
Nethergate,
DUNDEE.

BASSETT-LOWKE LTD.,
5, Frederick Street,
EDINBURGH.

WRIGHT'S DOLLS' HOSPITAL,
14, High Street,
ERDINGTON.

ROBERT BALLANTINE,
103½, St. Vincent Street,
GLASGOW.

C. BELL (The Children's House),
320, Byres Road, Hillhead,
GLASGOW, W.2.

CLYDE MODEL DOCKYARD,
22-23, Argyll Arcade, GLASGOW.
Model Makers to the Admiralty, the Railway Coys., etc.

The MARVEL MART (Wm. Ross & Co.),
110, West Nile Street,
GLASGOW.

WELTON & MESSENT,
5, Pond Street,
HAMPSTEAD, N.W.3.

FLETCHER'S TOYLAND,
77, Deardengate, HASLINGDEN.
Grand Building, RAWTENSTALL.

GAMLEYS,
The Hove Hornby Train Store,
78, Church Road, HOVE.

HAMMOND'S LTD.,
Paragon Square,
HULL.

PEARSON & DENHAM (PHOTO) LTD., 6, Bond Street,
LEEDS.

ROBOTHAM,
"Baby's Kingdom,"
Tel. 4809 LEICESTER.

BYCROFTS EMPORIUM,
366, High Street,
LINCOLN.

C. LUCAS, Hobbies Depôt,
35, Manchester Street,
LIVERPOOL.

Reliance Cycle & Motor Co.,
29/31, Manchester St., Liverpool.
Argyle & Conway Sts., Birkenhead.

The ARUNDEL CYCLE & SPORTS STORE, 52, Church Road,
Upper Norwood, LONDON, S.E.19.

F. R. POTTER & SON,
43, Market Place,
LOUGHBOROUGH.

H. G. PARTRIDGE & CO.,
10, Chapel Street,
Tel. 234 LUTON.

A. FRANKS LTD.,
95 & 97, Deansgate, MANCHESTER.
90, Bradshawgate, BOLTON.

A. INMAN, MANCHESTER.
105, Lapwing Lane, Didsbury. Tel. 1518.
179, Dickenson Rd., Rusholme. Tel. 2241.

EDWARD LLOYD,
268, Upper Chorlton Road,
Tel. 613 Chorlton MANCHESTER, S.W.

JOHN NESBITT LTD.,
42, Market Street,
MANCHESTER.

H. WILES LTD.,
124, Market Street,
MANCHESTER.

Meccano & Hornby Train Supplies

The fifteen dealers whose advertisements appear on this page carry full stocks of Meccano Outfits, Accessory Outfits and Meccano parts, Hornby Trains and Hornby Train Accessories all the year round. The names are arranged in alphabetical order of town.

R. SCUPHAM & SONS,
35, Linthorpe Road,
MIDDLESBROUGH.

WILLIAM OLLIFF,
13, Grainger Street West,
NEWCASTLE-ON-TYNE.

JANES & ADAMS,
13, The Promenade,
And Branches. **PALMERS GREEN.**

R. MARSDEN & SON LTD.,
115, Church Street,
Tel. PRESTON 1314 **PRESTON.**

DEAN & HOLT,
78, Yorkshire Street,
ROCHDALE.

ROCHESTER.
GERALD MORRIS,
24, High St., ROCHESTER.

SHEFFIELD PHOTO COMPANY,
6, Norfolk Row (Fargate),
'Phone 3891 **SHEFFIELD.**

THE REDGATE CO.
(SHEFFIELD) LTD.,
Moorhead, SHEFFIELD.

WILSON, GUMPERT & CO. LTD.,
57, Fargate,
Tel. 489 **SHEFFIELD.**

BIRMINGHAM & COVENTRY CYCLE CO., 140 & 151, Above Bar,
SOUTHAMPTON.

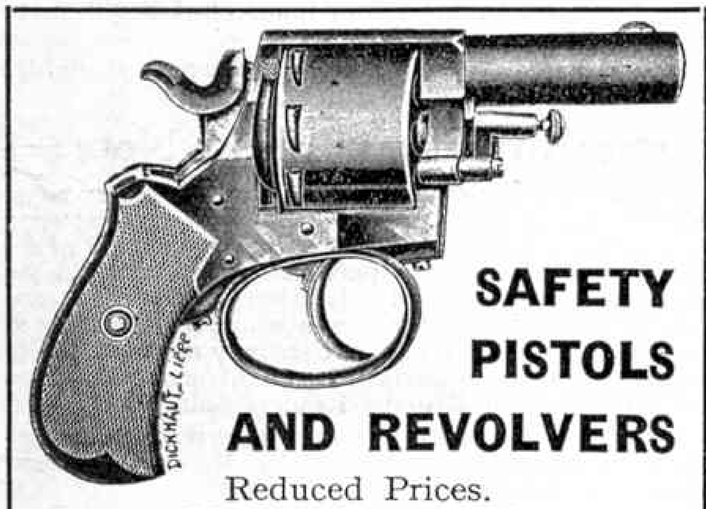
OSBORN & CO.,
9, High Street,
SOUTHAMPTON.

S. T. SIMPSON & SON,
589-595, Lord Street,
Tel. 999 **SOUTHPORT.**

H. W. GINN,
The London Motor, Cycle & Sports Co.,
Tel. 252 Staines 106, High St., **STAINES.**

SAXONS LTD.,
29/30, Holmeside,
SUNDERLAND.

SPORTS HOUSE **WOKING & WEYBRIDGE.**



SAFETY PISTOLS AND REVOLVERS

Reduced Prices.
No Permit required.

4½ in. Single Shot	...	...	1/11
6½ in. ,,	,,	...	2/6

REVOLVERS

5 in. Eight Shot	...	...	6/11
6½ in. Ten Shot	...	...	12/6
8 in. Full Size Colt Twelve Shot			15/6
Automatic Shape Revolver			8/6
Automatic with Self-ejecting Magazine	...	...	11/6
Blank Cartridges	...		1/4 per 100

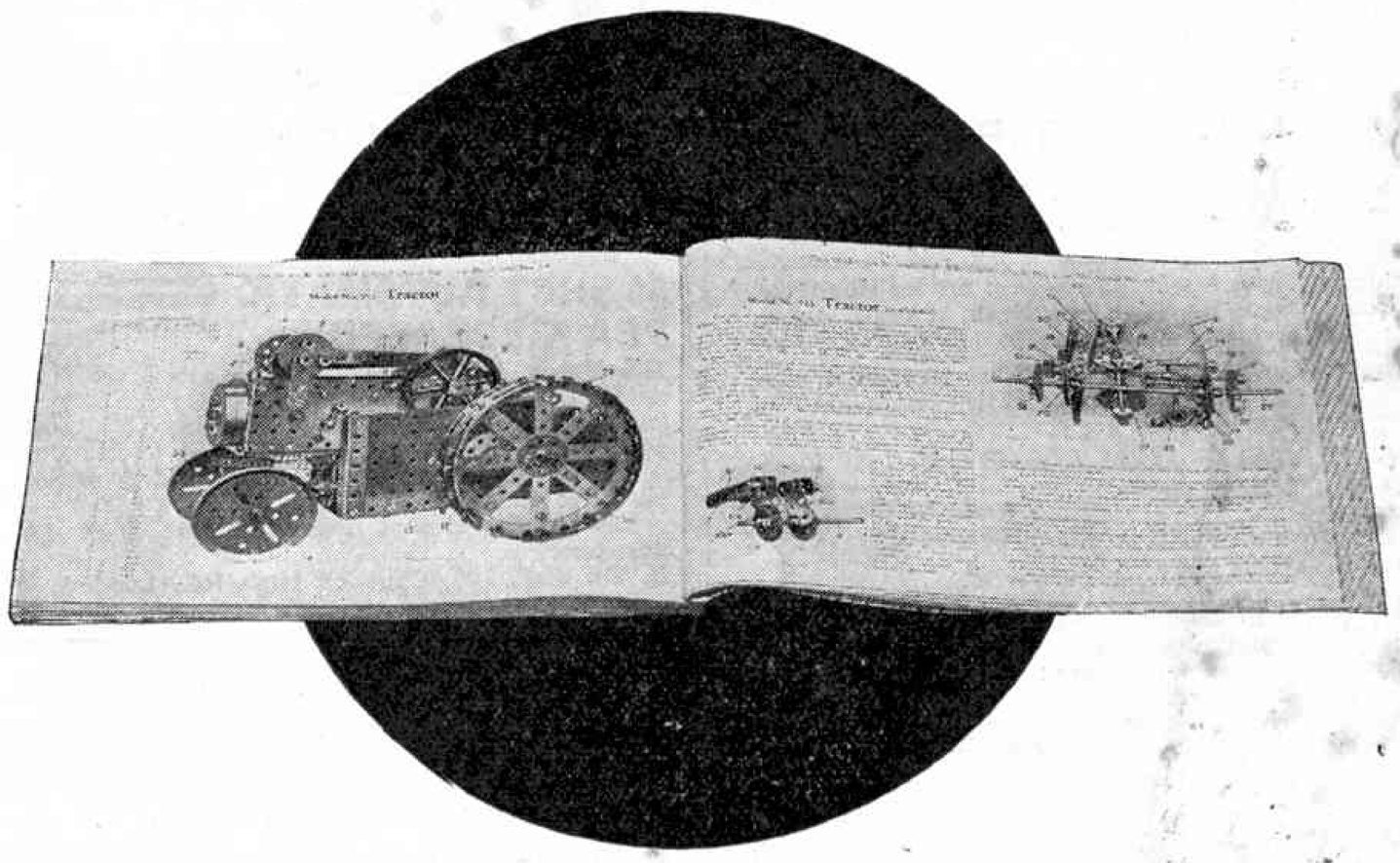
Postage **6d.** up to 6/11 size.
Larger Sizes **9d.** without Cartridges.

A. G. STEPHENS,
24, High Street Arcade, Cardiff.

"MECCANO MAGAZINE" BINDERS

There is no better way of keeping your Magazines clean and tidy than by binding them in one of the special binders we supply. These binders have strong stiff backs, covered with black imitation leather, tastefully tooled, and are lettered in gold. The large binder holds 12 Magazines—price 3/6 post free. The small binder holds 6 or 8 Magazines—price 3/– post free. Meccano Ltd., Binns Road, Liverpool.

The Meccano Instruction Manuals



The 1927 edition of the Complete Manual of Instructions is a superb production. It contains very clear illustrations—mostly in half-tone—and gives instructions for building over 380 models, covering every Outfit from No. 0 to No. 7.

Many models have been revised and a number of new models are included. Amongst these may be mentioned the Vertical Steam Engine, Log Saw, Tractor, Motor Cycle and side car, and 4–2–2 Locomotive, while numerous other models have been revised and brought up to date. A carefully prepared index is provided, giving ready reference to every model in the book. The price of the Manual in the United Kingdom is 2/6, or 2/10 post free. Overseas edition, 3/6, or 3/10 post free.

There are two other Meccano Instruction Manuals, the 0 Manual, containing models built with 00 and 0 Outfits, and the 0-3 Manual, comprising models built with any of the Outfits up to and including No. 3. Prices, including postage: 0 Manual, U.K., 5d.; Overseas, 7d. 0-3 Manual, U.K., 1/1½; Overseas, 1/7½. The Manuals are obtainable from all Meccano dealers or direct from Meccano Ltd., Liverpool.

READERS' SALES

(Rate: 1d. per word, min. 1/-).

Hobbies Steam Launch Peggy 15/-. King 1,000-Shot Air Gun, 5/-. Horizontal Steam Engine, cost 15/-, take 10/-. Stop Watch cost 15/6, take 10/-. Alarm Clock, 2/6. Crystal Set, 10/-. Nearest offers accepted. All almost new, in good condition. Postage extra.—V. Maher, Greenwood, Blackrock, Dublin.

Sale. Album containing over 1,700 Stamps, 15/-. Also 4/11 Miniature Railway, 2/9. Cigarette Cards, 100 1/-.—Burch, 15, Woodfield Avenue, Streatham, London.

Sale. 3,000 Cigarette Cards, 1/- 100.—E. Solly, 1, Digby Street, Lenton, Nottingham.

Two Diana Air Pistols, almost new. What offers?—Turner, Wellacres, Blockley, Worcs.

Wormar Engine, only used four times. Cost 10/6. Accept 7/6.—Bennett, 14, Davis St., Swindon, Wilts.

For Sale. Banjulele, Tutor and Capo, 14/-. Worth more. Also Air Rifle. Good condition, 7/-.—Apply W. H. Chapcott, 117, Divinity Road, Oxford.

Stamp Collection, catalogued £30, £5 or near offer.—R. Rigby, 20, Coniston Road, London, N.10.

Large Model Steam Engine, brass riveted boiler, heavy flywheel, cost £6. Sell £2, or exchange Home Cinematograph.—Brian Osborne, John Street, Sligo.

Sale. New Gibbons' hinged loose-leaf Album containing 150 stamps correctly mounted. Also about 1,500 different Stamps, Perforation Gauge, Watermark Detector, 2,000 Stamp Mounts, and 1927 Catalogue. Must sell. What offers? No reasonable offer refused. —Grigs, Crowborough, Sussex.

Cigarette Cards, 4d. 100, sets 50 5d. Send want lists.—Potts, 42, Alma Road, Windsor.

1,000 Imperfect Cigarette Cards 1/9, Postage 6d. 1,000 Ordinary Assorted 3/6, Postage 6d. Lists Free.—Thornton, 159, Grosvenor Road, Wavertree, Liverpool.

Model Sailing Yacht, cost 13/6. Magic Lantern, with 30 slides. Hammer-head Crane, 1 ft. 6 ins. high. *"M.M."* July 1921—January 1927. All going cheap. What offers? Ridehalgh, Eccles Road, Chapel-en-le-Frith.

Sale. Fretwork and Woodwork Tools and Electrical Objects. Lists. Earl, Chester Road, Middlewhich.

Wanted, bound volumes or loose copies of the "Boy's Friend," 1898 to 1907. State price. Box 801.

Wanted "Meccano Magazine" No. 1 at 1/-. Box 802.

For Sale, "Pathe" Cinematograph. Will take £4—worth double. A. Angel, 19, Waldeck Road, Dartford, Kent.

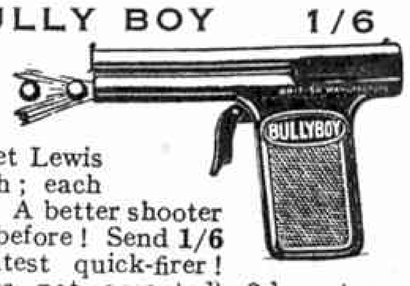
SMALL ADVERTISEMENTS

CINEMATOGRAPH FILMS FOR SALE CHEAP. Write for List.—I. Walton, 88, Barkerend Road, Bradford, Yorks.

Patents, Trade Marks, Inventions, Advice Handbook & Cons. free.—B. T. King, Regd. Patent Agent, 146a, Qn. Victoria St., London, E.C.4. 40 years' refs.

The "Knockout" Gent.'s Nickel Keyless Watch, 3/11. Post 3d.—Agent, 20, Holcroft Hill, Barrow-in-Fur.

1/6 THE BULLY BOY 1/6



20-Shot Rapid Repeater Action Pea Pistol. Fires a pea 25 feet at the rate of 100 a minute. A regular Pocket Lewis Gun! Bright nickel finish; each in box with ammunition. A better shooter than you have ever had before! Send **1/6** and don't miss our latest quick-firer! Colonial Orders (Stamps not accepted) 9d. extra.
J. Bishop & Co., 41, Finsbury Square, London, E.C.

MECCANO WRITING PADS

These Writing Pads are becoming increasingly popular and most of the letters we receive from Meccano boys are written on the familiar tinted paper. The pads are supplied in two sizes, each consisting of 50 sheets of printed bank paper, with cover. They are just the thing to use when writing to your friends, for the special notepaper shows at once that you are a Meccano boy.

Prices—Large, 1/- each (post free); Small, 6d. each (post free), from Meccano Ltd., Binns Road, Liverpool.

This Month's Special Articles

	Page
Air News of the Month	682
A Tour Round the World	670
Books to Read	712
Britain's Mightiest Locomotive ...	703
Chemical Gardens	714
Competition Page	727
Conquest of the Air	676
Eclipse Competition Results ...	717
Engineering News of the Month ...	706
Exploring the Arctic	673
Famous Inventors—James Watt ...	684
Famous Trains—"The Fishguard Express"	694
Fireside Fun	742–3
From Our Readers	698
Guild Pages	736–7
In Reply	724
Killing Fish with Dynamite ...	689
Longest Suspension Bridge in the World	708
Manchester Ship Canal—II.	666
Model-building Competition ...	731
Model-building Contest Results ...	728–9–733
Our Busy Inventors	700
Our Wonderful World	720
Outdoor World	692
Railway News of the Month ...	690
Stamp Collecting	739
Story of Coal	678
Suggestions Section	722
Wonders of Salvage	718

BOYS MAKE YOUR OWN LEAD SOLDIERS

Cowboys, Indians, Animals, Zulus, Model Station Staff, Rodeo, etc. Our CASTING MOULDS make thousands from any scrap lead WITHOUT PREVIOUS EXPERIENCE. Send stamp to-day for Illustrated catalogue.
Complete mould ready for work **2/6.**
RODWAYS, 102, Long St., Birmingham
Mention "Meccano."

DISGUISE

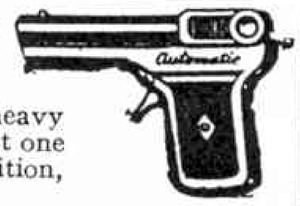
Original and instructive pocket MAKE-UP OUTFIT for Actors, Detectives and others.

Price 3/- each complete (post free)

Overseas 6d. extra.

Milton, 24, Station Parade, Norbury, London, S.W.16.

50 SHOT AUTOMATIC PEA REPEATER



The Super Pea Pistol. New heavy model, best black finish, 50 shots at one loading, each in box with ammunition, post free **2/9.**

The well-known 25-shot Automatic Pea Repeater, post free **2/3.**

New Model 17-shot Pea Repeater, black finish, post free **1/3.**

R. DILNOT, 125, Chiswick High Rd., London, W 4.

NATURE STUDY

Obtain your supplies of Books, Collecting Apparatus and Specimens from

WATKINS & DONCASTER, Dept. M.,
36, Strand, London, W.C.2 (P.O. Box 126).
'Phone: Gerrard 9451. Full Catalogue Post Free.

TORTOISES : GOLDFISH

LAND TORTOISES for your garden and greenhouses. Easily kept, and interesting, 2/- and 3/- each, carriage paid to your house.

GOLDFISH, all Colours, from 3d. each.

Fancy Fish also in stock.
Aquariums from 1/6 each.
Weed, Snails, Food, Instructional Books.
All Accessories for most interesting hobby.
Stamp for Illustrated Price List.

DE VON & CO.,
127, KING'S CROSS ROAD, LONDON, W.C.1.
'Phone: Museum 0767. Telegrams: "Oiseaux, London."

MECCANO MAGAZINE

Registered at G.P.O., London, for transmission by Canadian Magazine Post.

EDITORIAL AND ADVERTISING OFFICES:—
BINNS ROAD, LIVERPOOL.
Telegrams: "Meccano, Liverpool."

Publication Date. The *"M.M."* is published on the 1st of each month and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price 6d. per copy. It will be mailed direct from this office, 4/- for six issues and 8/- for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

Advertisements

Readers' Sales and Wants. Private advertisements (*i.e.*, not trade) are charged 1d. per word, minimum 1/-. Cash with order. Editorial and Advertising matters should not be dealt with on the same sheet of paper (see important notice below).

Small Advertisements. 1/- per line (average seven words to the line), or 10/- per inch (average 12 lines to the inch). Cash with order (see important notice below).

Display. Quotations for space bookings, and latest circulation figures, will be sent on request.

Press Day, etc. Copy should be sent as early in the month as possible for insertion in following issue. We usually close for press on or before 10th of each month for following issue. Half-tone blocks up to 100 screen.

Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher copies. Sent free to advertisers booking two inches or over. Other advertisers desiring vouchers should add 8d. to their remittance and should order voucher copy at same time.

Remittances. Postal Orders and Cheques should be made payable to Meccano Ltd.

Stamp Advertisers Please Note:—

The Readers' Sales and Wants column is reserved for advertisements dealing only with collections of stamps as a whole. A collection that is being disposed of on approval sheets, or by packets or sets, should be advertised in the small advertisement column, the rate for which is 1/- per line, average seven words to the line. Although the advertiser may not be actually conducting a stamp business, such advertisements are not to be classified under Readers' Sales and Wants.

Advertisers are asked to note that private advertisements of goods manufactured by Meccano Limited cannot be accepted.

Obtaining the *"M.M."* Overseas

Readers Overseas and in foreign countries may order the *Meccano Magazine* from regular Meccano dealers, or direct from this office. The price and subscription rates are as above, except in the case of Australia, where the price is 1/- per copy (postage extra), and the subscription rates 8/- for six months and 16/- for 12 months (post free).

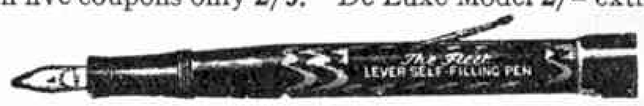
IMPORTANT.

Overseas readers are reminded that the prices shown throughout the *"M.M."* are those relating to the home market. Current Overseas Price Lists of Meccano Products will be mailed free on request to any of the undermentioned agencies. Prices of other goods advertised may be obtained direct from the firms concerned.

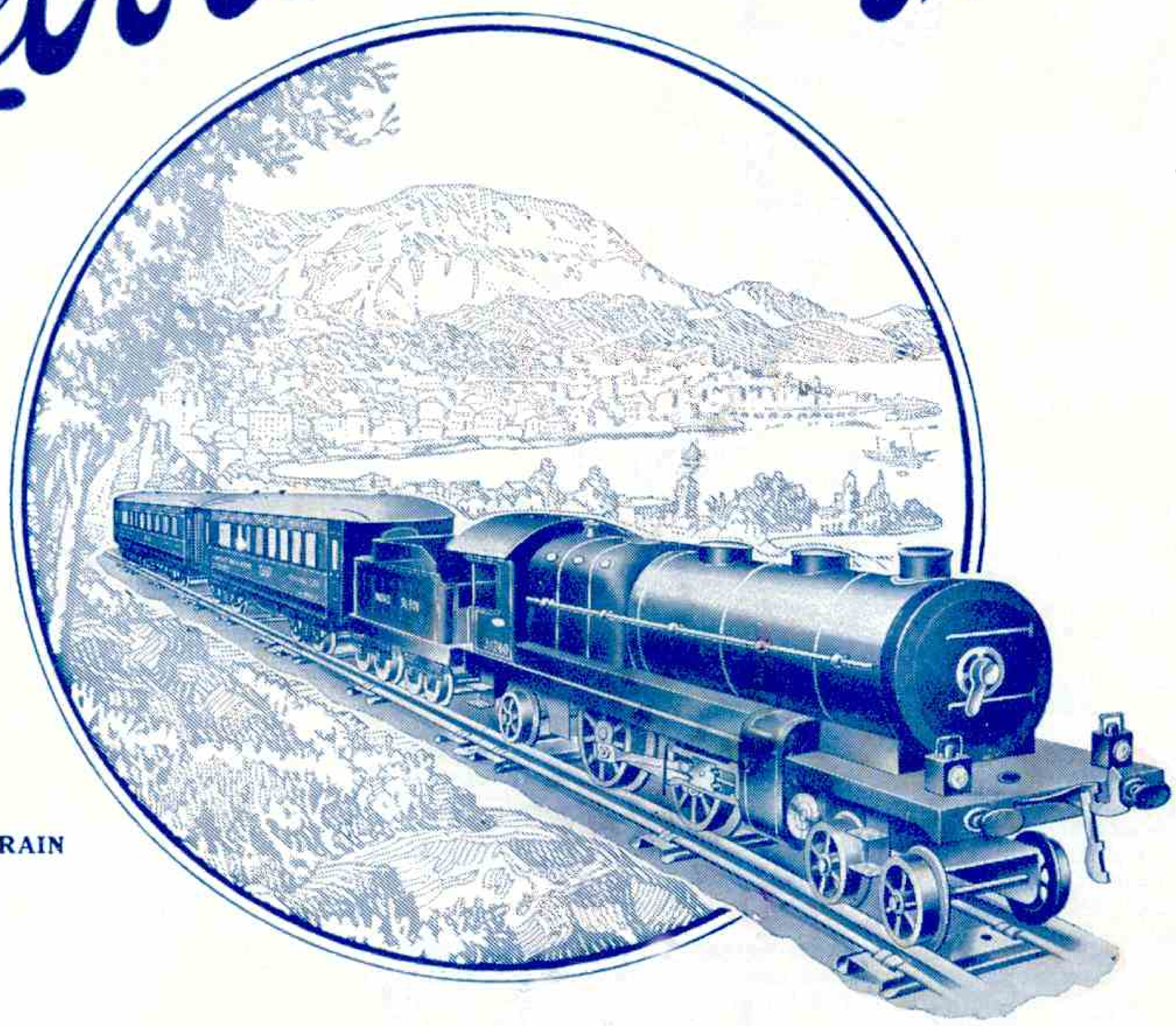
CANADA: Meccano Ltd., 45, Colborne Street, Toronto.
AUSTRALIA: Messrs. E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W.
NEW ZEALAND: Messrs. Browning, Ifwersen Ltd., P.O. Box 129, Auckland.
SOUTH AFRICA: Mr. A. E. Harris (P.O. Box 1199), Textile House, Von Brandis St., Johannesburg.

CUT THIS OUT

"MECCANO" PEN COUPON, VALUE 3d. Send 5 of these coupons with only **2/9** (and 2d. stamp) direct to the **FLEET PEN CO., 119, Fleet Street, E.C.4.** By return you will receive a handsome lever self-filling **FLEET S.F. PEN** with solid gold nib (fine, medium or broad), usually 10/6. Fleet price **4/-**, or with five coupons only **2/9.** De Luxe Model **2/-** extra.



The Riviera "Blue" Train



THE
RIVIERA "BLUE" TRAIN

THE Riviera "Blue" Train, as the Calais-Mediterranean Express is familiarly called, runs between Calais and the Mediterranean Coast. Inaugurated to meet the requirements of wealthy passengers travelling from London to the fashionable French watering places, it is unequalled in the luxury of its accommodation.

The Coaches, the property of the International Sleeping-Car Company, are built of steel, wood being used for internal decorations only. The exteriors are elaborately finished with royal blue panelling with gold-leaf lining, hence the title of the train.

The "Blue" Train, introduced last year to the Hornby Series, is a model of this famous train. Distinguished in appearance, strongly built and beautifully finished in correct colours, it is supplied with either electric (4-volt) or clockwork loco.

RIVIERA "BLUE" TRAIN SET No. 1

contains Electric Loco, Tender, two Coaches, Resistance Controller and Electrical Rails to form a circle 4-ft. in diameter. The Loco is fitted with an electric motor which is operated from a 4-volt Accumulator or from a suitable transformer connected to the main (alternating current only). Gauge 0.

Riviera "Blue" Train Set No. 1, complete, well boxed Price	85/-
"Blue" Train Loco No. 1 ... ... ,,	37/6
"Blue" Train Coach No. 1 ... ... ,,	16/6
"Blue" Train Tender No. 1 ... ... ,,	4/6
Resistance Controller ... ... ,,	3/6

RIVIERA "BLUE" TRAIN SET No. 2

contains a powerful Clockwork Loco, Tender, two Coaches and set of rails including a Hornby Control Rail. The Loco is fitted for Hornby Control and has reversing gear and brake mechanism. Gauge 0.

Riviera "Blue" Train Set No. 2, complete, well boxed Price	70/-
"Blue" Train Loco, No. 2 ... ... ,,	27/6
"Blue" Train Tender No. 2 ... ... ,,	4/6
"Blue" Train Coach No. 2 ... ... ,,	16/6

A HORNBY TRAIN LASTS FOR EVER!

BRITISH AND GUARANTEED

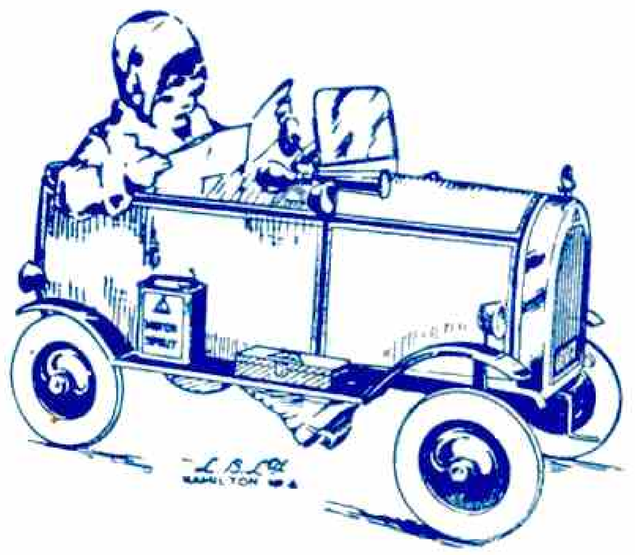
HORNBY TRAINS

Manufactured by MECCANO LIMITED, BINNS ROAD, LIVERPOOL

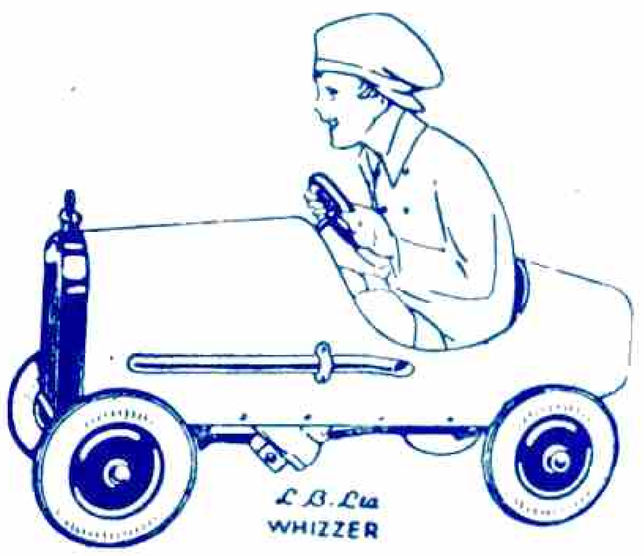
Take a 'NEPTUNE' away with you!

It's easily packed and only takes a minute or two to assemble. The Bar is 36" long, finished white or red, and is fitted with two bladders, attached by rustless wire frames. It will easily support an adult and affords hours of jolly good fun in the water. Everybody will take a Neptune this year. Don't delay—be sure you get *yours*. It will make your holiday an assured success. You can get one from good toy shops, sports dealers or stores, and it will cost you just **7/6**

FREE. *If you would like further details, send for the illustrated NEPTUNE Folder to-day!*



HAMILTON No. 4. Rather a jolly little 'bus' with balloon disc wheels, 5 lamps, bulb horn, driving mirror, adjustable windscreen, tool box, petrol can, adjustable seat, dash board, mudguards, a handsome nickel plated radiator, etc. It is fitted with Lines Bros. unique double crank drive with rubber pedals and has a door on the near side to open. Very complete like a real car - but costs only - - - - - - - - £3 : 3 : 0



WHIZZER No. 4. A speed car for the racing man. Body is made entirely of steel, nicely streamlined and fitted with a copper exhaust pipe. Black enamelled steel radiator and motometer are also fitted. Painted bright red, only - - - £2 : 8 : 0

SPORTS CAR No. 5. Quite the smartest Sports Model on the road. Beautifully streamlined polished aluminium body is nicely upholstered in red leather-cloth. Red disc wheels with balloon tyres and red mudguards make it really "hot stuff." Brake working on the back axle, horn, starter buzzer, adjustable windscreen, etc., are included. As illustrated. - - - - Can be supplied fitted with electric light. Extra 30/- £9 : 3 : 0

Lines Bros. Tri-ang Toys

Obtainable from all good toyshops and stores

British Made by

LINES BROS. LTD.

Tri-ang Works, Morden Road, Merton, S.W. 19

L. BROS. LTD. LONDON
BROS.
ENGLAND

Regd. Trade Mark.

PUBLISHED BY MECCANO LTD., BINNS RD., LIVERPOOL.
Printed by Stembridge & Co. Ltd., Albion Street, Leeds