VOL. XII. No. 1 JANUARY 1927

MECCANO MAGAZINE

THE SYDNEY HARBOUR BRIDGE (See page 2)

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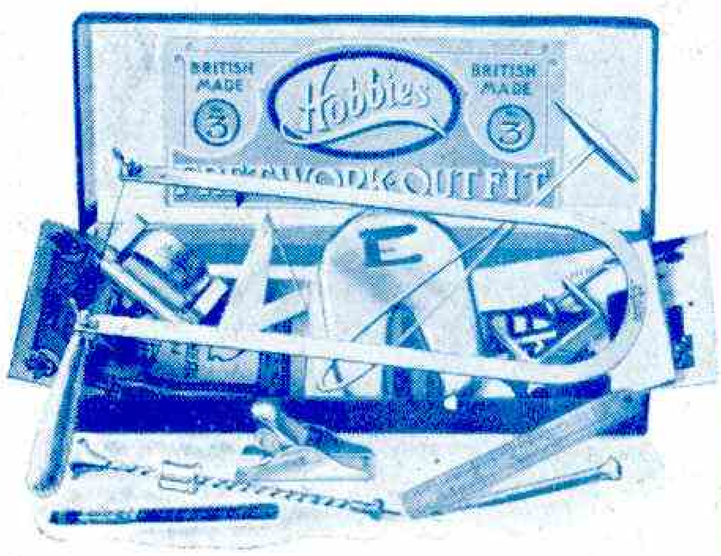

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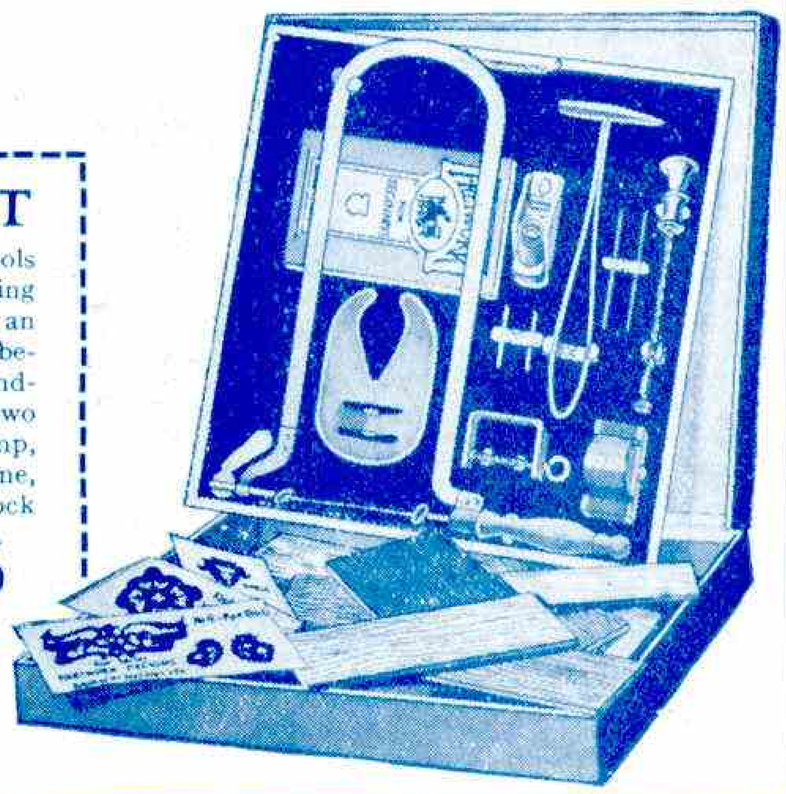

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MECCANO MAGAZINE

Editorial Office
Binns Road
Liverpool

Vol. XII. No. 1
January, 1927

With the Editor

New Year's Greetings to You All.

Every good wish for the New Year to all my readers! I hope it will be for each of you a year of joy and fun, and a year of progress in your studies or in your work, as the case may be.

I should like to take this opportunity of thanking my many readers for the wonderful array of Christmas and New Year cards that have reached me from all parts of the world, together with the hearty good wishes that accompany them. So many messages of good will from Meccano boys of almost every nationality, and the innumerable letters I receive every day, are most encouraging, whilst the suggestions sent to me are very helpful.

Over 20 Tons of December Magazines!

I often wonder if my readers realise to what tremendous proportions the monthly printing and distribution of the "*M.M.*" is growing. Our circulation figures have been increasing rapidly during the past two or three years, until of last month's issue we sold nearly 75,000 copies. For this one issue alone the paper weighed over 20 tons! As the paper before printing has always to be handled flat, twelve lorries were required to move it from the station at Leeds to the printers (see photograph on page 11).

After seeing these lorries, I was curious to work out a few details concerning the December "*M.M.*" I think the results of these calculations will be of general interest, for they convey a good idea of the success of the "*M.M.*" For instance, I found that if all the copies of the December issue when ready for despatch had been piled one on top of another, they would have reached to a height of over 1,000 ft.—that is considerably higher than the Eiffel Tower (984 ft. in height). Had the magazines been placed end to end, they would have stretched for over 13 miles!

The area of the paper used was over 100 acres in extent—there would have been more than sufficient to have covered the playing grounds of all the First and Second Division Football Clubs in the Kingdom! If the printed pages had been placed end to end there would be sufficient to form a continuous band over 1,300 miles in length—more than sufficient to lay a double line, the width of the "*M.M.*" page, from Land's End to John o'Groats!

If all the lines of reading matter in the complete printed edition could be placed side by side they would extend for over 37,500 miles! In other words, Sir Alan Cobham could have laid a line of print all the way to Australia and back, and there would yet remain sufficient type lines to lay a trail across the Atlantic to America and back again!

So that's that!

Interesting Railway Articles to be Regular Feature

Although the calculations mentioned above relate to the December issue, the figures can be applied equally well to the present number—and probably to every number during the coming year also. That being so, the effect of multiplying the results by twelve, for the year's output, shows a tremendous total and gives us some idea of the extent of the activity of the "*M.M.*" I have no doubt that in its present enlarged form its popularity will be greater than ever, and that next year I shall be able to announce a considerable improvement on all the figures above mentioned. In this matter each reader can help me by making known the Magazine to all his, or her (for we have numbers of girl readers!) friends. It is in this way that readers have helped to increase our circulation in the past, and I feel sure that new readers who place an order for a regular copy of the "*M.M.*" will not be disappointed.

I mentioned last month that I hoped to be able to make some announcement of importance regarding contributors to our future issues. I am pleased to be able to say that I have arranged for a series of regular contributions from Mr. Cecil Allen. Mr. Allen, who is a Member of the Institute of Transport and an Associate of the Institute of Locomotive Engineers, is a recognised authority on railway matters. Not only is his name well known to those acquainted with railway literature, but in addition he is the author of several popular railway books. From time to time Mr. Allen will write for the "*M.M.*" on various phases of railway matters and each month he will contribute a special article dealing with famous express trains and the routes over which they run. The first of this series, the "Flying Scotsman," appears on page 22 and future articles will include the "Atlantic Coast Express," the "Golden Arrow," "Hook of Holland Boat Express," "Liverpool Diner," "Southern Belle," etc.

In this connection I am glad to be able to announce also that we shall now be able to include illustrations by Mr. F. E. Mackay, one of the leading railway photographers whose "snaps" of engines and trains at speed are well known in railway circles. Mr. Mackay's work is second to none, and the clearness of his photographs is the envy of all camera men. I feel sure that his pictures will add very considerably to the interest of our pages dealing with railway matters.

Obtaining the "M.M."

For the information of new readers I should like to mention that the "*M.M.*" may be ordered from any Meccano dealer or newsagent. If at any time anyone experiences difficulty in this matter, they should write to me and I will gladly take the matter up, as there should be no difficulty in obtaining copies of the magazine on the 1st of each month, the publication day.

Oil Fuel Locomotives not a Success

A short time ago I made some reference on this page to the conversion of a number of main-line locomotives from coal to oil-burning, which was carried out because of the coal strike. It will no doubt be of interest to my readers to learn that a recently-published report of the railway engineers shows that the use of oil-burning locomotives does not pay on British railways. Although oil is useful for maintaining the services during a temporary shortage of coal, its general adoption as a fuel is uneconomical.

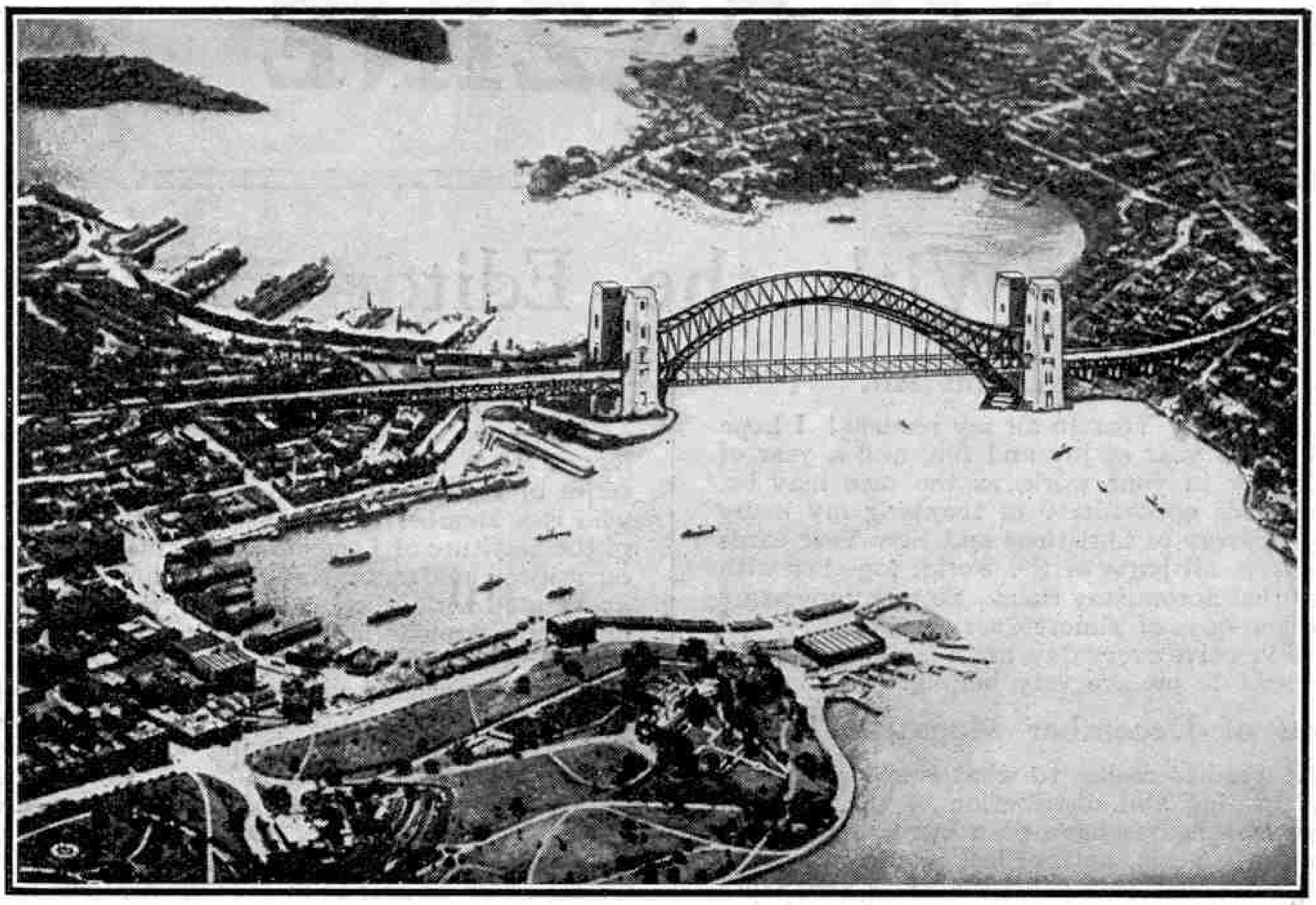
This conclusion has been arrived at after seven years of patient experimenting with oil fuel, the tests having commenced in 1919. It has been found that although oil costs on an average three times as much as coal, it gives results that are only twice as good. In countries such as Russia and the United States, where oil is easily obtainable locally and where coal is more expensive, oil is used on the railways to a large extent, but unless oil becomes very much cheaper the train services of Britain cannot be operated on this oil fuel.

Incidentally, it may be mentioned that the L.M.S. have now 200 locos equipped for burning oil fuel, and, although they perform their work quite satisfactorily, the equipment is only of a temporary character and will be discarded now that coal is available again. It is interesting to learn that the company would be able to run a skeleton service on oil, even if there was no coal whatever in the country.

Largest Arch Bridge in the World

Over 50,000 Tons of Steel to Span Sydney Harbour

LAST month we related how the proposals for the Sydney Harbour Bridge gradually developed into a definite scheme, and we described the bridge in detail. This month we deal with the problems involved in its construction and of the difficulties with which bridge-builders have to contend.



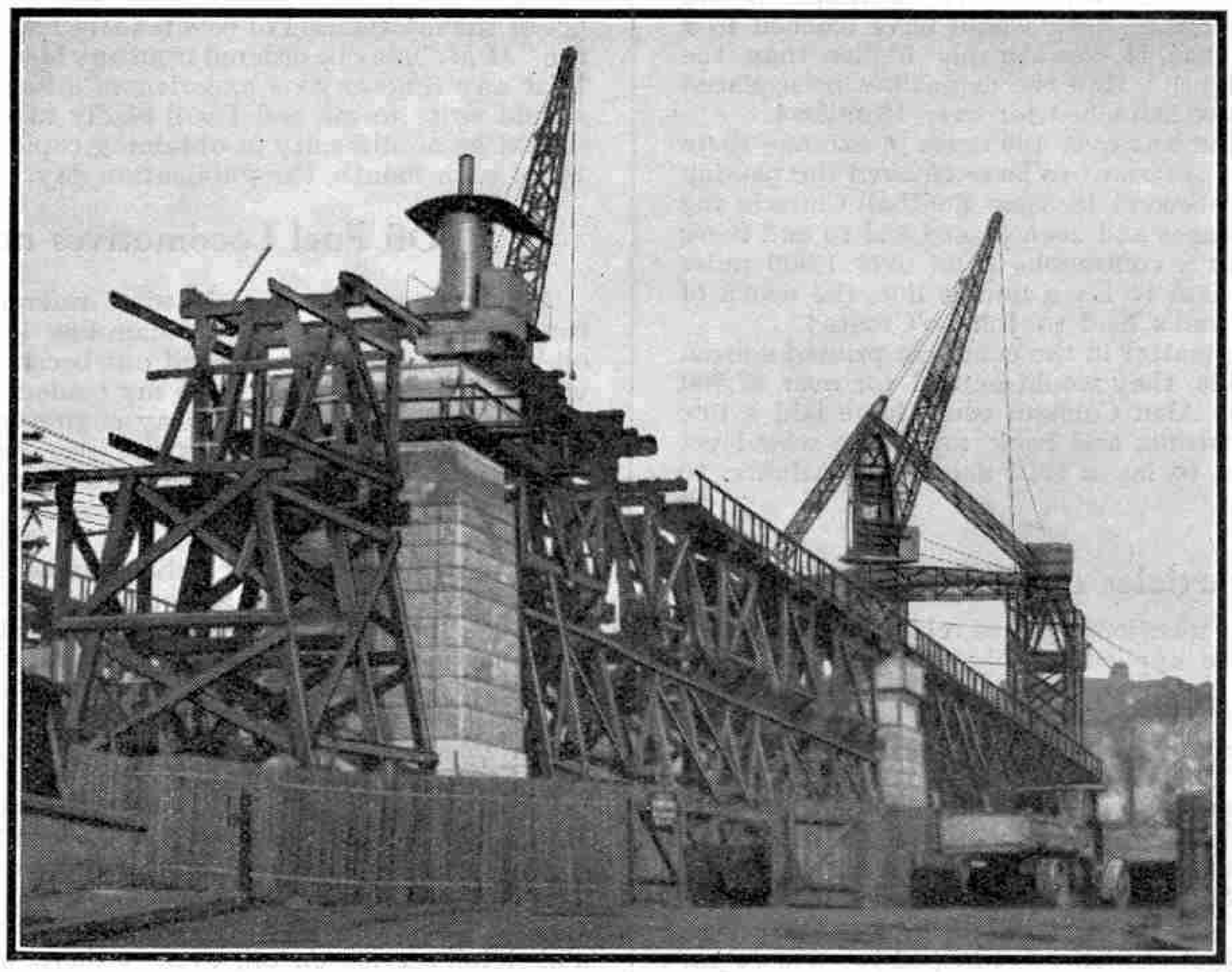
A composite drawing showing aerial view of the bridge as it will appear when completed

The erection of any bridge—and especially of such a huge structure as that which is to span Sydney Harbour—calls for the highest skill and engineering knowledge. Nothing can be left to chance, for the loss of hundreds of lives and of vast sums of public money might be the result of the slightest error in calculation. For years, therefore, work has been going on, on paper, in respect of this bridge, and calculations of strains and stresses, of the resistance of metals, and a hundred and one other things. Every small part has been fitted into position in theory. The place of every rivet and every bolt has been determined, and a legion of draughtsmen have been and still are at work on the detailed plans—the "blue-prints" of the engineering world.

Not the least of the many problems that confront the builder of bridges is the strength of his materials. A faulty girder or a badly cast truss may spell disaster or at least the ruin of many months of work, and consequently the most rigorous tests are applied, in a manner that will be described shortly.

Enormous Strains and Stresses

The Sydney Harbour Bridge will be called upon to resist enormous strains and stresses. Apart from its own tremendous weight of more than 50,300 tons, it will have to withstand the constant force of the wind and in a gale of hurricane violence the strain from this cause alone will be terrific. Quite apart from such outside causes as this, a tremendous strain will be imposed by the ordinary day's work of the bridge. The structure is designed to carry 160 trains, 6,000 vehicles and 40,000 foot passengers per hour and it is calculated that with a full load the deflection at the centre of the bridge will be $4\frac{1}{2}$ inches.



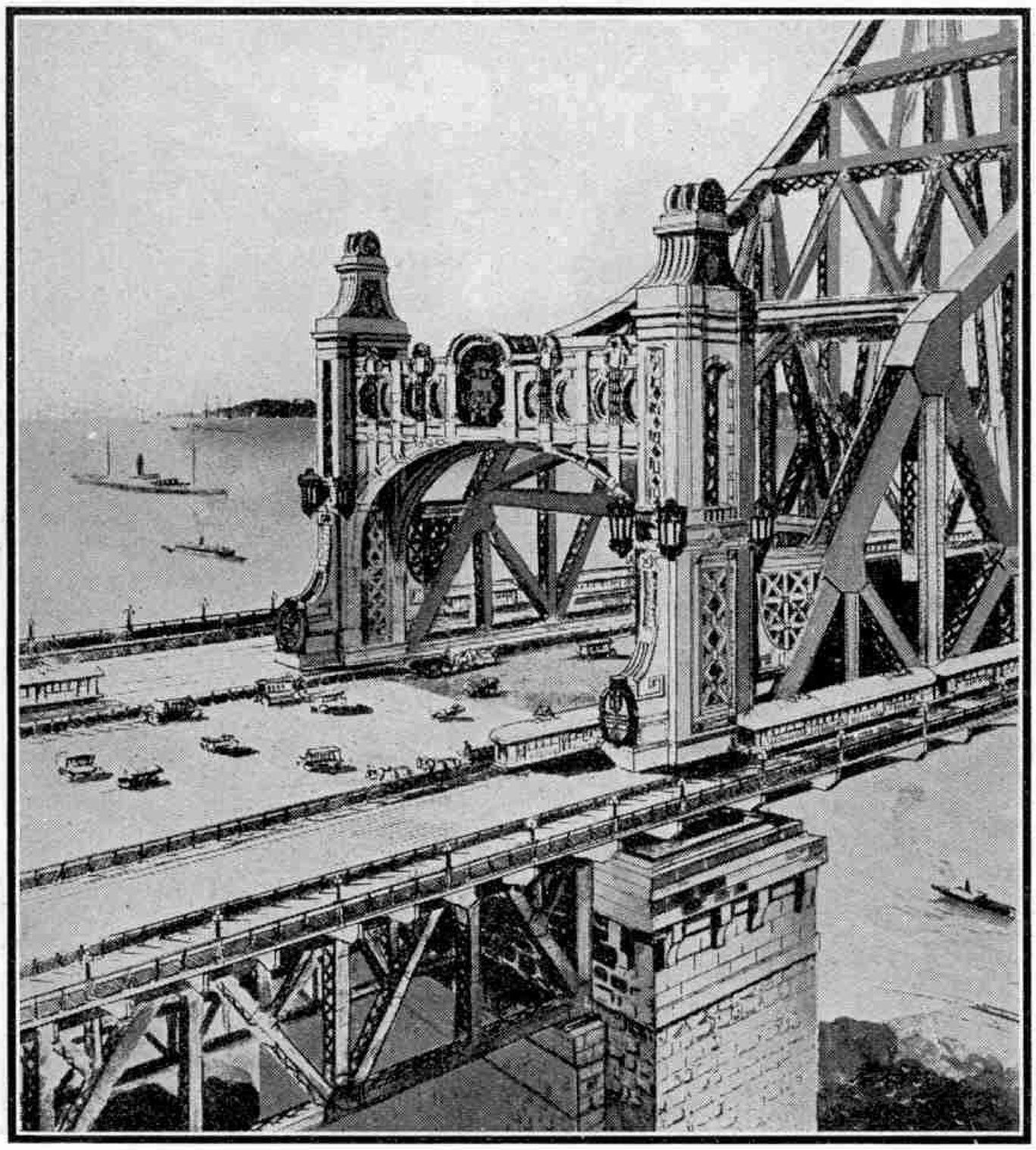
This photograph shows the progress made on the southern approach

The greatest pressure that each of the steel bearings—there will be two at each end—will have to carry will be 40,190,000 lb. Of this tremendous stress 73 per cent. will be due to the

bridge's own weight, 11 per cent. to wind pressure and 15 per cent. to traffic load, while the remaining one per cent. will be covered by the action of brakes and the rise and fall in temperature.

Testing the Materials

In bridge-building contracts the specifications often contain specially-devised tests for the various materials to be employed, and stipulate that any that fail to pass these tests are to be rejected. The component parts of a bridge are intended to withstand certain strains under certain particular conditions, and of course the ideal method of testing the materials would be to try them under these conditions. Such a procedure is obviously impossible and therefore the engineer has to use all his ingenuity to devise tests that are as near the real thing as possible. Since the time when bridge-building ceased to be largely a matter of guesswork and began to develop upon sound engineering lines, the problem of testing materials has been given unremitting attention and some amazingly ingenious machines have been evolved to carry out this work. Some of these machines will play an important part in the building of Sydney Harbour Bridge.



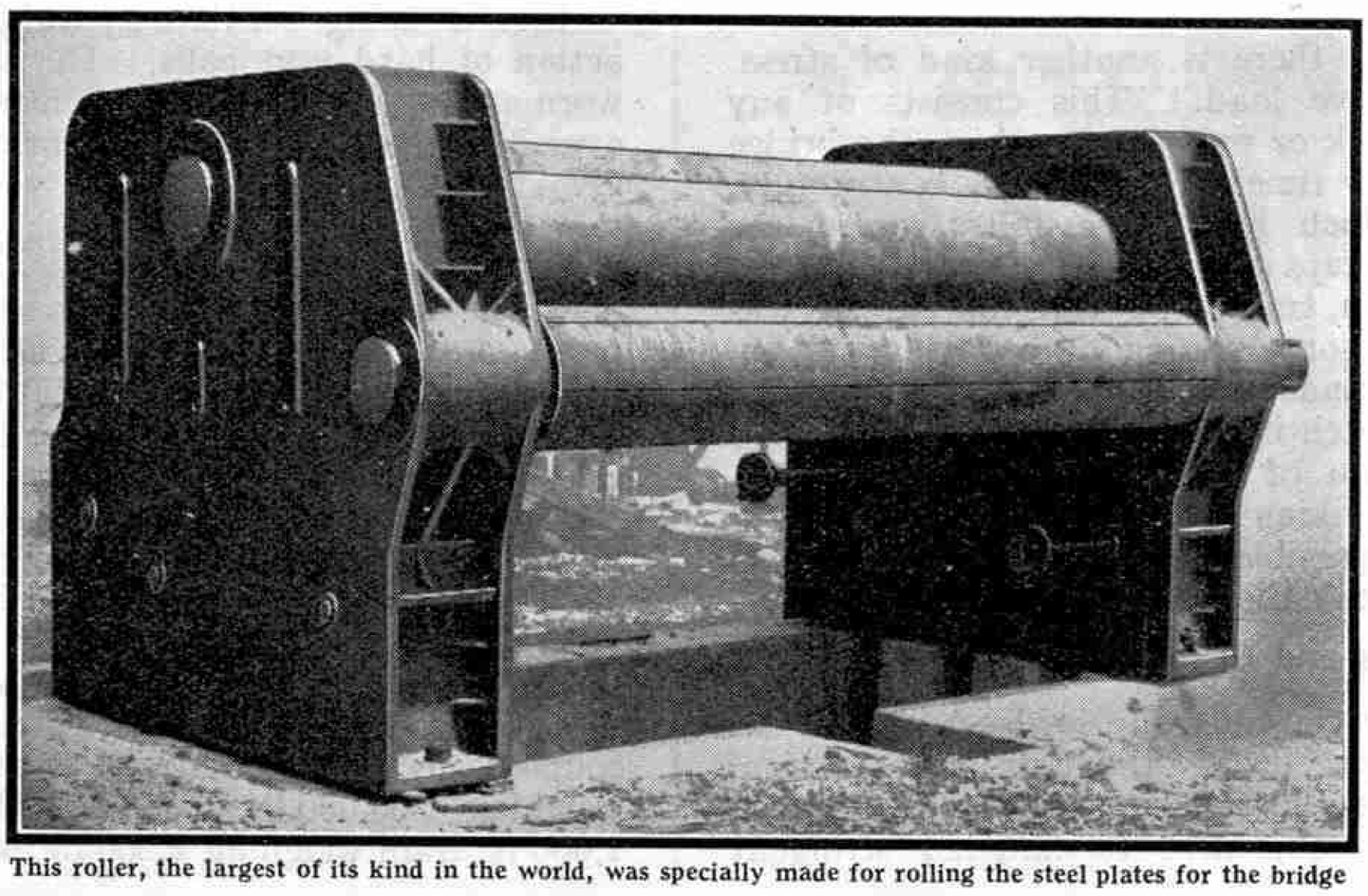
As it would have been with the cantilever bridge. The south portal, showing approach

Perhaps the most important test is that showing the tenacity of metal, and known as the "tensile test." It is really a tug-of-war—except that instead of finding out which is the stronger end, the aim is to find how strong a pull is necessary to break the material under test. In place of a rope, a bar of the metal to be tested is used. One end is held firmly in a vice while the other is gripped by a jaw of the testing machine. This jaw exerts a gradually increasing pull, the amount of which is shown—by an arrangement of levers accurately adjusted and working on knife edges—in pounds or tons per square inch of metal in the section of the test piece. The machines used in these tensile tests are of various kinds, some exerting a pull of only a few tons while other giant types are able to apply a force as great as 450 tons.

Stretching Metal Like Elastic

In conducting a test, the metal is first turned to the shape of a round bar of suitable thickness. The ends are then clamped in gripping jaws and the machine is set in motion. The metal bar immediately commences to stretch and continues to do so in proportion to the increase in strength applied. If the load is now removed, however, the bar will at once return to its original size, so that the metal may be termed elastic—a fact of which few people are aware.

As in the case of real elastic, the stretching powers of a metal bar are limited. If the pulling force continues, this limit will be reached, and any further force applied lengthens the bar permanently and at a surprising rate. Finally, as the pull increases still more, a stage is reached where the metal yields suddenly, and tehen only a very little force is needed to draw it out lik modeller's clay. If the drawing-out process is continued the bar soon breaks and the reading on the recording instrument is at once noted.



This roller, the largest of its kind in the world, was specially made for rolling the steel plates for the bridge

The breaking point is not the only information given by this test, however, for by carefully watching the metal while it is undergoing the pull, useful information regarding its properties may be obtained. For instance, if the metal is faulty its action under test may

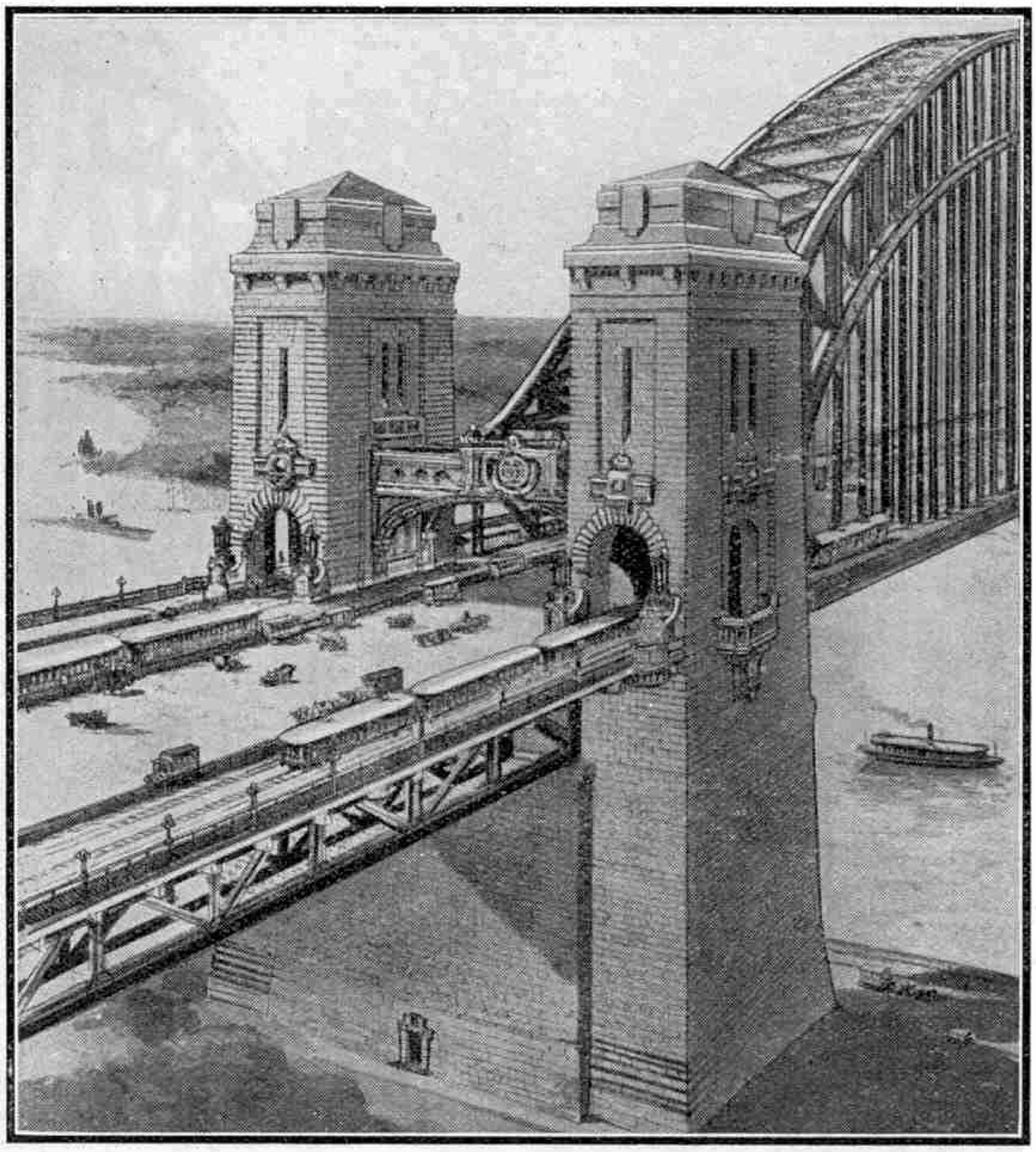
possibly show the cause and nature of the defect, and thus enable this to be remedied in future manufacture. The broken ends of the bar show the character of the metal, for normal mild steel will invariably break with one end slightly cupped and the other truncated.

Squeezing to Destruction

Another important test is the compression test. Compression is applied in exactly the opposite manner to the tensile test, the metal being squeezed instead of pulled, until it breaks or is hopelessly deformed.

Twisting and bending tests are more usually employed in the case of wrought iron or mild steel, brasses and bronzes.

Included in the specification for the Sydney Harbour Bridge are the figures of the weights to be used in calculating the weight of the structure when computing the stresses therein. Asphalt and stone concrete are to be calculated at 150 lb. per cu. ft.; granite, 170 lb. per cu. ft.; rolled steel, 490 lb. per cu. ft.; cast steel, 485 lb. per cu. ft.; wrought iron, 480 lb. per cu. ft. and cast iron, 450 lb. per cu. ft.



As it will be—the south portal of the arch bridge, showing the massive concrete piers

The "deadlock," as it is called, consists of the entire weight of steel and other materials in the structures, computed in accordance with the specified unit weights, with two per cent. addition to the calculated weight of steel for over-run.

In addition to this there is another kind of stress, however, termed "live load." This consists of any suddenly applied shock or pressure to which the bridge may be subject at any time. For example, a structure, the materials of which had successfully passed the tensile test, might perhaps collapse by the sudden passage over it of an express train. To test for this it was necessary to devise some means of applying sudden shocks to the metal under test. This is now generally done by making a notch in the metal bar and then, by means of a pendulum of known length and weight, breaking the bar by striking the test piece near the notch. In this manner it is possible to calculate the amount of force necessary to break the metal bar.

Testing Wood, Bricks and Concrete

We have seen how carefully the bridge-builder must test his metals before using them in construction. Other materials beside metals are used in the work, however, and these, too, have to undergo stringent tests before they are finally passed and used. Timber, stone, brick, concrete and even ropes all have their particular tests.

The crushing strength of wood is found by squeezing suitable lengths along the grain and then measuring the strain the wood will withstand without breaking. Another test for wood is to support a piece at each end so that it lies horizontally, and then apply a load in the centre of the unsupported centre span.

Bricks are usually tested in an iron drum in which they are revolved with a number of iron spheres about the size of a cricket ball. After having been turned for several hours, the drum is stopped and the bricks are withdrawn. As the result of this rough treatment the bricks have by then lost all their edges and corners and the extent to which they have withstood their battering determines their quality. If they have been badly made they may lose nearly half their weight.

Cement and concrete blocks are placed under a machine that subjects them to varying degrees of pressure, as required, at the same time also indicating the force exerted. By this means an accurate idea of the strength of the material may be obtained. In examining concrete slabs a special machine is employed. In it the slabs are rotated so that a known area of the surface is being continually subjected to the wearing action of hard iron balls. The stone quickly becomes worn and pitted as though millions of people had walked over it. As in the case of the brick test, the weight lost gives an accurate idea of the wearing qualities of the material.

The Sydney Harbour Bridge, with its four railway lines, roadways and footpaths will at times have to resist very heavy and sudden strains and stresses. It has been decided, therefore, that the deck system is to be designed to resist stresses of 100 lb. per sq. ft. over the footway. The flooring plates, rolled steel joists and stringers must be strong enough to resist a moving motor-lorry with a wheelbase of 12 ft. by 6 ft. The remainder of the road is to stand a live load of 100 lb. per sq. ft.

With regard to the railway section of the bridge, this is to be designed for the stresses produced by two coupled electric locomotives, each 65 ft. in length and weighing 360,000 lb. These will be followed by a 1,000 ft. train weighing 2,200 lb. per (Continued on page 66)

The Story of Metals

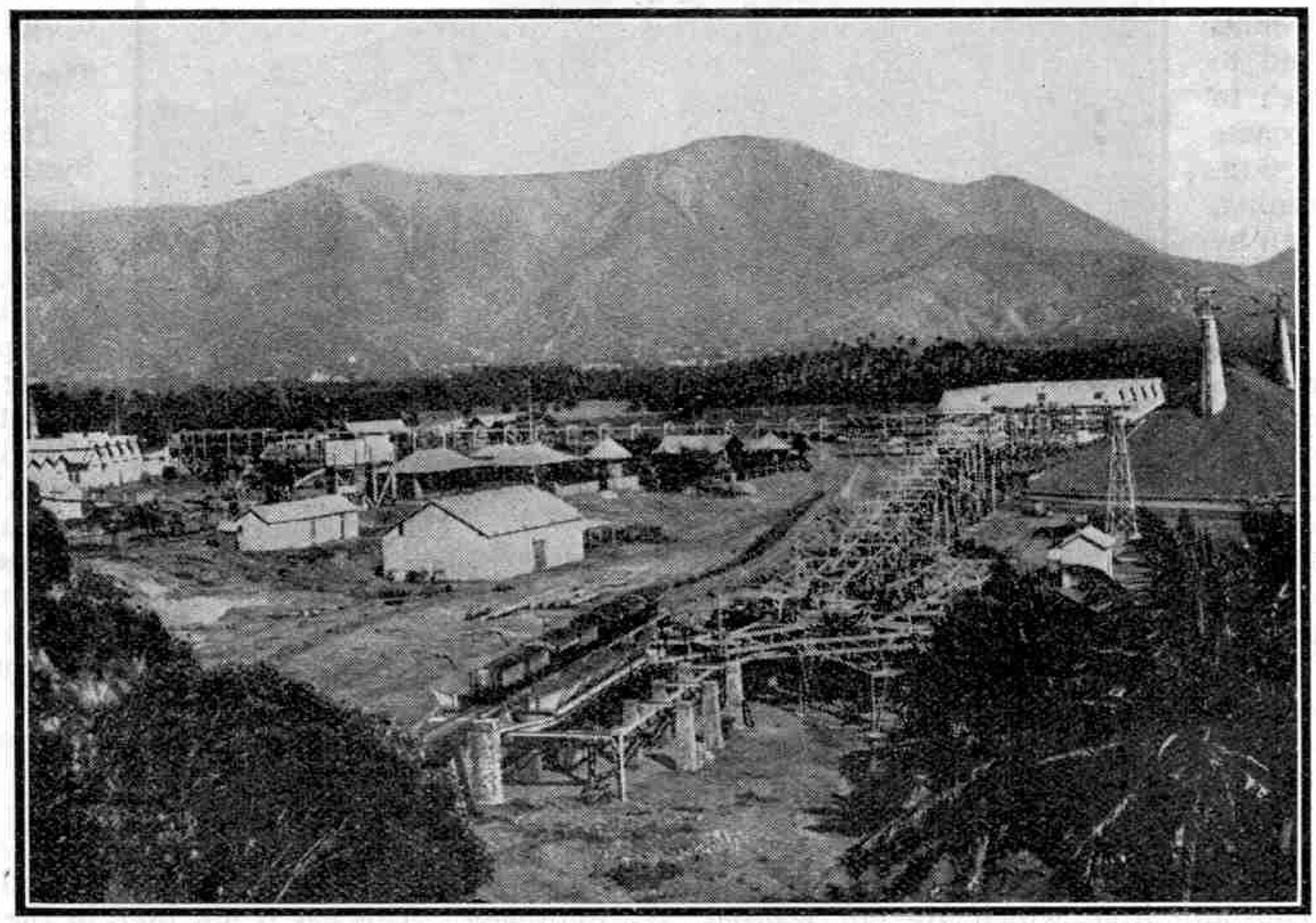
XV. NICKEL

IN comparison with some of the metals we have already considered—gold, copper, tin, lead, silver—nickel must be regarded as a comparatively "young" metal.

The first people to make use of nickel were probably the Chinese. They were not familiar with the metal in a pure state, however, but only in the form of an alloy to which they gave the name of "*paktong*," meaning white copper. This particular alloy was highly valued by the Chinese on account of its suitability for the manufacture of the gongs that played so prominent a part in the daily activities of their temples. Large quantities of *paktong* were exported from China to Europe during the 17th and 18th centuries.

We know also that nickel was used at a very early date by the Bactrians, a people living in Central Asia.

The province of Bactria, or Balkh, was at one time of great importance and its capital formed the centre of a thriving commercial intercourse between India, Persia, China and Central Asia. Coins issued in 235 B.C. by Euthydemos, King of Bactria, have been carefully analysed and shown to contain over 20 per cent. of nickel, together with some 77 per cent. of copper and a small proportion of various impurities. Bactria, it may be mentioned, gives its name to the Bactrian two-humped camel, which is less swift than the one-humped Arabian camel or dromedary, but is hardier and much less sensitive to cold.



General View of a Nickel Mine in New Caledonia

How the Metal received its Name

During the Middle Ages copper and silver were mined extensively in the Erzgebirge, a mountain range separating Bohemia from Saxony. During their operations the miners encountered from time to time deposits of a reddish-coloured ore which, to judge from its appearance, was rich in copper. These deposits also possessed a certain brilliance suggestive of silver. This unknown ore was found in abundance in the neighbourhood of the mining town of Schneeberg, and the miners firmly believed that they had discovered a new source of mineral wealth.

Then came bitter disappointment. Every method for the extraction of copper known at that time was tried with the mysterious ore, but without the slightest success. All that the processes yielded was a mass of unpleasant grey metal so brittle that a blow from a hammer would smash it into fragments. The intractability of the ore naturally exasperated the miners and they gave it the name of "kupfer-nickel," the word nickel meaning practically the devil, otherwise "Old Nick!"

Nickel was not isolated until 1751, when a Swedish metallurgist named Cronsted succeeded in obtaining a small quantity of the metal from ore from mines in Helsingland in Sweden. It took Cronsted five years of patient experiment to achieve this success and although the resulting metal was very impure, he proved that the ore could be worked. It was not until four years later that comparatively pure metallic nickel was produced. From that time extensive research was carried out and, the valuable quantities of the metal having been established, commercial refining operations were commenced about the year 1824 in London, Saxony and Hungary.

Main Sources of Nickel Ore

About this time rich deposits of nickel ore were discovered in Norway and these proved the most abundant source of supply during the next 40 or 50 years. In 1865 important deposits of nickel ore were discovered in the Pacific Island of New Caledonia, and it was not long before the island became a serious rival of Norway.

The experience of the Saxon miners was subsequently shared by miners in Ontario, Canada. In 1883, when the vast forests of this province were penetrated during the construction of the Canadian Pacific Railway, copper deposits of great richness were discovered. Great excitement prevailed and mining operations on

an extensive scale were quickly commenced. The mined ore was despatched to the United States to be smelted, but all in vain—nothing would induce the copper to separate from the ore! The trouble was traced to the presence of nickel and entirely new methods of treatment had to be evolved to bring about the separation of the nickel and the copper.

Once the smelting difficulty was overcome, the output of nickel from Canadian ore rapidly increased, and by 1923 more than 90 per cent. of the world's production of the metal was derived from Canada, the remainder being obtained mainly from New Caledonia.

Unloading a Bucket of Nickel Ore

Crushing and Smelting

The Canadian ore, when mined, is brought to the surface and passed to crushing mills where it is reduced to lumps small enough to pass through coarse screens of about 3 in. mesh. After screening, the material is taken by mechanical conveyors to sorting tables where as much as possible of the useless material is picked out by boys.

The "accepted" ore is now charged into furnaces for smelting. The heavy nickel and copper separate out by gravity, forming a molten "matte," while the lighter and valueless slag floats above. The matte is drawn off from the furnace and treated in a Bessemer converter similar to that used for the manufacture of steel. An air blast is blown through it and this results in the elimination of most of the sulphur and iron, which are not wanted. The remaining matte is then poured into brick-shaped moulds, and allowed to cool, the resulting ingots then being ready for refining. At this stage the ingots consist of about 40 per cent. each of nickel and copper and about 17 per cent. of sulphur, together with some oxygen and traces of iron.

Refining Operations

The final stages of the production of pure nickel are carried out in various ways, the particular method used depending largely upon the composition of the matte produced in the smelting process. Of these an entirely British method is used at Swansea, for the production of the major part of the world's supply, and was the invention of Dr. Ludwig Mond, father of the head of the great new chemical combine. A different method employed in New Caledonia is much simpler, and we will describe this first.

Nickel Cubes from New Caledonian Ore

After the smelting process already described the matte produced from New Caledonian ore contains about 75 per cent. of nickel and 20 per cent. sulphur. It is first crushed by hard steel balls in rotating steel drums until it will pass through a sieve with 60 wires to an inch, and then it is roasted. The effect of this is to drive off the sulphur and leave the nickel behind in the form of oxide, and it then remains to get rid of the oxygen, or "reduce" the oxide to the metal.

The powdered oxide is mixed with a small proportion of starchy material and moulded into cubes or into small cylinders called rondelles. After drying, these are placed in retorts with charcoal between the layers, and heated to just over 1,200°C. for from 24 to 48 hours, by which time the oxide will have been reduced to the metal. Before being put on the market the cubes or rondelles are given a clean surface by trundling them in drums.

The Mond Process

The process in use at Swansea is carried on chiefly with the matte from the Sudbury mines, in Canada, which contains 41 per cent. of copper, thus necessitating a variation of the reduction process. As already described in the case of the New Caledonian ore, the matte is crushed and roasted in furnaces through which it passes continuously in conveyors from the crushers. The resulting mixture of copper and nickel oxide is treated with dilute sulphuric acid, which dissolves out the copper oxide and leaves nickel oxide behind. In order to reduce this oxide the Mond process employs hydrogen. This gas is not used in the costly pure form, but instead water gas obtained by blowing steam over red hot anthracite is used, as more than half of this is hydrogen. The gas enters at the bottom of an iron tower while the nickel oxide is fed in at the top. Inside the tower are shelves with openings in them, and scrapers are arranged to spread out the oxide and make it travel from one shelf to another downward so that the oxide and the gas travel in opposite directions. The temperature is raised to about 350°C. and the hydrogen reduces the oxide to the metal.

Now comes the most striking feature of the Mond process. We all know of the gas called carbon monoxide. This gas is present in small proportions in ordinary coal gas to which it gives poisonous properties, and it is also formed in both coal and coke fires, in which it burns with the bright blue flame that is usually regarded, rightly or wrongly, as a sign of frost. Dr. Mond found accidentally that when nickel is gently heated in this gas it forms a new gas now called nickel carbonyl, and that the nickel is easily regained by heating more strongly. If this is done in a glass tube a beautiful mirror of metallic nickel is formed on the glass.

A Marvel of Industrial Chemistry

The first part of this process is carried out in a tower similar to the one used for reducing the oxide. Pure carbon monoxide enters at the bottom of the tower while the impure nickel passes from the top downward to meet the stream of ascending gas, thus forming the gaseous nickel carbonyl, which passes on to the decomposer. This is a long cylinder built in sections. The gas enters by a pipe passing down the centre of the cylinder and distributing the gas in the sections, where the temperature is kept high enough to decompose the gas, the nickel being deposited in a thin film on pellets of nickel already present from previous operations. The pellets are worked slowly down by mechanical means and discharged in small quantities at a time into a small lift which carries them to the top of the decomposer once again.

Testing a Sample of Ore at the Mine

In this manner the pellets grow slowly larger and larger until they are suitable for the market. The continuous motion gives a spherical shape and any pieces broken off provide a commencement for the formation of new pellets. The growth of these pellets is one of the marvels of industrial chemistry. If one is cut in two, the layers of nickel formed during successive descents through the decomposer are clearly seen in somewhat the same way as the rings showing the annual growth of trees are visible.

The carbon monoxide is led away from each section to a collecting tube from which it is returned by blowers "to give wings to nickel," as Lord Kelvin described it.

The Mond process gives a particularly pure result. The copper has been dissolved out and neither iron nor cobalt, the chemical twin-brother to nickel, forms a gas with carbon monoxide under the same conditions as nickel. The resulting metal contains 99.8 per cent. of nickel, which represents a very high degree of purity indeed for a commercial material.

Among the other processes used for the purification of nickel may be mentioned an electrolytic one. In this, a positive pole of impure nickel is placed in a tank containing a solution of a nickel compound, while iron plates are used for the negative poles or cathodes. By careful regulation of the electric current passing through the tank, pure nickel plates are formed on the cathodes, which can easily be detached. As many as twenty plates arranged in parallel are sometimes suspended in one tank.

The uses of nickel are many and important. The pure metal on account of its resistance to corrosion is of great value for the manufacture of cooking utensils and for coinage, while when deposited electrolytically upon metals that are liable to tarnish it provides them with a highly protective covering. In addition it is invaluable for alloying with steel and with non-ferrous metals such as copper, zinc, chromium, etc.

Nickel Increases Strength of Steel

The addition of quite a small percentage of nickel confers upon steel an increase in strength and toughness, at the same time rendering it more ductile and less liable to corrosion. On this account nickel steel is very widely used for such purposes as making the blades of steam turbines. The remarkable increase in tensile strength due to the presence of such proportions as from 3 to 3½ per cent. of nickel has been taken advantage of by structural engineers who have used extensively this grade of nickel steel in the building of large span bridges.

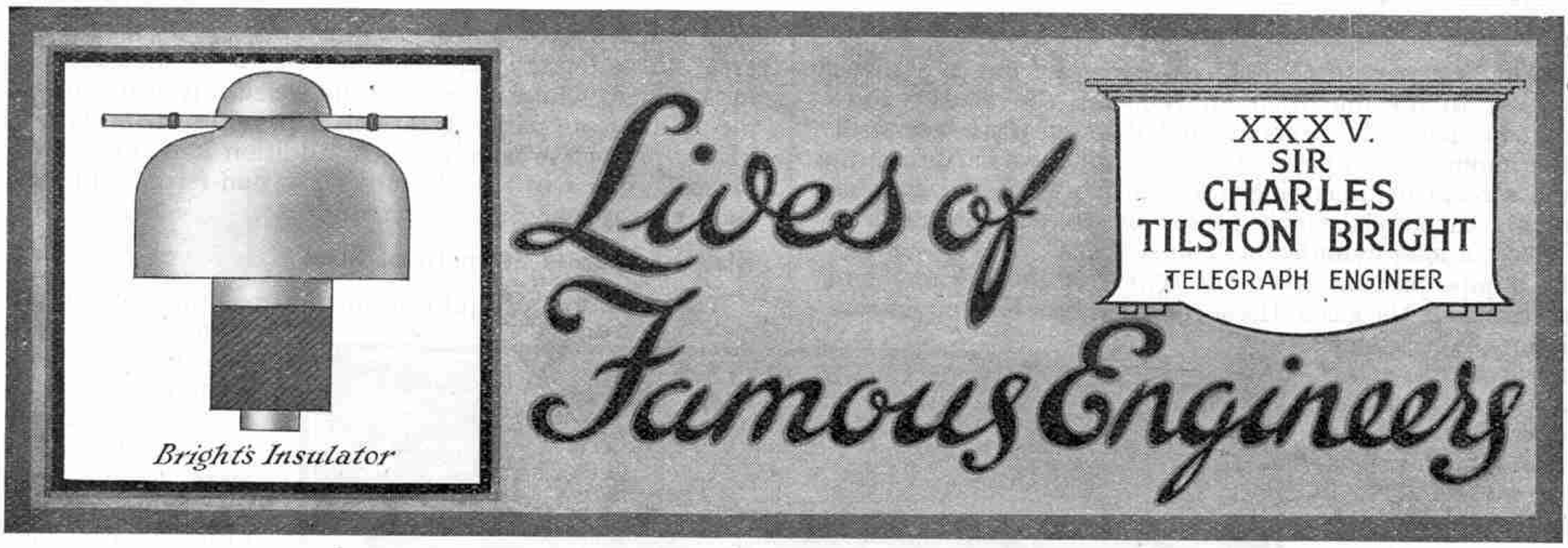
In nickel-chromium steel the strengthening effect of the nickel is further enhanced by the inclusion of a small percentage of the rare metal chromium. These remarkable alloys are specially suitable for machinery that is liable to sudden shock or very hard wear, and on that account they have been very largely used in making armour plate and armour-piercing projectiles. For the same reasons we find these alloys used extensively in the manufacture of the moving parts of high-speed engines.

A special alloy with very useful properties is "Invar," a steel containing 36 per cent. nickel. This alloy practically does not expand on heating and on that account is used very largely in the making of clocks, chronometers and scientific apparatus of all kinds in which expansion or contraction due to temperature changes would be disadvantageous. Another important alloy is "Platinite," containing 46 per cent. nickel, the value of which lies in the fact that its rate of expansion is practically the same as that of glass. On this account it is used for such purposes as making the lead-in wires that pass through the glass in electric lamp bulbs. "Platnam," an alloy containing 54 per cent. nickel, is used for valves that have to withstand the action of superheated steam.

Nickel is very suitable for coinage (Continued on page 81)

Previous articles in the "Story of Metals" series have appeared as under :—

Copper ...	February, March and April	1925
Lead ...	June and August	,,
Aluminium	October and November	,,
Tin ...	January	1926
Gold ...	March, April, May and June	,,
Silver ...	July, August and September	,,
Zinc ...	December	,,



IN November we outlined the career of Charles Tilston Bright up to his completion of the first Irish cable. This month we come to the most brilliant achievement of his career—the laying of the Atlantic cable. In his Presidential address to the Institution of Electrical Engineers in 1889 Lord Kelvin, referring to this great undertaking said: "We must always feel indebted to Sir Charles Bright as the pioneer in that great work when other engineers would not look at it and thought it absolutely impracticable."

A Bold Undertaking

It was indeed a bold undertaking for so young a man. Objections of every conceivable description were launched against the scheme and many of them seem very amusing when read to-day. Some of the criticism was serious, however, in that it came from engineers and scientists of sufficient eminence to have a great effect on public opinion. For instance, Professor Airy, who was then Astronomer Royal, stated definitely that it was a mathematical impossibility to submerge a cable to such depths, and that even if this could be done messages could not be transmitted through such an enormous length of cable.

Signatures of the original promoters of the first Atlantic Cable

As to the possibility of transmitting messages, Bright had already satisfied himself on this point between the years 1853 and 1855, during which period he and his brother Edward carried on a series of experiments on the great lengths of underground cable controlled by them. By linking up the cables to and fro between London and Dublin, or as an alternative the ten wires between London and Manchester, a total length of cable exceeding 2,000 miles was available for test, and the result definitely proved the practicability of transmissions through a cable of the length needed to cross the Atlantic.

The Irish Landing Place

During the period in which the foregoing tests were made, Edward Bright made a careful examination of the west coast of Ireland in order to determine the best place for landing a cable. He eventually decided that Valentia Harbour afforded the most suitable conditions. The wisdom of his choice has been fully demonstrated by the number of Atlantic cables that have been landed since that time either in Valentia Harbour or the immediate vicinity.

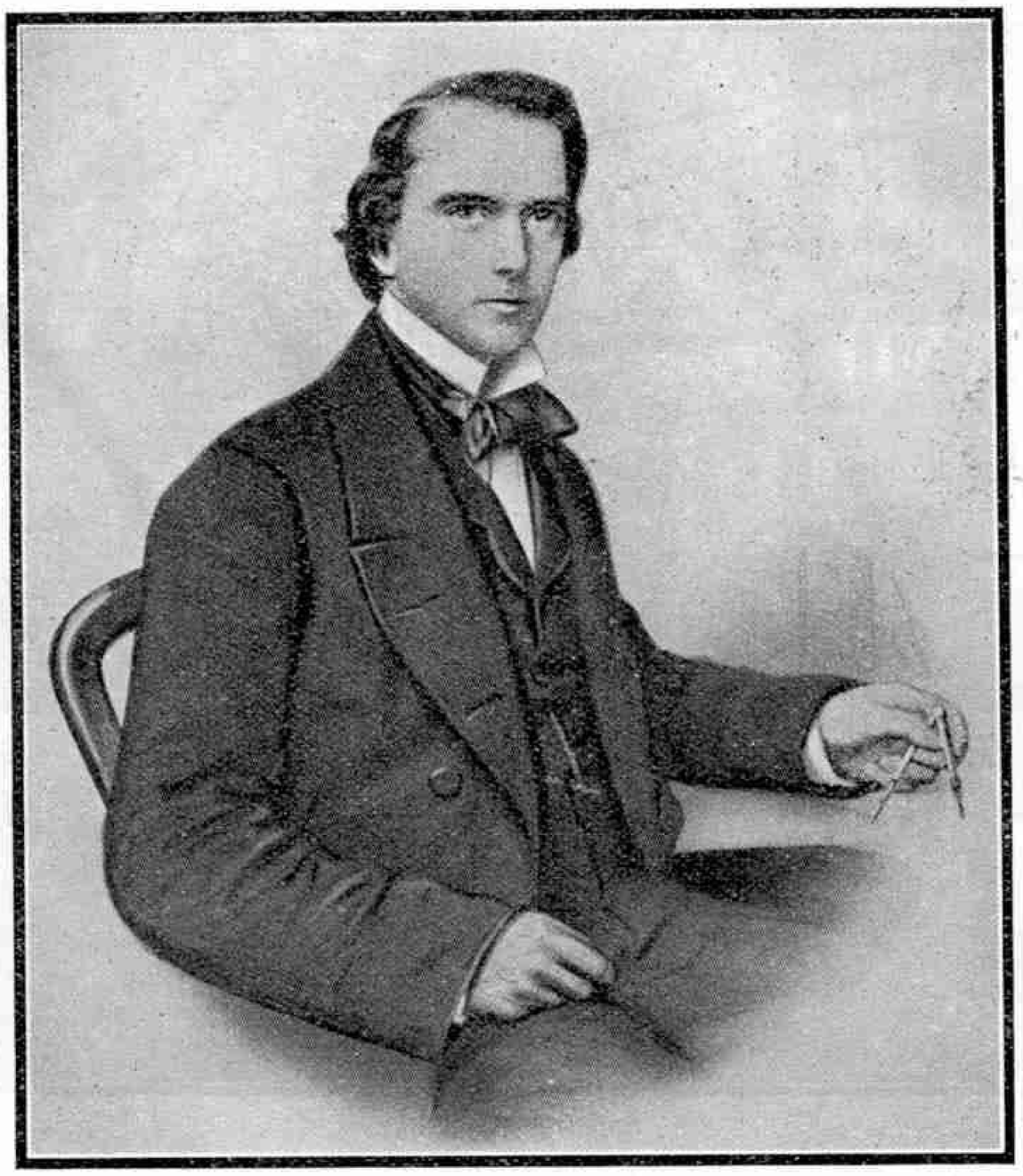
American Difficulties

The shore problems on this side of the Atlantic were nothing like so difficult as those on the American side, for in the latter case a long land telegraph was inevitable to cross Newfoundland over very wild country. In 1852, Frederick N. Gisborne, an English engineer acting with a small American syndicate, obtained an exclusive concession and sole rights of cable landing for thirty years in Newfoundland, subject to the construction of a line between St. John's and Cape Ray in the Gulf of St. Lawrence, from where messages were to be exchanged to and from Cape Breton on the other side of the Gulf, by steamer or, as was at first suggested, by carrier pigeons. After much difficulty Gisborne laid a cable between Prince Edward Island and New Brunswick and proceeded to lay some 40 miles of the line across Newfoundland, but lack of financial support brought his work to an end.

Then there came upon the scene Cyrus West Field, a retired merchant of extraordinary business energy and farsightedness. Gisborne had no difficulty in securing Field's interest in the idea of an Atlantic cable and this interest took the practical form of procuring an improved concession and raising a considerable sum of money among a few of his friends. In 1854 Field came over to England to order a cable of about 80 miles in length to span the Gulf of St. Lawrence between Cape Ray and the Island of Cape Breton, and while in this country he met John Watkins Brett who, with his brother Jacob, had brought about the establishment of the first cross-channel cables as described in the "*M.M.*" for July 1925. This Cape Breton cable was duly made and laid and in 1856 the preliminaries on the American side were completed by the construction of the land line across Newfoundland.

The Founders of Atlantic Telegraphy

The great project now took its first definite step towards reality. In the summer of 1856 Field once more appeared in England empowered by his associates to deal with the exclusive concession possessed by the company for the coast of Newfoundland. On his previous visit he had discussed the Atlantic line with Charles Bright, and on 29th September an agreement was entered into between Brett, Field and Charles Bright, by which they mutually and on equal terms, engaged to exert themselves in Bright's own words, "with a view to, and for the purpose of, forming a company for establishing and working all electric telegraphic communication between Newfoundland and Ireland." These three were joined a little later by Mr. Whitehouse, originally a doctor at Brighton, who had been engaged for some time upon experiments similar to those on which the brothers Bright had worked.



Sir Charles T. Bright at the age of 26

The Atlantic Telegraph Company was accordingly registered on 20th October 1856. The capital required was enthusiastically subscribed in a few days by members of the public, mostly by shareholders of the Magnetic Company that had proved such a success under Bright's engineership and management. Cyrus Field reserved £75,000 for American subscription, but the Americans for once lacked business foresight and it was only with great difficulty that he succeeded in obtaining a little more than a third of this amount. The Governments of both countries concerned came to recognise the grandeur and feasibility of this undertaking for linking together the two English-speaking nations, and both gave a subsidy, which jointly amounted to 8 per cent. on the capital. Directors were elected by the shareholders and among them was Lord Kelvin, then William Thomson, Professor of Natural Philosophy at Glasgow University. This was a most fortunate choice. Thomson was a firm believer in the practicability of the cable and his acquisition was destined to prove of vast importance, for his subsequent experience on the Atlantic cable led up to his invention of the mirror galvanometer, and many other valuable instruments. The directors appointed Charles Bright as Engineer-in-Chief, with Whitehouse as electrician, while Cyrus Field became General Manager and later Managing Director.

Construction of the Cable

The construction of the cable itself had already been commenced when Bright was appointed, and to his regret he found that it was much smaller than he would have recommended, having only 107 lb. of copper to the mile against his desired weight of 392 lb. It was too late to change this, however, so the construction of the cable was proceeded with, partly at Greenwich and partly at Birkenhead.

The conducting core was made of seven strands of copper wire, which were covered with three layers of gutta percha, and finally protected by a spiral winding of hemp yarn saturated with a preservative composition of tar, pitch, linseed oil and wax, and an outer covering of eighteen iron strands wound round in a long spiral. The construction of the 2,500 miles of cable required was a big undertaking, as it involved the preparation of 17,500 miles of copper wire, and also 315,000 miles of iron wire. The entire length of copper and iron wire employed was therefore 322,500 miles—enough to go round the earth thirteen times, and considerably more than enough to extend from the earth to the moon!

During the manufacture of the cable Bright was kept busy testing the strength of the wire used and deciding on the suitability of various mixtures for its protection and, in addition, in devising improved means for laying the cable in view of the great depth to which it was to be submerged. He had to select ships suitable to carry the cable and to prepare them to receive it, together with the requisite machinery, arranging the distribution of weight so as to keep them fairly in trim. In addition there was the necessity for more or less constant attendance on the directors and the preparation of frequent reports. It seems almost incredible that at this time, with these responsibilities thrust upon him, and with his success in laying the Irish cable behind him, Charles Bright was only 24 years of age.

Cable Stowed on Board

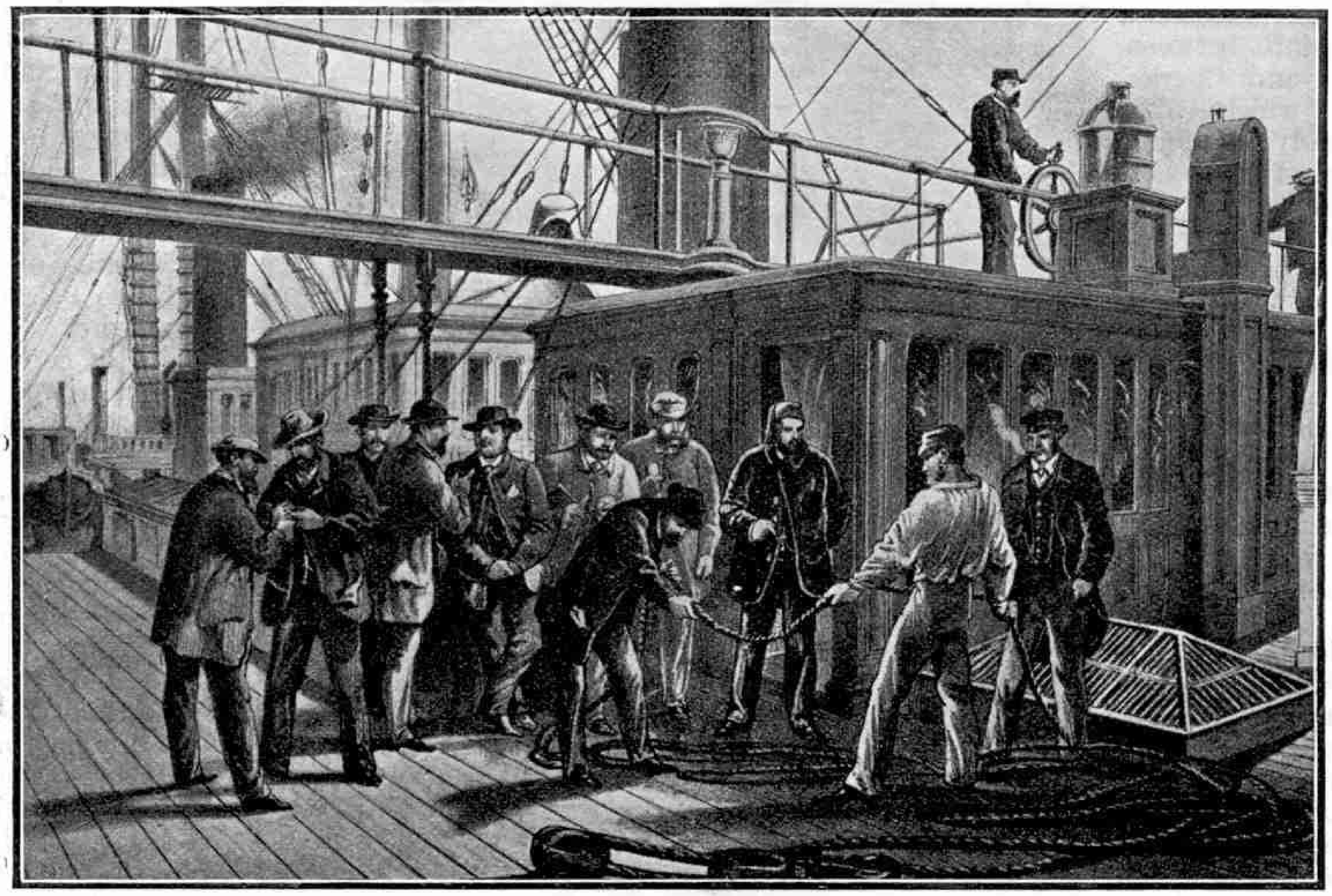
Finally the cable was completed and stowed in the holds of H.M.S. "*Agamemnon*" at Greenwich, and the U.S. frigate "*Niagara*" at Birkenhead, these ships having been placed at the service of the company by the two Governments. At Greenwich the workpeople and the sailors were entertained to a great banquet to celebrate the completion of the task, and it was noted in "*The Times*" report that the crew of the "*Agamemnon*" paid the greatest attention to the speeches and drank all the toasts with remarkable punctuality—at any rate as long as their three pints of beer per man lasted! The enthusiasm of Jack in the cause of science emptied all the mugs long before the Chairman's last toast had been gone through!

The two ships met at Queenstown on 30th July, when Bright and Whitehouse took the opportunity of joining the two halves of the cable and making a successful

test through its entire length. They were joined there by several other steamships detailed by the Governments to act as consorts, the whole fleet of seven ships being familiarly known as "*The Wire Squadron.*"

Cable Laying Commenced

Arriving at Valentia, Bright and his assistants soon occupied themselves in completing the arrangements for landing the shore end, which was made more massive than the rest of the cable in order to withstand damage from any anchorage in the Bay. The cable to be landed here was taken from the "*Niagara*" and when the American sailors jumped ashore with the hawser to which the cable was attached, every one present, including the Lord Lieutenant of Ireland, seemed desirous of having a hand in the great work.



Splicing the Cable

Next morning paying-out commenced. Bright had taken up his quarters on the "*Niagara*" to supervise the operation, but five miles only had been laid when the cable caught in some of the apparatus and parted. The lost end was found, lifted out of the water, and spliced to the gigantic coil on board. Laying then recommenced, the "*Niagara*" moving more cautiously than before. The cable was paid out at a speed a little faster than the ship to allow for inequalities of surface on the bottom. During the whole time an electric current was passing between ship and shore, and not only did the electricians telegraph back the progress they were making, but also private messages were sent to England. Everything seemed to be going on well when, on the fourth day out, the cable snapped after 380 miles had been laid, owing to mismanagement of the brake.

Loss of Cable Worth £100,000

The trip was apparently a failure, but much had been learned and there was no thought of abandoning the project, although a length of cable worth £100,000 was apparently lost for ever. Unfortunately there was not enough cable left to complete the work, nor was it possible to get more made and stowed on board in time to renew the attempt that season. Postponement until the following year was thus necessary.

Active and practical preparations were pushed forward for the new expedition. A new cable 700 miles in length was made, so that a total length of 3,000 instead of 2,500 miles was available, and a more satisfactory brake was evolved by Bright in consultation with several other engineers. Besides this activity Bright had to refute objections from men such as Airy, the Astronomer Royal, who, as already stated, said the whole thing was impossible; to return polite answers to the proposers of ludicrous ideas as to how things should be done and, in his own words: "By dint of bribing, bullying, cajoling, and going day by day to see the state of things ordered," to ensure that all was ready for the time of starting.

The same ships were again loaned to the company by the two Governments, and after taking the cable on board Bright made a trial trip to the Bay of Biscay, where practical rehearsals of splicing, buoying, paying-out, and hauling in were carried out with an old piece of cable until every man was perfectly familiar with his task.

The Effort Renewed

Finally on 10th June the expedition set out from Plymouth for a second attempt. This time the paying out was to commence in mid-Atlantic. The two ships and their escort arrived at the chosen spot, about half way across, after passing through a terrible storm. The weight of the cable in the holds of the "*Agamemnon*" and the "*Niagara*" occasioned great anxiety, and so violent was the storm that on the "*Agamemnon*" no less than 45 men were compelled to report sick, a large number of them from injuries caused by the rolling of the ship. The upper part of the cable in the hold also became seriously entangled.

After some days of work the coil was once more in order and on the morning of Saturday, 26th June, the end of the "*Niagara*" cable was sent on board the "*Agamemnon*." The splice was made, a bent sixpence put in, for luck, and the cable was then lowered slowly over the side. When each ship had paid out three miles or so, however, the cable came off its pulley on the "*Niagara*" and broke.

Another Failure

As the electricians were continuously sending messages from one ship to the other through the cable, the break was immediately detected, and the ships returned to the starting point and began again. Once more a break occurred, this time after 40 miles of cable had been paid out. A disquieting feature of the break was that it occurred under water, as though the cable had dropped on some sharp rock instead of the soft level bottom expected. A third attempt was immediately made, but again the cable broke after rather more than 100 miles had been paid out. In the end the various ships of the expedition returned to Queenstown.

The project now seemed to be a hopeless failure. The Vice-Chairman of the company became convinced of the impracticability of the undertaking, and resigned. Other officials suggested a sale of the cable remaining on board the ships, and the complete abandonment of the undertaking. But the original projectors of the scheme, Bright, Field and Brett, together with Kelvin and Whitehouse, were still convinced that the scheme ultimately would meet with success, and at length obtained from the directors an order for the immediate sailing of the expedition for a final effort. Bright's version of the prospects was characteristic of him. On his way to join the expedition he said: "I don't say we shall do it even this time, but we shall do it *some* time."

The Final Effort

On 17th July, with no public enthusiasm or cheering, the ships set out again from Queenstown on their "mad freak of stubborn ignorance," as it was by this time described. The prospects of success were very remote. The amount of cable in the two ships had been reduced by nearly 400 miles and recollections of three separate and unaccountable breakages were still fresh in the minds of all who had accompanied the first expedition. The voyage was uneventful, and the ships reassembled

at the point in mid-Atlantic where they were to re-commence the task. The weather was calm and no time was lost in splicing the cable and beginning operations, the ships moving away from each other at one o'clock on the 29th July.

Bright, as before, was on the "*Agamemnon*," which carried the portion of cable destined to end at Valentia. The great coil slowly grew less and less, the electricians testing it all the while for continuity, Lord Kelvin, using his new galvanometer for the purpose. Constant watch was kept to prevent any of the accidents previously met with, and the necessity for care soon appeared when a damaged piece of cable was discovered to be approaching the paying-out gear. Repairs to the damaged portion were immediately undertaken while the cable continued to run out, as former experience had shown that to check either the speed of the ship or the cable probably would be attended by fatal results. Fortunately the repairs were completed, amid great excitement, at the very last possible moment.

Another scare arose when Lord Kelvin reported that signals through the cable had failed. Fears of another underwater break seized the minds of all, when suddenly the signals again appeared at full strength. It was afterwards found that the trouble was caused by a defect in a battery on board. A gale of wind from the east caused the next tribulation, and fuel was consumed at such an enormous rate, in order to make any progress at all, that it began to look as if masts, spars and even the decks would have to be burnt in the effort to reach Valentia. On two occasions passing ships had to be fired at to warn them off the course of the cable-layer, and the nerves of all were kept in a state of tension.

Success at Last !

Finally, on 5th August, the "*Agamemnon*" steamed into the Harbour at Valentia, where a gun fired by her consort aroused the populace, who crowded round in their boats in the greatest state of excitement. The end of the heavy shore cable was safely brought on shore by Bright, to whose exertions the success of the undertaking is attributable.

Shortly after ariving the "*Niagara*" signalled that preparations were being made at Newfoundland for landing the American end of the cable. This ship had had a less eventful journey than the "*Agamemnon*" and also completed her task on 5th August.

Triumphant Reception in England

All England applauded the triumphant outcome of such undaunted perseverance, and the engineering and nautical skill displayed in this victory over the elements. The many previous failures rendered the final success all the more dramatic and the resultant public enthusiasm rose correspondingly high. The general public attitude towards the successful establishment of the cable is seen in the following extract from the leading article of next day's issue of "*The Times*" :—

"Mr. Bright, having landed the end of the Atlantic cable at Valentia, has brought to a successful termination his anxious and difficult task of linking the old with the new. Since the discovery of Columbus, nothing has been done in any degree comparable to the vast enlargement which has thus been given to the sphere of human activity."

The anxious and incessant watching of the progress of the cable had exhausted Bright and the rest of his staff, but a series of banquets still had to be faced. On his way to London after seeing that everything at Valentia was in order, Bright was entertained at Dublin by the Lord Mayor, and there an interesting ceremony took place, which he reported to his wife as follows :

A Well-deserved Knighthood

"The Lord Lieutenant having expressed a wish to see me, I had an interview with him this morning. He intimated his desire to confer upon me—on behalf of her Majesty—the honour of Knighthood, which ceremony will be performed to-morrow, after which I dine with him to meet a large party of the noble folks of the land, and then I shall be glad to get home and have a little quiet with 'Lady Bright.'"

Thus at twenty-six years of age Bright had carried out a stupendous engineering feat and had earned a knighthood—the youngest man who had received the distinction for generations past.

When the cable settled down to useful work, its value was quickly proved, and everything seemed to indicate a great future for it, but after a short time the signals began to grow weaker and weaker until finally the cable failed entirely, after 732 messages had been transmitted. This was a bitter disappointment, and the state of Bright's mind, after all his struggles, can be imagined. Still, he had the satisfaction of knowing that his portion of the undertaking had been completely successful and that no part of the blame could be laid on him.

There was no doubt that the cable was mechanically good, but electrically bad, for the evidence at the enquiry that was held into the failure proved conclusively that Whitehouse had damaged it by using power too great for it in order to get his apparatus to work.

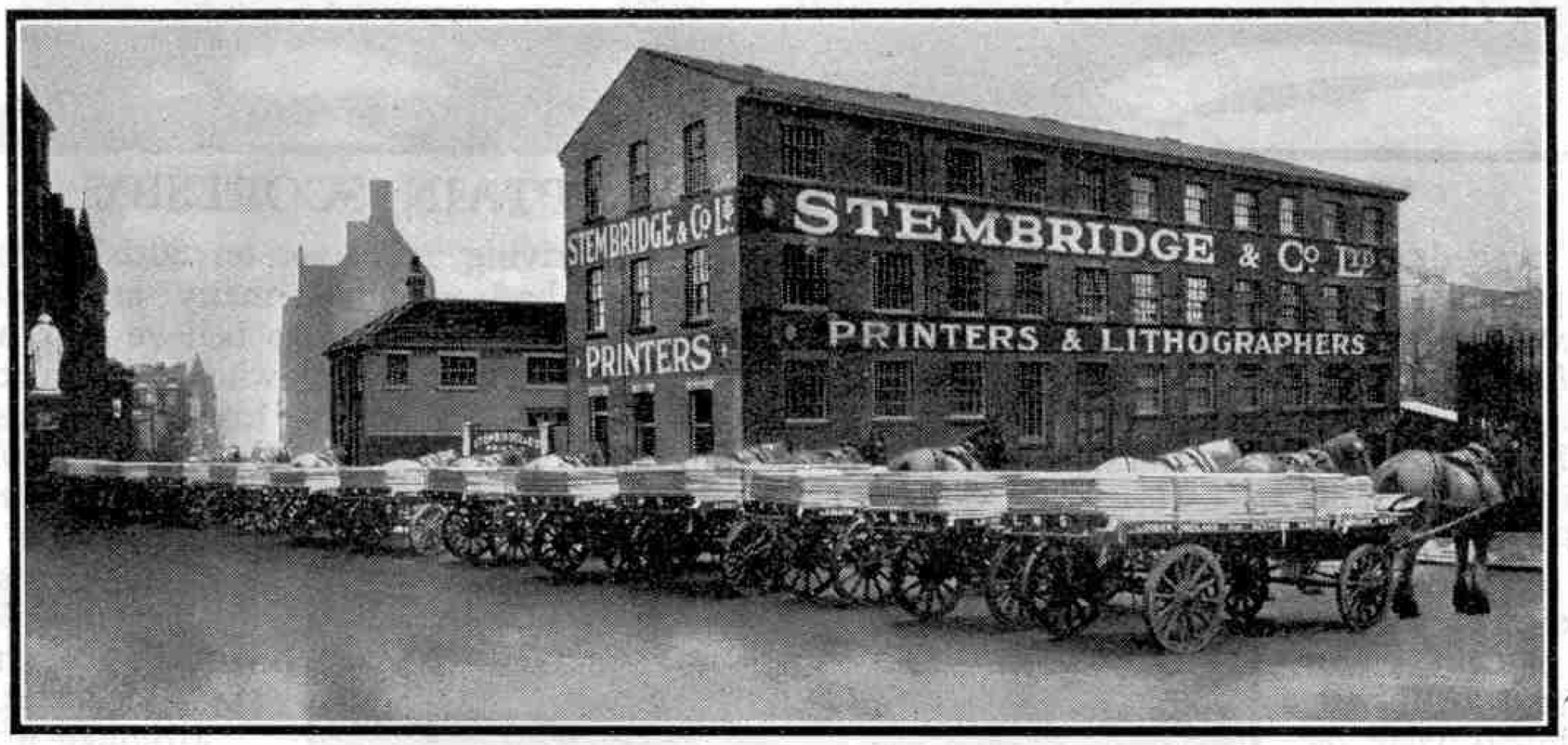
The "*Great Eastern*" Acquired

Seven years later the proposals for an Atlantic cable again took practical shape. Much experience had been gained in the meantime as the result of Bright's cable-laying in other parts of the world. Further, the cable was this time made from the designs of Bright himself, and had a weight of 300 lb. of copper and 400 lb. of gutta-percha per mile, being three times as substantial as the old cable. For the actual laying one vessel only was used, the "*Great Eastern*"—the "white elephant" of the ocean—the ship Bright would have used on the previous occasions had she been available.

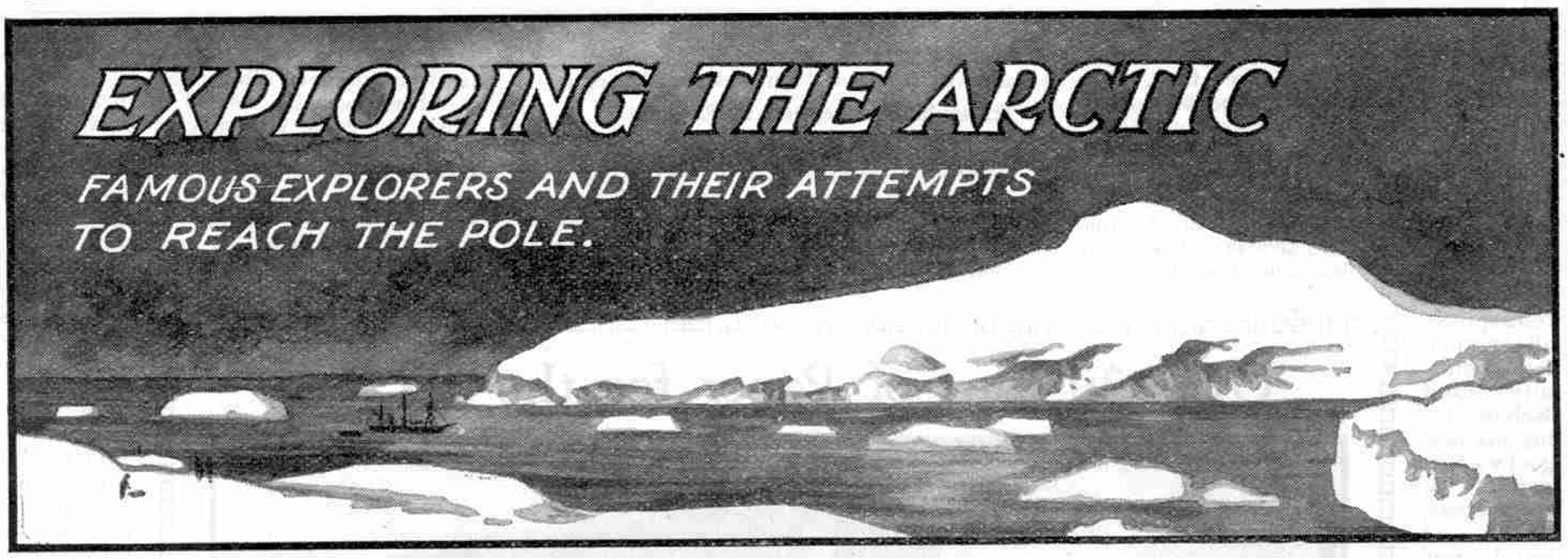
The "*Great Eastern*" left Valentia in July 1865, after joining up the end of the new cable to the shore, but this time Bright, although still consulting engineer to the company, did not accompany the vessel, being engaged elsewhere on Parliamentary Committees, etc. After an unsuccessful effort, at last the "*Great Eastern*" steamed into Trinity Bay, Newfoundland, fourteen days after starting, having laid 1,852 nautical miles of cable at an average depth of 8,400 ft. Two cables were established on this trip and they continued to work until 1872 and 1877 respectively.

Bright's share in the success, although indirect, can hardly be overestimated. He carried out the pioneer work and succeeded in laying a cable, and although the latter was too light, it was Bright who designed the cable that proved permanently successful.

Over 20 tons of Paper for the "*M.M.*"



Our illustration shows the twelve lorries required to move the paper for last month's issue of the "*M.M.*" from the station to our printers in Leeds. Some interesting figures in regard to this issue are given in an Editorial paragraph on page 1. Over 20 tons of paper are now required every month for printing the "*M.M.*" in its enlarged form



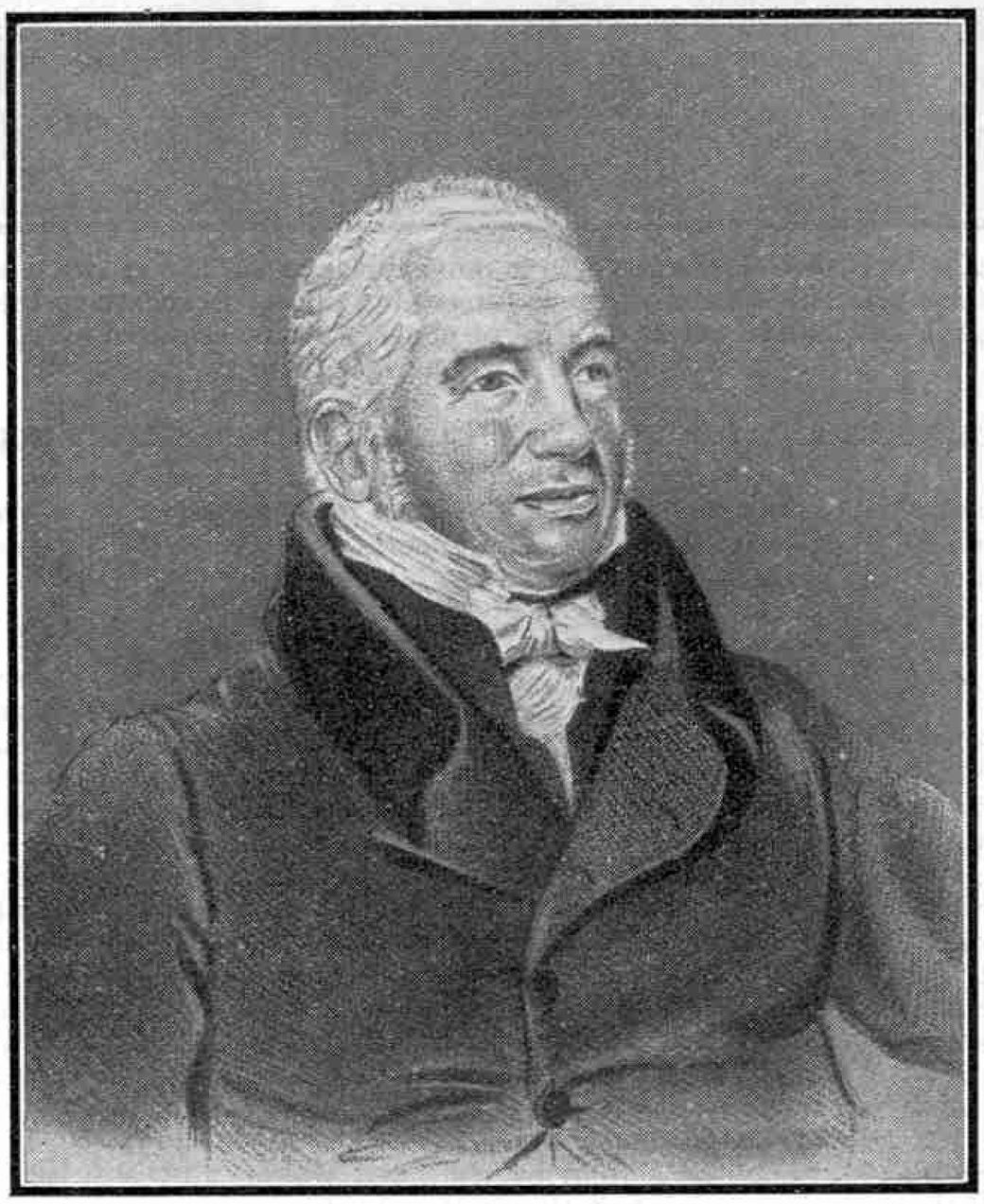
V. WILLIAM BAFFIN AND CAPTAIN SCORESBY

AFTER the tragedy of Henry Hudson—when the great explorer was infamously set adrift in an open boat in the Arctic, as described in last month's "*M.M.*"—the next name that comes up for consideration is that of Baffin.

William Baffin, who became a notable and enterprising seaman, was born in London in 1584. Nothing is known of his early life and his fame rests entirely on the voyages that he undertook between 1612 and 1616. In the first mentioned year he accompanied Captain James Hall on his fourth voyage in search of the north-west passage. In 1613 Baffin commanded one of the English vessels engaged in the Greenland fisheries and in whale fishing off Spitzbergen.

It was when on this—his second voyage—that he gave us the first description of the great glaciers at Spitzbergen. In his later voyages, Baffin completed the work that Davis had set out to accomplish in the exploration of the Hudson Strait. He sailed in Hudson's old ship the "*Discovery*" and discovered the land that now bears his name.

In 1616, Baffin's fifth voyage, which was again made in the "*Discovery*," was the most successful voyage of the 17th century. Robert Bylot was appointed master of the ship, which was fitted out by four London merchants, and William Baffin was the pilot. The little craft with its crew of 15, sailed from Gravesend on 26th March. Two months later the voyagers were off Sanderson's Hope in the Davis Straits. Next they discovered a great bay—subsequently called Baffin's Bay—to the north, crossed Melville Bay and by July had reached Cape Alexander, Lat. 77° 45′N. This was the most northerly point Baffin attained and he explored the great Bay, discovered a wide channel extending to the north from Davis Strait, and returned home, arriving at Dover on 30th August.


Captain William Scoresby

Baffin had made so many unexpected discoveries that the public refused to believe him, and as no other vessel succeeded in following the track of the "*Discovery*" for 200 years, his statements remained in doubt for this length of time. Geographers refused to insert his Bay in their maps until early in the 19th century, when its existence was confirmed by Ross and Parry, with whose adventures we shall deal later.

Although a few other voyages to the Arctic were made in succeeding years, the first phase of polar exploration is generally regarded as having ended with Baffin's splendid discoveries. The second phase did not commence until 1818, when these two explorers, Ross and Parry, again made history.

In the meantime, as a result of Baffin's work and the earlier discoveries, the Hudson Bay Company was incorporated in 1670, and various discoveries were made in the Arctic by the company's servants. Considerable rivalry in developing the possibilities of the Arctic existed later in the century between the English and the Dutch, whose boats came in fleets to the Polar Seas for whale and seal fishing. This Dutch enterprise continued to flourish until the time of the French Revolution, and at times there were as many as 100 ships engaged in the industry. The English whale fishery in the Spitzbergen Seas was even more prosperous, however, and was at the height of its prosperity between 1752 and 1820, when as many as 255 vessels were employed.

We may here pause to mention the work of Veit Bering, a Dane, who had entered the employ of the Russians. In 1725 he was appointed to command one of the most remarkable expeditions in history, which was entered into on the instructions of the Empress.

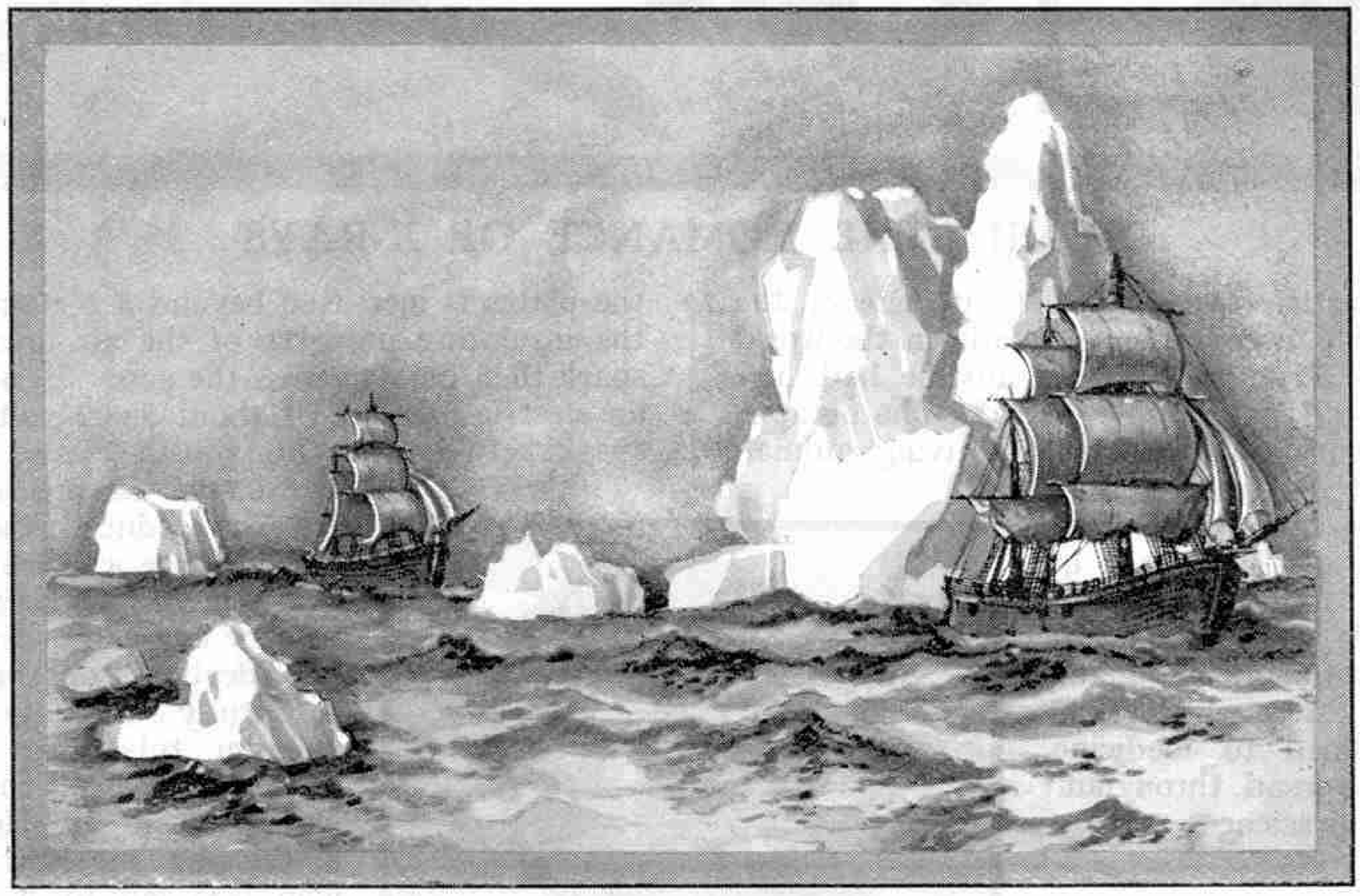
If the Emperor Nicholas required a railway to be built he took a map and on it ruled a line, ordering the engineers to make the railway follow it. He issued his order entirely regardless of physical or other difficulties, and woe betide the engineer who failed to comply with the command!

It was in a somewhat similar manner that the Empress Catherine ordered an expedition into the Arctic, and no one dared to raise any objections! Her instructions were that trees were to be felled in a forest on the Pacific coast and with their timber a ship was to be built. All the materials and stores other than this timber were to be carried across the Russian Empire—this in the days when there were no railways, and when for thousands of miles at a stretch there were even no roads!

Bering, who was placed in charge of this expedition, left St. Petersburg early in 1725 and of his subsequent adventures much could be written. Not for three years was he able to get the vessel on to the stocks. Three months later she was launched and christened the "*Gabriel*," and ten days later she put to sea. Sailing past the island of St. Lawrence and past the East Cape, Bering discovered the strait that now bears his name. Having come to the conclusion that there was no land connection between Asia and America, Bering decided that he had accomplished his mission and returned to the Kamchatka River. This was indeed a remarkable feat—in view of the fact that the voyage lasted less than seven weeks and was made in a vessel that required three months to build, on a site that took over three years to reach!

In the following year Bering made a second voyage but, meeting adverse winds, was blown back. In 1733 he set out once more, and despatching his colleague Spangberg to find Japan, himself went eastward to America. Incidentally, it may be mentioned that when Spangberg arrived at Japan—five years later after many adventures—he found, much to his surprise, that the Japanese knew more about maps and exploration than he did himself! After being away all this time, it must have been most annoying to Spangberg to be told on his return, by high officials at St. Petersburg, that he could not possibly have been to Japan, as this country was not marked on their maps where he said it was! He was ordered to again go to where he had already been, and as quickly as he could travel, to see if he had not made a mistake! He was unlucky, however, and could not repeat the voyage, so that the Russians did not believe Japan existed until a long time after.

Meantime Spangberg had used up so many provisions from the common stock that Bering was delayed in starting on his voyage to America—he did not in fact start until 1740. He explored the Aleutian Islands, but here he met with hardship and disaster. Some of his men died from scurvy and others were so ill that there were not enough to work the ship. At length on 8th December 1741, the climax came, when a huge sea lifted the ship clear over a reef into a lagoon, from which she could never escape. Although Bering died, a few survivors of the crew managed to return to Russia in a small boat built from the timbers of their ship the "*St. Peter*."



Whalers among icebergs

Little else of importance was done in Arctic exploration for a long time, except that in 1773 an expedition was sent out by the Royal Society to find out how far it was possible to sail towards the Pole. Two ships were used—the "*Racehorse*," Captain Phipps, and the "*Carcass*," Captain Lutwidge—and although Phipps sailed up every opening he could find in the ice beyond Spitzbergen, progress was barred on each occasion by a solid barrier of ice. After reaching Lat. 80° 48′N., the expedition returned to England.

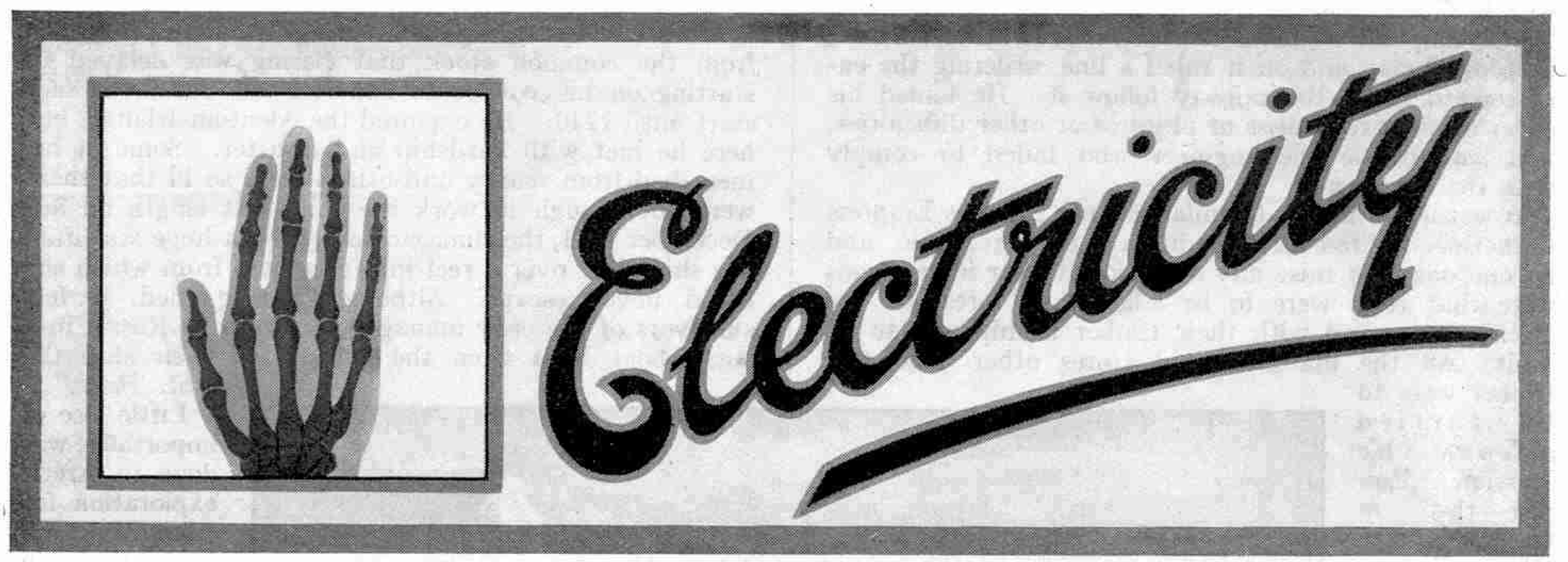
In 1776 Polar exploration received a considerable encouragement when the sum of £5,000 was offered by the British Government to the first ship to sail beyond the 89th parallel and £20,000 to any ship that succeeded in making a north-west passage.

In the early years of the 19th century good work was done by Captain Scoresby, a daring and able explorer, who, in 1806, sailed in the "*Resolution*" as far north as Lat. 81° 30′.

William Scoresby, born 3rd May 1760, was the son of a farmer who lived near Crompton in Lancashire. He went to sea when only 20 years of age and became one of the most successful and daring Arctic whale fishers, whose only equal was his son, also named William.

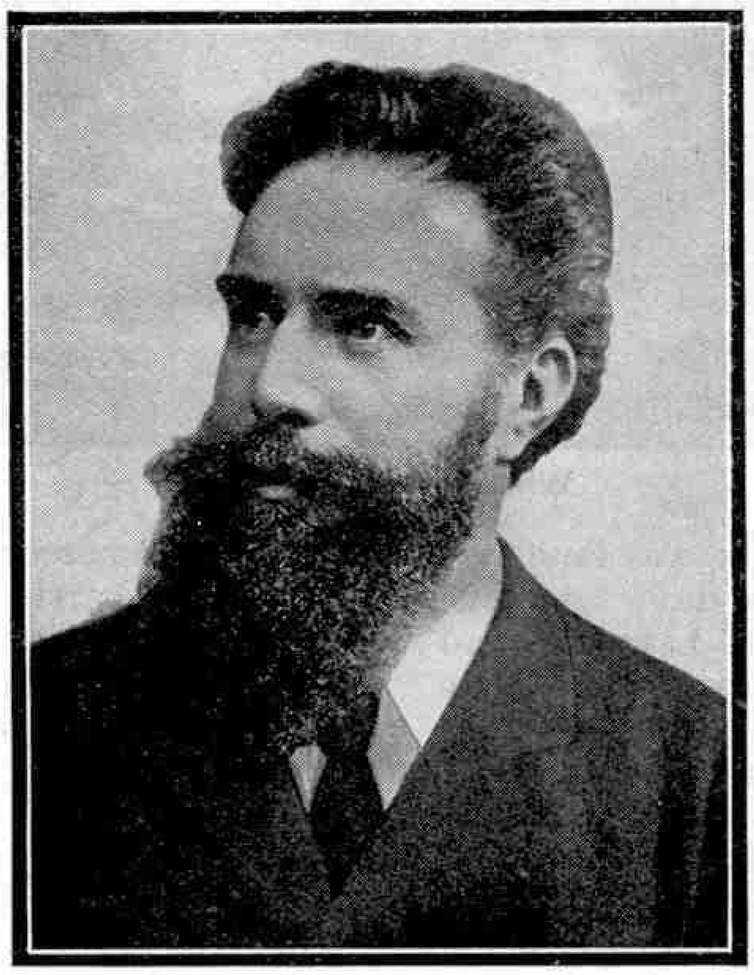
"Scoresby the Elder," as he is called, was a most remarkable man, it is to him that we owe the invention of the "crow's nest," the look-out tower subsequently carried by every ship engaged in Arctic service. In Scoresby's day the crow's nest took the form of a canvas-covered framework—entrance to which was obtained by a trap-door in the base—placed above the top-mast cross-trees.

Scoresby also invented many implements and devices—including the ice-drill—used in Polar exploration. He sloped off the fore and main courses of his ship, bringing them inboard to a boom fitted at the foot. In this arrangement he was followed (*Continued on page 29*)



XXXII. THE ROMANCE OF X-RAYS

IN this series of articles we shall deal with one of the most remarkable discoveries ever made in the world of electricity. Prior to 1895, if anyone had suggested that it would be possible to take photographs showing the interior arrangements of a living animal, he would have been treated as a candidate for the lunatic asylum. But the discovery of the X-rays by Konrad Wilhelm Röntgen actually made this possible, thereby placing in the hands of doctors an invaluable aid in their work. The value of the rays is not confined to medicine, however, but is spread throughout the whole sphere of science.


K. W. Röntgen

The Electric Egg

The beginning of the story of X-rays goes back to the middle of the eighteenth century when electricity, as produced by crude friction machines, was a matter of fashionable interest in Paris. A favourite electrical toy of the time was a glass globe called the electrical egg, through the air in which electric sparks were passed, while some of the air was removed by an air-pump. This gave rise to surprising and beautiful colour effects. The electric egg remained merely a toy for another hundred years, when an increase in the efficiency of air-pumps and a growing interest in the study of electricity led to the revival of the experiment on serious lines. Röntgen's famous discovery was the sequel to this new study of the passage of electricity, in the form of sparks, across air-gaps, and to this we will now turn our attention.

If two small metal plates or balls are placed close to one another and connected respectively to the positive and the negative poles of an electric battery with a small voltage, such as an accumulator, then no current will pass between them because the intervening air is, in such a case, a non-conductor of electricity. If the voltage between the plates is increased beyond a certain limit, however, the insulating property of the air breaks down and a spark then bursts across the gap. In normal conditions an electric pressure of about 5,000 volts will produce a spark between two brass balls placed one inch apart, but if the air pressure between the balls is reduced the same voltage will produce a much longer spark.

When the air pressure is reduced to very low values remarkable luminous effects are obtained, and in order to study these effects so-called vacuum tubes are now used. In its present form the vacuum tube was devised by Heinrich Geissler, a German inventor and physicist, who was led to it by a desire to exhibit the colours obtained in as attractive a manner as possible.

Modern Vacuum Tubes

Fig. 1 shows a simple form of vacuum tube. It is a glass tube, usually six inches to eight inches in length, the middle portion being of much smaller diameter than the ends and often twisted into various shapes to show off the luminous effects better. Two small platinum wires, A and C, called electrodes, are sealed in the glass by fusion. Electrode A, which is connected to the positive pole of the source of supply is called the anode, and C, which is negative, is called the cathode. By attaching an air pump to the side tube B the air or gas inside the tube can be reduced in pressure as required, and on reaching the desired low pressure the tube B can be sealed off. The pressure is never reduced to nothing as the name vacuum tube implies, since nothing would happen at all in a really empty tube. As we shall see later, gas tube would be a more suitable name.

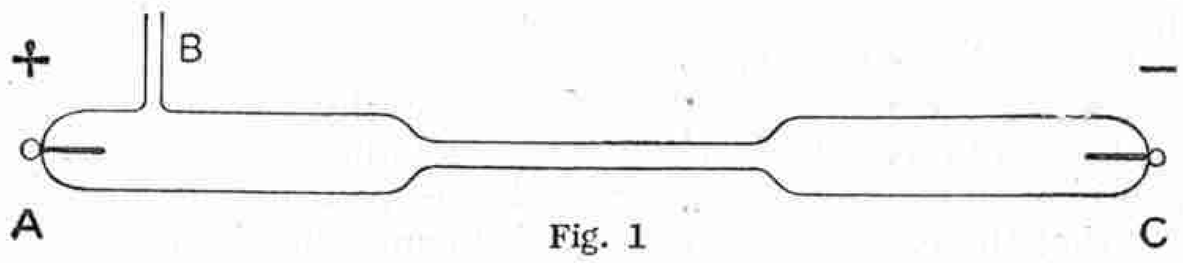


Fig. 1
Diagram of a typical Vacuum Tube

How High Voltages are Obtained

The voltages required for these experiments are much higher than those easily obtainable

from ordinary sources, although the current in amperes need only be small. An electrical machine such as the Wimshurst machine is a suitable source and large ones driven by electric motors have been used extensively in the United States. The usual source of electricity is, however, the induction coil, which is a simple transformer.

The principle of the transformer was discovered by Faraday, in the course of his long series of electrical experiments. He wound upon an iron ring two insulated coils of wire, which we may call A and B. Coil A was connected to a battery and coil B to a galvanometer. When the current was switched on or off in the primary coil A, currents were generated in the secondary coil B. In all transformers the voltages set up in the secondary coil are nearly proportionate to the relative number of turns of wire in the two coils. If the primary coil has 100 turns and the secondary coil 2,500 turns, then the voltage in the secondary circuit will be nearly 25 times as great as that used in the primary circuit. A transformer wound in this manner thus raises or steps-up the voltage of the current supply to it.

In the case of the induction coil, the primary coil usually consists of a few turns of thick copper wire and the secondary coil of a much larger number of turns of thin wire, both coils being carefully insulated. The place of the ring in Faraday's apparatus is taken here by a bundle of soft iron wires which become electro-magnets when the current is passed through the primary coil.

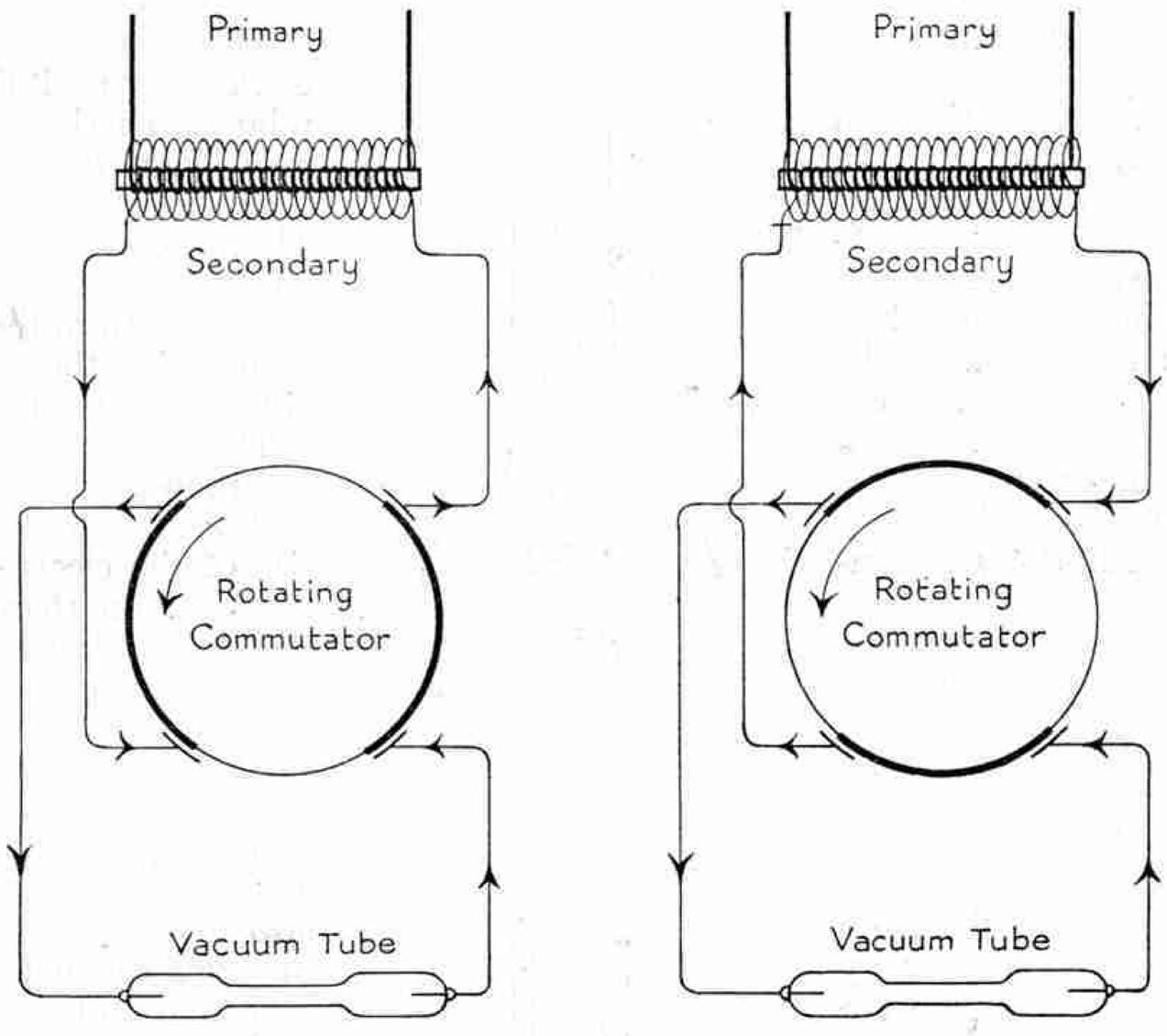


Fig. 2

Current Interrupters

As the currents in the secondary coil are only produced on making and breaking the current in the primary coil, it is necessary to adopt some means of performing these operations automatically. For this purpose two types of interrupters are in general use. In one of these, known as the mercury jet interrupter, a motor rotates a ring of contacts rapidly while at the same time a small pump forces a jet of mercury from the inside of the ring against the contacts. The primary current to the induction coil only flows when one of the ring of contacts comes opposite the mercury jet, and thus it is constantly broken and re-made. The rapidity of the interruption depends on the speed of rotation of the contacts. If very frequent interruptions are required, instruments are used in which both the ring of contacts and the mercury jet are made to revolve in opposite directions, thus enabling a frequency of interruption of 200 times per second to be obtained. In order to prevent tarnishing of the mercury by the air, the apparatus is usually filled with coal gas, or in some cases with paraffin oil.

A very ingenious apparatus that can take heavy currents is the Wehnelt interrupter, which is electrolytic in action. In a small vessel containing sulphuric acid dip two electrodes, the cathode being a lead plate while the anode is a platinum wire that just projects from a porcelain tube. When the current flows a small bubble of gas forms at the platinum point and, as gas is a poor conductor, the flow of the current ceases. The bubble of gas then immediately disappears, being cooled and contracted by the mass of liquid, thus re-making the current. The speed of interruption can be varied by altering the size of the platinum point.

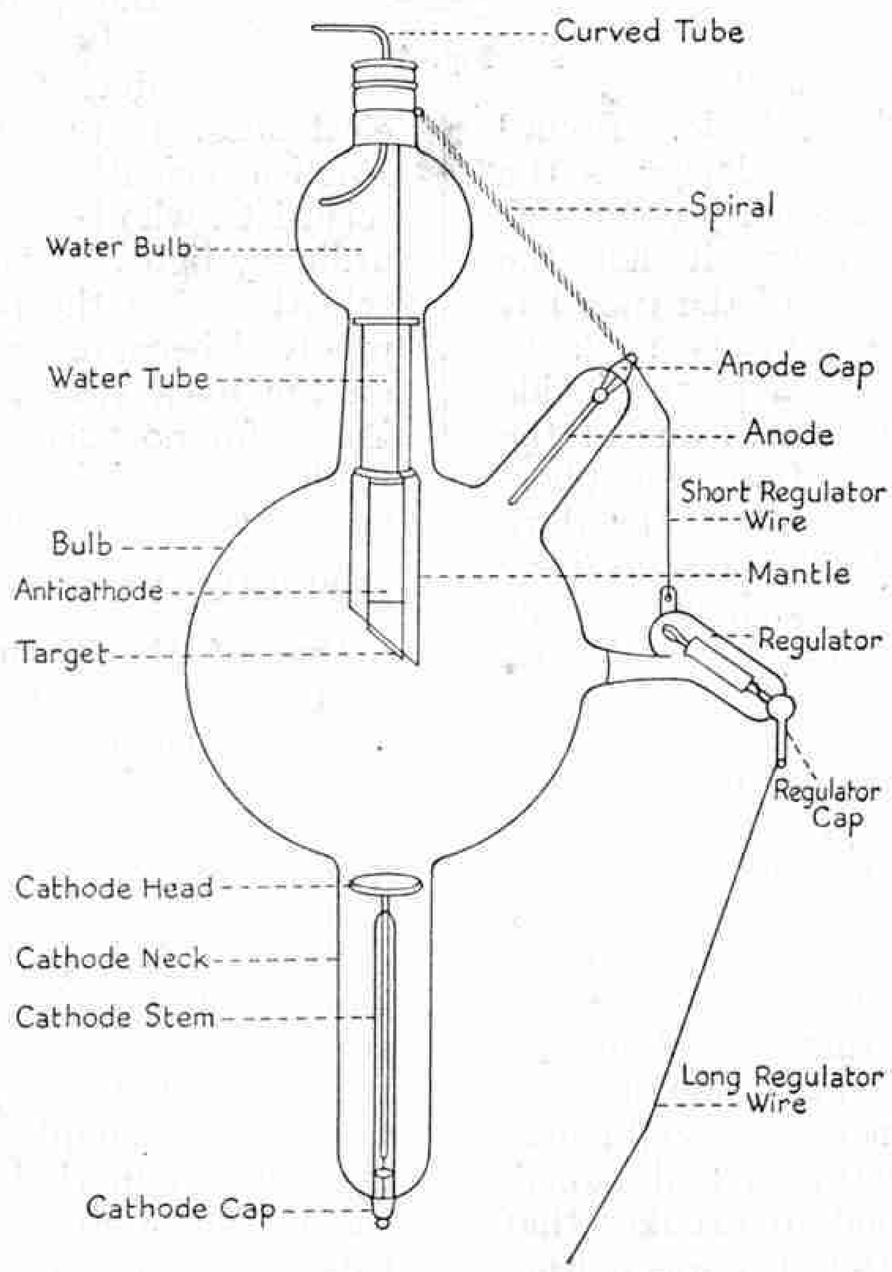


Fig. 3

Rectifying the Transformer Current

In any transformer the currents induced by the make and break of the primary current are opposite in direction, but it is necessary in the study of the passage of electricity through vacuum tubes that the current should always pass in one direction. The output of the transformer therefore must be rectified. This is usually done by a commutator, which consists of a split copper ring, mounted in suitable insulation, and rotated at a speed in conformity with the rate of change of direction of the secondary current. Sliding contacts which collect the current from the halves of the rotated copper ring can thus pass on to the vacuum tube a uni-directional current, as is seen in Fig. 2, which shows the general arrangement of the step-up transformer, rectifier, and vacuum tube in two different positions of the rectifier.

The famous Spottiswoode coil in the Royal Institution, London,

has 280 miles of wire in 340,000 turns for a secondary coil, and can produce a spark in air over 42 inches in length! It is not necessary, of course, to use such a coil for vacuum tube work, and one that will produce a half-inch spark in the air will suit a vacuum tube eight inches in length, and accumulators can be used as the primary supply.

With a tube of this kind, an induction coil and an air-pump, the effect of varying the pressure of air can be followed. At ordinary pressures, as we have seen, a very high voltage is required to produce even a small spark, but as the gas is pumped out the conditions become more favourable and a spark can be obtained with a lower voltage. As the pressure is still further reduced the spark becomes less definite and later spreads out to fill the whole tube with a beautiful glow of colour, which varies with the gas contained in the tube.

If the tube contains nitrogen, a rosy tint prevails with a violet glow round the cathode, while if hydrogen is used a splendid crimson glow is seen in the narrow part of the tube. At still lower pressures the glow in the middle portion breaks up into cup-shaped patches of light which vibrate rapidly. Many fine colour effects are obtained by using tubes made of uranium glass, or by enclosing the tube in an outer tube containing solutions of quinine. These substances have the property of fluorescence, which simply means that they can be excited in various ways to emit light of various and varying colours. One such substance is a chemical known as barium platinocyanide, which is of great importance as we shall see later.

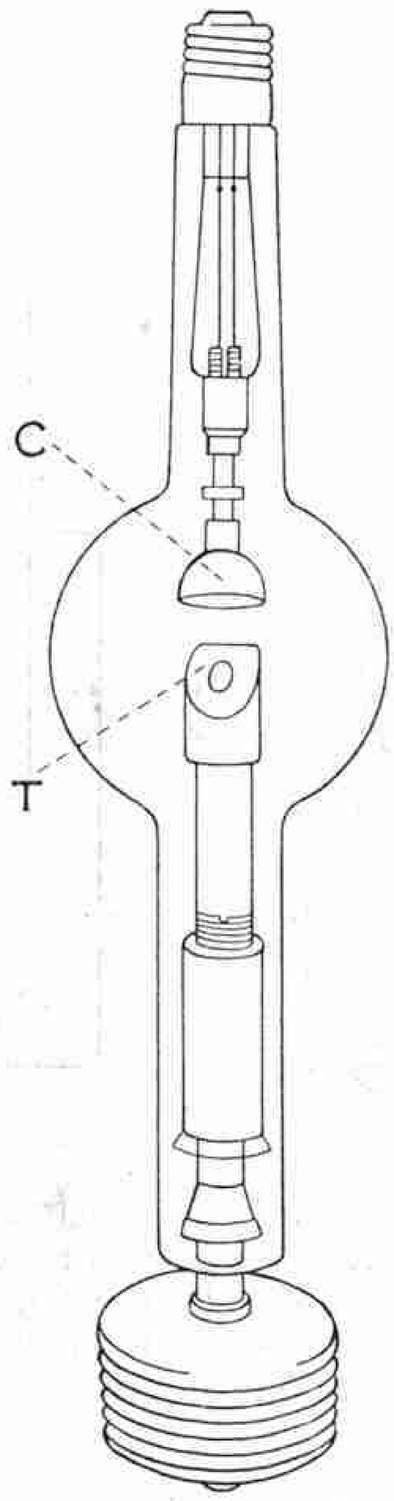


Fig. 4

The Radiant State of Matter

From a scientific point of view the most important part of a vacuum tube is the cathode. Round it a small dark space forms which grows larger as the pressure of the gas is reduced, until at such pressures as one-millionth of that of the atmosphere it fills the entire tube. In the meantime the glass of the tube has become phosphorescent, and many objects such as diamonds and rubies glow strongly when placed inside the tube. Sir William Crookes, who was one of the first to study these problems, found that this phosphorescence is due to rays streaming across the dark space from the cathode. These cathode rays, as they are called, travel in straight lines, as is shown by the fact that a cross made of mica gives a definite shadow on the phosphorescent glass.

Other experiments devised by Crookes seemed to show that the rays were material in nature. For instance, he arranged inside a vacuum tube a small paddle wheel, the axle of which rested on two parallel glass rods. The upper vanes of the paddle wheel, made of mica, were directly in the path of the rays, and it was found that the paddle wheel was driven away from the cathode, which obviously suggested that something was striking the vanes. Crookes also found that the rays were turned from their path by a magnet brought near them in such a manner as to show that they had a small negative electrical charge. It seemed to Crookes that he had discovered a new form of matter that was neither solid, liquid, nor gas, but composed of particles much smaller than the atom, and which were the materials from which atoms were built up. To this he gave the name *radiant matter*.

The Electron, an Atom of Electricity

These suggestions have been brilliantly confirmed, and the size and speed of the minute particles composing the cathode rays have been measured by the famous Cambridge scientist, Sir J. J. Thomson. They are now called electrons, and are in fact atoms of electricity that are here separated from the atoms of ordinary matter with which they are usually associated and given for a brief time a career of their own.

The weight of an electron is less than one-thousandth of the weight of an atom of hydrogen. To give a faint idea of the actual size of the electron, we may note first that it takes more than one million million million hydrogen atoms to weigh one gramme. This number is so enormous that to state it more exactly does not help us to realise what it means, and it seems more amazing still when we find that there would be no difficulty whatever in packing one gramme of hydrogen into a medicine bottle or even into still less space. Yet the electron is so much smaller that, if placed inside the hydrogen atom, it would look like a speck of dust in a room or a fly in a cathedral!

An electron is a small thing to exercise any influence in the world, but it has been endowed in this case with speeds in the neighbourhood of 60,000 miles per second, and it is the bombardment of the glass and the substances in the tube by these incredibly swift particles that gives rise to the phosphorescent effects just described.

Before Sir J. J. Thomson fully proved that the cathode rays were a stream of electrodes, there had been a great struggle between English scientists headed by Crookes, and foreign scientists, who believed the rays to be of the character of ordinary light. It was argued for instance, by German scientists that the paddle wheel in Crookes' experiment revolved because of the heat effects of the cathode rays on the mica vanes. This is certainly true as we now know, for no such result is obtained if the vanes are made of aluminium, which is a good conductor of heat and consequently does not get hot.

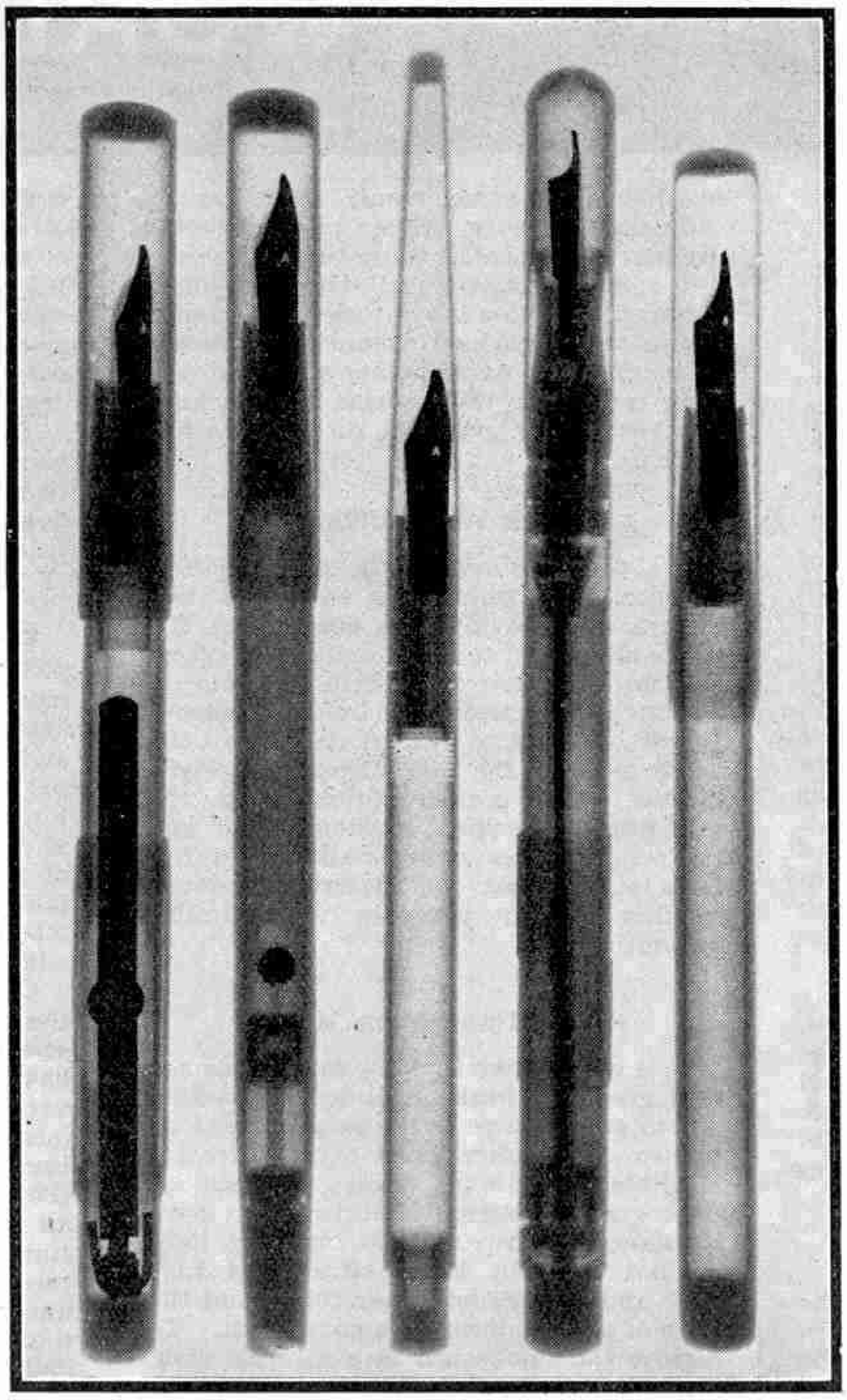
Röntgen's Discovery

One of the German scientists taking part in this controversy was Professor Konrad Wilhelm Röntgen, of the University of Würzburg. On one occasion he was "pottering about," as Sir Oliver Lodge expresses it, with a vacuum tube wrapped in black paper. About three yards away was a screen of barium platinocyanide which, as we already know, is made phosphorescent by cathode rays. To his surprise, this screen began to glow. On stopping the current in the tube the glow stopped, so that something in the tube was evidently the cause, but the glow could not be due to cathode rays as they could not penetrate the glass. It was due in fact to remarkable rays which he called X-rays, or the unknown rays. These rays were produced in the tube and could pass out through the glass and even through the black paper

Following up these results it was soon found that X-rays were produced when the cathode rays struck any solid object. In Röntgen's case, they were produced when the rays struck the glass of the tube, and other workers had often produced them without knowing it!

Röntgen's discovery solved mysteries that had been met with by Sir William Crookes. On one occasion Crookes had returned to the makers some photographic plates that proved, on development, to be fogged, and the makers replaced them with profuse apologies, little dreaming that they were the first X-ray photographs ever produced! Crookes must have been very near to the actual discovery, for he succeeded later in taking good X-ray photographs with some of his old tubes.

Röntgen himself always regarded his discovery as a piece of luck, but fortunately the luck fell to a genius who could recognise it and turn it to advantage. He was a pleasant and friendly man, who always remained modest and unassuming even when he saw his discovery extended to confer untold benefits on his fellow human beings, and to save countless lives. He died three years ago, at Münich. Crookes died in London in 1919, so that the two pioneers of X-rays lived long enough to realise what a magnificent discovery they had given to the world.



Courtesy] [Kodak Ltd.

Röntgen Ray Photograph of British and Foreign Fountain Pens. Taken on Wratten X-Ray Plate

Modern X-Ray Tubes

Having discovered the cause of the production of the rays, more convenient and efficient tubes were specially devised. A diagram of a modern X-ray tube is shown in Fig. 3. The tube is made of soda glass, as lead glass offers a greater resistance to the passage outward of the rays. The cathode head, which may be of aluminium, is made saucer-shaped in order to focus the stream of electrons on the target, when the X-rays are produced, spreading out in all directions in front of the target. The anode and the anticathode, the conducting support of the target, are usually connected by a wire on the outside of the tube.

The material of which the target is made is of importance for two reasons. In the first place the cathode rays are heat producing, and as they are concentrated on a small area a metal of high melting point is necessary. Secondly, the metals vary in their powers of absorbing and emitting X-rays. Fortunately, the metals of high melting point are usually metals of high atomic weight, and it is precisely these metals that are the best emitters. Consequently such metals as tungsten and platinum, which melt at 3,500°C. and 1,770°C. respectively, are used for the target.

The other factor of importance is the gas pressure inside the tube, as it is found that the X-rays produced at the lowest pressures are the more penetrative, or "harder," to use the technical term. As already pointed out, these tubes do not contain nothing in spite of their original name of vacuum tubes, and they are now called gas tubes to distinguish them from a special type of X-ray tube developed later.

Cooling the Target

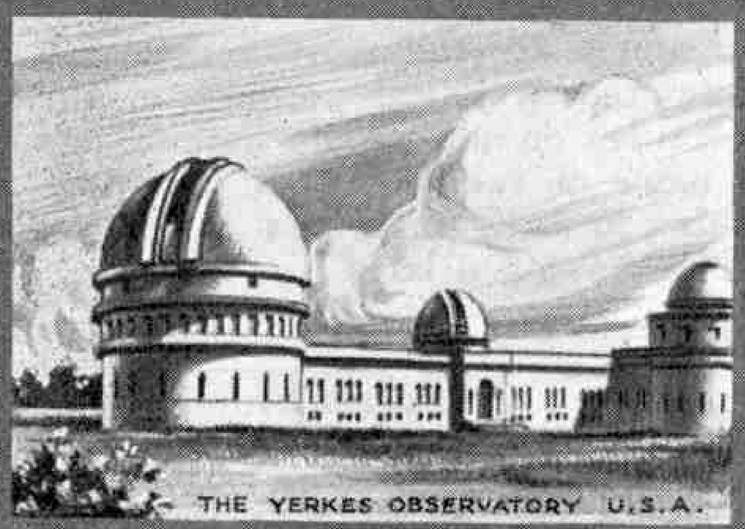
In order to avoid overheating the target, the focussing of the cathode rays was not usually made very sharp, and the X-rays produced were somewhat diffused. This can be avoided by cooling the target, the metal support of the latter being enclosed for a portion of its length in a glass tube through which cold water circulates.

Another ingenious method of cooling is to use as anticathode a tube of thin copper, closed at the end inside the glass tube and open at the outside end, a substantial platinum target being affixed to the lower end of the copper tube. A pair of heavy copper tongs fits inside this tube when slightly open and is held firmly in it by a spring, thus practically making the anticathode a solid block of copper. When the anticathode shows signs of becoming too hot it can be cooled quickly by withdrawing the tongs and substituting a fresh cool pair. The cooling process may also be assisted by having cooling fins at the end of the tongs, this method being, of course, the same as the one used to assist in the cooling of motor-cycle engines.

Restoring the Working Gas Pressure

A further difficulty that arises is that an X-ray tube becomes harder with use, owing to the absorption of positively-charged atoms of gas by the glass during the bombardment, and eventually becomes useless. This trouble is overcome by having in a small attached bulb a piece of asbestos coated with finely-divided platinum, which can be heated by an electric current. This and similar substances, have the power to absorb gases, which they give out on heating, the gas given out restoring the pressure to a suitable working value.

The regulator, as it is called, can be seen in Fig. 3, and in order to restore the pressure the hinged short regulator wire is put in contact with the anode cap, while the long regulator wire is brought within six inches or so of the cathode cap, and the current started. If the tube has become too hard, sparks will cross between the cathode cap and the wire, and the current will pass to the regulator bulb, through the asbestos and thence (Continued on page 81)



OUR WONDERFUL WORLD

Plant's Bodyguard of Ants

There are many instances in nature of small creatures seeking the protection of larger animals as a normal part of their lives, but similar associations of plants and insects must be very rare. One such case occurs in East Africa, where the acacia bush shelters a species of small ant and in return is itself protected against animals such as the giraffe and the antelope, which otherwise would feed upon its leaves.

The African acacias in the course of their growth become covered with green galls, which grow upon the stalks to about the size of a walnut. In their natural condition the galls are solid, but the ants gradually hollow them out. It is through this tunnelling process that the gall acquires the name of the "acacia flute," for when the wind blows through the hollow galls it creates a sound very much like a whistle. The exterior of the gall turns black and assumes a woody texture, while the interior is filled by the ants with a honeycomb structure in which larvæ and chrysalides are placed.

Up to this stage the acacia has merely acted as a host. If the plant is disturbed, however, the ants leave the galls in huge numbers and emit an evil-smelling liquid with which all the leaves become saturated. In this way the disturber is driven off and goes his way in search of a less noxious meal.

* * * *

Modern Alchemists

Many have been the searchers for the "Philosopher's Stone" that should turn base metals into gold, and still greater the number of swindlers who have imposed on eager and credulous victims. It is of great interest, therefore, to note that the old ideas show faint signs of revival in these days of radium and electricity. Sir William Ramsay claimed to have obtained lithium from copper, and Rutherford broke up the nitrogen atom, in each case by the use of radium. Two German chemists have claimed to be able to turn mercury into gold, and now Professor Baly and Dr. Riding, of Liverpool University, have announced the production of the rare gas neon, by passing electric sparks through a mixture of nitrogen and oxygen.

This is very interesting, as the same claim was made some years ago by Professor Collie and his co-workers. Doubts were freely expressed at the time, as nobody else seemed to be able to reproduce their results. The doubts of the unbelievers were due to the fact that there is a small proportion of neon in the atmosphere, and slight leaks of air into the sealed glass tubes used were always possible, as the work was done with rarefied gases. But now the Liverpool investigators have obtained the same result with gas at ordinary pressure, thus justifying the original workers after more than ten years.

It is interesting to recall that Sir William Ramsay, in whose laboratories the original results were obtained, would never repeat or confirm his experiments after publication, remarking that it was not his fault if other people could not do what he had done!

* * * *

Brick Waste Utilised

A simple process for the production of building stone from brick waste has been invented by two Swedish engineers. The waste is crushed to small lumps and sifted, the finer portion then being ground to powder and mixed with lime or cement. Water is added to this mixture until the whole assumes the consistency of a plastic mortar. The coarser brick from the preliminary crushing is then added and the resulting compound is allowed to dry. It is stated that the material produced in this manner possesses very durable properties.

* * * *

Health Through the Window

It is well known that the rays of the sun that give us a healthy tanned appearance on our annual trips to the seaside are those known as the ultra-violet rays, which are invisible, but mark their presence on photographic plates. Unfortunately, many substances transparent to ordinary light do not transmit these ultra-violet rays well, and the smoke of our towns and the glass of our windows are among them. To remove the smoke will be a gigantic task, for it will necessitate a complete change in our use of coal. There is good hope, however, that the glass used for our windows will eventually be such that the health-giving ultra-violet rays will pass freely into our houses and workrooms.

Among the substances that allow free passage to the ultra-violet rays is quartz, a kind of crystallized sand, which scientists have learned to fuse into a useful but costly glass. Recently varieties of glass containing quartz and other ingredients, and transparent to ultra-violet rays, have been introduced for ordinary use. Some time ago a class of school children was divided into two sections, which were taught in separate rooms, one of these having windows of the new glass. The pupils in this room made markedly greater progress than the others, and this is attributed to the greater alertness and vitality that resulted from their greater proportion of ultra-violet rays as compared with the other half of the class.

Further tests are now being made at the Zoo, where the new monkey-house has been fitted with one of the new glasses, called "Vitaglass." Monkeys suffer terribly from lack of sunshine in this country, but the trials already made have led to the belief that the new glass will change this considerably. It is even asserted that "Murphy," the big orang-outang, who was bald, has grown a fine crop of hair, thanks to "Vitaglass!"

The glass is still dearer than ordinary glass, but if further trials confirm the results already obtained, there will undoubtedly be a great demand for it.

* * * *

The Silent Screen Finds a Voice

Ever since the introduction of moving pictures, attempts have been made to reproduce the words which, presumably, accompany the movements of the actors and the introduction into some of our picture houses of the products of the De Forest Phonofilm Company gives promise at last of a genuinely successful solution of the problem. The first step has been taken and, as in the case of so many scientific inventions, perfection probably will be only a matter of time.

Only those people who have acquired the art of lip-reading can realise what screen artists are saying, the rest of us having to be content with a condensed version in the sub-titles that follow and interrupt a story. Gramophones have been tried in most attempts to supply the lack of speech, but as it is almost an impossibility by mechanical means to time the words exactly, very amusing results have often followed. It was no uncommon thing, for example, to find that a singer had stopped moving his lips and even gone out of the picture while the song still continued!

The real solution of the problem could not come until a speech record was impressed on the film itself along with the pictorial record, and this has been rendered possible by two recent inventions. One of these was the production of an electric cell that responded to variations of light, and the other was the introduction of the wireless valve that amplifies very small electric currents. In future issues we hope to tell the story of the cinematograph and to show how these two inventions have solved the problem of "speaking films."

* * * *

Big Ben Cracked

One can hardly believe that Big Ben, the best-known bell in the world is cracked. The crack is really a blessing in disguise, as it is not of sufficient magnitude to spoil the tone of the bell altogether, and it does damp down the vibrations of this thirteen ton mass of metal after each stroke so that we can get the next stroke quite clearly on our wireless sets.

Snow on Mars

Mars is the most interesting of all the planets on account of the changes that may be observed taking place upon it. In general the colour of the surface is orange, but in the Martian spring certain patches of green appear. As the summer approaches these patches turn to blue-green and finally to brown in the autumn. The remarkable feature about these patches is that they are connected by what appears to be a network of fine lines. Some astronomers believe that these markings are canals—that is, waterways constructed by the inhabitants of the planet in order to irrigate what otherwise would be barren desert. According to this view, the green, blue-green and brown patches are areas of vegetation made possible by the canals, and seen in their spring, summer and autumn dresses. Another striking change takes place at the poles of the planet. Here, white caps appear and disappear at seasonal intervals, thus behaving in a similar manner to the poles of the earth, in regard to the extension and contraction of the polar snow fields.

Three scientists have recently worked out a method of measuring the temperature of the surfaces of the planets with some degree of accuracy, and their measurements seem to indicate 0°C. as the temperature at the edge of the white cap at the Martian south pole. As this, of course, is the melting point of ice, it is suggested that here we have the first proof by measurement that snow and ice exist on Mars.

The same method has been applied to the other planets, which are found to have temperatures ranging from 57°C. on Venus down to –140°C. and –150°C. on Jupiter and Saturn, the low temperatures on the two giant planets confirming a belief already held that they have no internal heat. The Moon shows an increase of from 50°C. to 120°C. as the Sun rises towards the zenith. During the night the temperature probably falls as low as 200°C. below freezing point, so that any life on the Moon would have to accommodate itself to a temperature range of more than 300°C., as compared with a range in the habitable regions of the Earth of from 40° to 50°C. The explanation of the wide range of temperatures on the Moon is that no atmosphere exists there, and the radiations of the Sun thus produce their full effect on the Moon's surface.

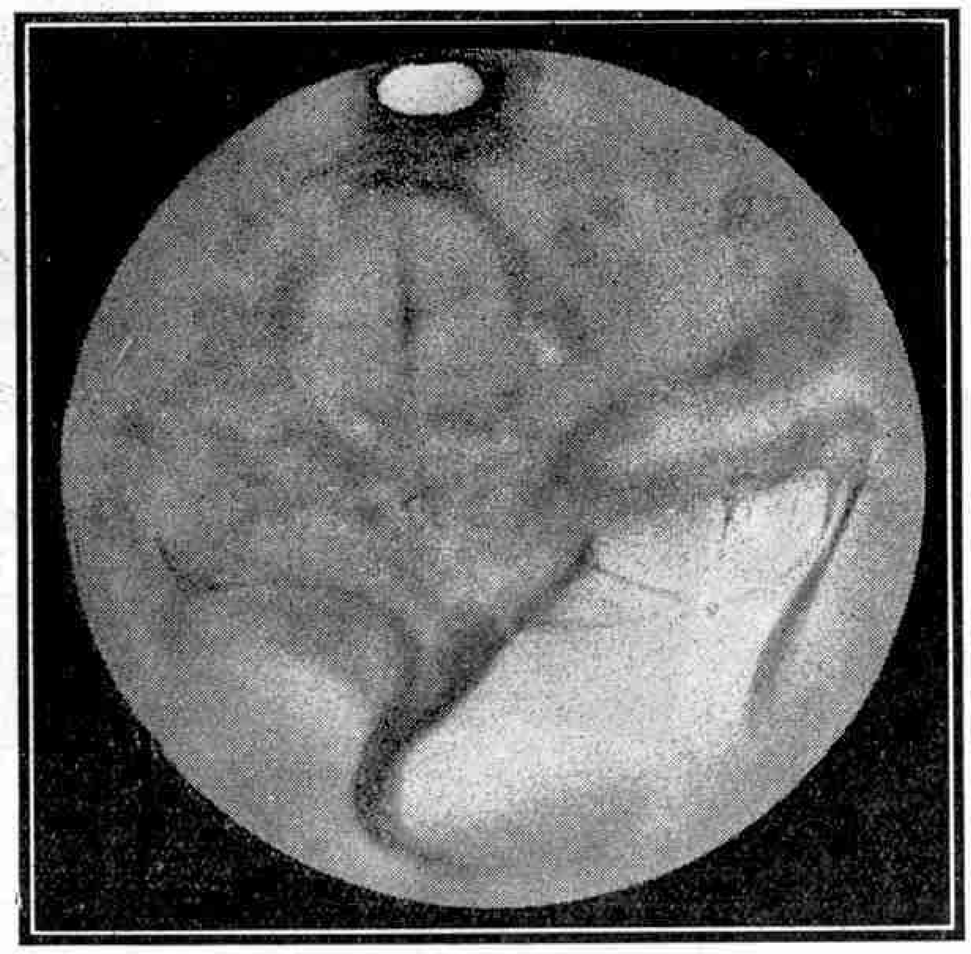
* * * *

Power from the Sea

The oil supply of the United States is reported to be within six years of exhaustion and we are often warned that the end of the world's coal supply is almost within sight, so that any new source of power would be welcome. The latest idea for such a source is one for utilising temperature differences in the ocean, and has been put forward by two French scientists, M. Claude and M. Boucheret.

These scientists propose to construct a turbine that will work with steam at a pressure of only three-hundredths of atmospheric pressure. This steam is merely the vapour given off by the surface water of the sea, while at the other side of the blades of the turbine will be a vacuum, which is to be maintained by cold water pumped up from greater depths.

The conditions required are met with in tropical seas. There the surface water is warm, while polar currents bring in cold water at great depths, the difference of temperature between water at the surface and water at a depth of 1,000 yards being from 20° to 25°C. In some tropical sea, then, the turbine would be set, and it is anticipated that it would make 5,000 revolutions a minute instead of the 30,000 that it would make with normal steam pressure.



A drawing of the planet Mars, showing the dark areas and (at the top) the circular south polar cap of ice and snow

The practical success of the scheme is doubtful, however. A large proportion of the energy produced would be used up in pumping and other ways, and the question arises as to whether there would be any energy left over after the demands of the machine itself were satisfied. A further point is that there are not many places in the tropics where large amounts of energy are required, and the transfer of energy over long distances cannot easily be made economically.

If these difficulties can be overcome, however, the scheme will provide a splendid means of utilising a power that will be available as long as the sun and the sea exist.

* * * *

The Spider as an Ally

The sight of a spider's web immediately sets the mother of every "*M.M.*" reader on the war-path, but there is at least one place where spiders have been welcomed and encouraged. This was in Sierra Leone, British West Africa, where swarms of wild bees had made their hives in the space between the inner and outer walls of a timber house. Hundreds of spiders appeared on the scene and spread their webs around the house, with the result that the bees, along with mosquitoes and various other insects, found an untimely end. The owner of the house deplored the untidy appearance of the webs but was grateful to their owners for their assistance in exterminating the bees.

Sierra Leone is a paradise for spiders. Some of them are large enough to cover the palm of a man's hand, and these monsters do not live on insects but on small birds!

The Last of the Gases Solidified

Since Faraday turned the well-known bleaching gas chlorine into a liquid, scientists have been endeavouring to perform the feat for all known gases. Some gases, such as chlorine itself, were easily liquefied by pressure alone, but others required cooling, and a certain number defied all efforts for some time and became known as permanent gases. Ultimately the problem resolved itself into one of obtaining temperatures sufficiently low, and as soon as methods of doing that were discovered, the so-called permanent gases were liquefied one by one, and in most cases frozen also.

Air was liquefied into a pale blue liquid and frozen into a white solid, which was then melted and boiled. It seems strange to speak of boiling air, but the only difference between the boiling of air and the boiling of water is the difference of temperature. In fact, liquid air will boil furiously on a block of ice!

One gas that has struggled to the last is helium, a very light gas that is now sometimes used for airships; but even helium had to yield before the attack of a Dutchman, Kamerlingh Onnes, who condensed it into a liquid after years of work. Some idea of his difficulties may be obtained when we realise that the temperature to which he had to attain was no less than 264° below the freezing point of water, or nearly three times as far below freezing point as the temperature of boiling water is above it! Having done this, he then tried to go a degree or two further down in order to solidify the liquid, and was still striving to do this when he died.

The attack on helium was continued in Kamerlingh Onnes's laboratory by Professor Keesom. He succeeded in cooling the gas in a brass tube to a temperature of 272° below freezing point of water, and then found that the passage through the brass tube was blocked, showing that the helium inside had become solid.

Thus to-day, a hundred years after Faraday first liquefied a gas, there is no gas left that has not been frozen, and it is satisfactory to know that a very great part of the work of getting down to these tremendously low temperatures has been done by Sir J. Dewar, in Faraday's own laboratory in London.

* * * *

Oil on Troubled Waters

Most of our readers know the old proverb dealing with the pouring of oil on troubled waters, but probably few know that the origin of the saying can be traced back to St. Aidan, the Celtic apostle. It is related by Bede, the famous Northumbrian scholar, that St. Aidan once gave a cruse of oil to a young monk who was commencing a voyage, and instructed him in its use in the event of a storm arising. In the course of the monk's voyage a gale sprang up, but by carrying out his master's instructions and pouring the oil upon the sea he was able to still the waves and save his craft. To-day the practice is followed by ocean-going vessels in rough weather, and during storms large quantities of oil are pumped overboard, especially astern to avoid the danger arising from following seas.

OUR MAIL BAG

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.

S. D. Cozens (Alberni, B.C.)—We like your photographs, especially those showing the ore of Port Alberni with the stacks of timber being loaded on to the steamers, the pine trees in the distance and the mountains beyond. We long to visit you, Stanley, but the "*M.M.*" holds us down.

R. Hart (Cricklewood).—How are you progressing, Ronald? We heard of your return from Evesham in the motor and were pleased you stood the journey so well. Write us when you feel a little stronger, and let us know what sort of a hand your mother is at nursing!

G. S. Robertson (Dunedin, N.Z.)—Thank you for the parcel of photos. You certainly possess a fine railway station in Dunedin. The snapshot of yourself is good and it goes in our album to-day. The "Otago Witness" is a fine paper and we shall be glad to receive the special issue you promise to send us.

R. Ivy ((Halfield, Pretoria, S.A.)—Your account of your first flight in an aeroplane is thrilling enough, but—although we have been up many times during the war—on the whole we think we'll stay down!

George Fraser (Auckland, N.Z.)—Listening on your wireless set to the pilot of an aeroplane who, whilst flying 10,000 ft. over Sydney, described the scenery, sang songs and told funny stories, is not so exciting as being "up there" but it is certainly more comfortable!

H. F. Guthrie (Muswell Hill).—Thank you for your first letter telling us of the romantic way in which you came to know of the "*M.M.*" Guild and Club literature has been sent to you by post.

I. D. Shah (Ahmedabad, India).—The Meccanograph is quite real and not at all imaginary. You could make one up for yourself without much trouble and it would give you lots of fun. We should soon get into trouble with our readers if we printed detective stories in the "*M.M.*"!

J. Minter (Ryde).—That's a pretty good and prosperous railway you and your co-directors are running—five Hornby locos and 50 pieces of Rolling Stock, all in constant use shipping farm produce and cattle, and Lott's Bricks, and sacks, and luggage without collisions or other disasters! Do the Directors wear tall hats? We wish we knew you well enough to be invited to a Board Meeting!

R. J. Dippy (Old Biseley).—What's a "swizz" R.J.? Neither our dictionary nor our encyclopedia, nor our office boy can tell us. You must be one of our very oldest readers if you can remember the first number of the "*M.M.*" It was very modest in those days, wasn't it, but we were proud of it, and it opened up a lot of new and lasting friendships for us.

M. Elliott (Pipps Farm).—It's a nice little story you have sent us, Margaret, about the squirrel. We have never seen one quite so close to—they always hop round a tree when we come along. Perhaps we shall meet a blind one some day who won't mind us so much, and who'll stop and be friendly.

"Scarlet Beak" (Leeds).—You appear to be in a somewhat trying situation. You have our full sympathy and we will tell you of a thoroughly efficient remedy for the trouble signified by your pen-name if you will send us your full address. If you are determined to hide yourself among the half million or so inhabitants of Leeds we are afraid your sufferings will have to continue!

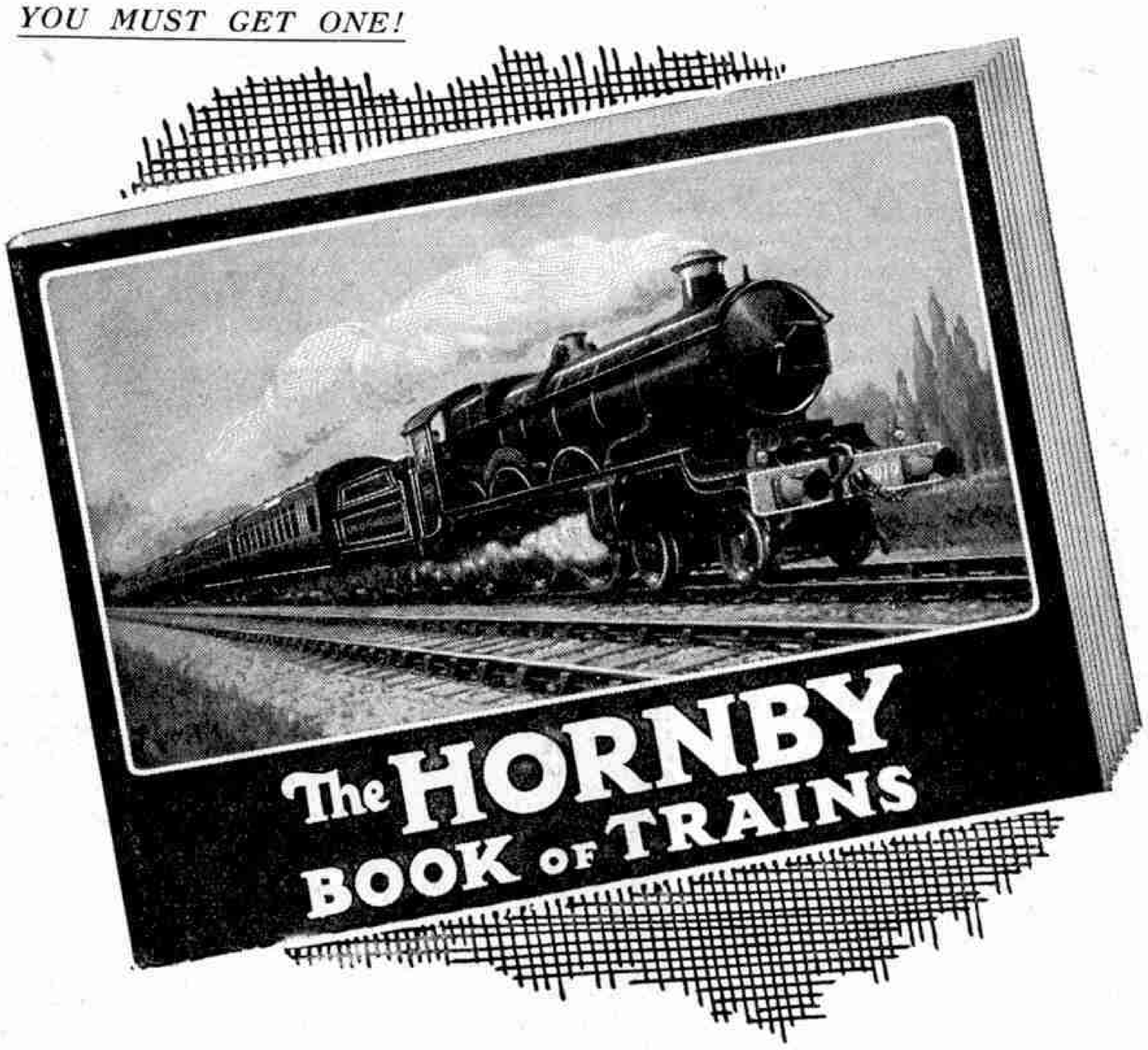
H. E. Davies (Oakville, Cam.)—"Once a Meccano boy, always a Meccano boy" is, as you say, a good slogan. We welcome such letters as yours from old Meccano boys.

K. Fletcher (Macclesfield).—We were very interested to read all about your cycling holiday and if we can find room for an account of it in the "*M.M.*" we will do so in an early issue.

W. Freeman (Bethlehem).—Your phrase "To be happy I must get the '*M.M.*' every month" to be repeated 20 times a day is a little different from M. Coué's famous phrase, but we shouldn't wonder if it is not much more effective for boy's use. Thanks, Wilfred, for your interesting description of the progressive little town of Bethlehem.

C. Campbell (Buenos Ayres).—We are sorry to hear that a recurrence of your old trouble has necessitated another spell in bed, but we hope you will soon be well and about again. Your letter dealing with your family history (of which, by the way, you have reason to be proud), broadcasting, wind storms and camp fires, finishing up with a picture of "Beer in the Making," was particularly interesting.

YOU MUST GET ONE!



Have you had your Copy?

There has been such an enormous demand for the 1926 edition of *The Hornby Book of Trains* that we were soon sold out. So many readers were disappointed because they were unable to secure copies that we have decided to print a final edition at once. Copies will be available in two or three weeks and those readers who have not already had one should send in their order at once for a copy from the final edition. A paragraph below tells you how to order the book. Send to-day or it may be too late!

This fine book is beautifully printed on art paper and contains 48 pages (11″ × 8¼″). A splendid reproduction of the "Cornish Riviera Express" at speed is printed on the cover. It will be remembered that in the original edition, published in 1925, we devoted the first half of the book to a story of the locomotive from its earliest days. In the new edition the same amount of space is occupied by a detailed description of the locomotive and other interesting railway mechanisms.

The following are the chief subjects dealt with :—

THE BOILER AND ITS PARTS.
HOW THE ENGINE WORKS.
HOW AND WHY STEAM IS SUPERHEATED.
RAILWAY BRAKES.
THE STORY OF BRADSHAW'S RAILWAY GUIDE.
HOW TRAINS ARE LIGHTED AND HEATED.
SIGNALS AND SIGNALLING.

FULL PARTICULARS OF THE NEW HORNBY TRAINS

The second half of the book is again devoted to a beautifully illustrated description of all the Hornby Trains and the latest additions to the Hornby Series of Rolling Stock and Accessories, including the new "M" trains, Metropolitan Trains and the "Blue" Train. The illustrations are printed in four colours and the reproduction of the Hornby Trains is most realistic.

HOW TO ORDER THE BOOK

Address your orders to "Hornby Book," Meccano Limited, Binns Road, Liverpool, and please write your name and address clearly.

The price of the book is 3d. (post free), and a remittance for this amount should be sent in stamps. There is no reduction if more than one copy is ordered.

Orders will not be acknowledged but copies will be sent as soon as they are received from the printer. Orders will be executed in the rotation received and when this, the final edition, is exhausted, no more books will be printed. If any orders are received too late to be executed readers will be advised and their remittances returned (less postage).

ORDERS FROM OVERSEAS

A special edition of "*The Hornby Book of Trains*" was printed for Overseas readers. Readers overseas who require copies should address their orders to the agency in their own particular country, listed in the next column.

Readers living in countries other than those mentioned should order from Meccano Ltd., Binns Road, Liverpool, and send a postal order for 6d. with their order.

The price for all books ordered from outside the United Kingdom is 6d. each.

AUSTRALIA. E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W. P.O. Box 1832.

NEW ZEALAND. Browning, Ifwersen Ltd., P.O. Box 129, Auckland.

SOUTH AFRICA. Arthur E. Harris (P.O. Box 1199), Textile House, Von Brandis Street, Johannesburg.

Your last chance to secure a copy!

Snow and Frost Photography

Some Seasonable Hints for Obtaining the Best Results

IT is unfortunate that there are so few chances in this country of photographing a really good snow scene, and as the delicate beauty of snow and frost vanishes so quickly, this is all the more reason that the photographer must be ready to quickly seize the opportunity when it comes his way.

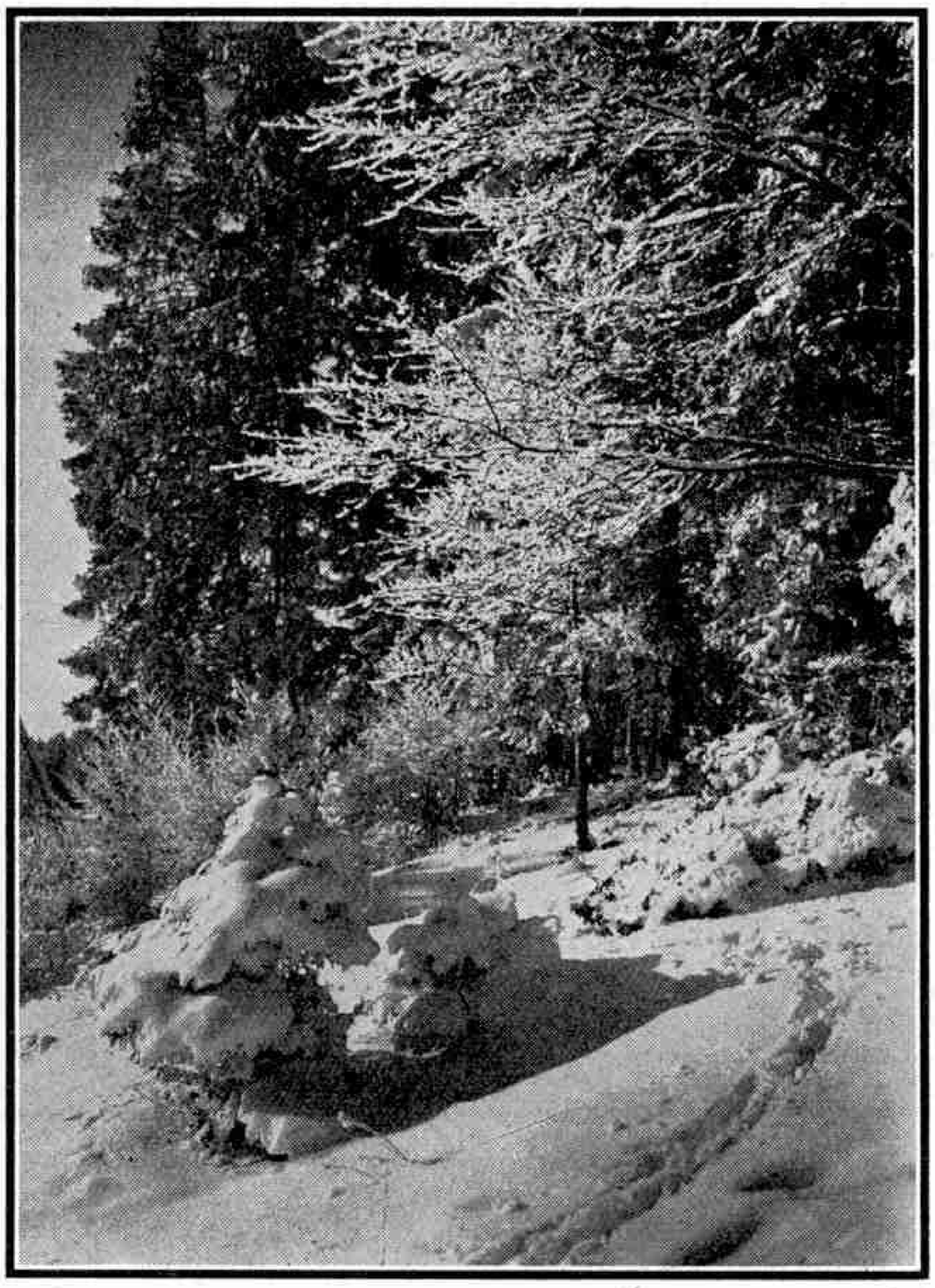
The most effective frost landscapes are seen after a combination of frost and fog, for then the moisture in the fog freezes on every twig and leaf, leaving them covered with delicate rime. Such a landscape is seen at its best in the morning sunshine, but of course it is only "the early bird that catches the worm" for the sun quickly spoils the delicate beauty of the frost and snow.

A successful frost photograph is greatly improved by the inclusion of a sharply-defined foreground. This effect can be secured most conveniently by including an overhanging branch of a tree close to the camera. Bearing this requirement in mind, it is obvious that the ideal frost scene is to be found in an orchard or small plantation.

Snow does not necessitate quite the same detailed treatment, for its beauty depends upon a wonderful variety in the combination of light and shade. Thus a bold sweeping landscape or a snow-laden corner of a garden may be photographed with equal success. The only essential requirement in each case is a heavy fall of snow—not a brief "half-hearted" affair, but a genuine old-fashioned storm that clothes the earth in a mantle of billowy waves. If the air is still at the time of taking the photograph, so much the better, for then there is a peaceful calm among the trees and little likelihood of their feathery load being disturbed.

Snow scenes, like frost scenes, are best obtained in the morning when the sun's rays are breaking through the mist, but in both cases speed is necessary. Unless the temperature is very low, the rays that infuse sparkle and light and shade into the scene will rapidly set up a thaw.

Any kind of camera is suitable for this work. The plates or films used should be orthochromatic and whenever possible a colour screen should be used. This point was dealt with in our photographic article in the September "*M.M.*," and all that need be said here is that the combination of orthochromatic plate and colour screen assists very greatly in capturing the effect of sunshine on the snow or frost, and also in giving the correct tone to the sky. Only those whose attention has been drawn to the point realise how dark the average sky appears in comparison with a wide expanse of virgin snow.



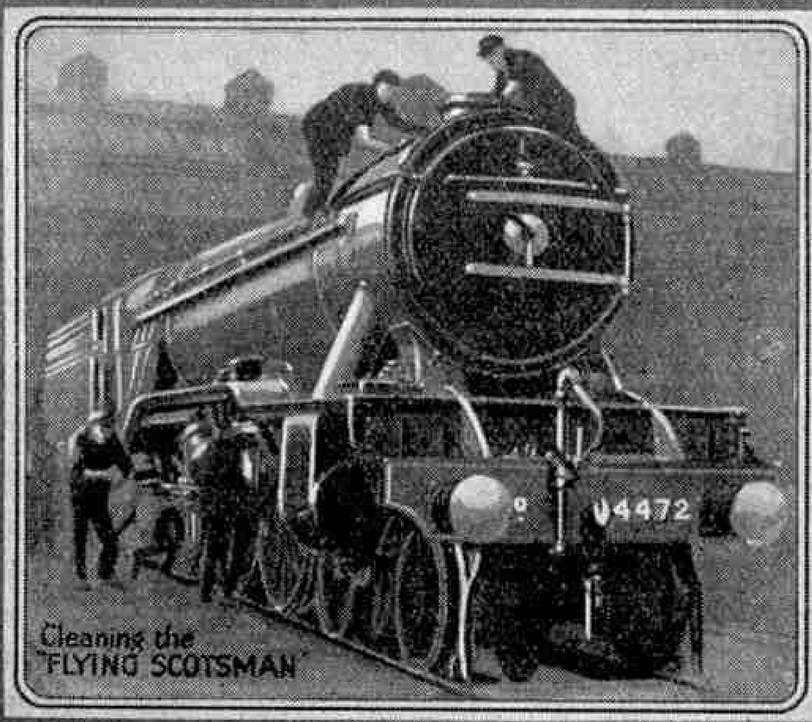
Snow scene near St. Croix-les-Rasses, Switzerland

Exposures are shorter than one would expect at this time of the year. This is due, of course, to the large amount of light reflected by the snow and the general absence of heavy shadows. We have found exposures to vary between one-tenth and one-fortieth of a second, using a plate of medium speed, but we strongly advise that an exposure meter or table should be consulted as conditions vary so greatly. The time of development of the plate or film should be rather shorter than normal in order to secure a negative full of detail but thin and without harsh contrasts. Over-development of snow scenes is fatal.

One other point may be mentioned and that is the desirability of maintaining the various solutions at approximately the same temperature. There is a greater difference than might be imagined between the temperature of water drawn from the tap and water that has stood for some time in a vessel in a warm room.

The best prints are obtained on gaslight or bromide paper. Such prints give us the black-and-white effect we require, and it is obvious that the brown or purple tones of P.O.P. or self-toning paper are quite out of place for snow scenes.

In conclusion we would remind our readers of the pictorial possibilities of winter sports such as skating or curling, for which the snow-clad landscape provides a beautiful setting. Bright sunshine is essential for success in such work, for snapshots taken on a dull day are utterly lacking in life and sparkle. Ideal days for this purpose are rare in this country and every opportunity should be seized without delay.



Famous Trains

and the Routes over which they run

by

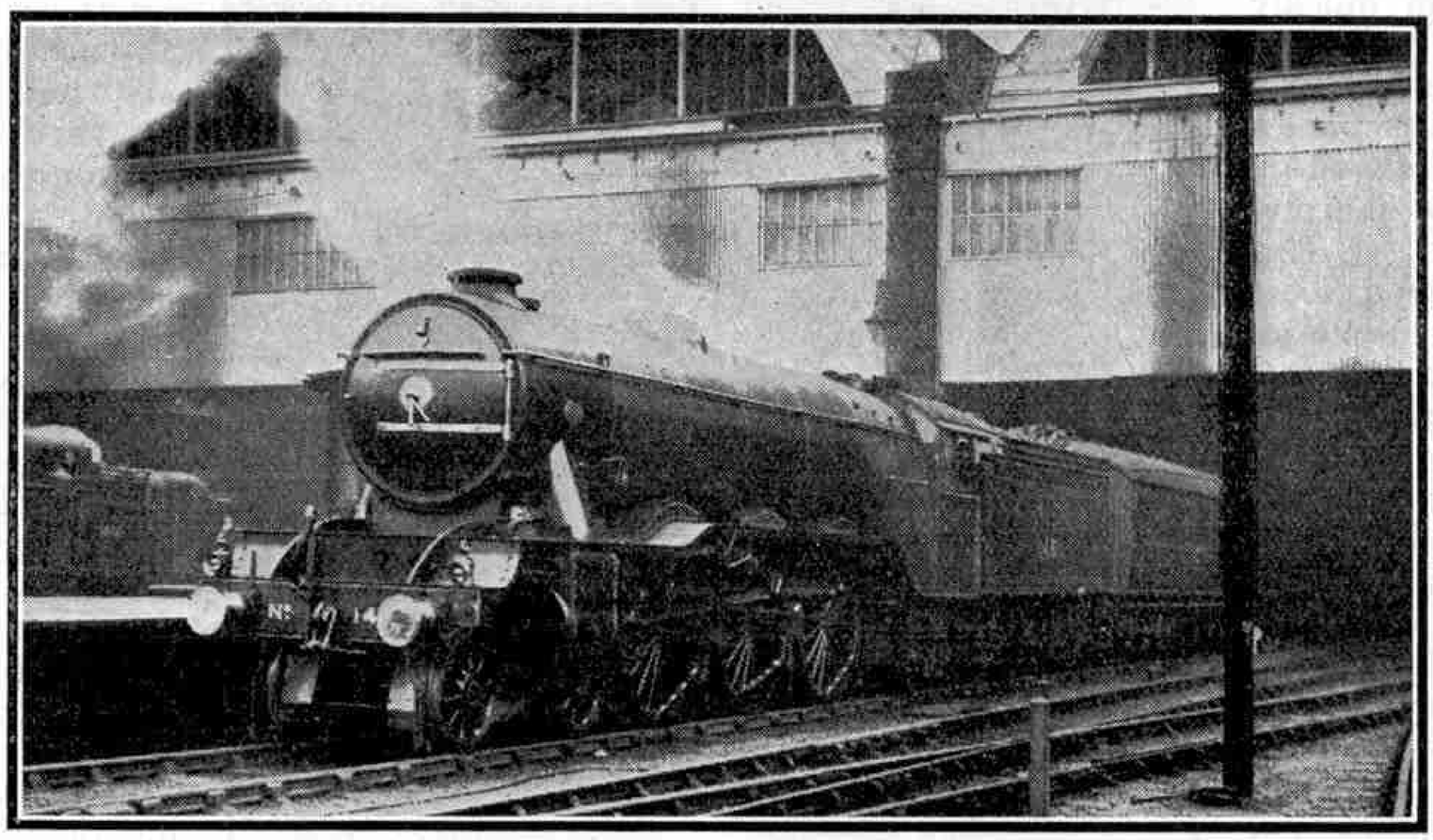
CECIL. J. ALLEN. M.Inst. T. Etc.

No. 1.—THE "FLYING SCOTSMAN," L.N.E.R.

"*SCOTSMAN*" is a title that, at one time or another, has been fastened on to many express trains connecting London with the other side of the Border. But there is one train, and one train alone, that can lay claim to the historic distinction of being the real "*Flying Scotsman.*"

This is the famous express that leaves King's Cross terminus in London on the stroke of ten o'clock every morning. This it has done for some 65 years, day in and day out—with the exception of Sundays—heading for Edinburgh, Glasgow, Perth and Aberdeen.

The southbound "*Flying Scotsman*" leaves the Scottish capital at precisely the same hour and rolls under King's Cross roof at 6.15 p.m., just as its "opposite number" is stopping in the Waverley Station at Edinburgh. Actually the two trains flash past each other, when they are running normally, somewhere near Raskelf, a station 13 miles north of York and almost exactly 200 miles from London.



The "*Flying Scotsman*" leaving King's Cross

A Wonderful Record

The continuity of the departure time is in itself a record of no mean order, and the only occasions on which it has been broken have occurred at times of railway and coal strikes, and then for very brief periods, hardly worth taking into account. During the summer, and at certain other busy times, the "*Flying Scotsman*" has to be relieved, and a train for Doncaster, Newcastle-on-Tyne and Edinburgh only, leaves King's Cross ten minutes earlier. In the opposite direction a similar rearrangement takes place, expresses leaving Edinburgh for London at both 10.0 and 10.15 a.m., and dividing up the important intermediate calls between them.

But it is with the real ten o'clock "*Scotsmen*" in each direction that we are concerned. No longer, unfortunately, do they make the fastest runs over the route that they traverse. Both south and north of York the expresses connecting Leeds with London and Edinburgh now show quicker timings, because, by an agreement made between the East and West Coast routes after the racing to Aberdeen in 1895, the running times of the "*Flying Scotsman*" to and from Edinburgh remain unchanged at $8\frac{1}{4}$ hours for the 393 miles. With the gigantic engines that to-day are entrusted with its haulage, the "*Scotsman*" could "fly" a great deal faster than it does, if its owners were to agree to the necessary acceleration.

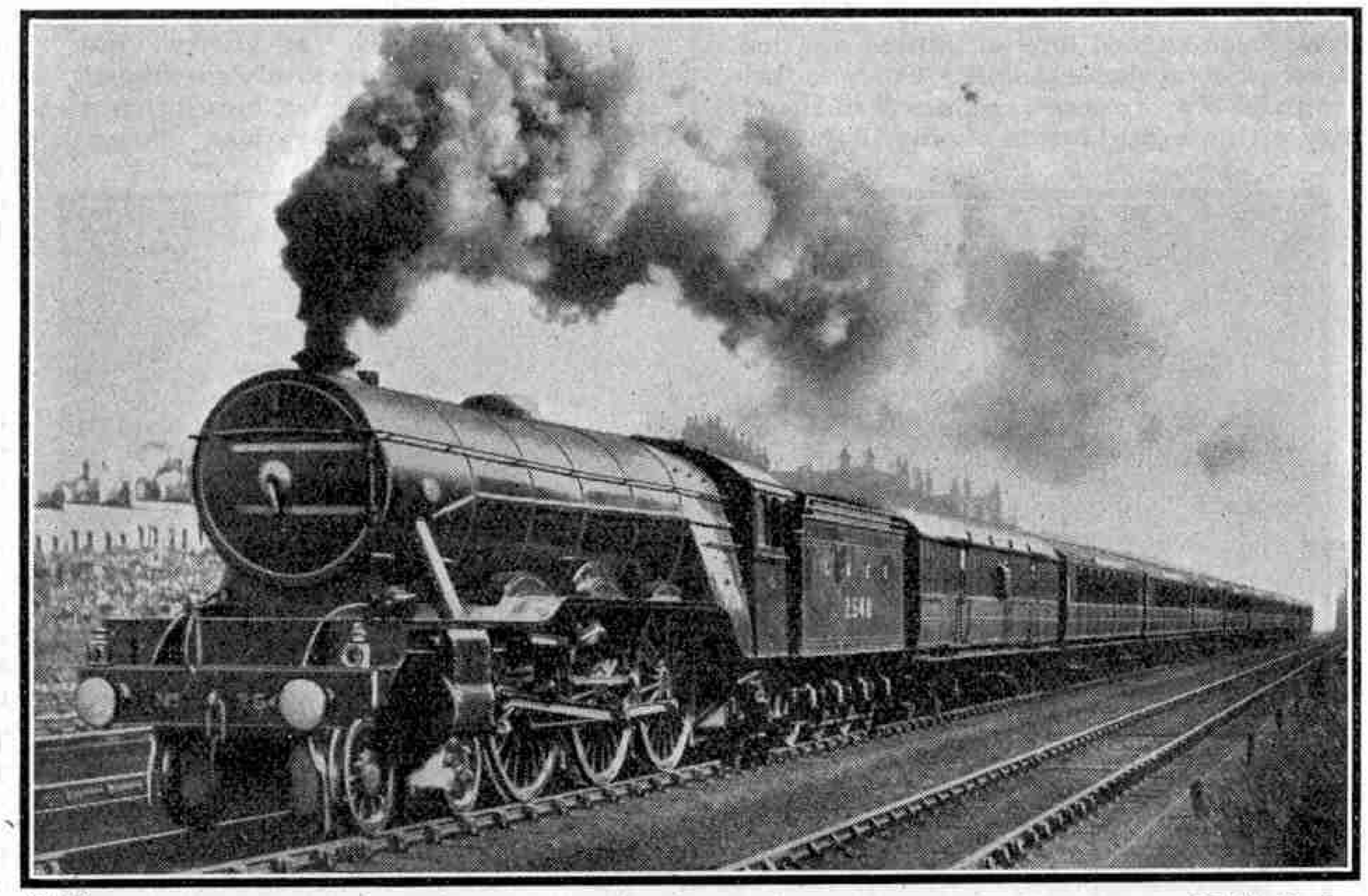
The L.N.E.R. are rather fond of advertising their three "10 o'clocks." One of them leaves Liverpool Street for all the principal towns and coast resorts of the Eastern counties, another sets forth from Marylebone for Nottingham, Sheffield and Bradford; but the chief of them, of course, is the 10 o'clock "*Flying Scotsman,*" which is to be found at No. 10 platform at King's Cross. It is worth while having a look at the train before we take our places in its luxurious coaches.

Normal Load of 380 Tons

For years the "*Scotsman*" has been growing steadily in weight, until it has now become a substantial train. Entirely new rolling stock was brought into use rather over two years ago and each of the 60 ft. coaches weighs round about 34 or 35 tons. On any ordinary week-day we shall probably find at King's Cross, ready for the start, eight of these vehicles, together with a "triplet" restuarant car set, the order, beginning from the engine, being a third-class brake and a first-and-third "composite" for Glasgow, a composite with luggage compartment for

Perth, a third-class coach, open third-class restaurant car, kitchen car, first-class restaurant car and composite for Edinburgh, and composite, third-class and large brake for Aberdeen. The weight of the eleven coaches is roughly 360 tons empty, and with a normal complement of passengers and luggage some 375 or 380 tons behind the engine tender.

Of all the coaches in the train, the restaurant cars are the most interesting. They are "articulated," which means that, although the first-class and third-class cars and kitchen have bodies quite distinct from each other, yet they cannot be separated. Coach articulation consists of carrying the adjacent ends of two coaches on a large steel casting which, in its turn, is supported on a single bogie truck. These three cars, therefore, are carried on four bogies between them, instead of the usual six, with the result that there is some saving in weight, as well as very smooth riding.



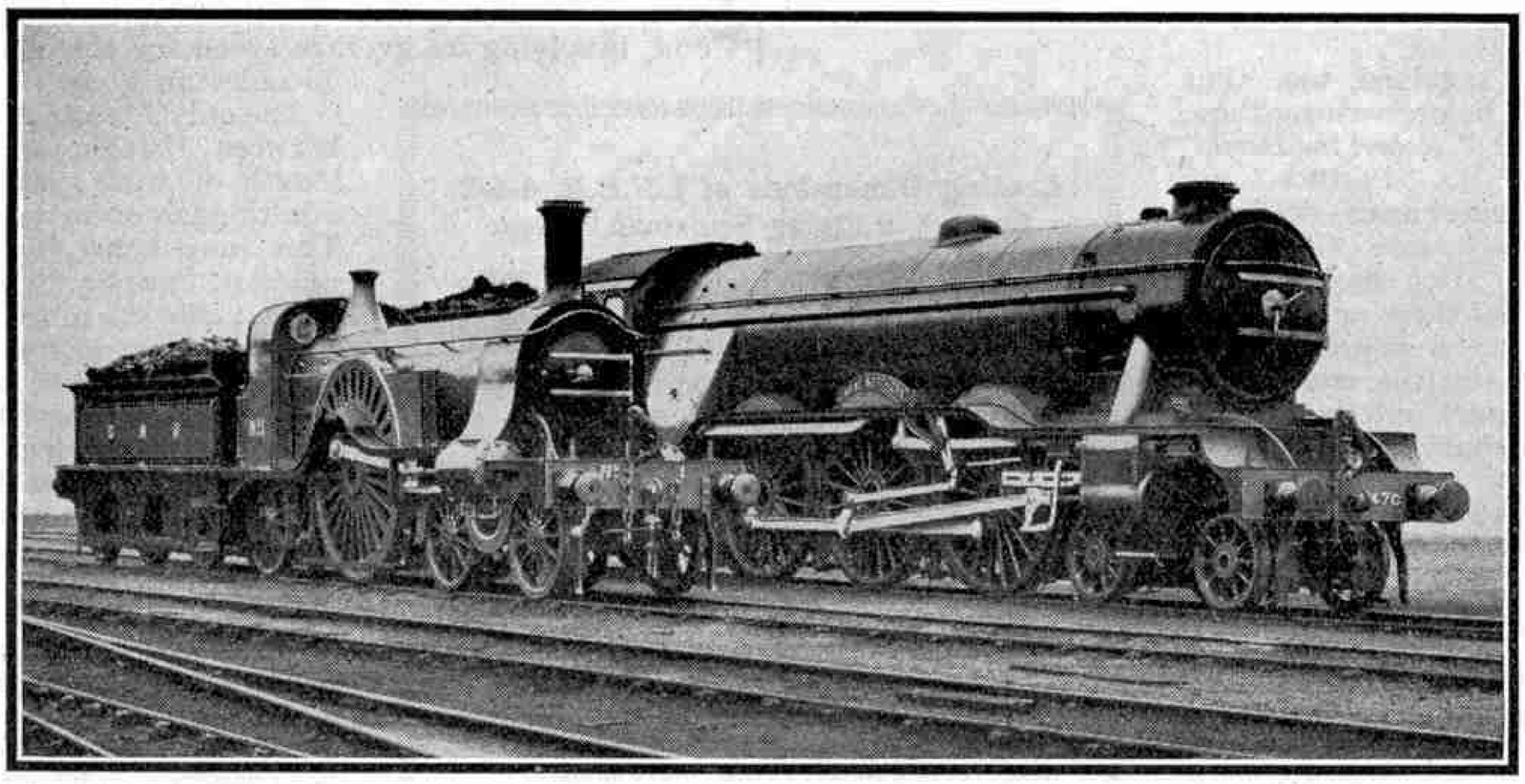
Photo] [F. E. Mackay

The "*Flying Scotsman*" passing New Southgate (Engine No. 2548, "*Galtee More*")

The middle coach of the "triplet" is given up entirely to kitchen and pantry, with accommodation for the restaurant car staff, and the most unusual feature of its equipment is the exclusive use of electricity, generated from the coach axles, for cooking and boiling.

Fire Danger Eliminated

Electric cooking is slow, but it is clean, and the staff who have to work in the confined space of the galley appreciate above all that, in comparison with gas, it is cool, which is no small consideration, especially in summer. Even more important, perhaps, is the fact that not a single cylinder of gas is carried throughout the whole length of the "*Flying Scotsman*," so that the danger of fire from burst cylinders, in the unlikely event of a derailment, is eliminated.



One of Patrick Stirling's famous Single-Wheelers (No. 1) alongside the L.N.E.R. "Pacific" No. 4470, "*Great Northern*"

The service of meals on a train like this is really hard work. Two five-course lunches have been served by the time that York is reached at 1.45 p.m., including the washing up of all the crockery in between. Another lunch follows, between York and Newcastle, and the remaining couple of hours or so are devoted to the service of hundreds of afternoon teas. The first-class car seats 36 passengers and the third-class car 42, so that 78 can be served at one time. On any normally busy summer day 150 lunches or more, as well as a large number of teas, will be dispensed to hungry passengers.

It is striking to remember that, when the present century opened, passengers by the "*Flying Scotsman*" who desired lunch had to make the best of 20 minutes specially allowed for this purpose at York, where they had to snatch a hasty meal in the station dining-room, to the peril of their digestions! It was not until August, 1900, that dining cars were introduced on the morning trains between King's Cross and Edinburgh, in both directions.

The Locomotive—1900 and Now

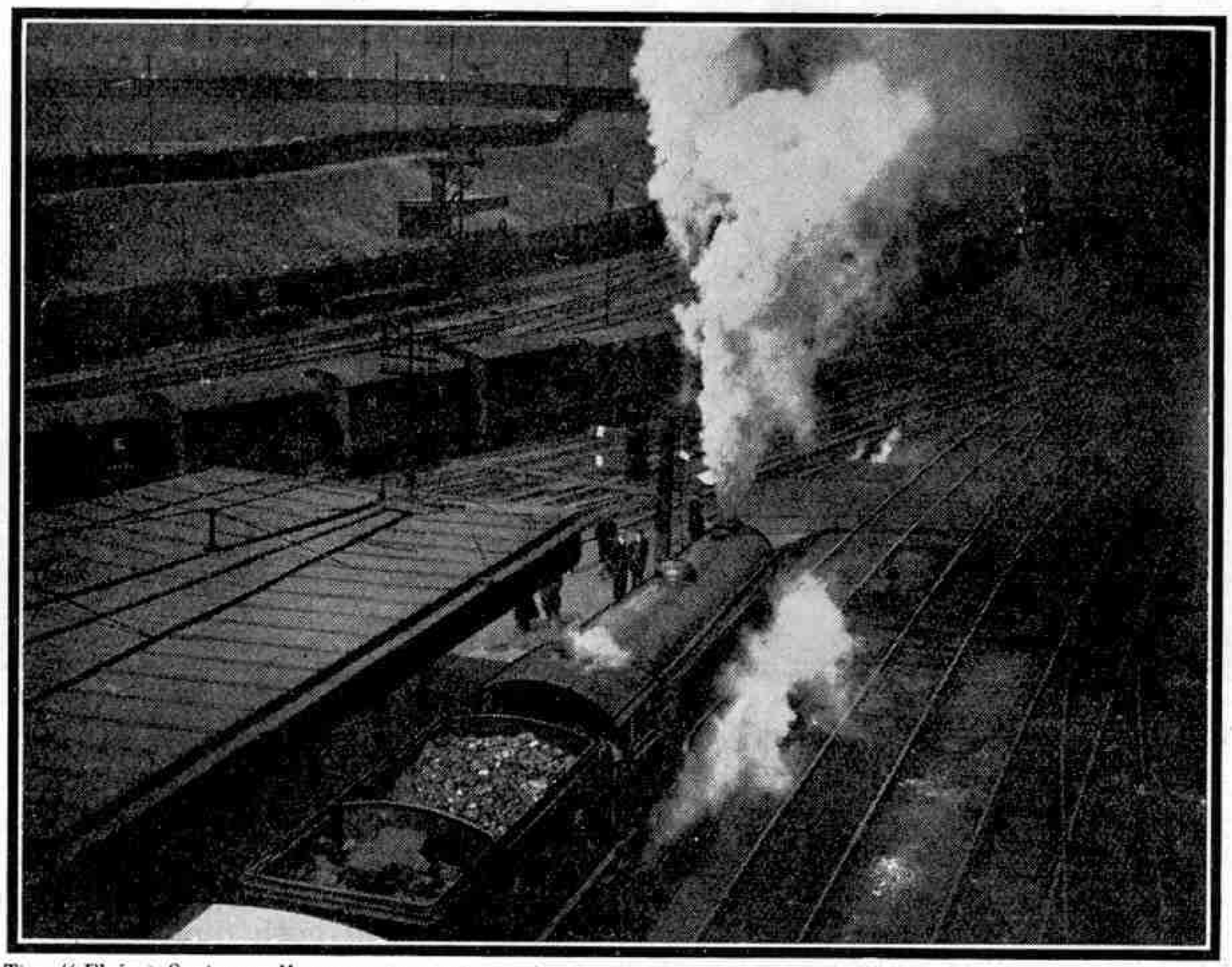
But we must hurry on to the engine. What vast developments have taken place in locomotive power during the quarter-of-a-century that has elapsed since 1900! In that year, even though the first Great Northern "Atlantic"—No. 990—had been turned out of Doncaster Works a couple of years earlier, the famous Stirling "eight-footers" were still taking a large share in the working of the "*Flying Scotsman*." They had single driving wheels, 8 ft. in diameter, and relied on some 18 tons only out of the total engine weight for their "adhesion," or grip between the driving-wheels and the rail. The giant "Pacific" that we shall be certain to find at the head of the same train to-day has six-coupled wheels, 6 ft. 8 in. in diameter, and no less than 60 tons of the engine weight are available for adhesion.

Instead of two cylinders of 18 in. diameter, we find that our modern 4–6–2 has three cylinders of 20 in. diameter. The boiler, too, has increased in size more than proportionately, until it has been all that the designer could do to squeeze his immense "Pacific" barrel, tapering out to no less than 6 ft. 5 in. diameter at the firebox end, above his big driving wheels, and all still within the narrow limits of the British construction gauge.

The manner in which all the parts of the L.N.E.R. "*Flying Scotsman*" locomotives have been stowed into so limited a space has been a marvel of ingenuity and mechanical skill. One wonders if it will ever be possible to build bigger express engines than these, to run over a British railway within a total height of only 13 ft. 6 in. above rail.

Value of Ample Engine Power

But what is the reason for this vast increase of power, if the booked speed of the "*Flying Scotsman*" has remained unaltered over so many years? The answer is simply that the rolling stock of to-day weighs more than twice as much, per passenger conveyed, as it did in 1900. Corridors, lavatories, sumptuous dining-cars and kitchens, and the more solid construction of coaches with a view to smoother riding, have all contributed to this result. The "*Flying Scotsman*" of 1900 was a train of 150 to 200 tons at most, and at the latter figure probably needed a pilot engine. To-day, as we have seen, the normal load is 380 tons, and this is frequently exceeded at busy times.



The "Flying Scotsman" ready to start on its journey northwards. This photograph was taken from the roof of King's Cross

During the reduced train services that resulted from the labour troubles of last year, the "*Flying Scotsman*" was made up at times to some simply prodigious weights, and it is greatly to the credit of these wonderful "Pacifics" that they have kept time with loads up to 600 tons behind the tender, scorning the assistance of a pilot locomotive.

Lost time has been regained, too. For example, only a week before writing these lines, I timed No. 4479, "*Robert the Devil*"—most of the L.N.E.R. "Pacifics" are named after famous racehorses—to bring the down "*Scotsman*" into Grantham three minutes early, after having been stopped at St. Neot's for three minutes and thereby losing quite seven minutes in the running. That is to say, the engine had gained roughly 10 minutes on the schedule from London to Grantham. Ample engine power thus makes for punctual running, as well as for the economy that results from the working unaided of such huge loads.

Commencing the Northward Journey

And now we will take our places in the train and see what faces the engine on its journey northward. Simultaneously the platform bell rings and the guard's whistle blows, and just as the first notes of ten o'clock are chiming from the clock-tower—incidentally, King's Cross is the only British terminus to possess its own striking clock—the driver opens his regulator and the "*Flying Scotsman*" moves out on its journey of 393 miles to Edinburgh.

The start is not easy. Up through two tunnels, in which the rails are always greasy with moisture, the line is steeply inclined at 1 in 105, and while the driver has no chance of a "run" at the bank, he has to be careful not to give his steed too much steam, lest the driving wheels should "slip." He breathes more freely when Holloway has been passed, as there is now a level stretch as far as Wood Green.

Six or seven minutes after starting, the engine is roaring through Finsbury Park, proudly conscious of having disdained the assistance in rear that is given to the trains out of various other London terminals. From Wood Green the line rises further for eight miles, threading five more tunnels on the way, to the crest of the "Northern Heights" at Potter's Bar. This gradient is not so steep as the one previously mentioned, being evenly at 1 in 200 throughout its length, but for all that it can be a gruelling obstacle to surmount with a heavy load. A gentle down-grade now follows, until the River Lea is crossed just beyond Hatfield, the speed increasing here to 67 or 68 miles an hour, from the 40 or so at which we topped Potter's Bar summit. It has taken 25 minutes to cover the first 17¾ miles to Hatfield, owing to the up gradient, but our average speed over the next 58½ miles to Peterborough is likely to be round about the mile-a-minute rate.

The First Track Troughs

The actual summit point out of London is at Woolmer Green, near Knebworth, to which next we rise. Immediately afterwards we run over the first set of track-troughs, from which our thirsty steed takes the long drink to which by this time he is justly entitled. Now comes the most glorious racing stretch of the whole down journey. At its steepest it is only 1 in 200, but we shall dash through Hitchin at something not far short of 75 miles an hour and shall quite probably cross the 80 line when we reach the foot of the steepest part of the bank at Three Counties. On the down "*Flying Scotsman*" I once noted a time of 21 2/3 minutes for the 27 miles from Hitchin to Huntingdon, involving an average speed for this distance of very nearly 75 miles an hour.

Leading Dimensions of L.N.E.R. 4-6-2 Engines, "Flying Scotsman" Type

Cylinders (3)	Diameter	20 in.
,,	Stroke	26 in.
Driving Wheels,	Diameter	6 ft. 8 in.
Heating Surface,	Fire Tubes	1,880 sq. ft.
,, ,,	Flue ,, ...	835 ,,
,, ,,	Firebox ...	215 ,,
,, ,,	Superheater (32 elements)	525 ,,
,, ,,	Total ...	3,455 ,,
Firegrate Area	... ...	41¼ ,,
Working Steam Pressure	...	180 lb. per sq. in.
Tractive Effort (at 85% wkg. pressure)		29,835 lb.
Water Capacity of Tender	...	5,000 gallons
Coal ,, ,,	...	8 tons
Adhesion Weight	... ...	60 ,,
Weight of Engine (in working order)		92½ ,,
Total Weight of Engine and Tender (full)		148¾ ,,
Length of Engine and Tender (over buffers)		70 ft. 5 in.

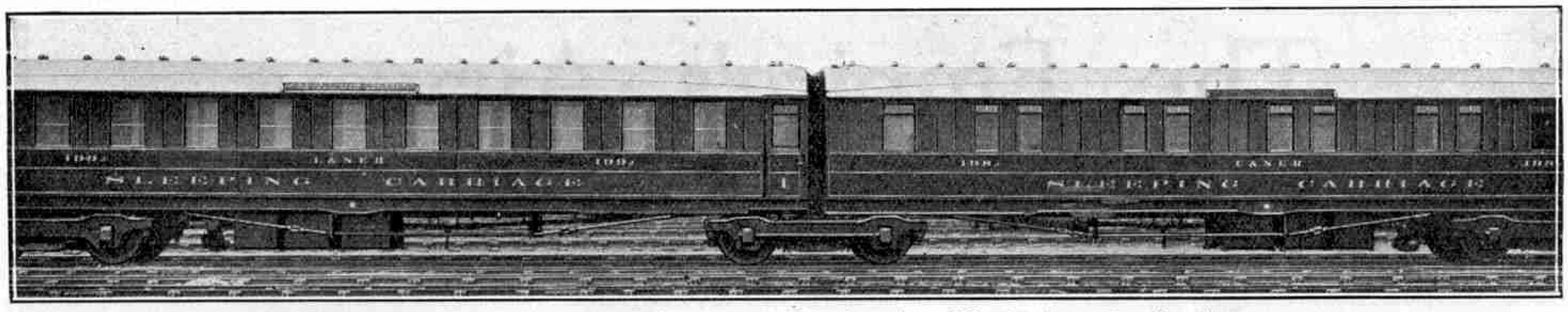
The only adverse gradient worth mention between Hitchin and Peterborough is a length of three miles at 1 in 200 from Huntingdon up to a signal-box called Leys. This may bring our speed down to 50 miles an hour or slightly less, and we shall then doubtless reach 70 again on a swift dash down to Holme.

Brakes grind on hard as we approach Peterborough, for the station is on a sharp curve, which demands a reduction of speed to 15 miles an hour. We have now covered 76½ miles of the journey in a time probably not exceeding 85 minutes.

First Stop Grantham

Gathering speed again across the level Fen country, the engine takes another long drink from track-troughs at Werrington Junction, three miles north of Peterborough. From here the line begins to rise, very gradually at first, but steepening beyond Essendine to 1 in 200 from Little Bytham to Corby, and 1 in 178 from there to Stoke Summit, exactly 100 miles from London and the highest point we have yet attained.

Speed drops little by little up this ascent, and at the top we may have fallen to 40 miles an hour or even a trifle less. A swift downhill run over the last 5½ miles into Grantham fills up the remaining few minutes of the two hours, and almost exactly at noon we make our first halt. The actual allowance for the 105½ miles is 122



Showing a middle bogie of Articulated Sleeping Car, King's Cross to Aberdeen

minutes, but more often than not the "*Flying Scotsman*" stops at Grantham a shade before 12 o'clock.

At some seasons of the year the engine is changed here, but not always. The great fire-boxes of these "Pacifics" enable so clean a fire to be maintained that it is possible to run the one engine through from King's Cross to York, and this is frequently done. But in any case we shall see a fresh driver and fireman take the place of those who have brought us down from London.

There is not much of note about the next section of the run, over the 82¾ miles from Grantham to York. The timing of 98 minutes is comparatively easy, seeing that the line is for the most part level. From Grantham to the valley of the Trent, at Newark, it is chiefly downhill, and 17 minutes probably suffice for this 14½ miles from the start. Then follow rising grades to Markham, with a drop to Retford, where we swing on the level across the old Great Central main line from Sheffield to Grimsby.

From Retford there is no grade worth mentioning the whole way to York. Track-troughs are provided just beyond Newark, and also at Scrooby, between Retford and Bawtry.

The up "*Flying Scotsman*" leaving Waverley, Edinburgh

The Great Curved Roof of York Station

Doncaster, where our engine was built, is 50½ miles from Grantham, and is probably passed in 55 minutes or so. At Selby there is a sharp curve and a swing-bridge over the River Aire, which together conspire to bring our speed down to 30 miles an hour. So the run goes on to the great station at York, with its beautifully-proportioned curved roof, where many important connections are made. Here we arrive at 1.45 p.m., and draw up at the exceptionally long No. 5 down platform.

Engines are now changed. Our "Pacific" might rest content, one would imagine, with having brought the "*Flying Scotsman*" over 188¼ miles from London to York, but there are not a few rostered turns in which engines of this type make the double journey of 376½ miles in the single day! Another "Pacific" locomotive will be certain to take us forward, and may not improbably run us through over the 204¾ miles from York to Edinburgh, with a change of crew at Newcastle.

The first 44 miles out of York are over that famous straight and level course across the Great Plain of York. Here is witnessed nightly the fastest booked run on the L.N.E.R. system—the evening Glasgow-Leeds "diner," booked to cover the 44 miles start-to-stop in no more than 43 minutes. But we shall take from 48 to 50 minutes to get through Darlington, and the next 36¼ miles, with sharply-graded ups-and-downs and various reductions of speed through the colliery districts—where the workings have in places undermined the line—as well as over Durham Viaduct, prevent any high speed from there on to Newcastle. Crossing the magnificent King Edward Bridge across the deep valley of the Tyne, we draw up in the Central Station at 3.32 p.m., having covered the 80¼ miles from York in 99 minutes.

Nearing the Coast

During the run northward through Northumberland we are gradually nearing the coast, and at Alnmouth Junction, 34¾ miles north of Newcastle, we are within a mile or so of the sea. After that the coast is no great distance away for the rest of the journey to Edinburgh.

For the first nine miles, to Cramlington, the line is mostly ascending, and at Killingworth we pass the site of George Stephenson's first labours as an engineer. Then downhill to Morpeth, where there is a severe slowing through the curved station; over an undulating course to Alnmouth; up Longhoughton bank, 3¾ miles at 1 in 170, and over another splendid racing-ground of 20 miles, until finally we rise up to Tweedmouth and cross the famous Royal Border Bridge over the Tweed into Berwick. We have covered 67 miles from Newcastle to Berwick in 78 minutes.

There is a stiff ascent out of Berwick for 4½ miles at 1 in 190 to Burnmouth, and after a brief respite there comes another long 1 in 200 climb to Grant's House, 16 miles out of Berwick, which is the highest point of the "*Flying Scotsman's*" journey, 371 feet above sea-level.

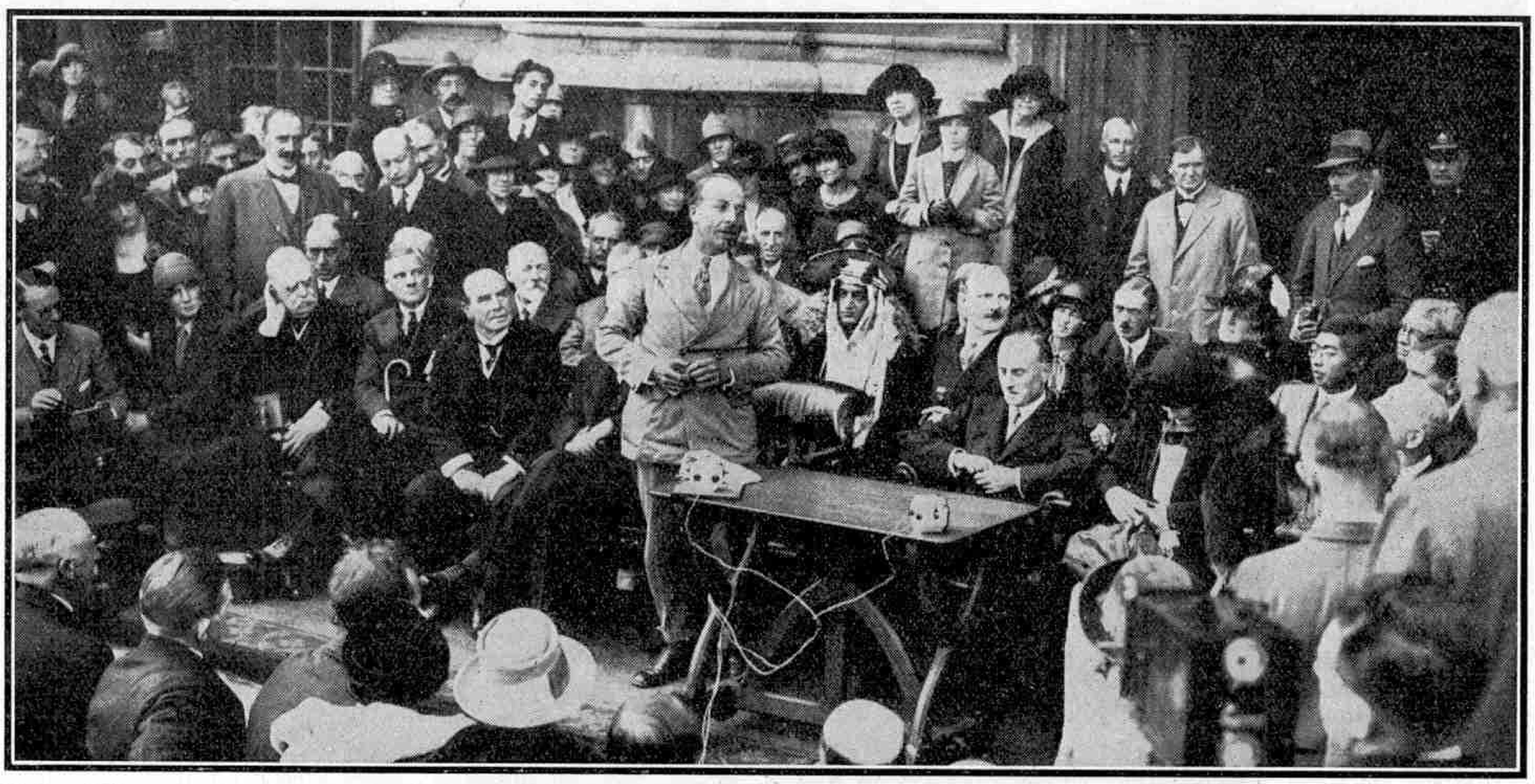
This is immediately followed by the steepest gradient of the whole journey, the line dropping sharply down Cockburnspath Bank for four miles at 1 in 96—the terror of heavy up trains. Then onward over gentle undulations by Dunbar and Drem until the rugged mass of Arthur's Seat bears into view. Rattling over the junctions at Portobello, we "rush" the last mile at 1 in 78 up through the tunnel, and a few moments later are at rest alongside the long down main platform at Edinburgh Waverley, on the stroke of 6.15 p.m. or, as is very likely to be the case, a minute or two earlier.

Here the career of the "*Flying Scotsman*" comes to an end. The "Pacific" that has brought us from York or Newcastle is uncoupled and quietly rolls away to the engine sheds at Haymarket. A Great Central "Director" 4-4-0 engine—of which many are now in use on the L.N.E. Scottish lines—backs down on to the Glasgow coaches and takes them off to the 6.28 p.m. Glasgow express, which is waiting in an adjacent platform. Another engine of the same type quietly annexes the Perth coach and whisks it away. Meanwhile a little "shunter" has drawn the last three coaches off the "*Scotsman*" and attached them to the rear of the express that will be leaving at 6.32 p.m. for Aberdeen, in charge of a North British "Atlantic."

Thus the various parts of the "*Flying Scotsman*" say "au revoir" to each other. It is only a brief separation, however, for ere ten o'clock strikes the next morning they will have returned to Edinburgh and have been reunited for the journey of the up "*Flying Scotsman*" to King's Cross.

The Empire's Airways

Air Minister on the Needs of the Future



Sir Samuel Hoare, Air Minister, presiding at the welcome to Sir Alan Cobham, who is seen replying. Sir Samuel Hoare is seated on Sir Alan's left, and Lady Cobham is the next figure to the right

SIR SAMUEL HOARE, Air Minister, delivered at the recent Imperial Conference an interesting and important speech on Empire air communications.

The urgent need of better communication throughout the Empire, said Sir Samuel, would not be disputed by anybody. The Prime Ministers of Australia and New Zealand still had to spend over 60 days each upon their journey to and from the Imperial Conference, and unless a sustained effort was made to introduce new methods and apply the results of invention and discovery, these Ministers were likely to have to face their 60 days' journey for many conferences to come.

The history of the development of transport in general was a long record of doubts, delays and difficulties. We might well take warning from the events of a little more than a century ago when, upon the eve of the great railway development, a well-known author wrote in the Edinburgh Review : " What can be more palpably absurd and ridiculous than the prospect held out of locomotives travelling twice as fast as stage coaches," and demanded that " Parliament shall in all railways where sanctioned limit the speed to eight or nine miles an hour."

Turning Point in Air Communication

We had now reached a most important turning point in the development of airways and air communication. Since the previous Imperial Conference the mileage covered by the regular air routes of the world had more than doubled. As to safety, what better record could there be than the five million miles flown by British services for four fatal accidents and the million miles flown in Australia for a single accident ? Further, what better proof could there be of the regularity of the services than the fact that to-day freight insurance premiums per £100 were by air less than half the premiums charged for surface transport ?

There was no technical or operational reason why, by aeroplane or airship, London should not be brought within a fortnight of the furthest cities and territories of the Empire. There was no technical reason why the journey to Canada should not be reduced to 2½ days, the journey to India 5 days, Cape Town 6 days, Australia 11 days and New Zealand 13 days.

The Route to the Far East

Hitherto, while certain European services had been safely and punctually operated for several years, there had been no civil air service plying between one part of the Empire and another. In the Middle East an air route between Egypt and Iraq had been flown regularly by military machines carrying mails and official passengers. The route, 866 miles in length, had been methodically equipped with landing grounds and re-fueling stations, and over it for five years had passed mails and official passengers in as many hours as it would have taken days by pre-war transport.

It was now proposed to substitute for this military service a regular civil line for the carriage of freight and

passengers, not only between Cairo and Baghdad, but also between Cairo and Karachi. The essential importance of this service greatly transcended the saving of 7 or 8 days in the journey between England and India. Its real significance lay in the fact that it was the first section of the great Empire air route to the Far East.

London to the Cape

So also with Africa. Just as there must be an Empire air route to the Far East stretching to Australia and New Zealand, so there must be an Empire air route from London to the Cape, with branches diverging to the West African Dependencies. An enterprising pioneer, with the help of the Governments of Kenya, Uganda, and the Sudan, had organised an experimental service covering 14,000 miles between Khartum and Kisumu. If that service were successful a period of from 10 days to a fortnight would be saved in the journey between Khartum and Uganda, and 8 days between Khartum and East Africa.

Blazing the Trail of the Empire's Airways
Sir Alan Cobham arrives at Melbourne and is greeted by a huge crowd

Need for Co-operation

Passing on to appeal for the co-operation of the Governments of Australia, India and South Africa in the development of Empire air communication, Sir Samuel said we were all too hard up for any one of us to undertake the heavy cost of an air route to Singapore or an air route to Cape Town. If we were to form these routes, we must each insert our particular stone in the design.

If the Royal Air Force undertook a certain number of service flights in conjunction with the civil lines, and if the Governments of South Africa and Australia would allow their air forces to co-operate with us, we should not only be obtaining valuable military training for our service units but also we should be making possible the experimental transport of mails and passengers over a large section of the British Empire. This proposal involved no subsidy and required nothing more than co-operation between one government and another and between military and civil flying.

Empire Airship Routes

Turning to the question of Empire airship routes, the Air Minister said he was frequently asked why the Empire should require such routes in addition to aeroplane routes, and how airships could ever be made immune from disasters such as those that destroyed the "*R.33*," the "*Dixmude*" and the "*Shenandoah*."

As to necessity, airships would carry out the long-distance non-stop air journeys of the future. The two airships that we were now building should, with a normal load of freight and 100 passengers, be able to fly in normal weather conditions, without re-fueling, a distance of some 4,000 miles. As to the question of danger, great progress had been made during the last two years, and it was believed that many of the weaknesses that occasioned the failures of the past had been discovered and eliminated. The structure of the airships now being built would be incomparably stronger in the matter of material than the structure of any airship yet built. In regard to the danger of fire, the airship that was being built at Cardington would be equipped, not with petrol motors, but with heavy oil engines.

If the Empire air routes were to come into being, it would be necessary to have the co-operation of the Dominion Governments, and as an example of what could be achieved in this direction the Air Minister pointed out that if the Indian Government would extend the Cairo-Karachi service to Bombay and Calcutta, a regular service between London and Australia immediately would be possible. The erection of mooring masts and collection of meteorological data also were essential preliminaries to the inauguration of the new airship service.

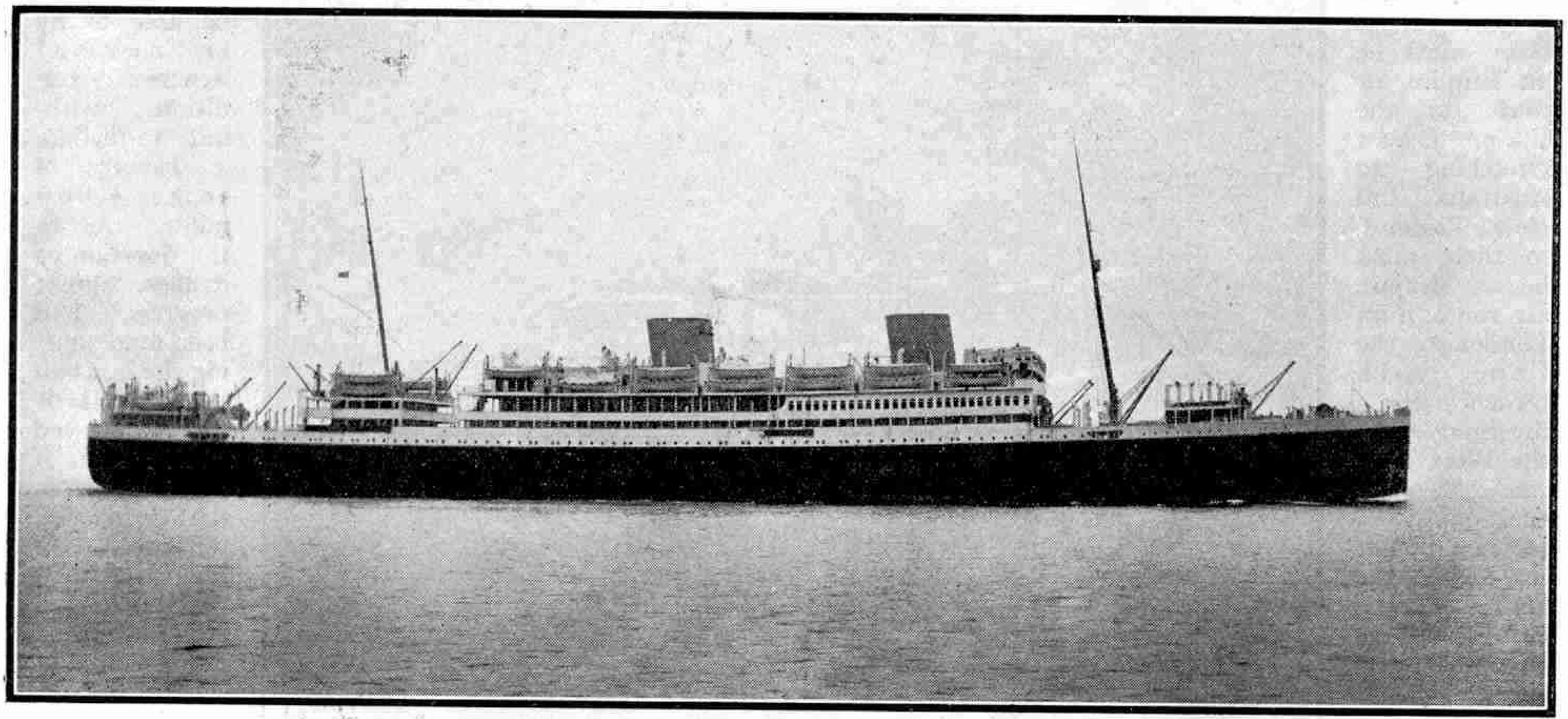
The Air a Highway of Peace

In conclusion Sir Samuel added:—"The invention of the flying machine, which the pioneers of successive centuries strove to achieve, was meant for something better than an instrument of concentrated frightfulness. With the horror of the last war in our memories and the limitless terrors of any future war in our minds, let us make the air a highway of peace, and the aeroplane an instrument, not for severing nations and destroying civilised life, but for making closer and more constant the unity of Imperial thought, Imperial intercourse and Imperial ideals."

Will Ships' Funnels Disappear?

The Story of the Evolution of the Smoke-Stack

By G. W. Greenland



R.M.S.P. "*Asturias*"

ONE of the most conspicuous features of all types of ships of to-day is the funnel. At sea, long before the whole of the vessel is visible, the funnel thrusts itself boldly over the horizon. Gradually the complete silhouette comes into view, and we may well spend a moment or two in considering how greatly this would have differed above deck in the old days of sails.

Many admirers of the magnificent sailing ships of the past have lamented the disappearance of the snowy mountains of canvas that used to tower aloft, but the writer believes that in the change from sails to funnels there has not been by any means a complete loss of beauty. The massive funnels of the great passenger and cargo liners of to-day are in complete harmony with the vessels that carry them, just as was the case with the sails of the ships of the past.

When the first funnels crept furtively from the decks of the early steamers and stretched upward into the regions sacred to the vested interests of centuries of sails, they were indeed tiny affairs. At that time steam was merely an auxiliary to sails, and it was not until sails began to disappear entirely that the funnel assumed the proportions of an important part of the vessel.

The early funnels were, of course, designed for the small boilers then in use, and had a comparatively small volume of smoke to carry away. As the power of the engines increased, bigger boilers were fitted and more coal had to be burned, and therefore higher funnels came into use in order to provide better draughts.

The funnel is simply a convenient means of isolating a column of air from the rest of the atmosphere. This column is heated at its lower end by the furnace and, becoming lighter than the surrounding air, rises up the funnel. Cold air now replaces it at the bottom of the funnel and rushes in by way of the furnace and firebars, thus creating the powerful draught so necessary to perfect combustion.

At first funnels were generally painted black to prevent the smoke from making them look dirty, but as they increased in size it was realised that to keep them all black was to make them ugly. Before long many funnels began to be coloured and emblazoned with their owners' badges. Blue, red and buff were the most popular colours, and it became customary to protect them from the smoke by a deep band of black round the top of the funnel.

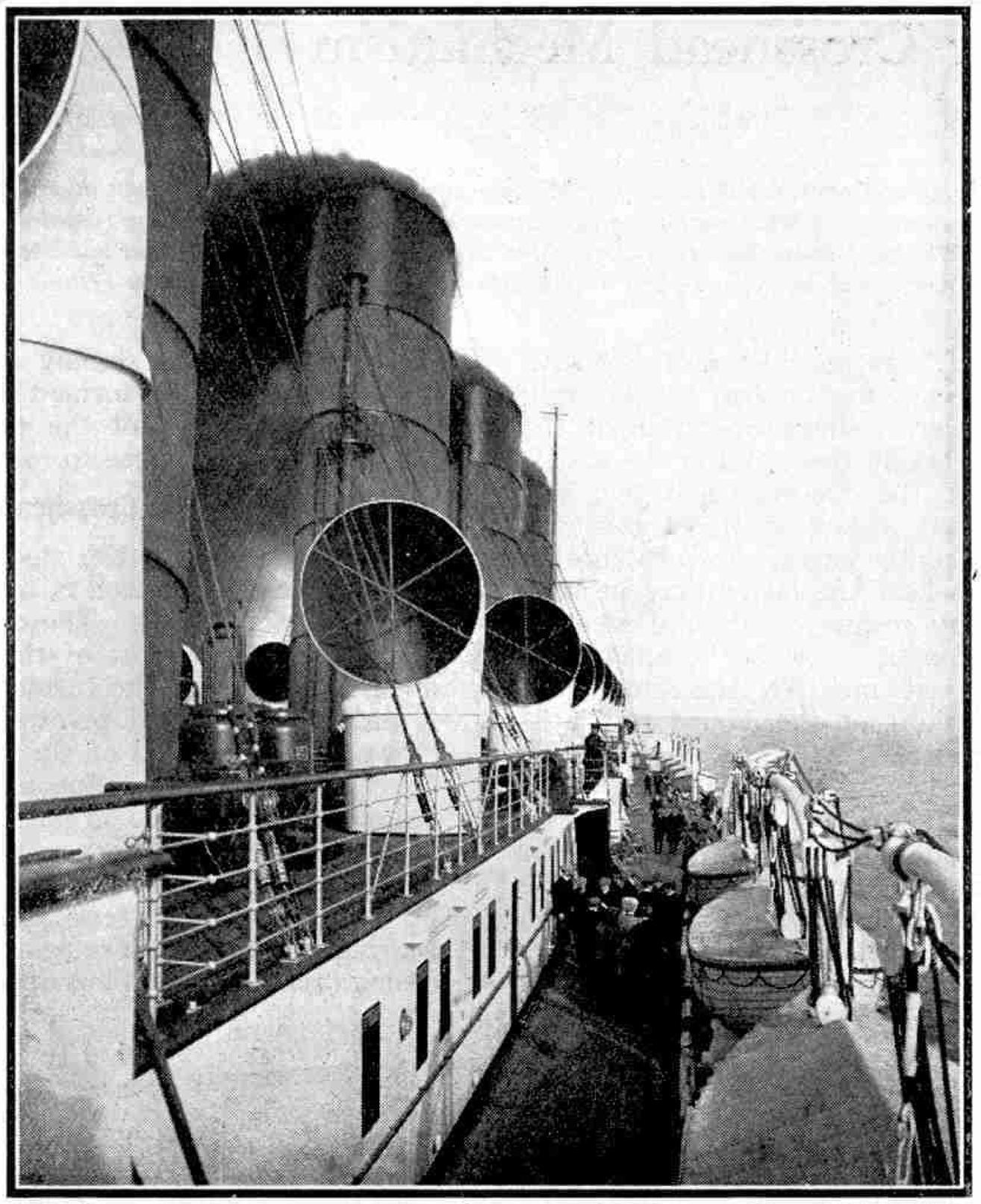
The structure that we see rearing itself so proudly above the vessel is not the whole of the funnel, but only the outer section. Inside, and slightly smaller in diameter, is the funnel proper, and between the two is an annular air space to prevent the outer funnel from becoming blistered with the heat. The inner funnel goes right down through the ship to the furnaces in the boiler room, but the outer casing is built up from the deck. Both the inner and the outer funnel are built up of rings of sheet steel riveted together. It is usual to support a funnel by means of several guys anchored to various points on the deck.

The dimensions of some modern funnels are very striking. The four funnels of the "*Mauretania*," for instance, are oval in cross section, 23 ft. 7 in. in depth

(fore and aft) and 16 ft. 7 in. in width, their tops being 153 ft. above the keel. Many difficult engineering problems were encountered and overcome in constructing these gracefully-raked monsters. One can imagine, for example, the pressure that had to be allowed for in such huge structures in winds blowing perhaps 60 miles per hour!

The funnels of the great ships of the Navy are not so huge as those of the big liners, but nevertheless they are of considerable size. The "*Renown*," for instance, has two oval funnels, the forward and higher one being about 50 ft. in height and approximately 26 ft. from back to front, while its top is about 115 ft. above the keel. The after funnel is 26 ft. deep, 45 ft. in height and 110 ft. above the keel. The magnificent vessels of the "Royal Sovereign" class have one massive funnel 24 ft. in depth, 45 ft. in height, and reaching to about 107 ft. above the keel.

The latest development of the funnel is in connection with motor-driven vessels, in which it is used to carry away the exhaust gas from the engines. Here something of a reaction has come from the tall funnel. The largest and most powerful motor vessel in the world, the 20,000-ton "*Asturias*" of the Royal Mail Steam Packet Co., has two very short funnels that are quite extraordinary in appearance. They rise above the top deck for only a height about equal to the depth of the ship's side from the water line to the top of the white line running from stem to stern. Their diameter is almost as great as their height, and certainly no better symbol of the vessel's power and speed could be imagined than these two well-raked, cream funnels.



Courtesy] [Cunard S.S. Co. Ltd.

Boat-deck "*Mauretania*"

Another motor vessel's funnel, and one quite normal in design, is that of the fine Rotterdam Lloyd twin-screw liner "*Lindrapoera*," recently completed for the Rotterdam-Java service. Her tonnage is 11,500, she is 500 ft. in length, has a speed of 15½ knots and carries 463 passengers. Her two Sulzer six-cylinder engines develop between them 3,500 h.p., and their exhausts and those of all the auxiliary machinery are passed to silencers in, and exhausted from, a fine funnel measuring 15 ft. in diameter and rising 46 ft. above deck, its top being 108 ft. above the keel.

It appears probable that motor-propelled ships will be built in future in ever-increasing numbers, and it may be that in time the funnel will disappear. It is true that in such ships the funnel is not needed to provide a draught, but it does provide a very useful means of carrying the exhaust gases well up and away from the ship. It should be noted that in steamers with forced draught or burning oil fuel the funnels are not primarily draught producers, but are merely huge pipes for passing off the waste matter from the furnaces.

It has taken us many years to become reconciled to the loss of sails, and if funnels do ultimately disappear it will take us at least as long to accustom ourselves to their absence. Funnels appear such an essential feature of a ship that certain emigrants refused to embark upon a two-funnelled liner because the advertisements that had lured them depicted a ship with three funnels!

Exploring the Arctic—(*continued from page* 13)

by every other whaler, so that the feature became a leading characteristic by which a whaling ship was at once recognisable.

Scoresby always managed to reach the fishing ground in quicker time than his rivals and, when he so chose to do so, was able to penetrate further into the ice. He managed to do this by discovering the advantage of flat sails and by bringing his weights well down by filling his oil casks with water as ballast, and packing them with shingle. Thus, instead of starting light on his voyage he was in the best of trim and was able to quickly beat to windward and so reach the fishing ground in "double quick time."

Scoresby, who often spent as many as twelve hours at a stretch observing from the crow's nest of the "*Resolution*," was most ingenious and resourceful in battling with the ice. For instance, on the occasion already mentioned on which he reached Lat. 81° 30′, he noticed indications that there was open water to the north and determined to get to it at all costs. He ordered his men to commence sawing and hammering the ice, and they even dropped the ship's boats on to it from the bow, to break it! He made the crew run in a body backwards and forwards across the deck, causing the ship to "sally" or roll, and used every means his ingenuity could conceive to attain his object. His efforts were not continued for a few hours, but lasted continuously from 13th May to 24th June! His reward was to pass the ice-barrier and reach the farthest north ever reached by a sailing vessel in these seas. In that position there was no ship within 350 miles of the "*Resolution*." It is pleasing to learn that fortune favoured the brave venture, for in the following 32 days the ship caught 24 whales, as well as seals, walruses, etc., so that the voyage proved to be one of the most profitable of the 30 he had undertaken.

A Meccano Demonstration of Emergency Hand Steering Gear and Rudder Crosshead Mechanism

By H. F. Lane

In this article our contributor describes with the help of Meccano some further interesting details of a ship's steering mechanism. Two articles of a similar character by Mr. Lane have already appeared in the "M.M." These were entitled "Ship's Helm Indicator in Meccano" and "A Meccano Demonstration of Hunting Gear," and appeared in the November and December issues respectively. In the near future we hope to publish an article from his pen dealing with the Flettner Rudder.

IN the November "*M.M.*" we considered the general arrangement of the gear employed in the steering of large ships by power, and the operation of the steering engine itself was briefly described in the article on "Hunting Gear" in the December issue. The Meccano model illustrated below demonstrates the method by which the steering engine imparts motion to the rudder, and shows how the latter may be controlled when necessary by means of a hand steering wheel. In this connection it may be recalled that reference was made in last month's Magazine to a stipulation in the regulations of the Board of Trade that all merchant ships must be fitted with some means of operating the rudder by hand as an alternative system of control in the event of failure of the power.

The rudder is represented in the model by two Sector Plates 1 (Fig. A) bolted together and attached to the stock or shaft 2 by means of two bolts, each of which passes through a hole in the surface of one of the Plates and is screwed into the flat face of an Octagonal Coupling mounted on the stock. It will be observed from the illustration that the rudder is of the partially balanced type—that is to say, it has a portion of its area on each side of the pivot. The advantages of this form of rudder over the earlier types, which were pivoted to the ship down the entire length of their leading edges, will be explained in the article dealing with the Flettner Rudder.

The stock passes through a lower guide bearing consisting of a Bush Wheel 3 representing a watertight stuffing-box and gland. This is packed with three Washers placed upon one of its bolts to maintain alignment of the stock where it passes through the sloping underframe of the vessel. The upper bearing is formed by a second Bush Wheel 4 bolted to the deck of the tiller flat or compartment. The rudder stock is free to rotate in both these bearings.

Arrangement of the Crosshead Mechanism

The upper end of the stock is secured in a further Bush Wheel 5, to which is bolted a 2½" Strip acting as the rudder crosshead. The crosshead is called upon to bear the whole weight of the rudder and stock 2; it must also transmit the turning movement to the stock. A link 6 is attached pivotally by means of bolt and lock-nuts to each end of the crosshead (see Figs. A and B). These links are connected in turn to the Threaded Couplings 7a mounted on parallel Threaded Rods 7 lying in a fore-and-aft direction.

The Rods 7 are prevented from moving longitudinally by Collars and set-screws placed on each side of their bearings, and they are so geared together that a rotation of one causes an equal but opposite rotation of the other. The effect of this is to cause one Threaded Coupling to move along its respective Rod towards the rudder head, and the other to move a corresponding distance away from the rudder head. The links convey this movement to the crosshead or, to use technical language, apply a "couple" to the stock and put helm on the rudder.

A special feature of the gear is that it cannot "walk back." The rudder is held rigidly in any position as soon as the "hunting gear" (described in the December "*M.M.*") has cut off the power. Moreover, no brakes or stops are required to prevent the rudder taking charge and threshing about due

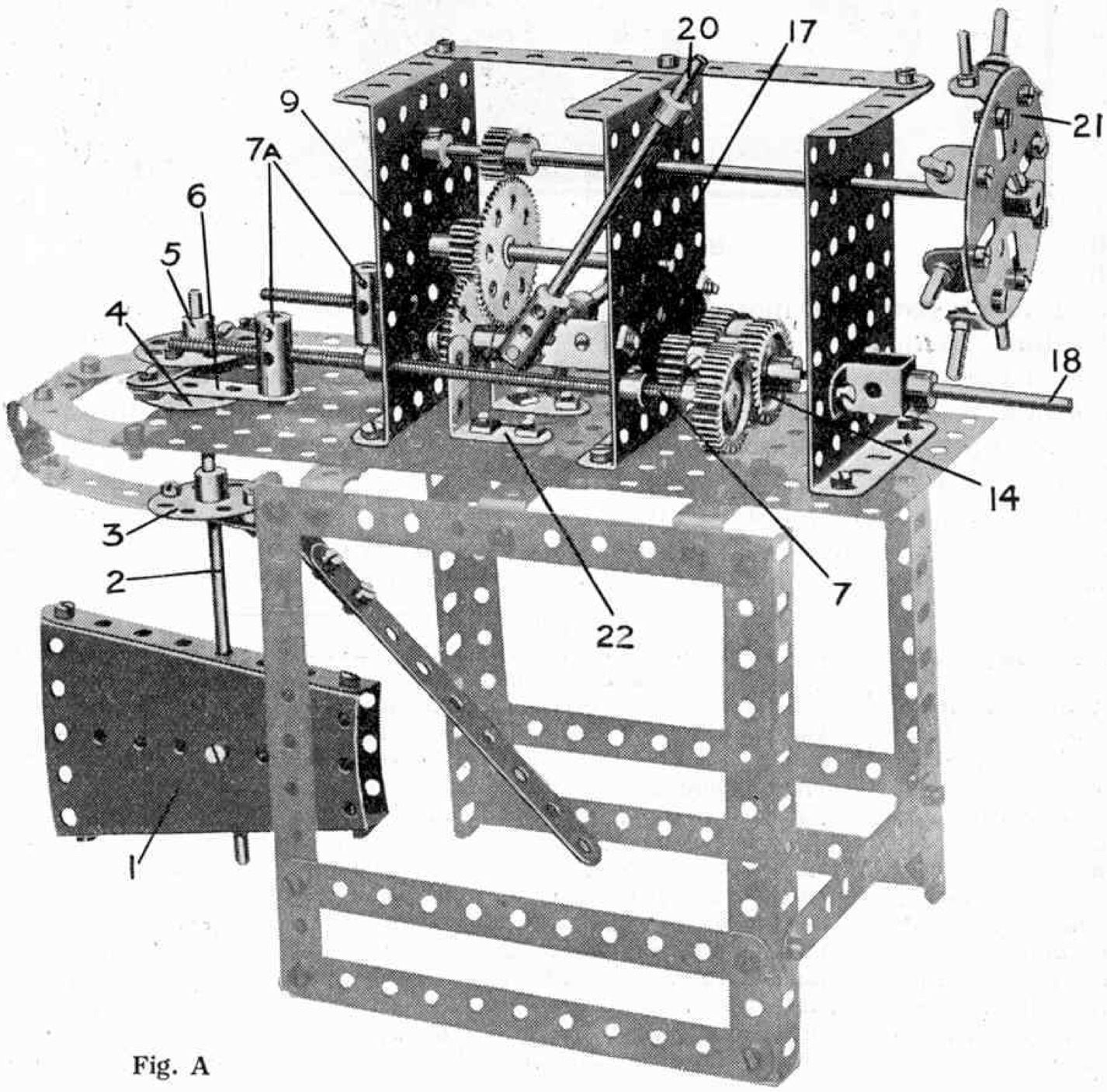


Fig. A

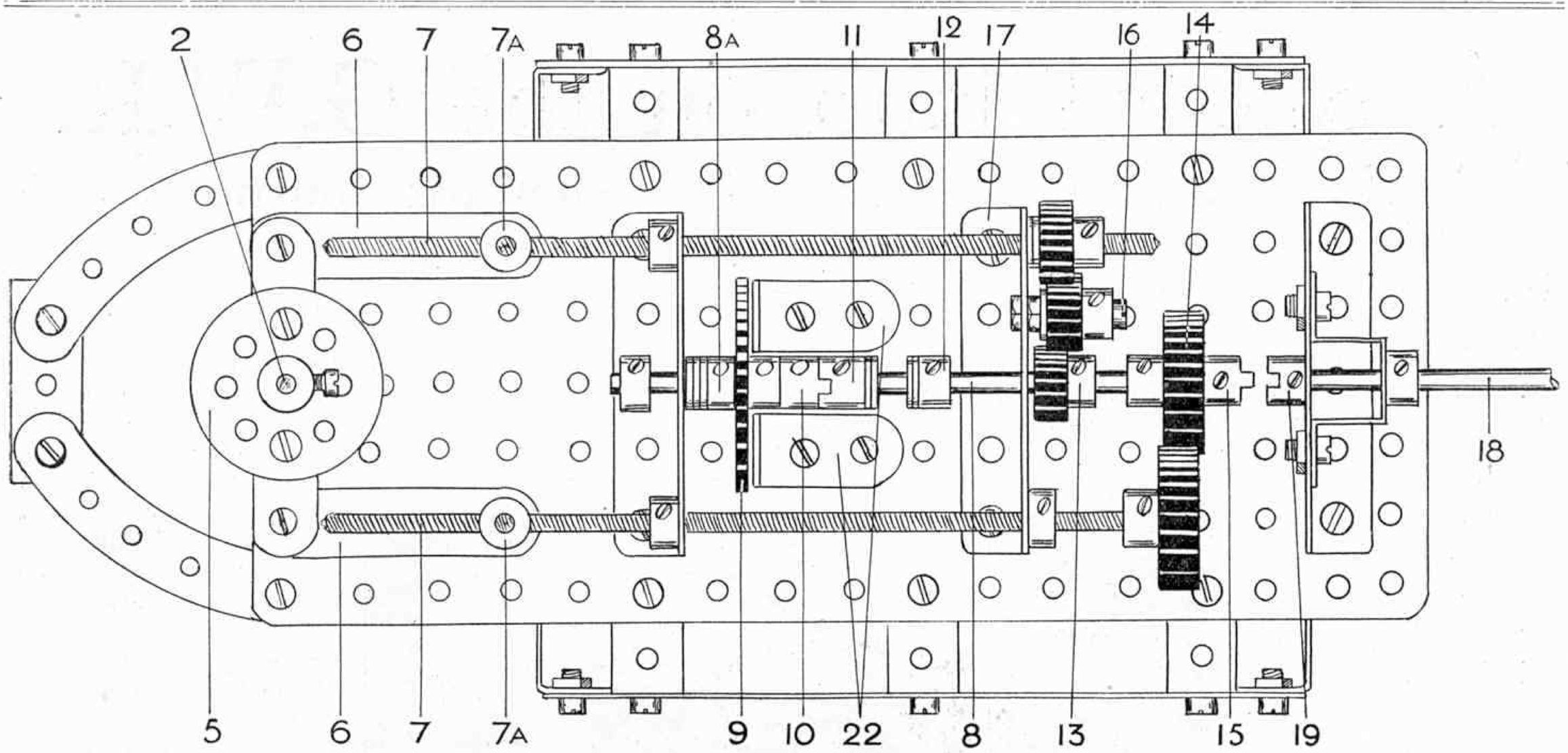


Fig. B. Plan of gearing, showing crosshead mechanism and clutch units, etc.

to the rolling of the ship, etc., when changing over to hand-gear or *vice versa*.

The plan shown in Fig. B clearly indicates the disposition of the Rods 7 in relation to the mechanism in the lower portion of the gear box. It will be seen that the Threaded Rods are connected by gearing to a central 4½″ Axle Rod 8. This latter Rod carries the following units, commencing from aft:—a Collar, secured in the position shown; three Washers; a second Collar 8a, free on the Rod; a 57-teeth Gear Wheel 9 (free); the male portion of a Dog Clutch 10, free on Rod *but soldered to Wheel* 9; a female Clutch 11, secured to the Rod; four Washers; a Collar 12, ½″ Pinion 13, 1″ Gear Wheel 14, and another male Clutch 15, all secured to the Rod.

Connection with the Steering Engine

It will be seen that the ½″ Pinion 13 and 1″ Gear Wheel 14 are geared to the Threaded Rods, the Pinion 13 driving its respective Rod via another ½″ Pinion that is free to rotate upon a ¾″ Bolt 16 rigidly secured to the Plate 17, while the Gear Wheel 14 engages directly with a second 1″ Gear Wheel secured to the other Threaded Rod. This arrangement provides that the Rods 7 will rotate in opposite directions. The steering engine is coupled to the shaft 18, which carries a female clutch member 19.

Alternative Power or Hand Control

The lever 20 (Fig. A) is rigidly connected to a transverse 3″ Rod journalled in a 2½″×1″ Double Angle Strip bolted to the Plate 17. This 3″ Rod carries a Collar secured in place by a ¾″ Bolt used in lieu of the set-screw. The head of the bolt is directed downward, so that the shank rests against the Rod 8 between the clutch 11 and Collar 12 (Fig. B). Consequently movement of the lever 20 imparts a sliding movement to the Rod 8, with the result that the clutches 11 and 15 may be engaged or disengaged, as desired, with their respective counterparts.

In both illustrations the lever is so placed that the clutch members 10 and 11 are engaged. As already stated the member 10 is rigidly secured to the Gear Wheel 9, which is connected through the gear train shown in Fig. A to the hand steering wheel 21; consequently in this position of the lever the rudder may be operated by rotation of the wheel 21, independently of the steering engine. If the lever 20 is thrown over to the opposite position the clutch members 10 and 11 are disengaged and 15 and 19 engaged. The unit 9 and 10 is now free to rotate idly about the Rod 8 and consequently the wheel 21 is put out of service, the rudder being operated from the shaft 18, which is driven from the steering engine.

The Gear Wheel 9 carrying the clutch member 10 is prevented from moving longitudinally by the Collar 8a on one side and the 1″×1″ Angle Brackets 22 on the other.

It will be observed that the steering wheel 21 is constructed from a Face Plate having bolted round its circumference a number of Angle Brackets, to which are secured the Threaded Pins representing the spokes.

Joining the Clutch and Gear Wheel

The rudder is not built to scale and the details of the casing, bed-plate, etc., are approximate only. In actual practice these details vary in design according to the space available in the particular vessel and the shape of her stern, etc.

In a foot-note to last month's article on "Hunting Gear" it was mentioned that we hope to introduce in the near future a Meccano Sleeve Coupling. This part, when ready, will serve to connect rigidly together the clutch segment 10 and the Gear Wheel 9, and will thus obviate the necessity of reverting to the use of solder.

Meanwhile readers should experience little difficulty in soldering these pieces together. Before doing so, however, the ends of the two parts should be cleaned thoroughly by running a file over them, and during the process of soldering they should be secured in the required position on an Axle Rod.

In preference to the above method, some readers may decide to manufacture for themselves a part to serve the purpose of a Sleeve Coupling. As explained last month, such a part may be fashioned quite easily from a ½″ length of metal piping.

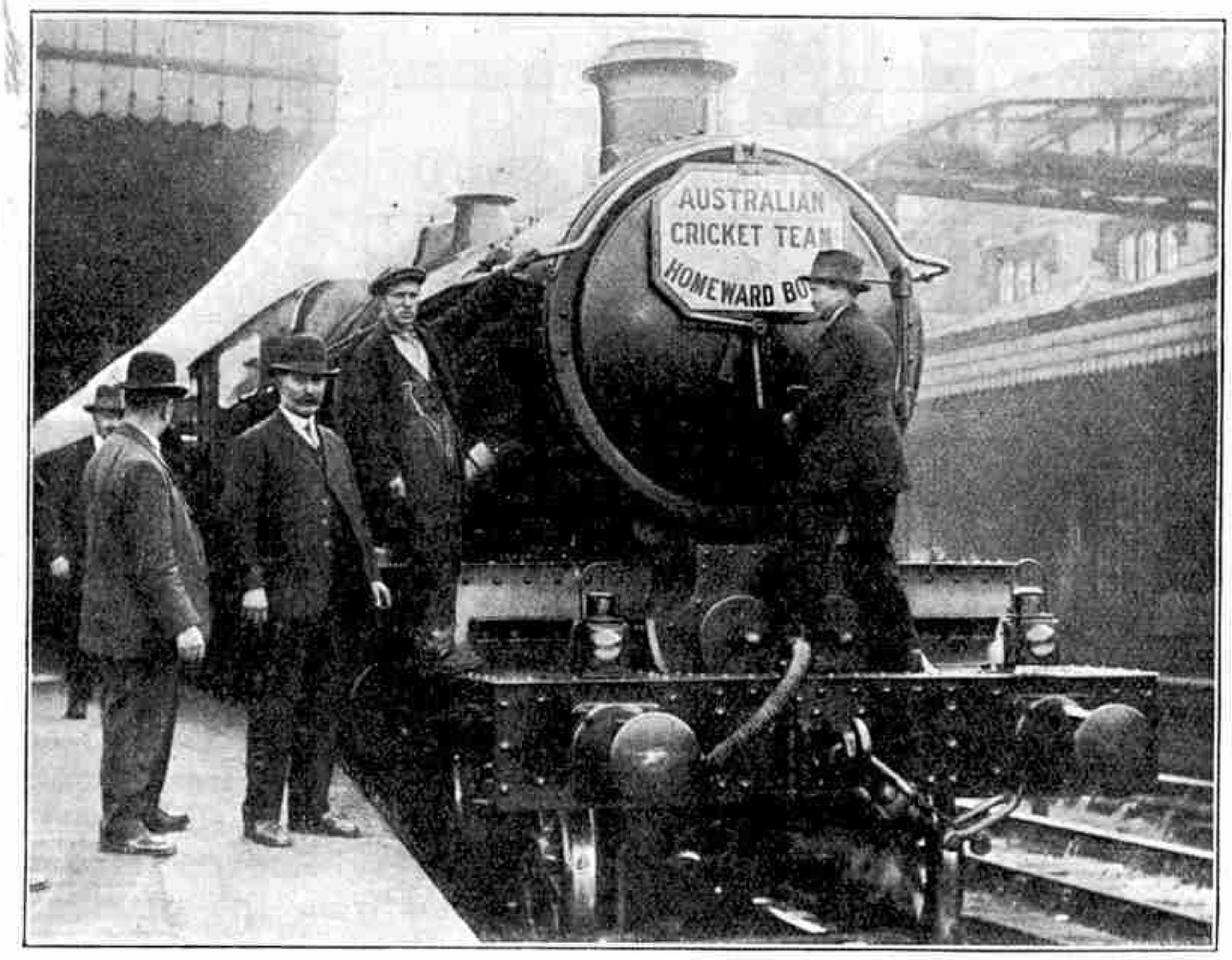
A Record Run on the G.W.R.

The Australian Cricketers' Homeward Journey

By One of the Party *

TWICE last year visitors from overseas had stirring experiences on the Great Western Railway. The first event was in April last, when the American hotel proprietors boarded the special trains at the port of Plymouth and, in their own words, were "hustled to London." The second occasion was on 1st October when the Australian cricketers journeyed by special train from Paddington and, as Mr. Macartney observed, were "hustled to the port of Liverpool."

The history of the Great Western Railway contains no more remarkable record than the running accomplished by the famous *Windsor Castle* engine, No. 4082, which headed the train, as a compliment to the Australians.



The Australian Cricketers' Special Train; Engine, "Windsor Castle"

Starting at 9.5 a.m., five minutes before the regular Birmingham and Birkenhead train, the magnificent special of saloons of the Royal pattern drew out of the station, amidst resounding cheers from crowds on the platform.

At the six-mile post it was evident that Driver Roberts was intent on keeping record time, and the pace rapidly increased, until at a point near Haddenham a speed of 92 m.p.h. was attained.

To the traveller it was curious to note that the greater the speed of the train, the less indication was there of abnormal pace. Without the speedometer fixed in the coach it would have been difficult to realise what was happening.

When the train was at its highest speed morning coffee was brought in. The Australians were much amused at the dexterity of the restaurant-car conductor, who served the guests without any apparent difficulty.

Birmingham was reached in 106 minutes, a record for the 110 miles, the regular service taking two hours. The train passed through Birmingham without stopping—another record, according to Chief Inspector Thomas, who has to his credit over fifty years' service and a notable experience in these matters. At Shrewsbury a halt was made to change engines, the time taken from start-to-stop being 160 minutes for a journey of 152 miles 71 chains.

The *"County of Bucks,"* No. 3811, in charge of Driver Jones, took over the running to Birkenhead (Woodside), and the entire journey of over 210 miles was accomplished in 3 hours 55 minutes. The average speed to Birmingham and Wolverhampton was 60 m.p.h. The average speed overall excluding the stop at Shrewsbury, was 54.6 m.p.h. The weight of the train, excluding engine, was 250 tons.

The story of the record run to Birmingham had already reached Liverpool when we crossed the Mersey, and the Australians and their friends were able to take a printed record of their remarkable journey. It also resulted in the collection of a great crowd to greet the Australians, whose departure would otherwise have been overshadowed by Sir Alan Cobham's homecoming. It was Sir Alan who afterwards said that people became so familiar with modern means of transport that a special event was necessary to stir the imagination. Fast trains are a daily occurrence on the Great Western Railway, but a record run never fails to provide outstanding interest.

The visitors from Overseas were full of admiration for the efficiency of the British railwaymen, and a world traveller told

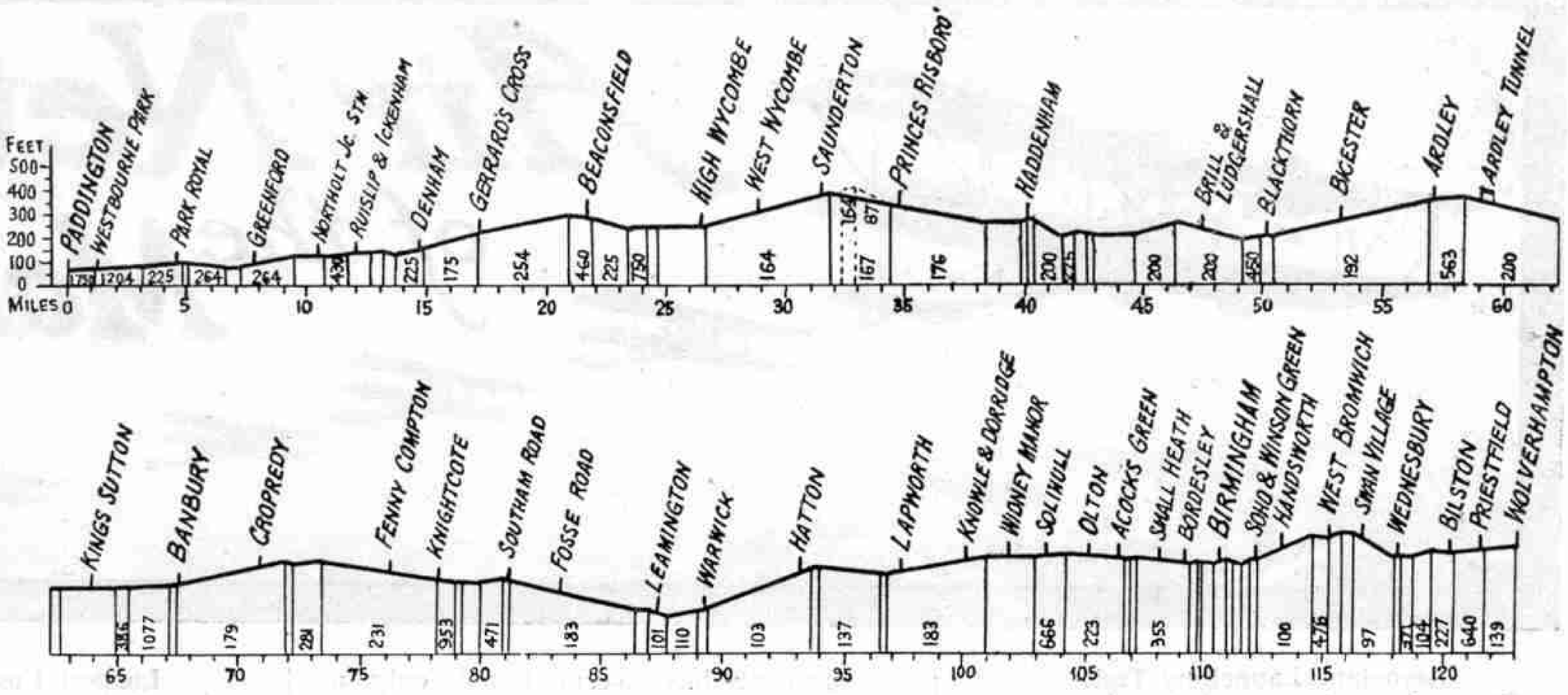
LOG OF SPECIAL TRAIN—PADDINGTON TO BIRKENHEAD, WITH AUSTRALAIN CRICKET TEAM.

		Distance M. Ch.	Time. a.m.	m.p.h.
Paddington ...	dep.	— —	9· 5	—
Old Oak Common	pass	3 22	9·11	32·8
High Wycombe	,,	26 44	9 33	63·6
Princes Risboro'	,,	34 54	9·43½	46·4
Ashendon Jnct.	,,	44 4	9·51	75·0
Aynho Jnct. ...	,,	62 33	10· 7	68·9
Banbury ...	,,	67 38	10·11½	67·5
Leamington ...	,,	87 28	10·29	68·1
Birmingham ...	,,	110 53	10·51	63·6
Wolverhampton	,,	123 3	11· 8	43·7
Wellington ...	,,	142 49	11·30	53·3
Shrewsbury ...	arr.	152 71	11·45	41·1
	dep.	—	11·49	—
			p.m.	
Gobowen	pass	170 72	12·10	51·4
Ruabon ...	,,	178 26	12·19	49·4
Wrexham ...	,,	183 9	12·24	57·6
Chester Cutting	,,	195 18	12·36	60·5
Birkenhead ... (Woodside)	arr.	210 32	1· 0	37·9

*Reprinted by permission from the "G.W. Rly. Magazine."

the writer that if the British people only realised it, English railways provided more fast trains and efficiency in working than are to be found in any other country.

The result achieved by the running of the Australians' special train was entirely due to Great Western team work. All the operating departments were concerned in the equipment and operation of the train, and it was due to their keenness that at every stage of the journey nothing occurred to delay progress.



The Gradient Section from Paddington to Wolverhampton, where the record run was made

The Australians will long remember their "Kangaroo Express," as the engine was humorously labelled, and will carry home with them pleasant recollections of their record run.

The following are the details of the run :—

Time occupied :—Paddington to Birkenhead—3 hours 55 min.

Average Speed overall (excluding stops)—54.6 m.p.h.

Average Speed Paddington to Wolverhampton—60 m.p.h.

Maximum speed attained—92 m.p.h.

Weight of Train excluding engine—250 tons.

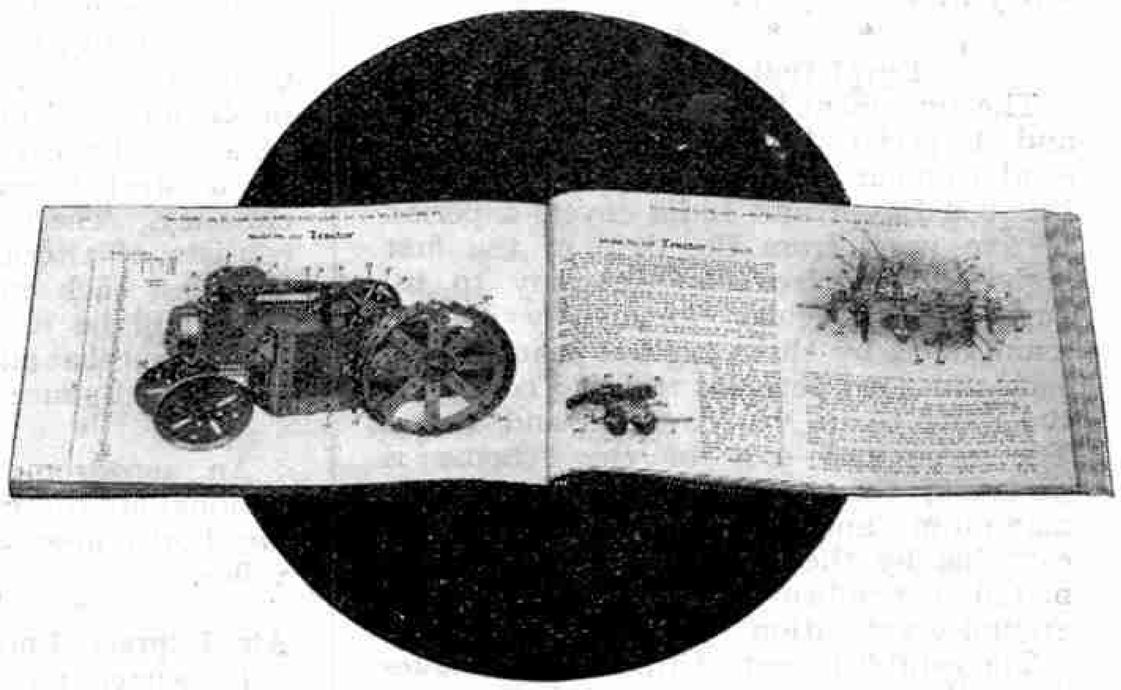
Engines :—4082 "*Windsor Castle,*" Paddington to Shrewsbury ; 3811 "*County of Bucks*" Shrewsbury to Birkenhead. Driver Roberts, Paddington to Shrewsbury ; Driver Jones, Shrewsbury to Birkenhead.

The excellence of this "homeward bound" run that gave so excellent a last impression to our Australian visitors makes it worth while to recall the first impression of the other visiting party to which reference was made in the opening paragraph of this article.

The party consisted of 300 American hotel proprietors. They landed at Plymouth on 9th April from the steamer "*La France,*" and were conveyed to Paddington in two special trains drawn respectively by loco No. 4083, "*Abbotsbury Castle,*" and loco No. 4085, "*Berkeley Castle.*" The first of these trains——that hauled by the "*Abbotsbury Castle*"—weighed 273 tons and covered the journey of nearly 227 miles in 3 hours 53 minutes, although scheduled for 4 hours 4 minutes. The second train was somewhat heavier, weighing 286 tons, but took only two minutes more. The average speeds of the trains were 58.5 and 57.5 m.p.h. respectively, and in both cases the maximum speeds, 72.7 and 70.1 m.p.h., were touched on the 95½-mile run from Westbury to Paddington, the actual times over this final stretch being 90 minutes and 89 minutes respectively.

The journeys of both the Australian and the American parties were accomplished by special train, but in neither case did the drivers set out with the intention of breaking records. There are indeed several scheduled runs on the G.W.R. the timing of which calls for a greater average speed than that achieved on the runs described. Thus the journey between Swindon and Paddington, 77.3 miles, is regularly covered by one train each day in 75 minutes, representing an average speed of 61.8 m.p.h. This is only slightly faster than the booked speed achieved by two trains daily between Paddington and Bath, 106.9 miles, covered in 105 minutes. Another fast service is that between Paddington and Bristol, a distance, according to route, of 118.3 or 117.6 miles, which is covered at an average speed of 58.8 m.p.h. for the up journey and 59.2 m.p.h. for the down run.

A point of special importance in connection with the scheduled runs is that the loads are usually considerably greater than those of "special" trains. Almost without exception, the speeds achieved by British locos in the maintenance of their regular schedules do not represent the uttermost limit of their capacity. Greater speeds could be attained, but it is doubtful whether any practical advantage would result.



THE MECCANO MANUALS

There are three Meccano Instruction Manuals, the 0 Manual for simple models built with the 00 and 0 Outfits, the 0-3 Manual comprising models built with any of the Outfits up to a No. 3, and the Complete Manual, which includes all the models shown in the smaller Manuals and a selection of models for every Outfit up to a No. 7. This latter Manual is a fine publication and should be in the hands of every Meccano boy. It contains instructions for building 378 models and the illustrations are beautifully printed in half-tone. Most of the models that it includes have been recently designed or improved.

Prices of Manuals:

0 Manual, postage free,	U.K. **6d.**	Overseas, **6d.** (postage extra)
0-3 Manual ,, ,,	U.K. **1/1½**	Overseas, **1/6** (,, ,,)
Complete Manual ,,	U.K. **2/10**	Overseas, **3/6** (,, ,,)

Aeroplane Launching Tests

Further experiments in launching aeroplanes from an airship in flight were carried out recently by the airship "*R.33*" in the course of a flight from Pulham to Cardington. On this occasion two Gloster "Grebe" fighting machines, equipped with 385 h.p. engines, were slung from the launching apparatus, which has been improved considerably since the tests described in our February issue were carried out.

As soon as "*R.33*" reached a height of approximately 2,000 ft., one of the aeroplanes was released after its engines had been started up by a gas starter operated from the airship's keel. The machine dived at an acute angle for nearly 100 ft. and then straightened out and, after performing various manœuvres, landed safely at Pulham. The second machine also was to have been released over Pulham, but owing to temporary trouble with the gas starter the attempt was postponed until Cardington was reached. The second machine was then launched successfully and alighted safely at Cardington.

* * * *

Egypt-India Air Service

The agreement between the Air Ministry and Imperial Airways Limited for the establishment of an air transport service between Egypt and India covers a period of five years from the date of the first flight. It requires the company to inaugurate a regular fortnightly service maintained by three-engined machines in each direction between the two countries, the route to lie via Baghdad and Basra. The estimated cost of the scheme is £500,000, this amount allowing for the maximum annual subsidy of £99,600 earnable by the company and the estimated expenditure of £65,000 on the ground organisation.

The establishment of this service makes it possible to withdraw a squadron of the Royal Air Force that hitherto has undertaken the fortnightly mail service.

* * * *

British Company Organise Greek Aircraft Factory

About a year ago the Blackburn Aeroplane and Motor Company opened an aircraft factory at Old Phalerum in Greece on behalf of the Greek Government. The Blackburn Company have acted only as organisers and supervisors of the scheme, all the factory operations being carried out by Greek labour trained by British representatives. The experiment has been extremely successful. The Greek Government have secured not only a factory operating on first-class British lines, but also a sufficiency of skilled labour and of trained pilots. Already several torpedo-planes, convertible if required into land machines, have been built and have proved most satisfactory in performance.

* * * *

New Continental Air Route

Negotiations are in progress between the German Luft-Hansa Company and the Italian Aero-Lloyd for the inauguration of an air service between Munich and Rome via Milan and Bologna. If these negotiations are completed successfully a direct air link will be provided between the German and the Italian capitals.

* * * *

Croydon Air Lighthouse

The cone-shaped air lighthouse at Croydon aerodrome is being dismantled as it has been replaced by the neon air-light that was brought into use in the middle of last November. The new light is placed in the south-west corner of the aerodrome and is approximately 46 ft. above ground level. It is red in colour and is of 13,700 candle power. In clear weather it can be seen throughout a radius of 45 miles. The lamp itself consists of 16 neon tubes each 20 ft. in length mounted on a steel tower erected on a disused chimney. The light is not continuous but consists of alternate periods of light and darkness each one second in length. The lamp will be used only when notice has been given that aircraft may arrive between sunset and sunrise.

* * * *

An aerodrome to be used by international air routes is to be constructed by the Portuguese Government near Carcavellos.

* * * *

Air Express Encounters Migrating Birds

Passengers on several of the Continental air routes have had excellent opportunities during the last few months of observing the migratory habits of birds that spend the summer in Northern Europe and in the winter go south to warmer climates. On one occasion in early October the Imperial Airways express on the Zurich-London route, when crossing the Alps, encountered vast flocks of small birds, not unlike sparrows in appearance, flying at a height of nearly 6,000 ft. The birds were flying in formations that were likened to spear heads and the pilot of the air express said that one of the spear heads was several hundred yards in length and must have consisted of over a million birds.

Longest Upside-Down Flight

An officer of the Royal Air Force flying a Sopwith "Snipe" has succeeded in flying upside-down for a period of seven minutes four seconds, which is the longest on record. His altitude was approximately 3,000 ft. Incidentally this flight was an interesting demonstration of the ease of control of some of the old Army machines.

* * * *

Germany's Principal Air Port

The rapid development of Hamburg as an air port is indicated by comparison between the figures for August 1924 and August 1926. In August 1924, the traffic totalled 279 machines carrying 352 passengers and 3,822 tons of general merchandise and mails. In August last year these figures had grown to 952 machines, 2,862 passengers and 37,219 tons of freight and mail. Hamburg is the converging point for many of the international air routes and the figures given include machines of all nationalities.

* * * *

London to Pekin Air Route

In conjunction with the German Luft-Hansa Company, Imperial Airways will shortly inaugurate an air route from London to Pekin, a distance of approximately 5,500 miles. The sections from London to Moscow are in operation and it is anticipated that at the outside the complete journey will take seven days, instead of the eighteen now required by the ordinary land and sea route. By flying at night over some of the Far Eastern stages a further saving in time of 3½ days would be obtained, and this would bring about the possibility of flying from London to Pekin and back within a week. The 4,000 miles of route beyond Moscow have been surveyed and negotiations for the passage of the machines operating the service are going forward with the Soviet and the Chinese Governments.

* * * *

Non-Stop Flight of 3,340 Miles

A further record for a long-distance non-stop flight has been set up by two French aviators, MM. Coster and Rignot, who succeeded in flying from Le Bourget to Djack, approximately half way between Bandar Abbas and Charbar on the Persian Gulf, a distance of approximately 3,340 miles. The machine used was a Breguet 19 fitted with a 500 h.p. Hispano-Suiza engine. The time occupied in the journey was 32 hours and the average speed on a straight line basis was therefore slightly more than 100 miles per hour.

Western Australian Airways

Sir Alan Cobham's comments upon the bright future of Australian flying have brought the existing Australian air services into considerable prominence. In a recent note we gave some details of the Queensland and Northern Territories Air Services, and another line that is equally efficient is described in the brief article below, contributed by Arthur Hill of Cottesloe, Western Australia.

Western Australian Airways is one of the longest passenger and mail-carrying air services in the world and links up all the important ports between Derby and Perth on the North-West coast of Australia. The company was formed in August 1921, and operates the mail-carrying contract between Perth and Follows Creek. Since the inauguration of the service in December 1921 nearly 670,000 miles have been flown. In the past twelve months over 256,000 letters have been carried, the largest number in any one month being approximately 25,000, in addition to more than 3,000 passengers. The approximate distance between the two points on the mail-carrying line is 1,400 miles.

The ordinary work of carrying passengers to schedule is supplemented by a considerable amount of private hire work and this has already proved the value of aviation as a means of rapid communication between the towns and "back-blocks."

The machines employed include six Bristols and three D.H. machines, each of these being equipped with Armstrong-Siddeley Puma engines of 240 h.p. each. The average speed at which the services are maintained is between 85 and 90 miles per hour, but the machines are stated to be capable of reaching 110 miles per hour when called upon.

The complete service is carried on in three sections and each machine works a week at each section before returning to the Perth headquarters for a complete overhaul and examination. This is in addition to the customary examination undertaken before each flight. The pilots all have seen service either in the Australian Flying Corps or the British Royal Air Force, and one man already has flown nearly 150,000 miles on the Western Australia coast routes.

* * * *

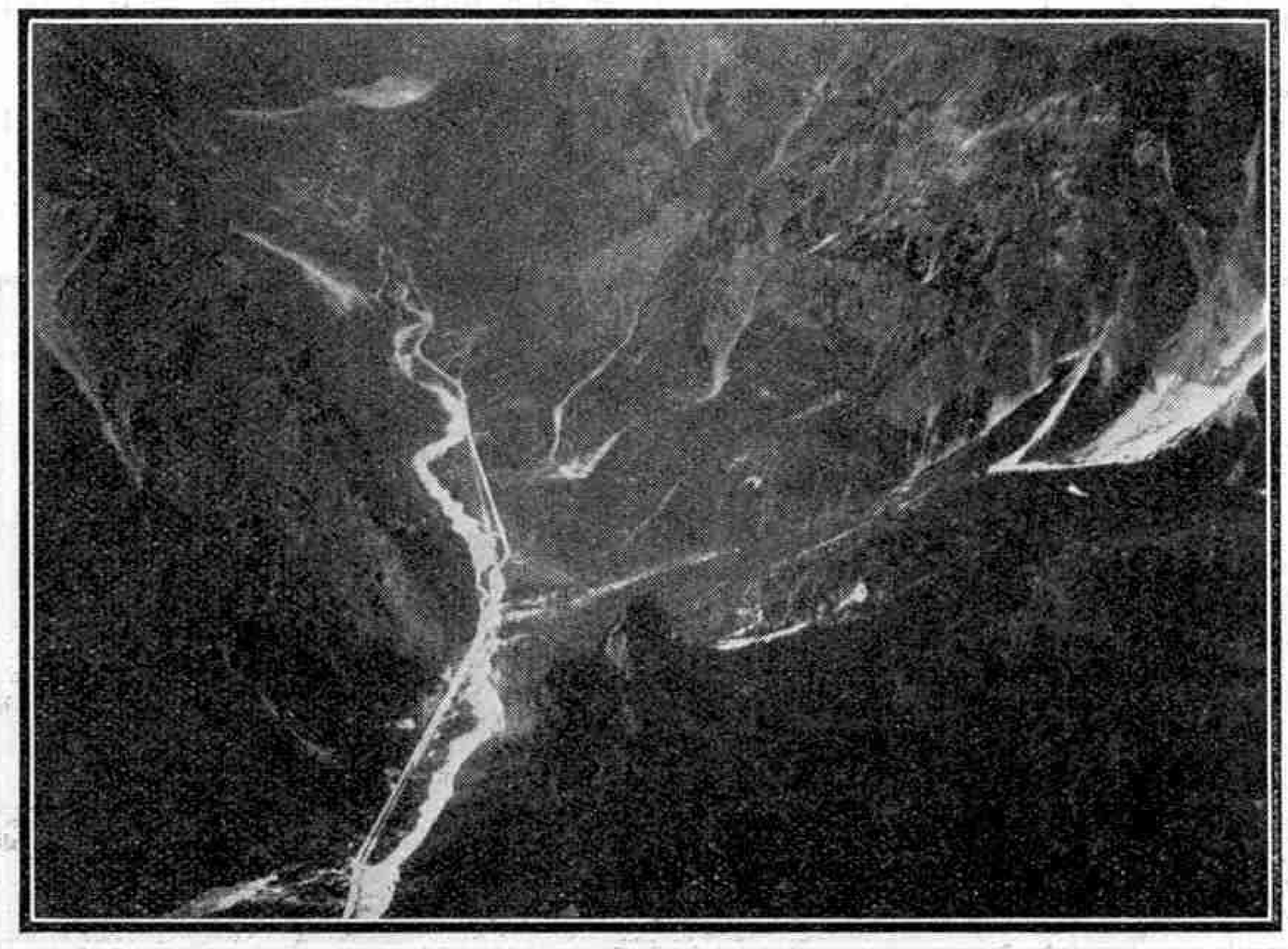
First Turkish Aircraft Factory

The first aeroplane factory to be opened in Turkey has been set up at Kaisarich in Anatolia. Herr Junkers, the famous German designer, is interested in the project, which is being financed by German capital.

New Junkers Machine

A huge aeroplane that will be over 550 ft. in length and provide accommodation for 100 passengers is at present being constructed at the Junkers works at Dessau, Germany. It will be used for overseas flights and will be equipped with four engines. The passenger cabins are to be fitted up in a manner very similar to Pullman railway coaches, and cabins will be provided in the after part of the machine for the crew.

Over the Alps with a "Cherub"



A wonderful view of one of the Alpine passes. Note the river flowing through the valley. (*See article on page 56*)

A New Taxi-Plane

The Handley-Page "Hamlet" described as the "safety-first air-taxi," recently made its first flight at the Handley-Page Cricklewood works. Embodying all the experience gained from the operation of the giant Handley-Page air expresses working the London to Paris and Cologne routes, the machine is stated to have exceeded all anticipations by its speed and easy performance.

The single wing is slotted to secure a low landing speed and the whole of the machine's design is carried out with the sole object of securing safety in the air. The cabin is fitted with four lounge chairs grouped around a table placed in the centre.

* * * *

The Irish Free State Army Air Force has selected the D.H. "Moth" as the standard machine for the training of its pilots and recently four "Moths" were delivered to the Baldonnell Aerodrome, Dublin.

* * * *

London-Amsterdam Route

To enable Imperial Airways Ltd. to concentrate on the Paris and Cologne air services, an arrangement has been made between that company and the German Luft Hansa Company, under which the latter will operate the London-Amsterdam route with Junkers machines. Imperial Airways Ltd. are withdrawing their machines from the route.

British Flying Boats

The report recently published by the Air Ministry on the performances of the "Southampton" Supermarine flying boats proves in the most satisfactory manner that the British aircraft constructor does not in any way lag behind his Continental competitors. A great deal of publicity has been given to the performances of foreign flying boats, while the British machines were upon the Air Ministry's secret list, and therefore up to the present a true comparison has been impossible.

The following are interesting extracts from the official report on the first stage of the Supermarine Southampton's flight from Calshot up the Irish coast to Belfast Lough, from where the machines flew to Campbeltown in Scotland :—

"Throughout the period bad weather was experienced, the wind at times reached gale force with rain and low clouds. Visibility at times was reduced to 200 yards with clouds as low as 100 ft. During the gale on September 15th the three flying boats landed safely at Campbeltown on completion of exercises and refuelled from H.M.S. '*Calliope*' without any difficulty while the gale was still at its height. All flying boats landed well on the water and rode well at their moorings."

"Both cruises have shown that under conditions of weather which must throughout be considered distinctly bad, the 'Southampton' flying boats are capable of keeping the air and carrying out such observations as visibility will admit. What is more important, it demonstrates that a programme once having been drawn up can be adhered to practically independent of the weather. Refuelling at sea was carried out on all occasions without a hitch and provided a certain amount of shelter is available when the flying boats are not flying, it has been demonstrated that they can function successfully and independent of their land bases."

* * * *

Monoplane to Carry 40 Passengers

The largest monoplane yet constructed in this country is nearing completion in a North of England factory. Full details of its construction are not available, but it will be an all-metal machine, equipped with three engines having a total output of nearly 2,000 h.p. Some idea of its vast size will be gained when it is stated that its landing wheels are 7 ft. 6 in. in diameter.

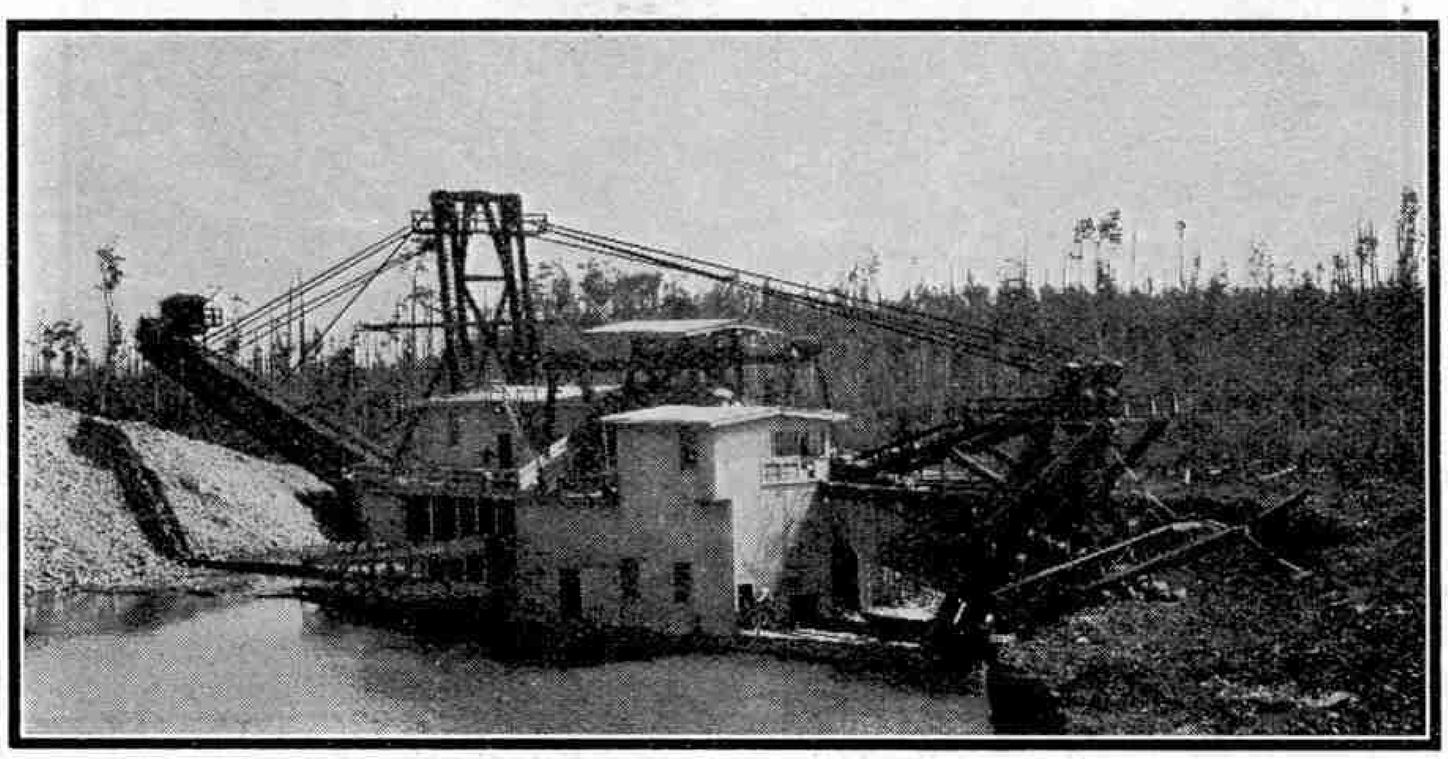
The machine will be capable of a 500-mile non-stop flight when carrying 40 passengers and it is to be used at first on one of the cross-channel air routes.

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.

Largest Gold Dredge in Australasia

Situated in the Westland District of the South Island of New Zealand is the largest gold dredge in Australasia, and I thought that a brief description of this would be of interest to those who read the articles on Gold in the March, April and May issues of the "*M.M.*"

The dredge is driven by electricity, the current being generated at a hydro-electric power station at Kanieri Forks, 15 miles distant. The dredge, which works continuously night and day and excavates hundreds of tons of "wash-dirt" every 24 hours, floats upon a large pontoon that covers nearly half an acre, and the pontoon itself floats upon a dam covering nearly two acres. The wash-dirt is brought up by means of buckets fixed upon an endless chain and as these buckets come up from the bottom of the dam they automatically empty themselves and are carried below again. The standing bush has to be cleared regularly in order that the dredge may advance, as its progress each week is great.


The Large New Zealand Gold Dredge

The dredge, which is known as the Rimu Electric Gold Dredge, was built and is operated by an American Company. PRINCE EVANS (Hokitika, N.Z.)

Buckets coming up full of "Wash-dirt"

A Visit to a Gas-Mantle Works

Some time ago I had the opportunity of accompanying a party on a visit to the "Ironclad" gas-mantle factory at Earlsfield, S.W.

Here we first saw special yarn knitted into stockinette by machines constructed to produce all kinds of fabric according to the type of mantle required. The rolls of stockinette are then boiled in a strong solution to remove all traces of grease or impurities which, if left, would affect the illuminating power of the finished mantle. After being washed and rinsed in distilled water the stockinette is unrolled and hung up on racks in a warm room.

When perfectly dry the stockinette is cut up by machines into short lengths according to the size of mantle required. Actually the dimensions of the lengths are more than twice those of the mantles into which they are to be made, to allow for the shrinkage that takes place in the later stages of manufacture. The lengths are then dipped into a solution of the nitrates of thorium and cerium. After being dried the pieces are sewn up at one end, tied to a clay ring and turned inside out. At this stage the mantles look like limp pieces of rag. The yarn is now burned out of the mantle, leaving behind the hard residue of oxides of thorium and cerium of which the mantles are composed. High-pressure gas jets are used to shape the mantles while they are being burned.

The mantles are now in their finished state, but owing to their extreme brittleness they are dipped into a solution of collodion, which makes them firm and gives them the shiny appearance with which we are familiar in new mantles.

G. M. HALE (Raynes Park, S.W.20).

A Trip in a Fishing Smack

A short time ago I had the enjoyable experience of a cruise in a fishing smack.

A fussy tug took us about a mile out to sea and then all sails were set. A stiff breeze forced the vessel through the choppy sea while showers of spray flew over the bulwarks and along the deck. The latter soon became very slippery and at one very heavy lurch I measured my length, but apart from bruises was none the worse for the fall.

To reach the cabin one descended through a narrow trapdoor-like opening in the deck, called the companion hatch, and down a short, steep flight of steps. The cabin was about 5 ft. in height, 12 ft. in length and 9 ft. in width.

Round two sides of it were lockers that could be used as seats and above these were the bunks, which opened and closed by sliding doors. These bunks were built right into the bulwarks, so that only a stout piece of oak lay between the sleeper and the sea! My first meal consisted of a plump sole, potatoes, brown bread and boiled rice, the cooking being done on an oil stove at the fore-end of the cabin.

When the lead showed a depth of 20 fathoms, about 120 ft., the beam trawl hanging on the fore quarter of the smack was made ready. This trawl gets its name from the heavy beam of wood, about 35 ft. in length, that keeps the mouth of the net open. The net is a huge three-cornered affair that can be opened at the small or "cod" end as well as at the beam end.

At the mouth of the net the holes are about 5 in. square but at the "cod" end they are only 1 in. square. The net was allowed to sink slowly, the towing rope meanwhile being paid out. This rope was quite 6 in. in diameter. While trawling, the boat moves at a speed of about 3 knots, and the net usually remains in the water for about 6 or 8 hours.

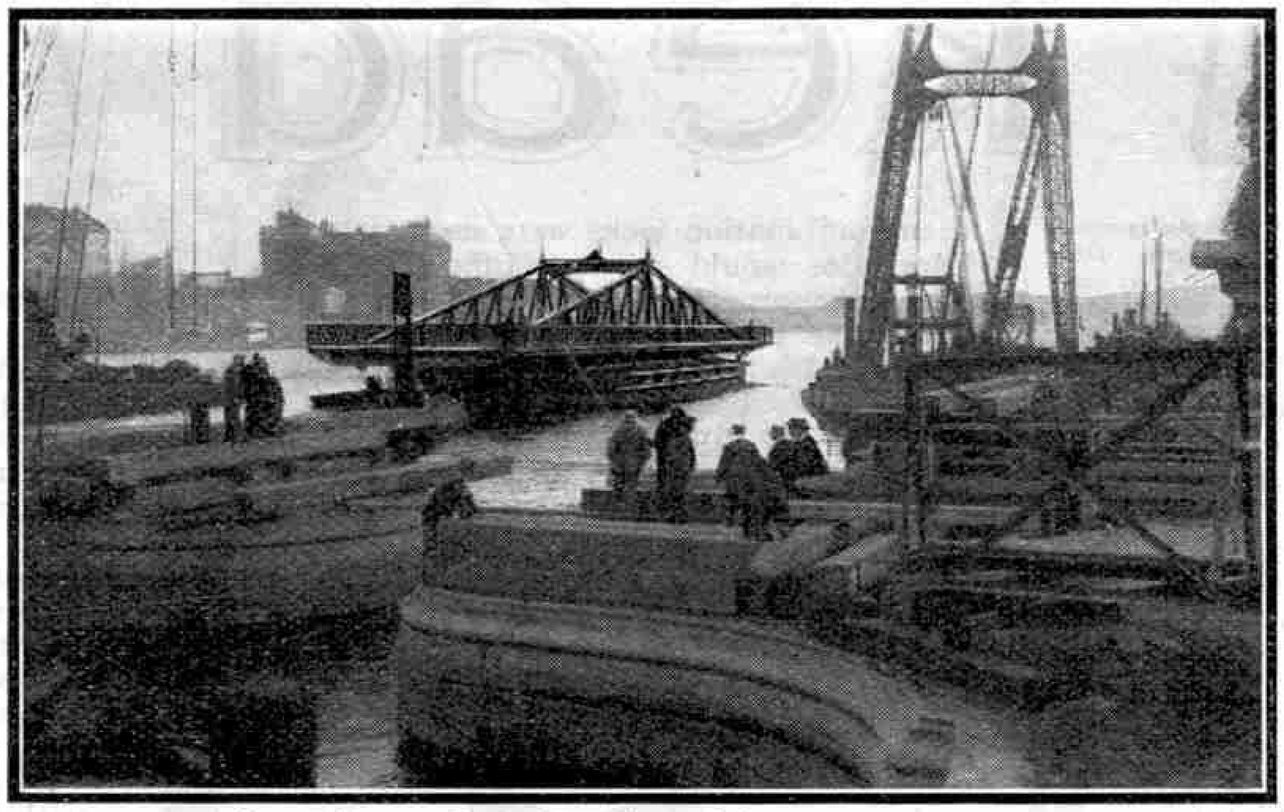
When it was decided to haul in the net, two of the crew stood by a winch to which the towing rope was made fast, and the net was then slowly drawn in. As soon as it was aboard the cod line was slipped and out tumbled the most motley collection of fish I ever saw. One of the crew then lifted a hatch and the whole of the finny captives were scooped into the smack's well.

Such was my first experience of a fisherman's life at sea. I was fortunate in making my trip in calm summer weather when all the conditions were as nearly ideal as possible. I have often tried to imagine what the fisherman's life must be like in the cold and stormy days of winter. Handling the trawl in a blinding snowstorm while the boat is pitching and tossing in a heavy sea must be as unpleasant and dangerous a task as any men are called upon to face.

W. G. LEWIS (Kingston).

An El Dorado for Meccano Boys

In Rotterdam two new bridges are being built—one a footbridge of the ordinary balance type and the other a railway bridge of a more interesting type. In the case of the latter bridge, a high tower is erected on both sides of the river, and between these towers the bridge is raised and lowered. One of these towers is shown on the left of the lower illustration.

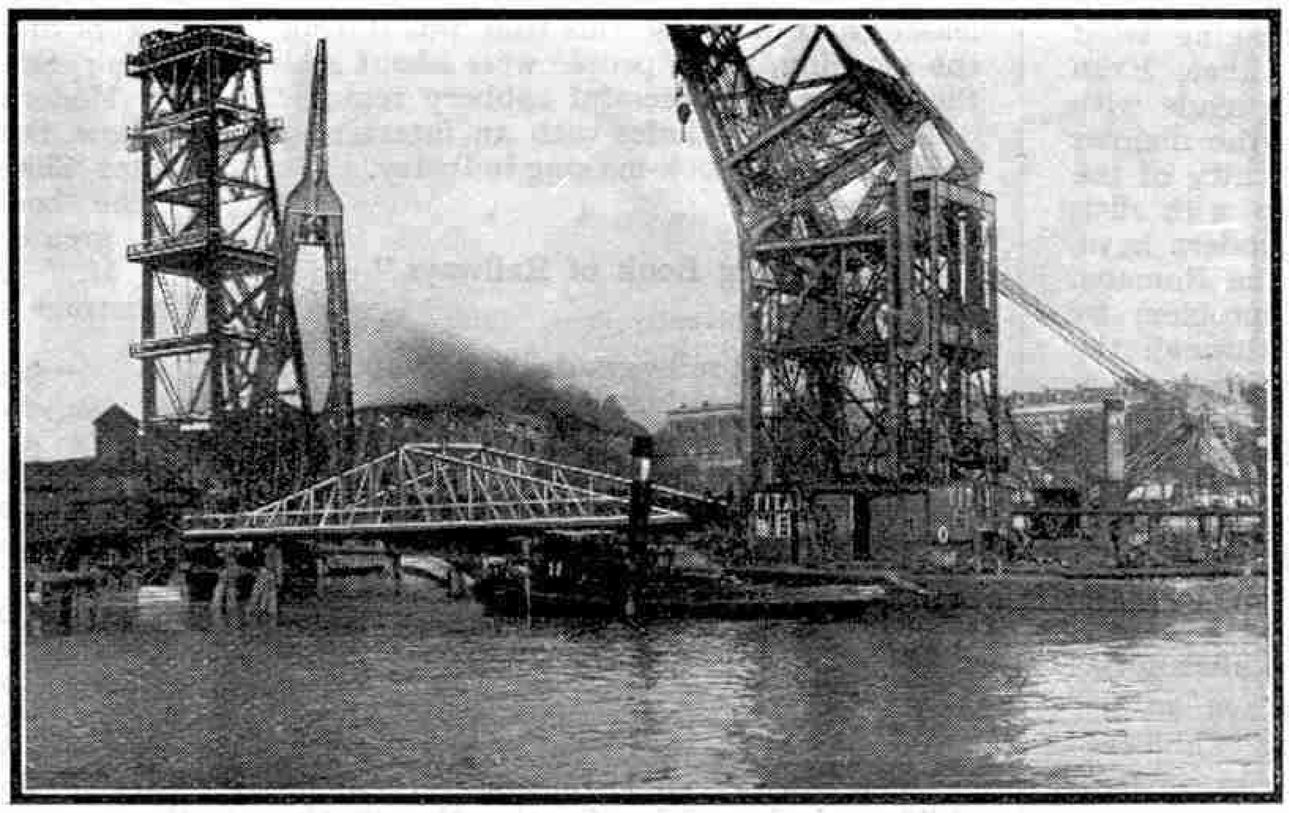


New Bridge at Rotterdam: Spans being towed into position

The towers were erected without disturbing the traffic, although no temporary bridge was used. A temporary bridge was necessary for the new footbridge, however.

From the accompanying photographs, taken while the bridge was under construction, I think all "*M.M.*" readers will agree that this spot is, indeed, an El Dorado for Meccano boys who are always particularly interested in both bridges and giant cranes. We often see huge floating cranes in this country because we have a celebrated firm who manufacture them, and the great floating crane "*Mammoth*," belonging to the Mersey Docks and Harbour Board at Liverpool, was made in Holland.

F. J. KOOT (Rotterdam).



Span in position with Huge Floating Crane alongside

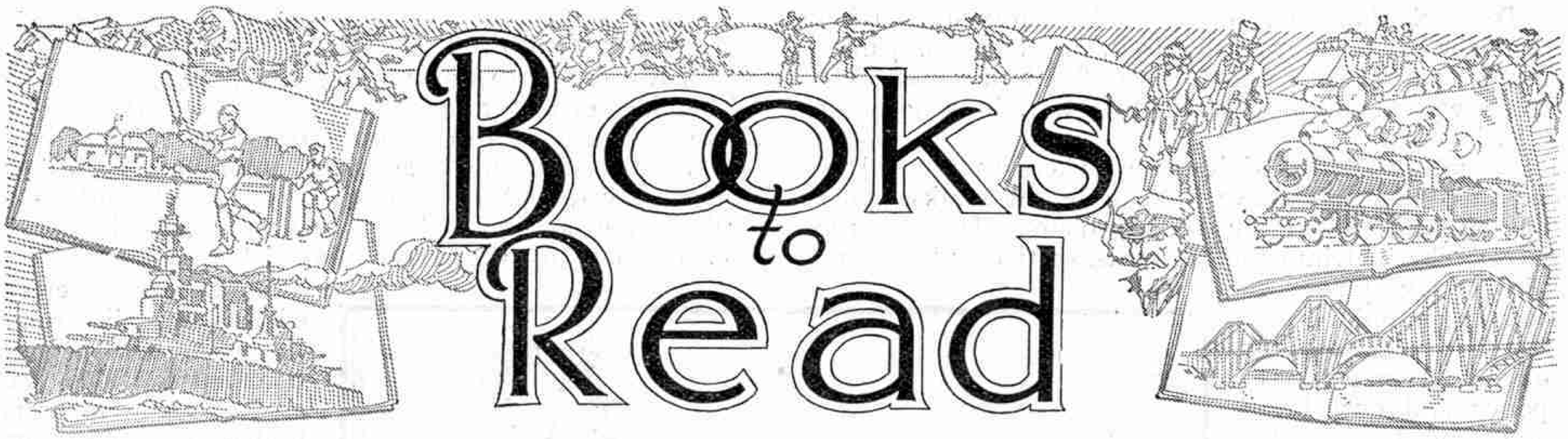
The Oldest Tree in the World

The Singhalese nation, small though it is, boasts one precious possession. In the city of Anuradhapura there grows a Bo-Tree, which is claimed to be the oldest historic tree in the world. It is said to have been brought by pious Buddhists from India about 2,200 years ago, when Ceylon was at the height of its prosperity.

Of this tree, Mr. Tennant, an authority on Ceylon, writes:—

"It was planted 288 years before Christ and hence it is now 2,147 years old. Ages varying from one to five thousand years have been assigned to the Baobabs of Senegal, the Eucalyptus of Tasmania, the Dragon Tree of Orotava, the Wellingtonia of California and the Chestnut of Mount Etna. But all these estimates are matters of conjecture and must be purely inferential, whereas the age of the Bo-Tree is a matter of record." Do any of your readers know of a tree that can be proved to be older than this?

V. HALPE (Kandana, Ceylon).



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

"Locks and Lock-Making"

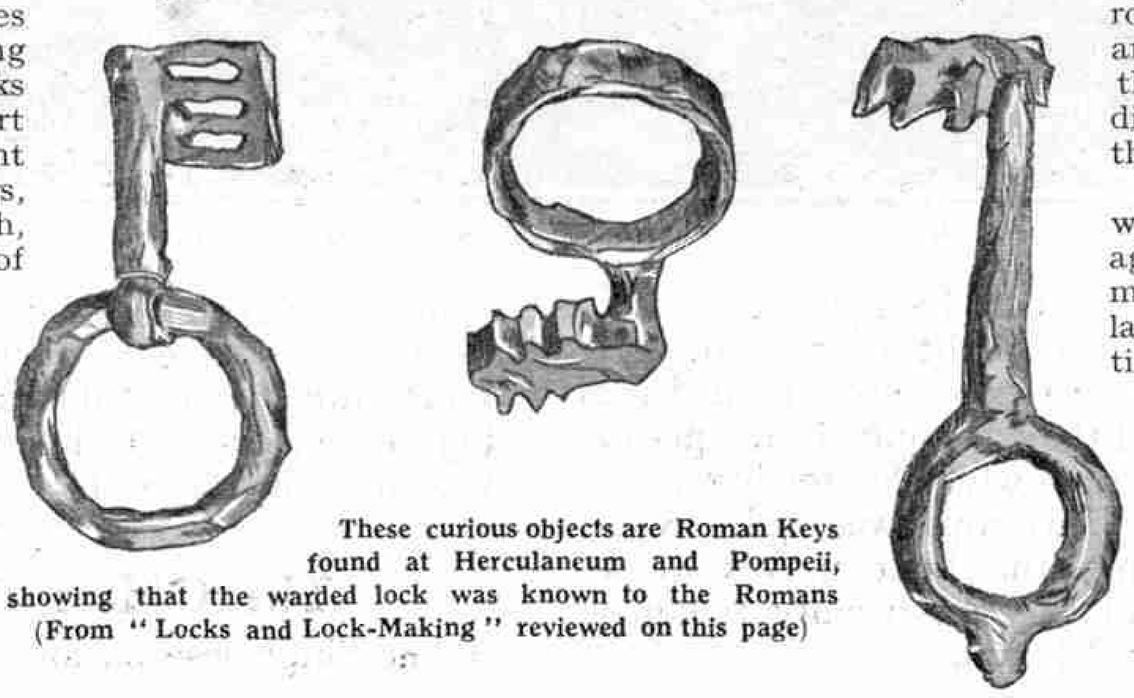
By F. J. Butter. Pitman. 3/-)

Locks and keys are always of interest to those who are mechanically inclined—in fact, as Mr. Butter says :—"locks are really little machines, and many folk take a delight in mechanical contrivances with working parts." It is surprising to find that, although many books dealing with the locksmiths' art have been written in different languages during the last 250 years, only one has been written in English, and this deals with early forms of locks and keys. Mr. Butter now gives us a most interesting account of the branches of the subject, however, and takes us as far back as the time of ancient Egyptians, some of whose locks and keys show a remarkable ingenuity, although constructed entirely of wood.

Locks and keys were used by the Romans, although some of the Roman keys found in England are of such a shape that it is not always easy to imagine what the locks themselves were like. Even in those early days keys were made with either pin or pipe-stem, after the manner of modern keys, and the difficulty of the hole in a key being filled up with dirt, as often is the case with our modern keys, was even given attention by the Romans. They ingeniously solved the problem by drilling the hole completely through the pipe so that any dirt or other obstruction could be pushed through! Some of the locks and keys of the middle ages were elaborately decorated and beautifully shaped, and some fine examples of mediæval locksmiths' art are to be found in our museums.

After dealing with safe deposit, change key, springless, and other peculiar forms of locks, there is a chapter on master keys—always an interesting subject—followed by a chapter on locks without keys, or combination locks, in which revolving rings have to be set in a certain order to allow the lock to be opened.

It is interesting to learn that the first time-lock was patented in 1831 by William Rutherford, a bank agent of Jedburgh. The time-lock requires a key to open it after a given period of time, and it is believed that there are now more than 35,000 in use, mostly in the United States and in Canada where they were introduced to counteract the increasing number of burglaries and safe robberies. Previously, when combination locks were used, armed desperados would seize an official of the bank and compel him, by threats of torture, to disclose the combination of the locks or give up his keys. So successful were the robbers that bankers were at their wits end until the time-lock appeared. Then the burglars found that no one, not even the bank officials themselves, could open the safe doors before the predetermined time at which the lock was set to be released, and of course this time was during the morning, when people were about and the chance of successful robbery remote.



These curious objects are Roman Keys found at Herculaneum and Pompeii, showing that the warded lock was known to the Romans (From "Locks and Lock-Making" reviewed on this page)

The book concludes with an interesting chapter on the lock-making industry.

* * * *

"The Big Book of Railways"

(Oxford University Press. Price 2/6)

This book of railways deals with signals, engines, the development of the railway coach, the story of the tunnel, and other similarly interesting chapters in railway history. Although written in a humorous and entertaining manner, there is much useful information in its pages, and it is quite an original idea to give voices to the signals, the trains and the tunnels and to make them desire to talk to each other about their histories and the present happenings in railway-land.

Since the book is meant for young children it is a wise forethought on the part of the publishers to see that it is provided with a strong and serviceable back, and printed on stout paper that will stand any amount of wear and hard use. Young eyes will not be strained in the reading since the print is large and clear. For the young boy who shows an interest in railways and engines—and, surely, this means practically every young boy—and for one who enjoys a tale rather than a lesson, this Big Book of Railways is a happy means of instruction.

"Marvels of Modern Mechanics"

(By T. Wilkins. Fisher Unwin. 10/6)

It is almost impossible to pick up a newspaper without reading some account of new and epoch-making inventions; of the application of newly-discovered scientific principles to departments of mechanics and engineering; of working marvels that a short while ago were deemed to be impossible; or of the fulfilment of the fantastic dreams of some romantic novelist. So numerous are the discoveries and so great the advances that it has become a difficult matter to keep abreast of the progress of modern mechanics.

This book is an attempt to deal with the romance of this wonderful age of mechanism in an interesting manner and in plain but graphic language with due regard to scientific accuracy, and the facts recorded are as up-to-date as it is possible to make them. Among the subjects dealt with are the Wonders of Radio; the Romance of Excavation and its Modern Mechanics; Surveying Unknown Seas; Wonders of Modern Salvage; the Sun's Secrets; Underground and Miniature Railways; the Strange Powers of the Gyroscope; Electric Cable Ships; Safer Airways; the Scenic Art of the Modern Theatre (including the story of how Drury Lane works its marvels); Motor Ships, etc.

The book should undoubtedly be of the greatest interest to readers of the "*M.M.*," and will make an excellent Christmas gift.

* * * *

"Sea Songs and Shanties"

(James Brown & Sons (Glasgow) Ltd. 2/6)

After a long period of neglect, sea shanties have won for themselves an assured place in popular esteem. Not only do they appear in the programmes of concerts of all descriptions, but they have been brought to the notice of millions of listeners by the transmissions of the British Broadcasting Company.

The present collection has been abridged by Capt. W. B. Whall from his larger work on sea shanties and it contains 24 thoroughly representative songs. In the case of each song the words are given and a sufficient indication of the music, together with a brief description of the origin and history of the song. The collection can be thoroughly recommended to all who are interested in these fascinating relics of the old days of sail.

It is interesting to note that Capt. Whall went to sea in 1861 in the old passenger-carrying East-Indiamen in which the rendering of shanties reached a very high standard.

"Sailing Ships at a Glance"

By L. G. Carr Laughton

(Architectural Press. Price 6/-)

In the introduction to this book we are told that "probably no one has ever made a calculation of the number of different ship-types that have existed since the dawn of history, nor indeed, would it be possible to do so. But it may be calculated roughly that even from the days of Elizabeth to the present, there have been of English ships and vessels alone probably at least 500 major types, which again might be almost minutely subdivided."

The book is a pictorial record showing the development of the sailing ship from the earliest times to the present day, and is well illustrated with 150 line drawings. The subject is so extensive that it is, of course, impossible in a book of this kind to more than indicate some of the phases through which the sailing ship has passed. In the case of many of the early ships, the illustrations are based on tradition, for no authentic records exist.

Chapters are devoted to the evolution of the hull and the sail; to primitive craft and early ships; Ships of the Romans, Vikings and the Crusades. Details of the ships of the Elizabethan age are of the greatest interest, for they enable us to understand more clearly this important period in the sea-history of Britain. There are also several chapters devoted to modern ships, including, of course, the famous clippers.

The drawings have been most carefully made and no old drawings have been reproduced without first investigating their authority. Taking the book as a whole, it is safe to say that nothing more accurate has been published up to the present.

* * * *

"Evolution and Creation"

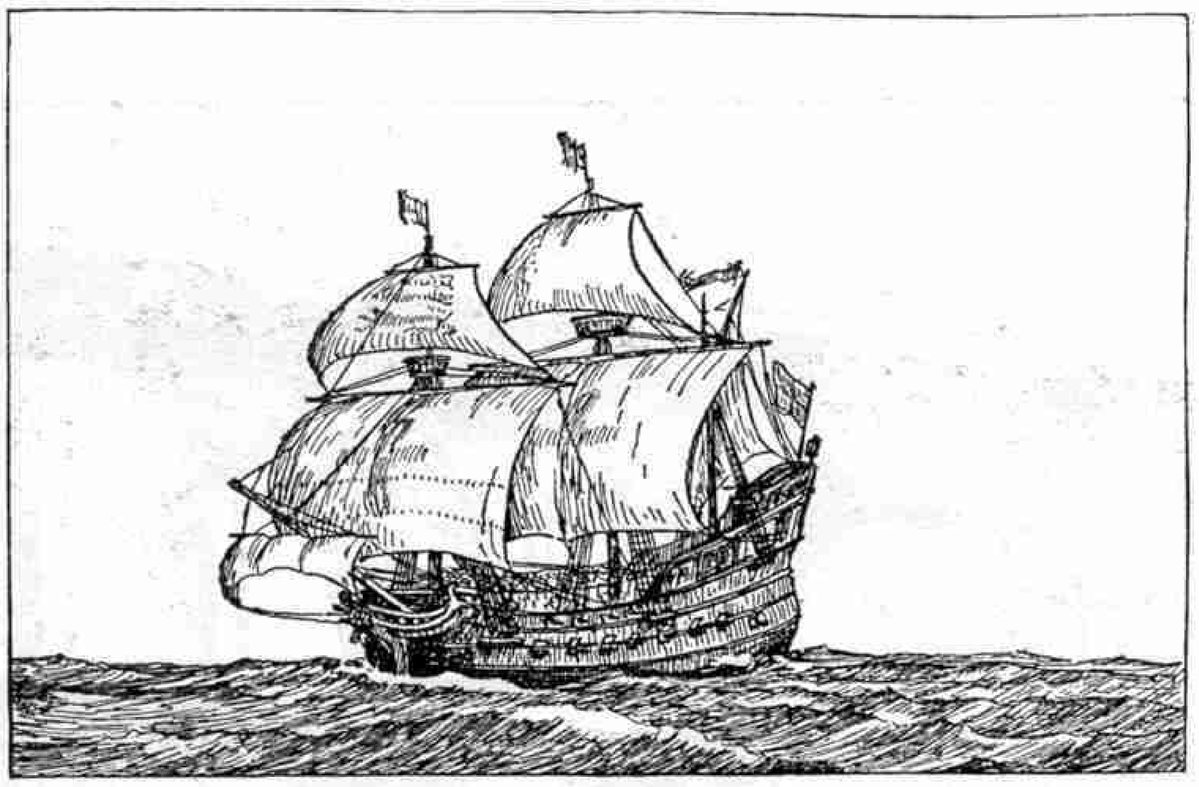
By Sir Oliver Lodge

(Hodder & Stoughton. Price 3/6)

Sir Oliver Lodge's name is familiar to readers of the "Meccano Magazine" more particularly, perhaps, in connection with his researches in wireless. His interest is not confined to this subject, however, and he is well known for his work in many other scientific fields. A short time ago he broadcast a series of talks, and these talks have served as the basis for more than one of his recent books.

In the present book he deals with the difficult subject of Evolution, and he interprets in a reasonable manner the Scriptural account of Creation found in the book of Genesis. "The old idea of creation," he says, "as a sudden achievement without intermediate steps, without any process that could be followed by the human mind, and without any extensive lapse of time, was seen to be erroneous, and yet most of us now perceive that it contains some elements of truth."

The book does not deal with the origin of life, with which subject it is not indeed concerned, but deals rather with the unfolding process of life called evolution in the belief that creation is still going on. From what he has written it is evident that Sir Oliver believes that matter comes into being, passes away and is born again. That from the lowliest atom to the great universe, life continues to unfold itself, steadily working to some high purpose that we cannot conceive.



One of the Ships of Good Queen Bess. (Circa 1590)

"Castles"

By Sir Charles Oman, K.B.E., F.S.A., etc.

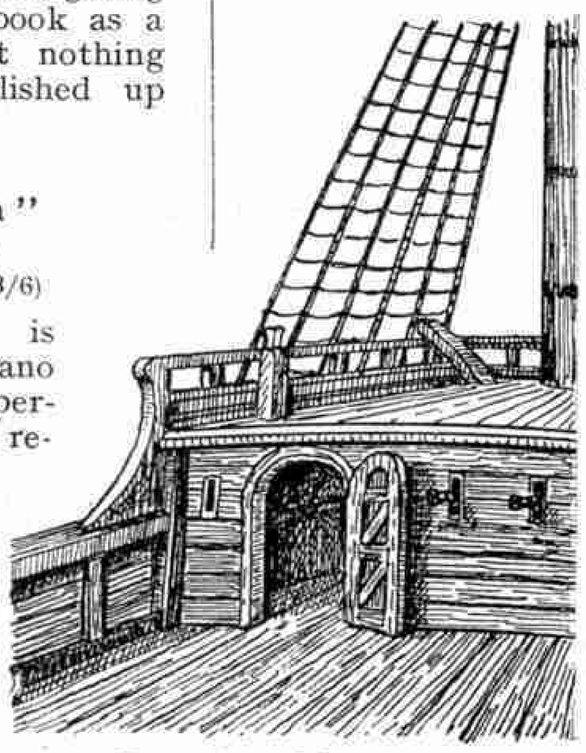
(Great Western Railway. Price 5/-)

There is a particular interest attached to historic castles and everyone likes to visit a ruin and to learn of the important part it has played in history. The next best thing to visiting a castle is to read about it, and this book contains full descriptions of eighty castles. Our only regret is that the castles dealt with are limited to the country on the Welsh border, the Thames Valley, the counties of Somerset and Devon and Wessex and the West Midlands.

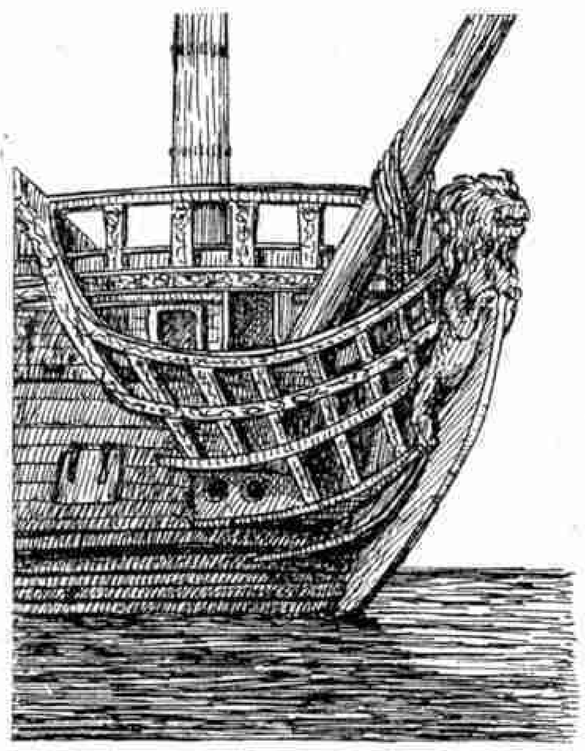
In the introduction the author explains the definition of a castle, traces the origin and describes the two classes of English castle—Royal and Baronial. "The most common cause of fortification was the danger of civil strife within the realm," we are told, ". . . such as . . . the war between John and the barons of the Great Charter. . . The King required castles to overawe the larger centres of population, most of which were already towns walled in the old Saxon style, with ditch and palisade. Of some thirty royal castles built before 1100, the majority are inside or alongside the walls of some considerable town. . ." It is curious and interesting to find that in many cases the King built his castle not *inside* the town, but against its outer walls. This was a mark of suspicion—he did not wish to have his castle hemmed in with houses or too easily accessible. These were, of course, the royal castles and they were all of strategic importance. The baronial castles "were simply the spots that the new Norman landholders chose as the most eligible sites . . . for the purpose of dominating the lands of their fiefs."

The architectural and historical interest of individual castles is explained in an appreciative manner and the development of the castles during the twelfth to fourteenth centuries is also dealt with. Sir Charles Oman considers that the end of the castles came about when it was discovered that "a system of passive defence behind stone walls may protract a war, but does not decide it." The owners of the baronial castles in most cases seem to have abandoned them as dwelling places and to have built more splendid mansions or halls in less accessible places, although in a few cases the dark and uncomfortable dwellings were modernised and continued to be inhabited. Most of the royal castles did not altogether fall into ruin but their end was equally humiliating, for they became mere town prisons.

The book, which is beautifully illustrated with over 100 photographs, numerous line drawings, etc., is remarkably good value and will be a splendid addition to the library of anyone interested in this subject—more particularly so if they have the two companion volumes "Abbeys" and "Cathedrals," previously issued.



Forecastle Bulkhead Pierced for Guns. (Circa 1580)



Head of a Ship. (Circa 1680)

(From "Sailing Ships at a Glance," reviewed on this page)

Interesting New Books

We hope to deal with the undermentioned books in an early issue.

"A STURDY YOUNG CANADIAN" *by* Lt.-Col. Brereton (Blackie) (C. A. Pearson Ltd.), 3/6 net

"MYSTERIES OF THE SEA" *by* J. G. Lockhart. (Phillip Allan & Co. Ltd. Price 8/6)

"MY LIFE WITH ESKIMOS" *by* V. Stefansson. (G. G. Harrop & Co. Ltd. Price 5/-)

"BRITISH SPIDERS, THEIR HAUNTS AND HABITS" *by* Theodore H. Savory. (Clarendon Press, Oxford. Price 6/-)

"SCIENCE FOR ALL" (Ward, Lock & Co. Ltd. Price 6/-)

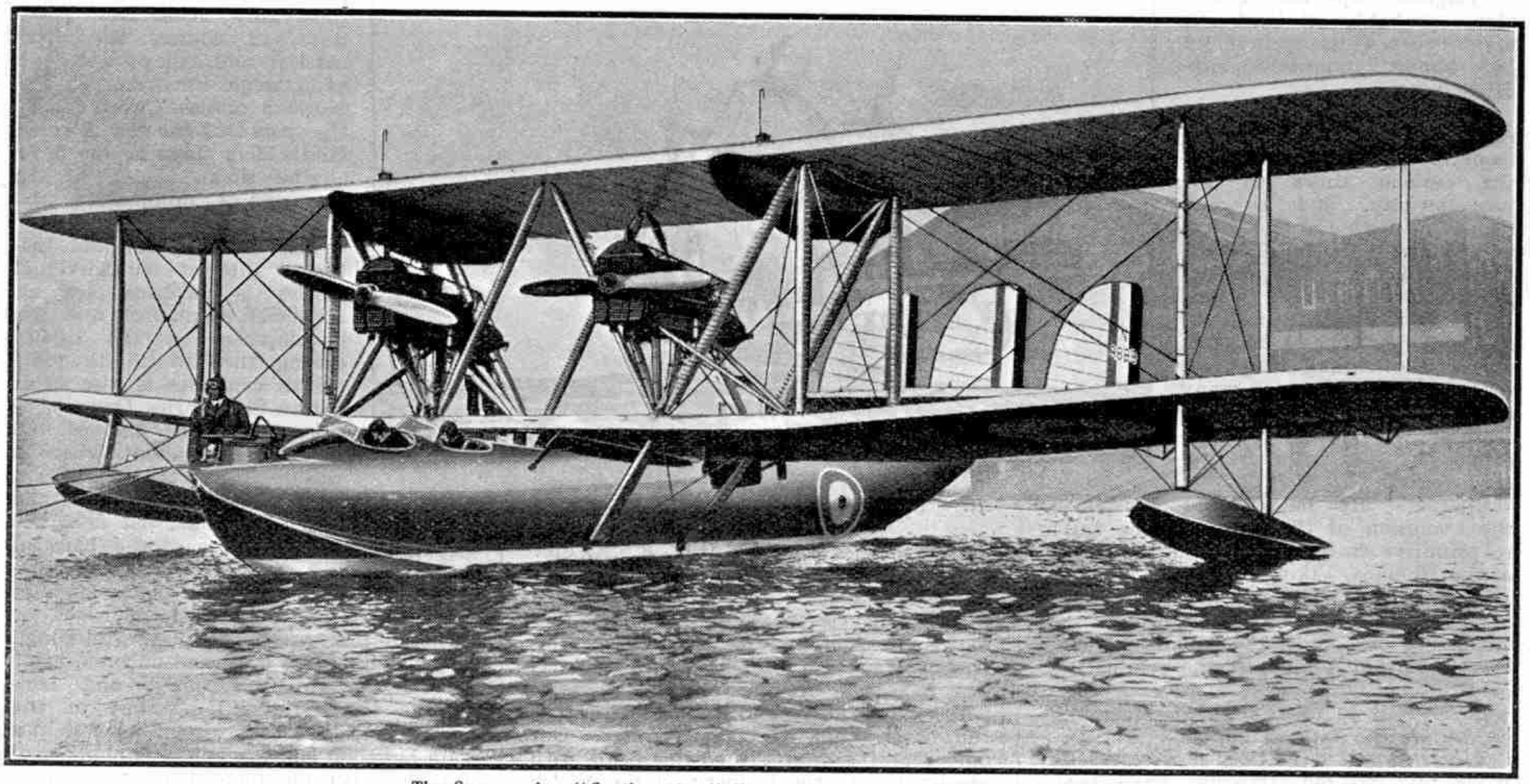
"THE LIFE OF ELBERT H. GARY. THE STORY OF STEEL" *by* I. M Tarbell. (Appleton & Co.), 12/6 net

"SHIPS OF THE SEVEN SEAS" *by* H. Daniel. (Heinemann), 15/- net

"MECHANICS FOR ENGINEERING STUDENTS" *by* G. W. Bird. (Sir Isaac Pitman & Sons Ltd.), 5/-

Conquest of the Air

XXI. The Supermarine "Southampton" Flying Boat



The Supermarine "Southampton" Twin-engined Flying Boat, ready for a flight

THIS machine, which appeared for the first time in the early part of 1925, is now the standard twin-engine reconnaissance flying boat of the Royal Air Force and large numbers have been ordered for duty with the Naval Co-operation Squadrons.

As will be seen from our illustration the machine is a biplane and it is fitted with two 470 h.p. Napier "Lion" engines, although if desired Bristol "Jupiter" engines may be installed without structural alterations.

The "Southampton" is of very clean design and is fitted with a monoplane tail with three cantilever fins above it. The advantage of this type of tail, which is one of the many novel features of the machine, is that the machine-guns with which it is armed have an unrestricted field of fire to the rear. The design has proved that a flying boat can defend itself most efficiently, a fact that has revolutionised all previous ideas on this matter.

The "Southampton" has a wing span of 75 ft., is 49 ft. 8 in. in length and 18 ft. 7 in. in height. Its weight fully loaded is 14,300 lb. and weight unladen 8,981 lb. Its maximum speed is 108 miles per hour, landing speed 52 miles per hour, and it is able to climb to 5,000 ft. in ten minutes.

Reducing Risk of Fire

The machine is extremely sea-worthy and will ride out the roughest seas under which conditions it can be taken off or landed with speed. The hull is very roomy and there is a through passage from the bow to the stern. No petrol is carried in the hull—this is carried in the top planes thus reducing the risk of fire to a minimum.

The disposition of the crew is as follows:—In the bow there is a gunner and bomb operator; behind are two pilots, seated in tandem with complete dual control. The rear pilot has also a complete navigating compartment, aft of which is the wireless compartment. This opens out into two rear gun positions behind the main planes.

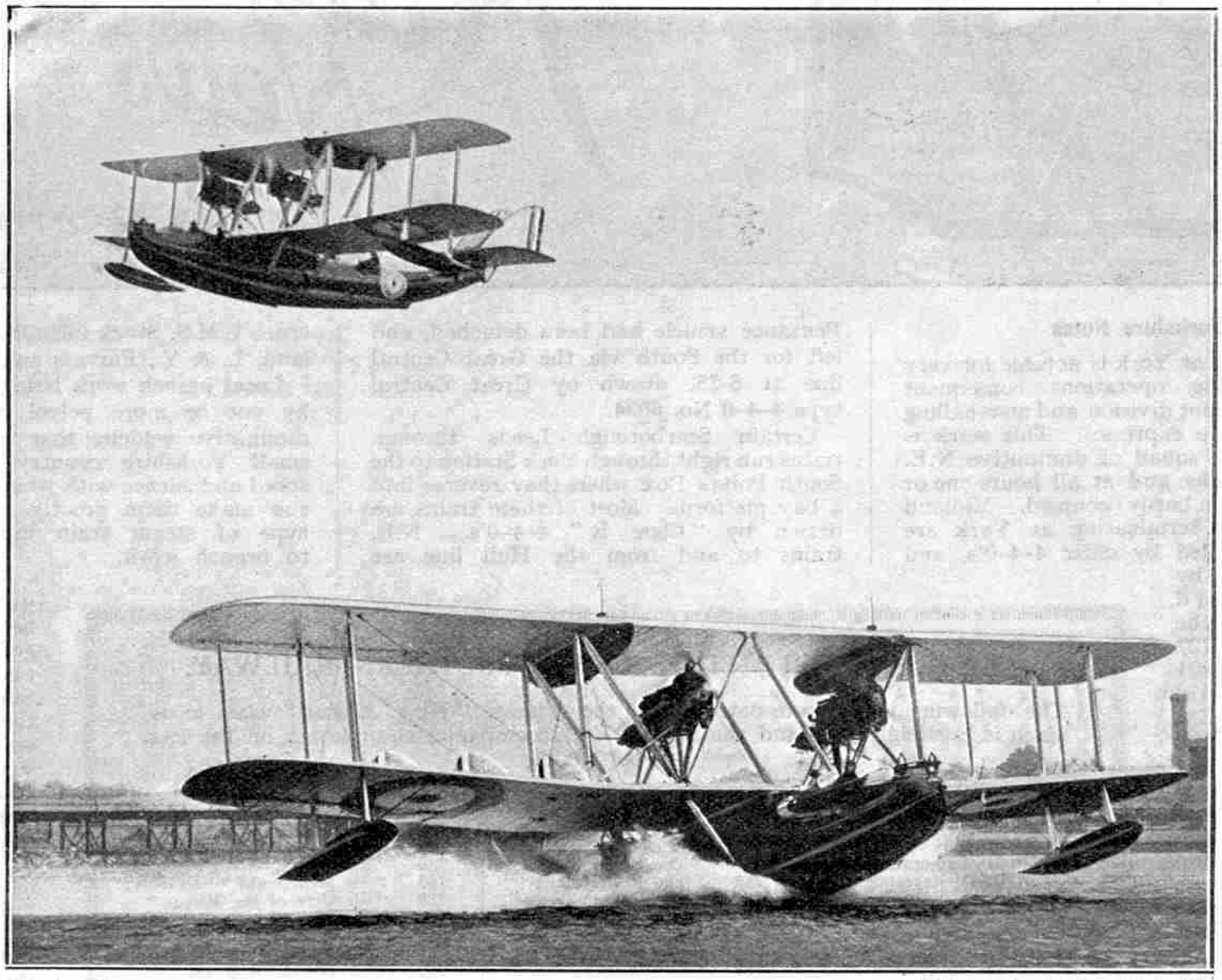
Usually a crew of five is carried and their accommodation is very comfortable and efficiently planned, being unusually free from noise and draughts. It is

Previous articles in this series have appeared as under:

1.	Lympne Trial for Light Monoplanes	March	1925
2.	Beardmore "Wee Bee I."	April	"
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"	August	"
7.	Beardmore-Rohrbach Flying Boat	October	"
8.	Fokker C.V. Scout	November	"
9.	Vickers "Vimy" Ambulance	December	"
10.	The Cierva Auto-Giro Flying Machine	January	1926
11.	Boulton "Bugle"	February	"
12.	The Flight from London to the Cape	March	"
13.	Light Aeroplane Clubs	April	"
14.	D.H. 54 (de Havilland) "Highclere"	May	"
15.	Vickers (Rolls-Royce) "Vanguard"	June	"
16.	De Havilland "Hercules"	August	"
17.	Handley Page "Hampstead"	September	"
18.	The Gloster "Gamecock"	October	"
19.	The Parnall "Plover"	November	"
20.	Sir Alan Cobham's Flight	December	"

even possible to fit up hammocks so that the crew can sleep on board and remain afloat for long periods should this be necessary.

The Napier "Lion" engine was described in our June 1925 issue, and not the slightest engine trouble has been experienced throughout the many thousands of hours that these machines have been in the air. It is interesting to know that although the machine is fitted with two engines it has been flown continually on one engine and can be manœuvred and turned without difficulty with only oneengine working.



Courtesy of] [Supermarine Aviation Works Ltd.

Supermarine "Southampton" Flying Boats, in the air and taking off

Re-fuelling at Sea in a Heavy Gale

No doubt our readers will remember the successful cruise around the British Isles by four of these machines in 1925, and again of the flight in July of last year to Egypt and back.

In the former cruise the total distance covered was over 10,000 miles and although the weather was bad the original programme was carried out.

As the cruise was intended to demonstrate the facility with which modern flying boats can work away from their own base under any weather conditions, it is interesting to know that on occasions the boats were successfully re-fuelled at sea. When the boats landed at Campbeltown, a gale was raging but notwithstanding this they re-fuelled from H.M.S. "*Calliope*" without difficulty while the gale was at its height. On the return journey two of the boats made a non-stop flight of 510 miles in $5\frac{3}{4}$ hours, the other boats visiting ports en route.

Over the Mediterranean

The more recent flight to Egypt and back was the first long-distance foreign cruise to be made by R.A.F. flying boats. The flight was undertaken as an ordinary service exercise to a set timetable with standard machines. In each case a crew of four was carried, in addition to a full service load.

The total mileage covered was 6,000 sea miles (nearly 7,000 land miles) and the machine miles flown were twice that figure.

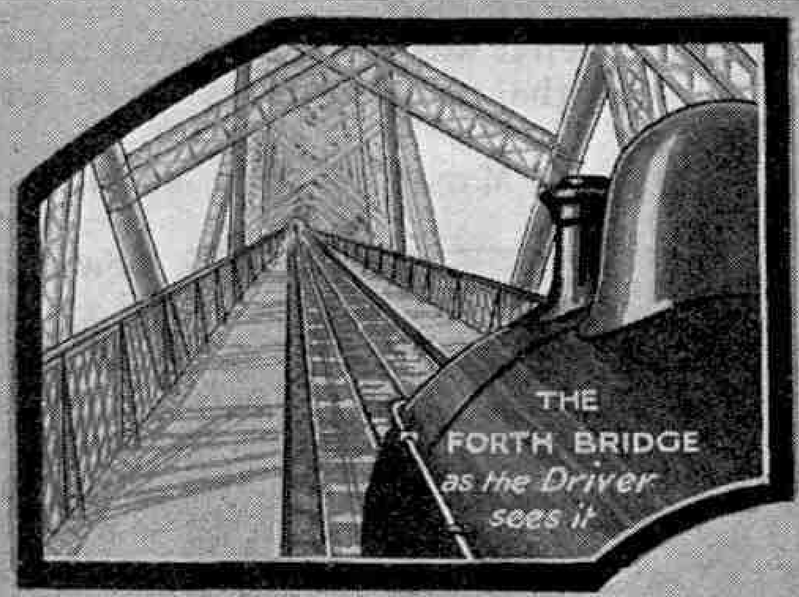
The first stop was at Marseilles from whence the boats flew to Naples and by way of Malta to Benghazi on the north African coast. The journey was continued by Aboukir, Haifa and Cyprus, the return being made by way of Athens and Corfu to Malta, and thence by way of Naples and Berre. No trouble was experienced either with the aircraft or with the Napier "Lion" engines, the latter working perfectly.

Constant communication was maintained with R.A.F. and other wireless stations whilst the boats were in flight, and to and from Hourtin (Bordeaux), the boats were in regular communication with the R.A.F. station at Plymouth. In the Mediterranean the flight was in direct communication with the R.A.F. station at Malta and Ismailia, Egypt, from which stations they received weather information. To them they transmitted their position from time to time and the course they were following.

At each port of call the machines were moored out to buoys, one member of the crew remaining aboard each night to keep watch.

The result of the cruise showed clearly that it was possible to make up a timetable and programme prior to a flight and to adhere to it irrespective of weather conditions, etc. It once more proved also that these flying boats are perfectly capable of long distance flights independently of their bases or of a parent ship.

From a general standpoint, it is gratifying to be able to give publicity to the fact that in this class of aircraft the British constructor is still well ahead of his competitors. "Official secret lists" have for long held some surprising secrets and the perfection of British air-boats has not been the least of these.



Railway News OF THE MONTH

Yorkshire Notes

The working at York is notable for very smart shunting operations consequent upon the frequent division and marshalling of long-distance expresses. This work is entrusted to a squad of diminutive N.E. type 0–6–0 tanks, and at all hours one or two may be seen busily occupied. Midland Section trains terminating at York are invariably hauled by older 4–4–0's, and more recently by new standard 0–6–0's. Of the former class, 727 (Sheffield) and 401 and 340 (York) were noted. Expresses from the Lancashire and Yorkshire line are brought in by 4-cylinder "Class 8" 4–6–0's and the well-known 4–4–2's of that section. Nos. 1506 (old numbering) and 10303 (new numbering) were seen, the former retaining her funereal black livery. L. & Y. 4–4–0's also work into York.

"Z" Atlantics

L.N.E.R. "Atlantics" of both N.E. and G.N. types are much in evidence on East Coast and other expresses, the 3-cylinder "Class Z" being commonest. One recalls that the sight of two of these massive locos standing on the Royal Border Bridge over the Tweed at Berwick is said to be one of the most impressive sights to be found on a British railway. Among "Z's" seen at York were 728, 722, 2206, 2168, and 706.

Gresley "Pacific" No. 2568, "*Sceptre*," one of the favourites of this celebrated type, arrived from the North one minute early with an express that included through portions for King's Cross, Leeds, Swindon and G.W. line (G.W. stock) and the through Aberdeen-Penzance carriage, in this instance a North British corridor coach. The Leeds portion left at 5.58 p.m. behind "Class R" 4–4–0 No. 2018, while the London portion, with several Hull vehicles added, left behind "Pacific" No. 4480, "*Enterprise*" (Doncaster-built). The G.W. carriages, together with the Penzance vehicle had been detached, and left for the South via the Great Central line at 5-25, drawn by Great Central type 4–4–0 No. 6034.

Certain Scarborough - Leeds through trains run right through York Station to the South Points Box, where they reverse into a bay platform. Most of these trains are drawn by "Class R" 4–4–0's. N.E. trains to and from the Hull line are generally taken charge of by smaller 4–4–0's, although a Doncaster 2–6–0 is working on this section also.

An express of Southern Railway vehicles from Bournemouth, etc., to Newcastle was brought in by a "Z" Atlantic and resumed its journey, made up to no less than 13 carriages, including three East Coast dining cars, behind "Class V" Atlantic No. 696. Once round the sharp curve north of York Station, down expresses have a good start down a slight gradient, and no locos get away better than the 20-years-old "Atlantics" of the former G.N.R.

Mixed Stock

During the busy evening period at York, rolling stock from the following sections was seen, and the various styles made interesting contrasts:—North Eastern, Great Northern, Great Eastern, East Coast, North British, Great Central, Great Western and Southern. L.M.S. Stock included L.N.W., Midland, L. & Y., Furness and Highland.

Local branch work is largely performed by one or more petrol motor coaches, diminutive vehicles that serve halts and small Yorkshire country stations. The speed and silence with which these coaches run make them greatly superior to the type of steam train usually relegated to branch work.

During quiet periods many heavy mineral and goods trains pass through York Station, enabling the enthusiast to see some of the varied L.N.E. goods locos at work. Fast fish and parcel trains are frequently hauled by the "S3" class of mixed-traffic locos, which have three cylinders and good accelerative powers. Apart from the small shunting tanks already referred to tank locos are not much in evidence. One or two of the heavy 4–4–4 N.E. class were seen, also an 0–6–2 of Great Eastern design.

Veterans at Work at Leeds

Old locos still hard at work are perhaps more noteworthy nowadays than the great variety of modern types to be seen every day. Some railway centres are notorious for accumulating veterans more than due for scrapping, but Leeds is not one of these. On a recent day, however, four express locos of a bygone day were seen within an hour; their combined age could not be much less than 200 years! At the L.M.S. (Midland) terminus, N.11, an old 2–4–0 with outside frames, brought in a heavy train on time, while old 4–4–0 No. 314 was also in the station. The latter is one of the few remaining unrebuilt express type introduced by Mr. Johnson for hauling main line expresses during the '80's. They were among the earliest Midland locos having the 4–4–0 wheel arrangement.

A Liverpool-Newcastle express arrived

"KING ARTHUR" CLASS LOCOS, SOUTHERN RAILWAY.

The following is an up-to-date list of the famous "King Arthur" class locos. Each is Eastleigh built and the letter "E" accompanies the number on the loco number plate.

No.	Name.	No.	Name.	No.	Name.
448	"Sir Tristram"	751	"Etarre"	783	"Sir Gillemere"
449	"Sir Torre"	752	"Linette"	784	"Sir Nerovens"
450	"Sir Kay"	753	"Melisande"	785	"Sir Mador de la Porte"
451	"Sir Lamorak"	754	"The Green Knight"	786	"Sir Lionel"
452	"Sir Meliagrance"	755	"The Red Knight"	787	"Sir Menadcuke"
453	"King Arthur"	763	"Sir Bors de Ganis"	788	"Sir Urre of the Mount"
454	"Queen Guinevere"	764	"Sir Gawain"	789	"Sir Guy"
455	"Sir Launcelot"	765	"Sir Gareth"	790	"Sir Villiars"
456	"Sir Galahad"	766	"Sir Geraint"	791	"Sir Uwaine"
457	"Sir Bedivere"	767	"Sir Valence"	792	"Sir Hervis de Revel"
736	"Excalibur"	768	"Sir Balin"	793	"Sir Ontzlake"
737	"King Uther"	769	"Sir Balan"	794	"Sir Ector de Maris"
738	"King Pellinore"	770	"Sir Prianius"	795	"Sir Dinadan"
739	"King Leodegrance"	771	"Sir Sagramore"	796	"Sir Dodinas le Savage"
740	"Merlin"	772	"Sir Percivale"	797	"Sir Blamor de Ganis"
741	"Joyous Gard"	773	"Sir Lavaine"	798	"Sir Hectimere"
742	"Camelot"	774	"Sir Gaheris"	799	"Sir Ironside"
743	"Lyonnesse"	775	"Sir Agravaine"	800	"Sir Meleaus de Lile"
744	"Maid of Astolat"	776	"Sir Galagars"	801	"Sir Meliot de Logres"
745	"Tintagel"	777	"Sir Lamiel"	802	"Sir Durnore"
746	"Pendragon"	778	"Sir Pelleas"	803	"Sir Harry le Fise Lake"
747	"Elaine"	779	"Sir Colgrevance"	804	"Sir Cador of Cornwall"
748	"Vivien"	780	"Sir Persant"	805	"Sir Constantine"
749	"Iseult"	781	"Sir Aglovale"	806	"Sir Galleron"
750	"Morgan le Fay"	782	"Sir Brian"		

at the Leeds New Station in charge of an unnamed "Claughton" piloted by 819, "*Constance*" of the well-nigh obsolete "Precedent" family. "*Constance*" has been station pilot at Manchester (Exchange) for several years, and worked back from Leeds as pilot to a "Prince" on a corresponding Newcastle-Liverpool express. It is interesting to note that quite frequently expresses are piloted over the difficult Leeds-Manchester section by old 2–4–2 radial tank locos.

The fourth veteran noted at Leeds was a North Eastern section 2–4–0, No. 1474, working from York via Church Fenton. Built in 1885, this class has unusually big coupled wheels (7 ft.), and when not overloaded is very sprightly. No. 1474 retains the scarlet-painted siderods that characterised certain North Eastern locos prior to grouping.

Other locos noted at Leeds on the same day were L. & Y. type 2–4–2 tank 10303 (newly painted in standard livery); Midland type 0–4–4 tank 1413, stationed at Skipton and rebuilt with Belpaire firebox and Pop valves; Midland 4–4–0 453 (Skipton) and 4–6–0 "Prince" 621, "*Telford.*" * * * *

Illinois Central Railroad

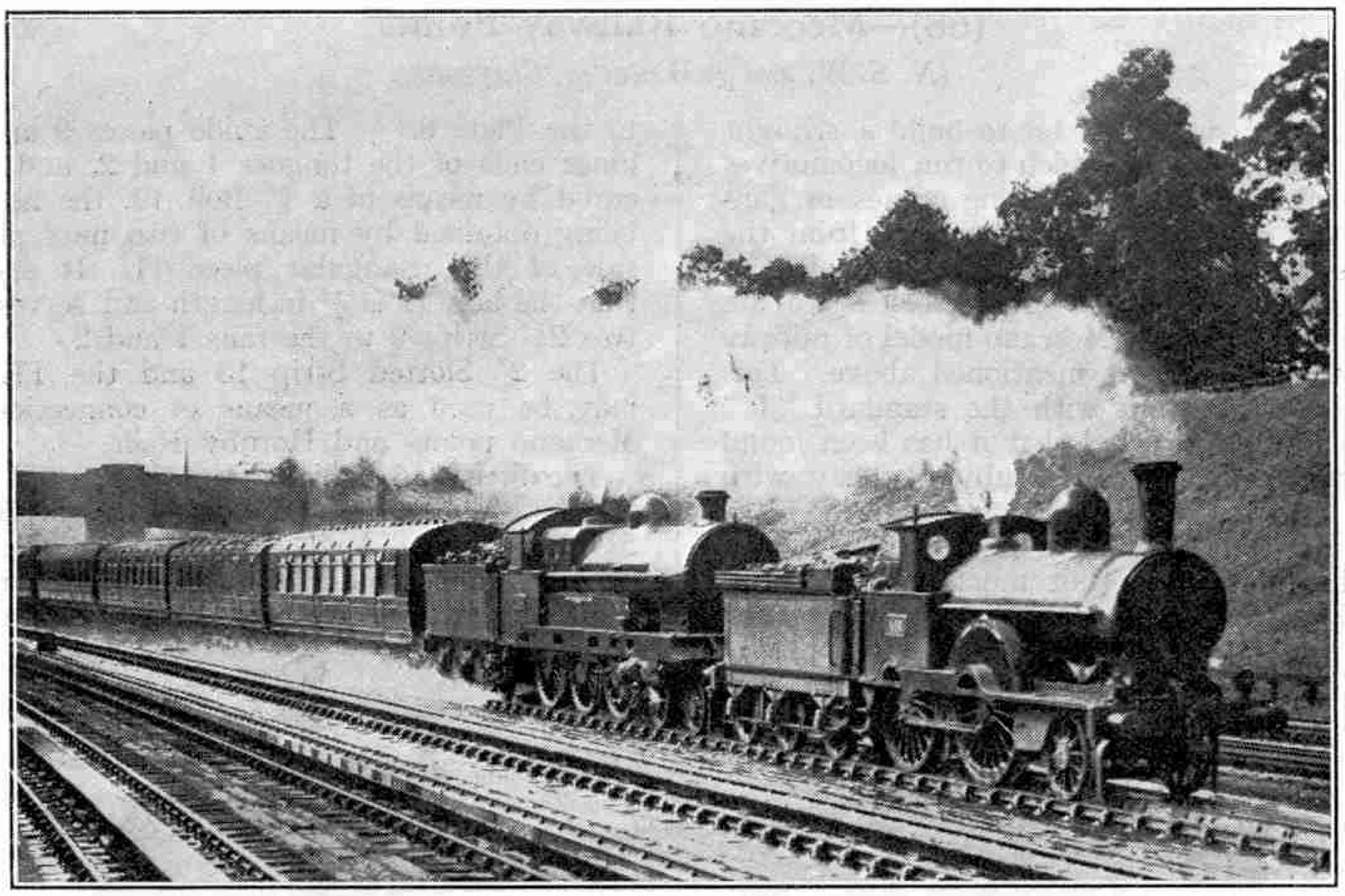
The electrification of the Illinois Central Railroad has been completed seven months in advance of the time allowed by the Act under which the electrification was authorised. Although the work now finished is only part of a big scheme of improvements and extensions, more than 470 miles of message and contact wires and 293 miles of transmission wires have been erected, while 130 motor cars and a similar number of trailer cars have been provided to maintain the new service.

The complete scheme provides for the addition of another 250 miles of track and the electrification of 420 miles of railway. Some 120 miles of track will have to be relined and cuttings and embankments made over a total distance of 80 miles. This last portion of the work will involve the removal of over 10,000,000 cubic yards of earth.

Track Extensions Contemplated

At the end of 1925 only 76 miles 74 chains of new railways were under construction in Great Britain, despite the fact that Parliament had granted authority for extensions to a total of over 709 miles. Widening of existing track accounted for nearly 405 miles of this total. The L.M.S. contemplate widening 176 miles of track, the L.N.E.R. 150 miles, the S.R. 63 miles and the G.W.R. slightly less than 15 miles.

"Double-Heading" on the L.M.S.



The 10-30 a.m. Liverpool Express taking water at Bushey
(2-4-0 No. 866 "Courier" and 4-6-0 No. 2426 "Sir F. Dent")

Paris-Orleans Railway Electrification

Work is being pushed forward rapidly on the scheme for the complete electrification of the Paris-Orleans Railway and already the installation between Paris and Orleans, a distance of nearly 75 miles, has been completed. It is expected that before the end of this month the electric system will have been extended a further 50 miles south to Vierzon, on the main line.

The Paris-Orleans railway now has a total of over 100 miles of electrically-operated track, and the Paris suburban system has been in operation for some months. * * * *

Irish Rail Motor Service

Three rail motor cars fitted with Ford engines and providing accommodation for 22 passengers each are being placed in service on the County Donegal railways, and will operate over a stretch of 125 miles of narrow-gauge track.

* * * *

A new branch railway three miles in length is to be built by the L.N.E.R. to serve the Stanton Iron Company's new colliery that is being developed at Bilsthorpe in Nottinghamshire.

Safety of British Railways

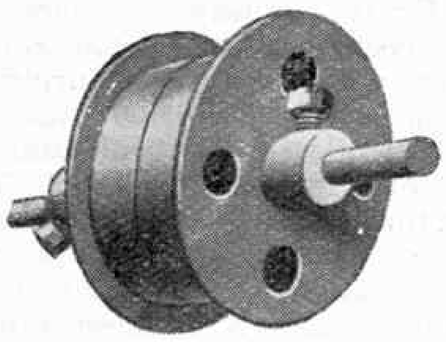
No finer tribute could be paid to the safety of British railway travelling than the figures recently issued by the Ministry of Transport, which show that during 1925 only one in every 4,500,000 passengers was injured, while the ratio of fatal accidents was one in 1,700,000,000! There is no doubt that these figures are favourably influenced by the freedom from accident on the railways of the Underground group. During the year these railways carried 319,000,000 passengers, the trains covering an aggregate of 14,182,000 train miles.

The major portion of the credit for the safe operation of the London electric railways must be attributed to the efficiency of the electro-pneumatic signalling system that controls the remarkably frequent service of trains and at the same time eliminates almost entirely the possibility of accidents. One or two of the Underground sections have a more frequent service than any other railway in the world and therefore it is not surprising to learn that in the course of each day the signalling apparatus is called upon to perform over 2,000,000 different operations. Among the many safety devices employed is one that automatically stops any train that over-runs a signal and at the same time sets at danger the signals further behind on the track.

* * * *

Travelling Post Office

The recent protest by clerks employed in the travelling Post Offices on the French Railways, against their coaches being placed next to the locomotive, recalls that the first all-steel passenger coach in America was introduced as the result of a similar protest made by American postal clerks. In the event of an accident occurring to the train, the first coach would be the one most likely to be damaged and as a result of the clerks' agitation the American Postmaster-General inserted a clause in the mail-carrying contracts requiring all Post Office vans to be of steel construction throughout.



Meccano Belt Pulley, constructed from two Flanged Wheels

Suggestions Section

Edited by "Spanner"

(68)—Meccano Railway Points

(N. S. W. and J. Wheatley, Claygate)

IT is a comparatively simple matter to build a straight length of Meccano track on which to run locomotives and other models, such as travelling cranes or gantries, but it is not always easy to construct from the existing parts switch rails and curves with which to complete the "permanent way." Nevertheless we are able to illustrate an interesting Meccano model of railway points built by the two readers mentioned above. This model is designed to conform with the standard "0" gauge, and is so well constructed that it has been found possible to incorporate it in a Hornby Railway with great success.

The construction of the points is quite simple, as will be seen from the photograph, but much care must be taken in adjusting the various pieces so that they shall present a smooth surface to the vehicles that run over them, and at the same time conform throughout to the stipulated gauge of $1\frac{1}{4}''$.

The movable tongue 1 consists of a $5\frac{1}{2}''$ and a $3\frac{1}{2}''$ Strip overlapped two holes, whilst the corresponding piece 2 is built up from a $5\frac{1}{2}''$ Strip and a $5\frac{1}{2}''$ Slotted Strip overlapped about $2\frac{1}{2}''$. These latter Strips are held together by two bolts passing through the $5\frac{1}{2}''$ Strip and engaging one of the slots in the Slotted Strip. The tongues 1 and 2 are secured to the Threaded Rod 3 by means of nuts screwed tightly against each side of the Strips, and are bolted near their other ends to Angle Brackets that, in turn, are bolted to the $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip 4.

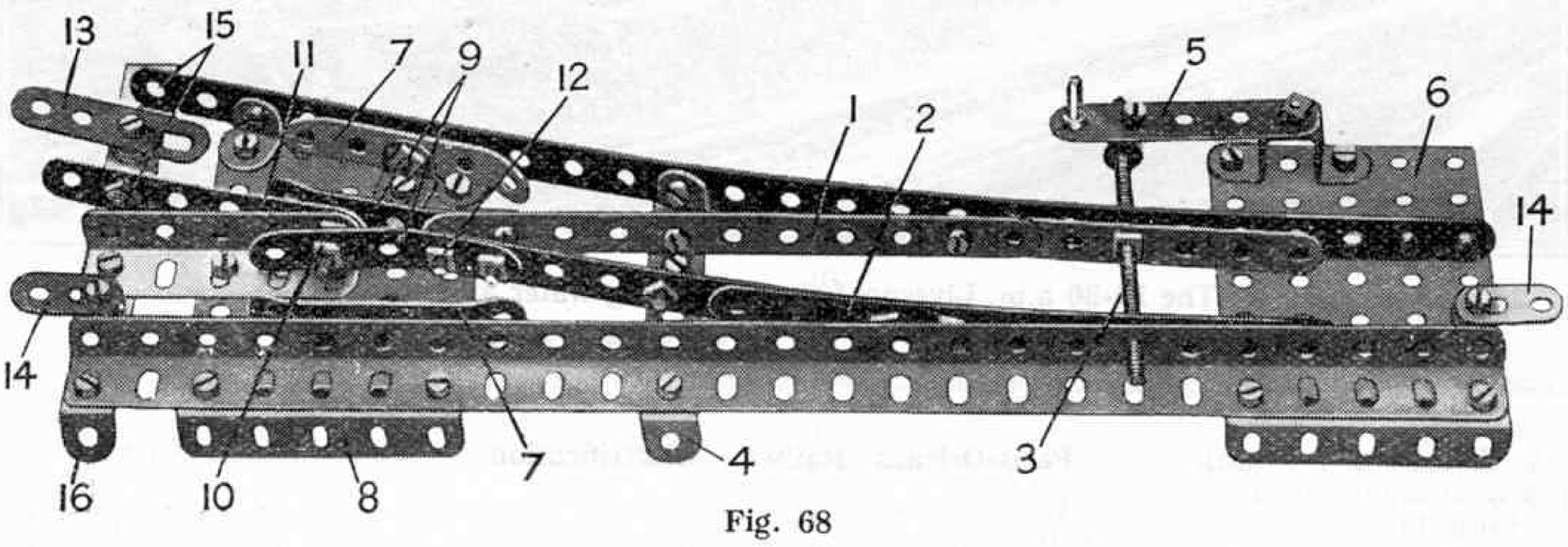


Fig. 68

Operating the Meccano Points

Although the strips 1 and 2 are thus rigidly secured to the Angle Strip 4, their longer arms are of sufficient flexibility to allow for a movement from side to side of the track. This movement is effected by the operation of the hand lever 5, which consists of a Threaded Pin and a $2\frac{1}{2}''$ Strip pivotally attached to a Double Bent Strip bolted to the base plate 6.

The outer check rails 7 consist of $2\frac{1}{2}''$ Strips slightly bent as shown and bolted by means of Angle Brackets to the Plate 8. The guide pieces 9 are bolted to the inner ends of the tongues 1 and 2, and are further secured by means of a $\frac{3}{4}''$ Bolt 10, the necessary spacing being obtained by means of two nuts placed on either side of the triangular piece 11. It should be noted that the bolt 12 is $\frac{1}{2}''$ in length and serves to secure the two $2\frac{1}{2}''$ Strips 9 to the rails 1 and 2.

The 2" Slotted Strip 13 and the Flat Brackets 14 may be used as a means of connection between the Meccano points and Hornby Rails.

The Strips 15, which form the curved portion of the points, are bolted by means of Angle Brackets to the $5\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip 16 and the base Plate 8. The Brackets should be mounted in every case so that their elongated holes are bolted to the base portions of the rail, as this permits small adjustments to be made if necessary when testing the points.

Our contributors state that they have been able to run Hornby Trains over the points at full speed without any derailments. The chief merit of the model, in our opinion, lies in the fact that the points may be built to any desired gauge, and may therefore be incorporated in the "runways" of many different types of Meccano models, ranging from small trucks to heavy locomotives or travelling gantries.

(69)—Magnetic Screwdrivers

(J. R. Cottrill, St. Annes-on-Sea)

A magnetic screwdriver is most useful for picking up grub-screws, etc., and inserting them in awkward positions in a model. Any steel screwdriver can be magnetised, but unless it consists of specially hard metal its powers of attraction diminish quickly.

The Meccano long screwdriver (Part No. 36a) can be magnetised by stroking it several times from end to end of the metal blade with a good strong horseshoe or bar magnet. It is immaterial which pole of the magnet is used first, providing the screwdriver is stroked always in the same direction with that pole; it may be stroked with the other pole in the *opposite* direction. If necessary the blade can be hardened beforehand by heating it to blood-red hue and plunging into cold water. After magnetising the tip should be again held in a flame until it turns blue; this softens the steel slightly and prevents it from crumbling owing to excessive hardness.

(70)—Epicyclic Transmission Gear

(E. Armitage, Garston, Liverpool)

The arrangement shown in Fig. 70 is designed to provide a gear ratio of two in one between any two shafts. Its chief merits lie in the compactness of its construction and in the fact that the driving and driven shafts may be mounted in direct line with one another.

The handle 1, consisting of a Threaded Pin bolted to the end of a Crank, is secured to a 2″ Axle Rod journalled in the reinforced bearings 2. This 2″ Rod is free to rotate in the boss of a 1½″ Contrate Wheel 3, but is secured in one end of the Coupling 4. A further Axle Rod 5, which is secured in the other end of the Coupling 4 and journalled in further reinforced bearings 6, carries the 1½″ Contrate Wheel 7 fixed in the position shown.

A 1½″ Rod 8 gripped in the central transverse hole of the Coupling 4 carries a ¾″ Pinion 9, which is free to rotate about the Rod but is retained in position by a Collar and set-screw 10. The Pinion is engaged by the teeth of both Contrate Wheels 3 and 7.

The Double Bent Strip forming the bearing 2 for the driving Rod is bolted to the side plate by means of two ½″ Bolts, the shanks of which enter holes in the face of the Contrate Wheel 3 and so prevent the latter from rotating.

On operation of the handle 1, the Pinion 9 travels round the teeth of the fixed Contrate Wheel 3 and is caused thereby to turn rapidly about its own axle. The rotation of the Pinion is transmitted to the Contrate Wheel 7 on the shaft 5, and it will be found that this secondary shaft 5 rotates twice as fast as the driving Rod carrying the handle 1. Alternatively, by using the Rod 5 as the driving shaft, a one in two reduction gear will be obtained, for the 2″ Rod will revolve once only to every two revolutions of the Rod 5.

If desired, the device can be repeated several times in a straight line, when a great difference in speed will be obtained between the primary shaft and the final driven Rod, whilst the space occupied by the intermediate gearing is reduced to a minimum.

A similar type of speed acceleration or reduction gear was described in the "Suggestions Section" in the "*M.M.*" for May 1926, under "Sun and Planet Mechanism" and "Sun and Planet Winding Gear" (see Suggestions Nos. 38 and 39 respectively).

Various forms of epicyclic gearing are used in actual practice where lack of space or other considerations make this type of drive transmission preferable to ordinary spur gearing, which requires parallel shafting.

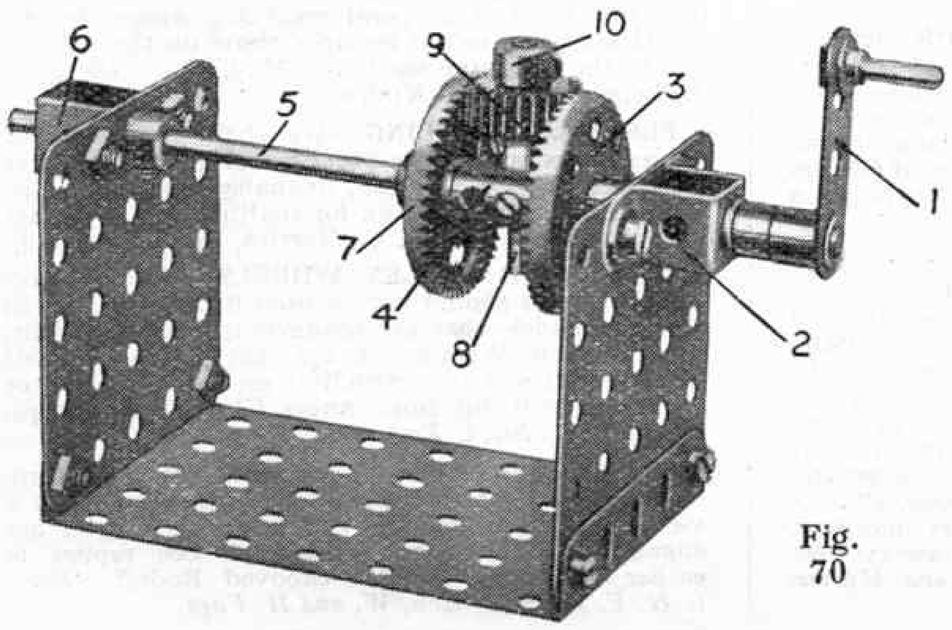


Fig. 70

(71)—Reversing and Drive-Changing Gear

(H. A. A. and R. M. A. Hankey, Limpsfield)

The mechanism shown in Fig. 71 enables two or three different operations to be controlled from a single driving shaft separately or simultaneously and in forward or reverse direction. It is of compact construction, simple to control and reliable

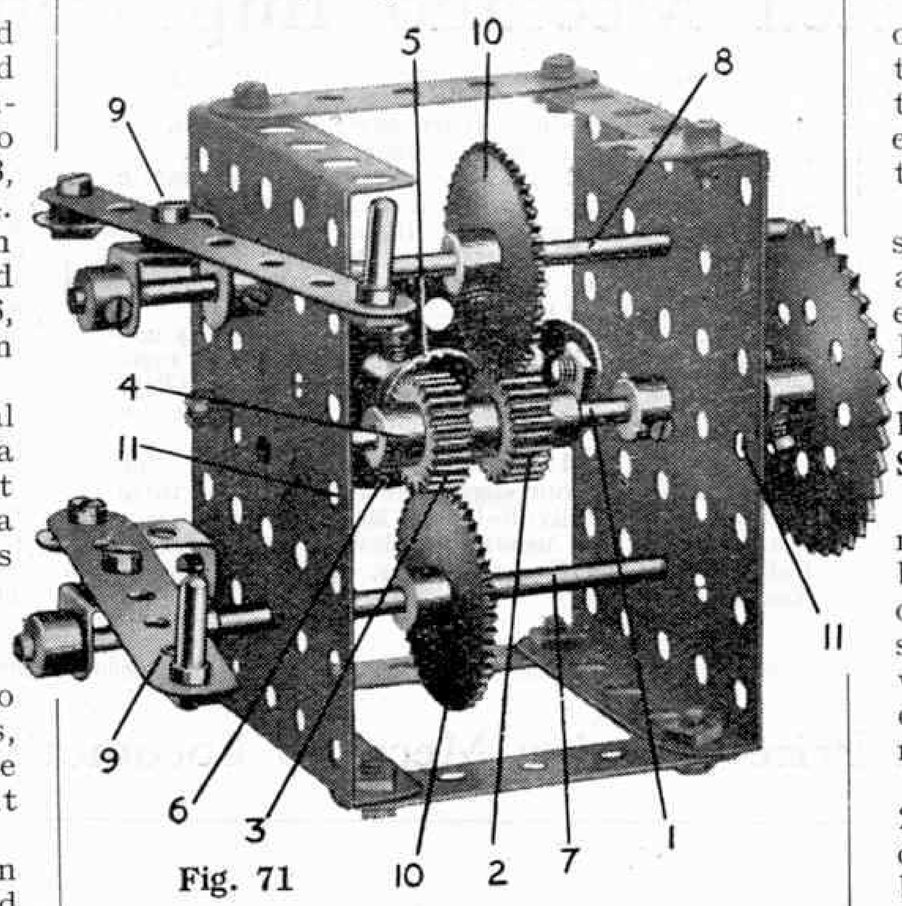


Fig. 71

in action. The advantages that it offers when fitted to a crane or similar model are apparent.

The Rod 1, which takes the drive from the Motor, carries a ¾″ Pinion 2 secured in the position shown. A similar Pinion 3 is free to rotate on the Rod but is retained in position by a Collar and set-screw 4. The Pinions engage with opposite sides of a ¾″ Contrate Wheel 5 and the latter is free to turn on a short Rod secured in the boss of a Bush Wheel 6. This wheel is bolted rigidly to the 2½″ × ½″ Double Angle Strip that connects the side Plates of the gear box.

It will be apparent that the Pinions 2 and 3 must rotate in opposite directions, for the former drives the Contrate Wheel 5 while the latter is *driven by* that wheel.

The secondary Rods 7 and 8 are slidable in their bearings and their movements may be controlled by suitable levers 9. Each Rod carries a 50-teeth Gear Wheel 10, and on operation of its respective lever this Gear Wheel may be caused to engage with one or other of the Pinions 2 or 3, or it may be placed in neutral, i.e. in a central position between the Pinions.

A third shaft can be journalled in the holes 11 of the side Plates and controlled from the driving shaft 1 in exactly the same way. The gear box, therefore, enables the shafts 7 and 8 and the imaginary shaft journalled in the holes 11 to be driven simultaneously or separately from the single driving Rod 1. Moreover any one of the three secondary shafts can be reversed or thrown out of gear without affecting the operation of the remaining two or altering the direction of rotation of the Rod 1.

(72)—Automatic Brake

(S. May, Elmers End, Beckenham)

This simple but ingenious device is particularly adaptable to Meccano motor cars and other models that are propelled by means of the Clockwork Motor. It provides a form of automatic brake that is brought into action immediately the model is lifted from the table or floor.

The road wheels 1 (Fig. 72) are mounted on a Crankshaft 2, which is driven from the Clockwork Motor. It will be observed that the Crankshaft is journalled in the elongated holes of Flat Brackets secured to the sides of the base Plate 3.

A 2″ Axle Rod 4 is gripped by the set-screw of a Crank 5 bolted to the base Plate, and a Coupling 6 mounted on the lower end of this Rod carries the horizontal 2″ Rod 7. To the outer end of the Rod 7 a Coupling 8 is secured in the vertical position shown.

Stopping the Clockwork Motor

So long as the weight of the vehicle rests on the Crankshaft 2, the latter will be forced to the top of the elongated holes of the Flat Brackets. The Rod 4 should be so adjusted that, in this position of the wheels, the Coupling 8 just clears the bent centre portion of the Crankshaft and the road wheels 1 are therefore free to rotate.

If the model is lifted, however, the shaft 2 and wheels 1 will fall by reason of their own weight to the bottom of the slotted bearings. In this position the centre of the crankshaft strikes the Coupling 8, so preventing the wheels from rotating and consequently stopping the Clockwork Motor.

The axle 2 should be coupled to the Motor by means of a Sprocket Chain drive, and the chain should be of just sufficient slackness to permit the vertically-sliding movement of the axle. If gear wheels are used for the drive transmission, the axle 2 is liable to become disengaged when freed of the weight of the vehicle, with the result that the braking device loses its effect and the Motor is free to "race" independently of the road wheels.

This Month's Awards

N. S. W. and J. Wheatley will be jointly awarded with a cheque to the value of ten shillings and sixpence for Suggestion No. 68, while H. A. A. and R. M. A. Hankey will together receive cash to the value of seven shillings and sixpence for No. 71.

E. Armitage and S. May will be presented with five shillings each for Suggestions 70 and 72 respectively, and J. Cottrill will receive a special Certificate of Merit and a complimentary copy of "Meccano Standard Mechanisms" for Suggestion No. 69.

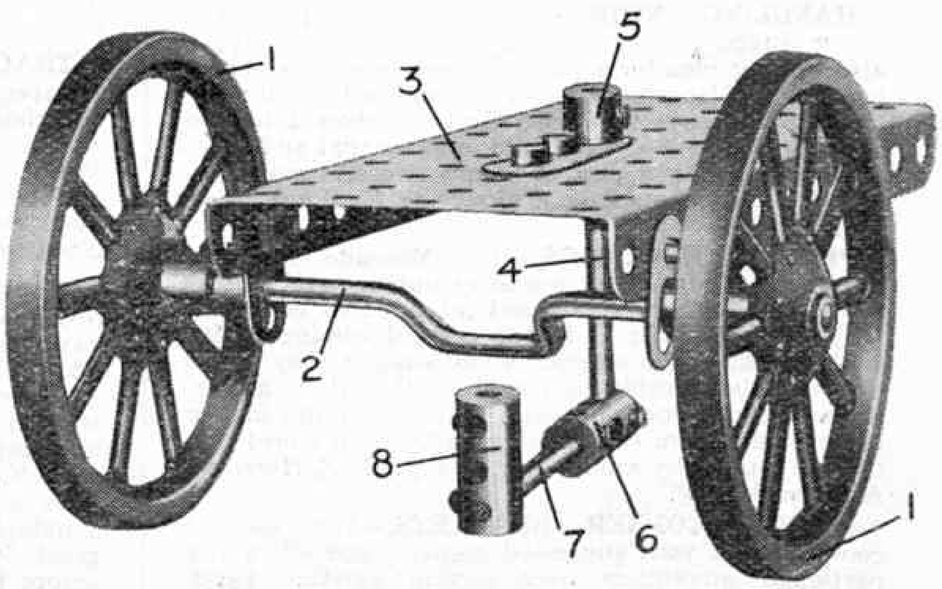


Fig. 72

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. Every idea, however, whether acknowledged in these columns or not, is carefully examined and considered. Practical suggestions that prove to be in popular demand are marked down for adoption at the first available opportunity. It would be of great assistance if readers, when submitting suggestions for consideration, would write them on separate sheets of paper and include their name and address on each sheet used.

Suggested Meccano Improvements

MOTOR LAUNCHES.—We are unable to entertain this idea at present, since the manufacture of model boats is not in accordance with our usual practice. (*Reply to A. Machin, Levenshulme, Manchester*).

LIFE STORY OF MECCANO.—As stated in previous issues we hope to persuade Mr. Hornby to re-write the story of the invention, growth and present-day manufacture of Meccano, with a view to publishing same in serial form in these pages. (*Reply to J. Price, Stoke-on-Trent; A. Davis, St. Kilda, Melbourne; L. O'Brien, Johannesburg; J. Pye, Swinton; and others*).

GUILD BADGES ON MODELS.—We note that you favour the suggestion regarding the supply of Guild Badges adapted for attachment to Meccano models, but apparently there is little demand for this innovation. (*Reply to J. B. Crossland, Lancaster, and G. H. Wallis, Hull*).

GOVERNOR FOR CLOCKWORK MOTOR.—We doubt whether it would be possible to adopt your suggestion re the addition to the Clockwork Motor of a variable governor. An efficient automatic speed governor, constructed from Meccano parts and suitable for use in conjunction with this Motor, was described under Suggestion No. 29 (see "*M.M.*" for April 1926). (*Reply to F. Aston, Palmerston North, N.Z.*)

IMPROVED CLOCKWORK MOTORS.—See our replies concerning the Clockwork Motor in the November "*M.M.*" (*Reply to Bernard Harrison, Moreton Marsh, and F. Aston, Palmerston North, N.Z.*)

Suggested New Meccano Parts

LARGE BASE PLATES.—Flanged or Flat Plates of the dimensions suggested, i.e., 12½″ × 12½″, 11″ × 5″, etc., would prove both unwieldy and costly, and we consider that on the few occasions such parts are required, it is desirable to substitute a plate built-up from the existing elements. (*Reply to B. Hilliar, Karachi, India, and S. Edwards, Welling*).

IMPROVED THREADED PINS.—The addition of a squared shoulder to the Threaded Pin (Part No. 115) would certainly constitute an improvement, but the necessary alteration presents several manufacturing difficulties. However, we are now carrying out experiments with a view to overcoming these difficulties. (*Reply to C. Acland, Sydney; T. Fish, Gunthwaite; and T. de Souza, Bambalapitiya, Colombo*).

NEW SPANNER.—We agree that your proposed special spanner, having a cup-like attachment to hold the nut when working in awkward positions, would provide a valuable aid to model-building, but the occasions on which such a tool is required appear to be too infrequent to warrant its manufacture. (*Reply to J. A. Cook, Mackay, N. Queensland, and R. Fearn, London, E.13*).

HANDLING NUTS.—Our remarks upon the above suggestion concerning a new spanner apply also to your idea for a pair of tweezers with which to handle the Meccano nuts. It should not be difficult for Meccano boys to devise for themselves a tool to serve the purpose. We should imagine that an instrument resembling a pair of stamp tweezers would be useful in this connection. (*Reply to E. White, Worcester*).

PROPELLER BLADES.—The Meccano Propeller Blades are designed for use in aeroplanes and similar models, and of course are not intended to be driven by a current of air as in the case of windmill sails. If their design was altered as you suggest they would no longer be suitable for use in models where an air-screw forms the motive power. It is a simple matter to construct from the existing parts a fan wheel that may be rotated by wind power. (*Reply to B. Harrison, Moreton Marsh*).

CURVED CORNER BRACKETS.—We do not consider that your suggested corner piece offers any particular advantage over certain existing parts, such as Nos. 90, 108, or 133. (*Reply to J. B. Crossland, Lancaster*).

CHUCK.—A specially-designed chuck would prove a very costly addition to the Meccano system. As a rule a Coupling or similar part may be adapted to this purpose. (*Reply to M. McDonald, Kirkcaldy*).

SEMICIRCULAR PIECE.—We doubt the practicability of your suggestion for a semicircular shoulder-piece to act as a guide for lift-cages and for other purposes. The diameter of the Meccano Rod is too small to permit of the method of coupling that you propose. (*Reply to O. Bell, Oxford*).

SMALL RUBBER TYRES.—We are already considering the possibilities of miniature rubber tyres, of a diameter to fit the 1″, 1½″, and 2″ Pulleys. (*Reply to Guy Warwick, Burnhope, Durham, and L. Williams, Ramsgate*).

MECCANO RAILS.—We doubt whether we shall be able to adopt your suggestion regarding the introduction of specially-designed Meccano rails, as a suitable track can usually be devised from Hornby Rails or existing Meccano parts. (*Reply to Michael Kravtchenka, Rome*).

WHEEL AND CLUTCH UNIT.—We note your suggestion that a grooved pulley wheel should be supplied with a Dog Clutch section secured on each side in place of the usual boss, with a view to operating two separate movements by sliding the pulley laterally on its shaft. In the near future, however, we hope to introduce a Sleeve Coupling with which Dog Clutches or other parts may be coupled rigidly to Meccano Wheels or Pinions, etc., and this should obviate the necessity of the special part that you describe. (*Reply to L. Hollyoak, Earlsdon, Coventry*).

IMPROVED CRANK HANDLES.—The manufacture of a handle bent at right-angles to its shaft offers several disadvantages that at present outweigh the advantages of the proposed part. (*Reply to Tom Fish, Gunthwaite, Near Penistone*).

WING NUTS.—As pointed out in the August 1926 "*M.M.*," existing parts may conveniently be used in place of wing or "thumb" nuts. For example, a Coupling engaging by its central transverse hole a Threaded Rod or Bolt will serve admirably for this purpose, while another form of wing nut may be constructed from a Threaded Boss, in either side of which a Threaded Pin is screwed at right-angles to the Boss. (*Reply to W. E. Cheary, Forestville, S. Australia*).

WIRE WHEELS FOR MOTOR CARS.—We note that you support the suggestion published in the September 1926 "*M.M.*" regarding the introduction of miniature wheels with wire spokes for use in motor cars and similar models. The objections raised in that issue, i.e., cost of production and lack of general adaptability, are still considered insuperable, however. (*Reply to H. Pipes, Melbourne, Near Derby, and F. Ferguson, Partick, Glasgow*).

JOINING AXLE RODS.—When connecting the ends of two Axle Rods together by means of a Coupling, we have found little tendency on the part of the Rods to bend out of alignment. If such is the case, however, the tendency could be obviated to a large extent by gripping each Rod by a second set-screw mounted in the opposite side of the Coupling to counteract the thrust of the first set-screw. We are unable to decrease the diameter of the longitudinal bore, as this is of standard dimensions. (*Reply to George Bowdler, Kidderminster*).

STAY-RODS.—We doubt whether Axle Rods tapped with the standard Meccano thread at either end would possess any particular advantage over the existing ordinary and Threaded Rods, but we shall bear your idea in mind. (*Reply to M. McDonald, Kirkcaldy*).

LARGER HINGES.—We have several suggestions in hand regarding an improved type of hinge. (*Reply to J. H. Waring, Newton Abbott*).

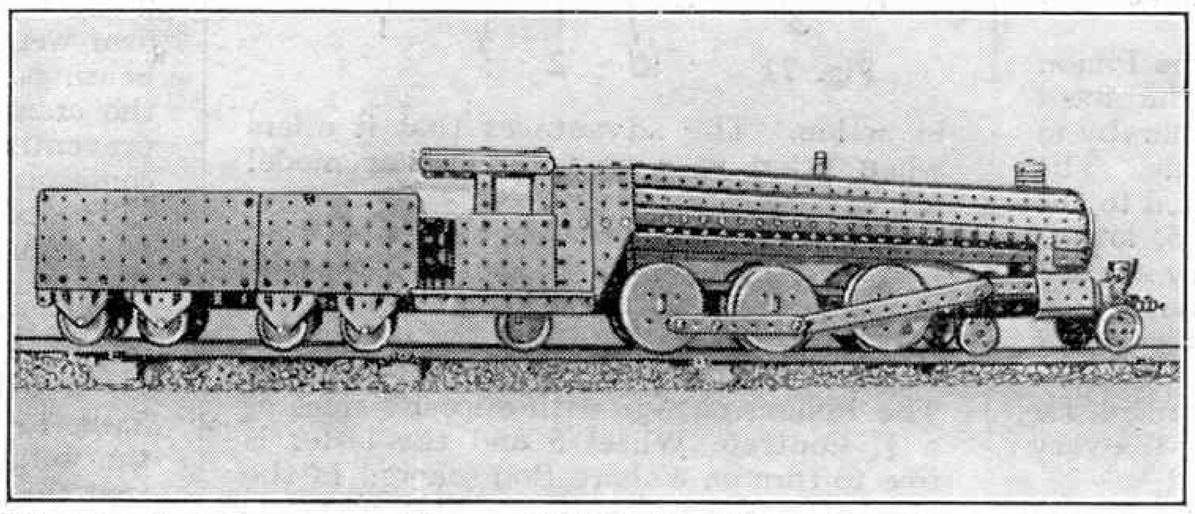
CURVED SLOTTED STRIPS.—We shall consider your suggestions re curved Slotted Strips. With reference to your proposal regarding wing-nuts, we would refer you to our remarks above on the subject and in the Magazine for August 1926. (*Reply to Malcolm McDonald, Kirkcaldy*).

FLEXIBLE COUPLING.—We shall consider your suggestion regarding the provision of Collars at either end of the Meccano Spring, to enable the latter to be used as a flexible coupling for shafting, and for other purposes. (*Reply to N. G. Morrish, London, S.E.23*).

TRACK FOR PULLEY WHEELS.—The ordinary Pulley Wheels should not be used for the purpose of guiding models that are required to travel on rails. The Flanged Wheels are specially made for this purpose and will run splendidly on Hornby Rails or on track built up from Angle Girders and Strips. (*Reply to E. Birch, Rotherham*).

FLUTED SHAFTS.—The possibility of introducing fluted shafting and other accessories, with a view to making possible sliding gear changes, has engaged our attention constantly. See replies in earlier Magazines under "Grooved Rods." (*Reply to H. F. Lane, London, W. and H. Fagg*).

A Prize-Winning Meccano Locomotive



This interesting Meccano model of an L.N.E.R. "Pacific" type express passenger engine secured a cash prize in the 1925/6 Meccano Locomotive Model-building Competition for H. J. Welch, of Willoughby Road, Acton Vale, London, W.3. The tapered boiler is reproduced in a realistic manner, and the model conveys a good impression of this famous class of locos.

GROOVE FOR 3″ WHEELS.—We note your suggestion that the circumference of the 3″ Wheels (No. 19a) should be grooved to take the Meccano Rubber Rings, but we doubt whether these parts, if so equipped, would present a more realistic appearance than the 3″ Pulleys when used for motor car wheels or similar purposes. (*Reply to J. B. Crossland, Lancaster*).

SKEW GEAR.—We are surprised to learn that you experience difficulty in driving a ½″ Pinion with the Worm Wheel, as we have had no trouble in this direction. We do not think the advantages to be obtained from the introduction of skew gear for this kind of drive would be sufficient to compensate for the additional expense and inconvenience that it would cause. (*Reply to C. Acland, Sydney*).

TRACTOR WHEELS.—There is little demand for specially-designed wheels for use in road tractors, as existing parts can be adapted to the purpose quite easily. For the front wheels we suggest the use of 3″ Wheels, 3″ Pulleys, or Flywheels, while the large driving wheels can be built up from Hub Discs, Circular Girders or Plates, 6″ Pulley Wheels, etc. (*Reply to John Sarginson, Bury St. Edmund's*).

TUBULAR ELEMENTS.—Probably you have observed from recent issues of the "*M.M.*" that we have had in mind for some time past the question of adding tubes, boilers, etc., to the Meccano system. We agree that such parts, providing they can be standardised with the existing system, would prove invaluable in model locomotives, or for use as ship's funnels, cylinders, gun-barrels, winding drums, tubular beds for lathes and other machines, or as central standards for roundabouts or similar models, etc. A great deal of experiment will be necessary, however, before the feasibility of the idea can be ascertained. (*Reply to J. Wheatley, Claygate, Surrey and Michael Kravtchenka, Rome*).

Suggested Hornby Train Improvements

WIDER PARALLEL POINTS.—We shall consider your proposal concerning an alteration in the width of the Parallel Points, to enable the Island Platform to be inserted between two parallel tracks connected to the arms of the Points. (*Reply to R. de Ferry, Jr., Liverpool*).

PLATFORM EXTENSIONS.—Passenger Platforms and Ramps, suitable for attachment to the existing Hornby Station, are already included in the System. By means of these accessories the station platforms may be extended to any desired length. See latest Hornby Catalogue. (*Reply to J. B. A. Glennie, Leamington Spa*).

MINIATURE STATION STAFF.—Miniature porters, passengers, engine-drivers, etc., for use in connection with Hornby Trains, are not in demand and we doubt whether their introduction would prove popular. (*Reply to J. B. A. Glennie, Leamington Spa*).

DETACHABLE LAMPS.—We have noted your suggestions. See our replies in the "*M.M.*" for August last re lamps on locos and brake vans. (*Reply to J. A. Wallace, Leith; D. F. E. Nash, Sutton, Surrey; J. H. Neville, Darlington, W. Australia; A. J. Haworth, Feniscowles, Near Blackburn; and others*).

LARGE RADIUS CURVES.—See our remarks in last month's "*M.M.*" under the heading "4 ft. Radius Curves." (*Reply to J. H. Neville, Darlington, W. Australia*).

COMPOSITE BRAKE VAN.—We have had this suggestion under consideration for some time but it is not possible yet to make a definite statement concerning it. (*Reply to W. T. Castle, Clitheroe, and E. L. Chapman, Toronto, N.S.W.*)

8-WHEELED GUARD'S VAN.—The question of introducing a guard's or brake van mounted on four-wheeled bogies has been noted for consideration together with the above suggestion regarding a composite brake van. (*Reply to F. Aston, Palmerston North, N.Z.*)

8-WHEELED WAGON.—We have received a large number of suggestions regarding the introduction of open mineral wagons equipped with two four-wheeled bogies, and the matter will have careful attention. (*Reply to J. E. Jenkins, Terowie, S. Australia; D. Ely, Epsom, N.Z.; R. Wright, Norwich; F. Aston, Palmerston North, N.Z.; and others*).

SIGNAL GANTRIES.—We pointed out in the Magazine some time ago that there appeared to be little demand for signal gantries. Nevertheless we are keeping a careful record of all suggestions received in this connection. (*Reply to J. H. Neville, Darlington, W. Australia, and A. Malkin, Leek*).

HOW TO RUN A HORNBY RAILWAY.—A booklet entitled "The Hornby Train System" may be obtained from this office, price 3d. post free. We think you should find this of considerable interest, for it contains numerous valuable hints that will enable you to derive the best possible fun from your model railway. The Hornby Control System is dealt with in a separate leaflet, which may be obtained free of charge. (*Reply to E. de Ferry, Jr., Liverpool*).

NEW HORNBY RAILS.—We note your remarks concerning the alteration in the design of Hornby Rails. The new Hornby Rails with three sleepers possess several important advantages over the old style. They are of much stouter construction, and add greatly improved rigidity to any layout. In addition they possess a unique advantage in the use of rail connecting plates in place of the old-style locking device. These plates grip the ends of two rails tightly together, and a layout in which they are used can be lifted intact from the floor or table. The fitting of the connecting plates is a simple matter, and it takes only a second or so to slide each one into position. A quantity of the plates will be found in every Hornby Train set, or they may be obtained separately, price 6d. per half dozen. (*Reply to E. Shipway, Clifton, Bristol; E. Wright, London, W.C.1; C. T. Smith, Birmingham; L. Elkins, Sparkbrook; and many others*).

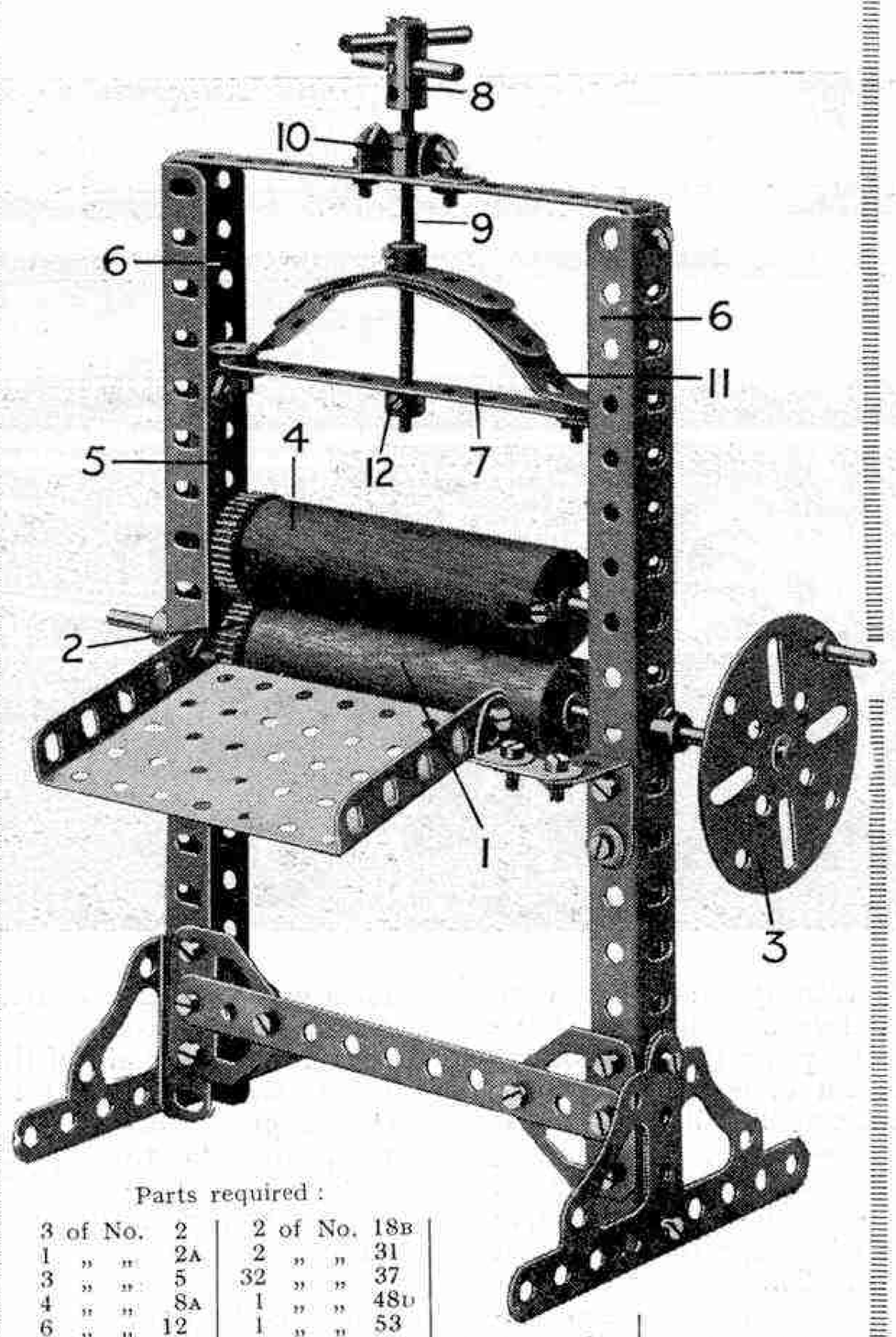
OVAL BUFFERS.—We note your proposal that the buffers on all rolling stock should be oval instead of round, in order to prevent fouling during shunting operations, etc. We have experienced little difficulty of this kind, however, and should like to receive further opinions on the matter. (*Reply to C. Dawe, London, S.E.17*).

WOODEN SLEEPERS.—We regret that we are unable to consider the introduction of scale-model permanent way, with wooden sleepers, chairs, keys, etc., as the cost of manufacture would be very great. (*Reply to A. Ley, Welwyn Garden City; D. F. E. Nash, Sutton; P. Petty, Westcliff-on-Sea; and others*).

PERMANENT WAY.—The cost of introducing a model permanent out-door track with brass rails would be quite prohibitive. (*Reply to L. Page, London, S.E.20*).

MAIL VAN AND ACCESSORIES.—We note that you are in favour of the various suggestions dealt with in these pages concerning mail train operation, and we hope to announce something definite concerning them in the near future. (*Reply to M. Hilditch, Wirksworth, and H. Storer, London, S.W.18*).

A Meccano Clothes-Wringing Machine



Parts required:

3 of No. 2	2 of No. 18B	
1 " " 2A	2 " " 31	
3 " " 5	32 " " 37	
4 " " 8A	1 " " 48D	
6 " " 12	1 " " 53	
2 " " 12A	6 " " 59	2 of No. 80A
1 " " 13A	1 " " 63	2 " " 106
1 " " 15	1 " " 64	4 " " 108

1 of No. 109
1 " " 115
2 " " 126A

This novel Meccano Mangle is very simple to construct, and we believe that it will provide an effective means by which Meccano boys may demonstrate to their sisters the remarkable adaptability of Meccano! The Meccano Wood Roller 1 is secured by a Collar and set-screw inserted in the recess at one end and by the set-screw of the 1" Gear Wheel 2 at the other to the 8" Rod carrying the hand wheel 3. The spindle of the upper roller 4 is inserted in the lower holes of 2½" Strips 5 These Strips are free to move up and down in the groove formed by the side Angle Girders 6, and are bolted at their upper ends to Angle Brackets secured to the transverse 4½" Strip 7. Pressure is exerted upon the upper roller 4 by the hand screw 8, the Threaded Rod 9 of which passes through a Threaded Boss 10. The latter is held against rotary movement by bolts engaging its transverse holes and secured in the Angle Brackets shown. Consequently rotation of the hand screw 8 causes the Rod 9 to move longitudinally in the Boss, and this movement exerts pressure upon the roller 4 by means of a Collar and set-screw pressing upon the spring 11, which is composed of Meccano Strips bent as shown in the illustration. The lower Collar 12 engages the Strip 7 and lifts the roller when the Threaded Rod 9 rises in the Boss 10.

TARPAULIN SHEETS.—Your suggestions concerning the introduction of miniature tarpaulin sheets, stamped with the initials of the various railway companies, are interesting and will receive further attention. (*Reply to A. E. Wheal, London, E.7; J. Marshall, London, S.E.18; and J. A. Wallace, Leith*).

DESTINATION BOARDS FOR COACHES.—See our reply in the December 1926 "*M.M.*" (*Reply to Norman Newcombe, Leicester*).

ENGINE SHEDS.—We note that you support the suggestions previously acknowledged regarding the introduction of engine sheds. We hope to announce our decision in the near future. (*Reply to D. Miller, Birkenhead, and J. H. Neville, Darlington, W. Australia*).

6-WHEELED VEHICLES.—The introduction of six-wheeled Brake Vans, Passenger Coaches, and goods vehicles would not constitute any particular advance in realism, we consider. Such vehicles would be suitable for large radius curves only. (*Reply to J. A. Wallace, Leith; L. Harris, Belfast; and D. Parsons, Flackwell Heath*).

NUMBERS ON LOCOS.—The wheel-classification numbers have already been abolished from the sides of locos, and an ordinary serial number has been substituted. (*Reply to E. de Ferry, Jr., Liverpool*).

HORSE VAN.—See our reply on this subject in the November "*M.M.*" (*Reply to E. de Ferry, Jr., Liverpool*).

IMPROVED TUNNELS.—We have noted your requests for longer and improved tunnels, and they will receive careful consideration. (*Reply to H. Helliwell, Sheffield; D. F. E. Nash, Sutton; and J. E. Thorne, Maidstone*).

TUNNEL ENTRANCES.—Your suggestion concerning the supply of tunnel entrances is interesting and will receive further attention. Meanwhile, we think Hornby enthusiasts would experience little difficulty in devising entrances and the necessary framework for long tunnels from Meccano or fretwork. The framework should be covered, of course, with any suitable material, such as stout paper, etc., and coloured to represent appropriate scenery. (*Reply to G. Innes, London, W.9*).

MILK CANS.—Miniature Milk cans, as supplied in the Hornby Milk Van and Station Accessories Set No. 2, may be obtained separately, price 3d. each. (*Reply to N. G. Morrish, London, S.E.23*).

COLOURED SMOKE-BOXES.—We are interested to learn that you have been able to blacken the smoke-box portions of the boilers on your No. 1 and No. 2 Tank Locos with "Robiallac" enamel, and that the latter has dried excellently without spoiling the appearance of the other enamelled parts of the locos. It is possible that a number of readers may care to adopt this plan, although great care must be taken in the task if really good results are to be obtained. We explained in an earlier issue that the advantages of enamelling the smoke boxes of Hornby Locos in a different colour to the boilers during the process of manufacture would hardly justify the extra expense incurred. (*Reply to L. Rimmer, Wavertree, Liverpool*).

SIGNAL AND BRAKE-RAIL CONNECTIONS.—We are interested in your proposal regarding connections between a Signal and a Brake Rail to enable these two accessories to work in unison. This arrangement is provided for, however, by the new Hornby Control System, in which both the Brake Rail and the Signal may be controlled from the same Signal Cabin. (*Reply to Philip and Leo Eaude, Dumfries, Scotland*).

SIX-COUPLED LOCOS.—As previously stated in these pages we do not favour the introduction of locos having six or more driving wheels coupled together. Such models would be unsuitable for the curves found in gauge "0" tracks. (*Reply to J. H. Neville, Darlington, W. Australia; D. Mimby, London, E.10; and W. E. Cheary, Forestville, Australia*).

4-4-2 LOCOS.—We do not consider that any considerable advantage would be obtained from the conversion of the No. 2 Loco to the 4-4-2 wheel arrangement. We may point out, however, that the new "Blue" Train Loco is of the "Atlantic" type. (*Reply to A. W. Cockman, London, N.12*).

L.N.E.R. ELECTRIC LOCO.—A miniature reproduction of the powerful type of electric loco used on certain portions of the L.N.E.R. would prove a very costly addition to the Hornby System, and we are therefore unable to adopt your suggestion at present. (*Reply to G. Innes, London, W.9*).

TUBE RAILWAY.—See our replies under this heading in the August and December 1926 Magazines. (*Reply to Norman Newcombe, Leicester and H. J. Evans, London, N.13*)

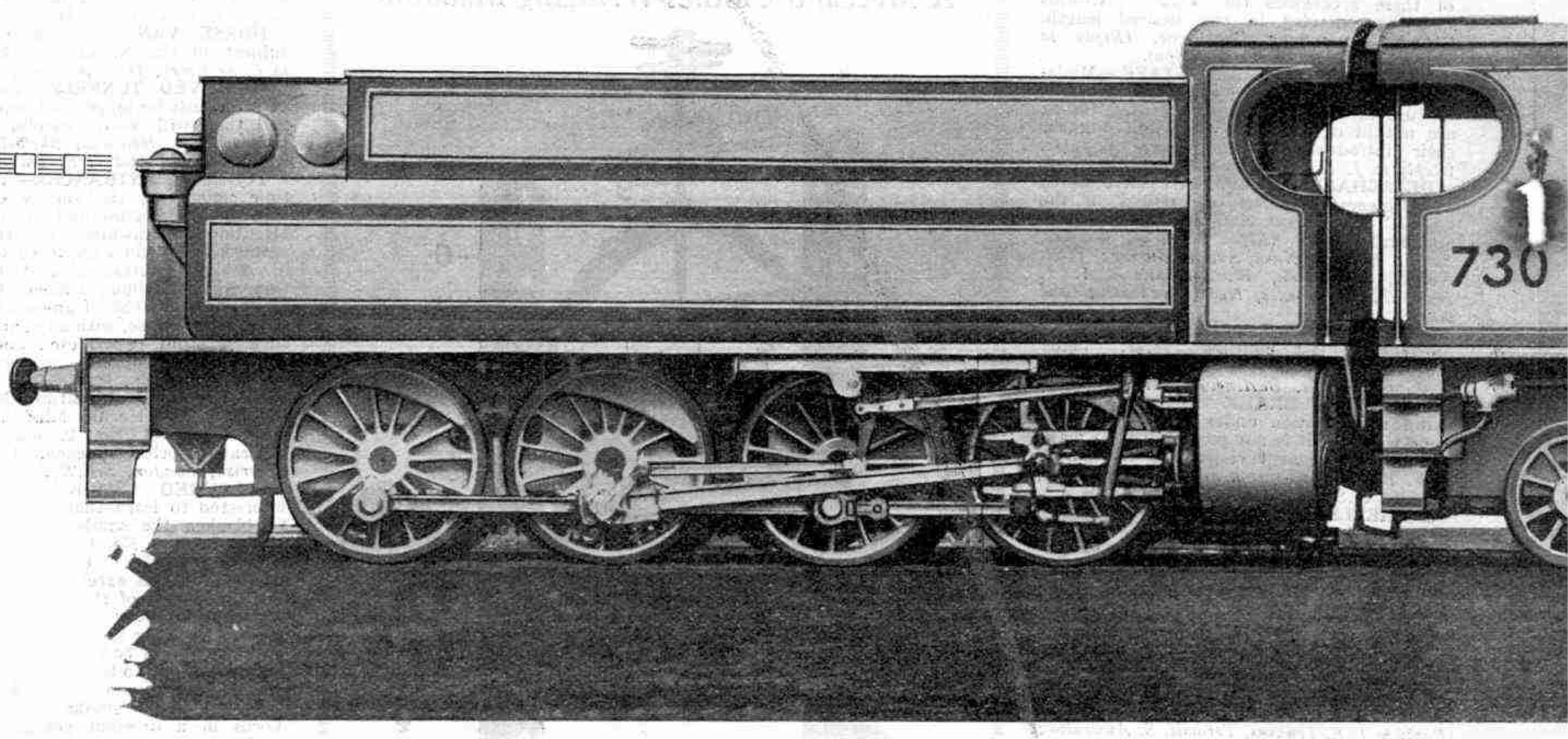
L.N.W.R. BRAKE VANS.—These accessories were included in the system at one time, but the lettering is now obsolete, of course, as the L.N.W.R. is grouped under the L.M. and S. Railway. (*Reply to Norman Newcombe, Leicester*).

CAST WHEELS.—We note that you are in favour of this suggestion, but we regret that we are unable to adopt it owing to the fact that the provision of cast wheels would result in extra weight being placed behind the locos while productive costs would be increased still further. (*Reply to Patrick Cundy, Plumpton Green, Nr. Lewes*).

GOODS STATION.—Goods Stations are already included in the Hornby System. (*Reply to S. Ellins, Kensworth, Dunstable*).

LARGER TURNTABLES.—See our reply in the September 1926 "*M.M.*" (*Reply to L. Linnell, Buxton*)

The Poultney Locomotive: A Increased Power with a Minimum



THE modern methods of operating railways, coupled with increased working costs and altered labour conditions, have naturally created a demand for more powerful locomotives and greater economy in working. In an endeavour to meet these requirements a new type of locomotive has been designed by Mr. E. C. Poultney, O.B.E., associated with Mr. A. H. Gilling and Mr. H. A. Akroyd of the Yorkshire Engine Co. Ltd., Sheffield.

The new type, which incorporates the articulated principle already familiar to readers of the "*M.M.*," is specially designed for moderate speed, heavy freight service. The basis of the new design is the increased power for a given steam production, obtained by using the limited cut-off principle. It is claimed that with the adoption of the Poultney type of loco great economies are effected.

The two chief objects attained by the new type are increased power in existing locomotives, with the same coal and water consumption, and locomotives of greatly increased power over ordinary types with reduced coal and water consumption.

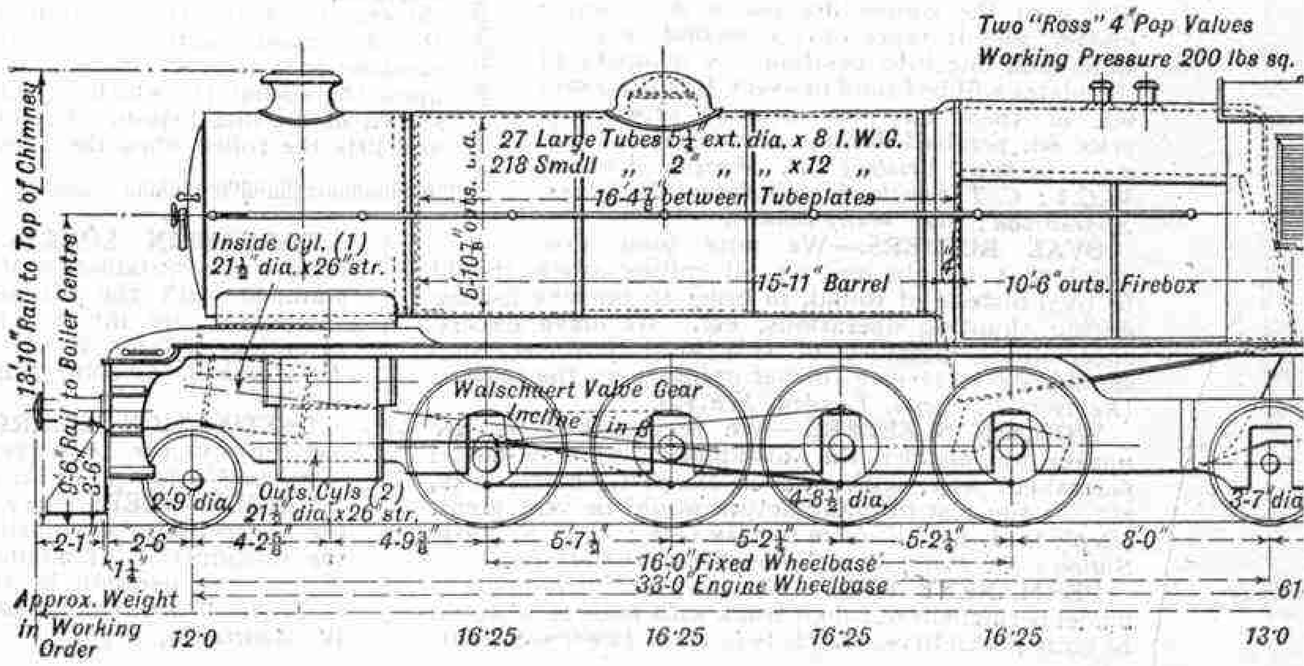
Converting the dead weight of the Tender into useful Effort

The underlying principle of locomotive design is that connecting weight and power. Most locomotives consist of an engine and tender and of the combined weight of these, only part of that of the engine portion is available for the purpose of traction, the amount varying according to the wheel arrangement. For engines having the 4–6–0, 2–6–2, 2–8–2 or 2–10–0 wheel arrangement, the amount (in terms of per cent. of the engine weight) may be as high as 90% or as low as, say, 70%. When the total locomotive weight is considered, however, these ratios are much less, and become roughly as follows:—For the 2–6–0, 50%; 4–6–0, 40%; 2–8–2, 45%; 2–10–0, 55%. These figures though only approximate, are sufficient to indicate that generally the total weight necessary for a given tractive effort is quite large.

In ordinary types of locomotives any increase in power is usually only obtained by augmented adhesive weight, but this is not always permissible owing to restricted axle loads. There is no reason why the weight of the tender, or part of it, should not be used, however, for the tender offers a possible means of converting its dead weight into useful effort. In the Poultney system full advantage is taken of this opportunity by applying driving gear to the underframe of the tender. This results in two special advantages, which are that for a given axle loading on the engine the tractive effort of the locomotive can be increased; and that for a given tractive effort, axle loads, and hence bearing pressures, may be decreased.

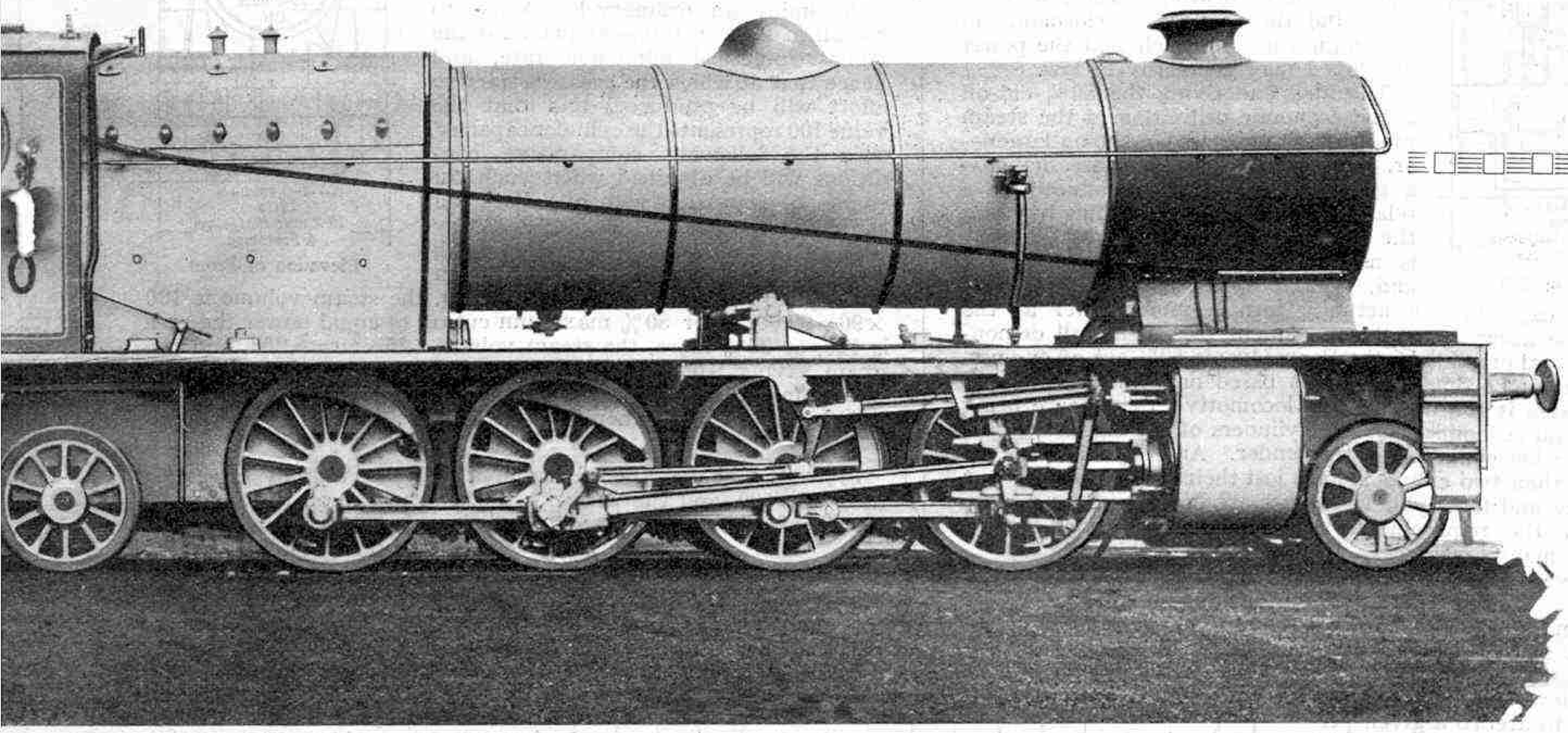
Using part, or all, of the tender weight for driving wheel weight means that, of the total adhesive weight 60 to 70% will be on the engine portion, and 40 to 30% on the tender. A general study of many locomotive examples has brought out the fact that 70% of the total power can be developed by the engine and 30% by the tender, and of the entire locomotive weight, that available for traction may run about 70% of the total, instead of not more than from 55% to 60% for locomotives of normal construction. The advantage gained by utilising the tender weight in this manner is obviously very important.

Gauge of Rails	*5'-6"*
Engine Cylinders (3)	*21½" dia. x 26" stroke*
Tender Cylinders (2)	*17½" dia. x 26" stroke*
Coupled Wheels	*4'-8½" dia.*
Working Pressure	*200 lbs/sq. in.*
Adhesive Weight, Engine, Full	*65 tons*
" " Tender, Empty	*36 tons*
Tractive Effort Starting	*58829 lbs*
" " Running	*54721 lbs*
Adhesive Factor, Engine, Starting	*3·8*
*" " Tender " *	*3·93 (When Empty)*
" " Engine, Running	*3·8*
*" " Tender " *	*4·91 (When Empty)*



New Type of Modern Design

Coal and Water Consumption



The Importance of the Adhesive Factor

Having thus briefly outlined the problems involved from the weight utilization standpoint, it is desirable to consider boiler capacity and engine characteristics. But first of all let us deal with the adhesive factor—that is the value of the product of tractive effort divided by adhesive weight.

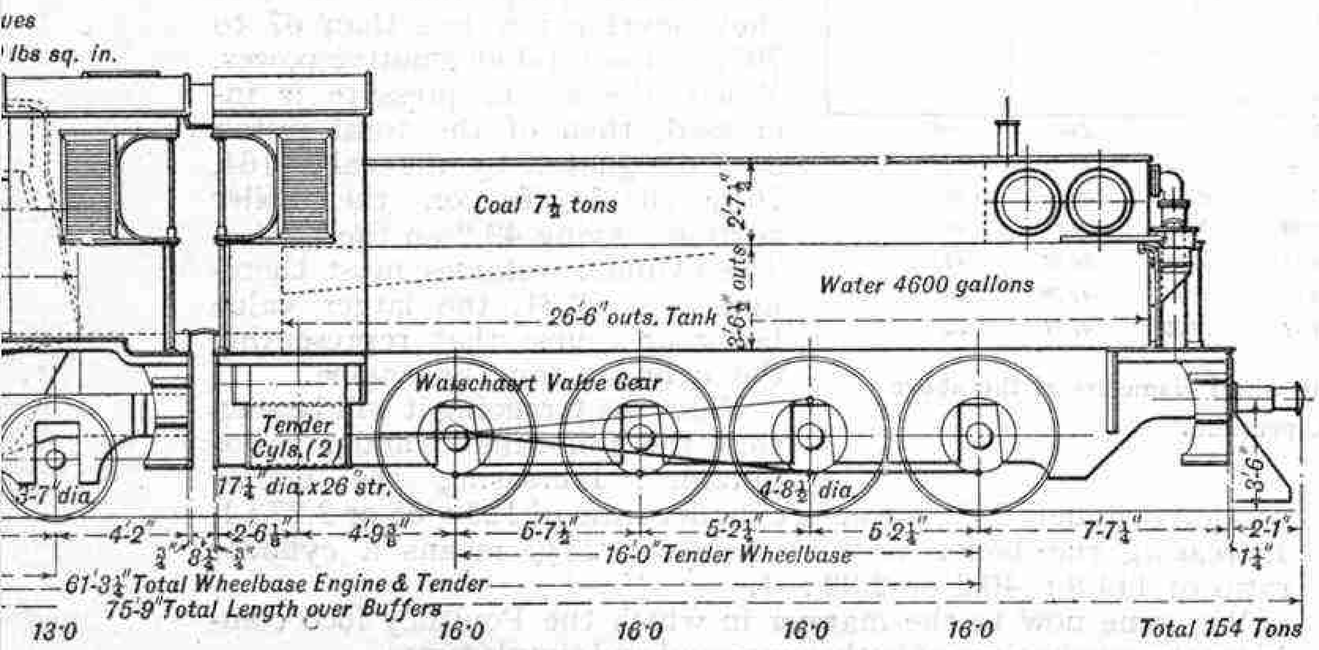
Heating Surface, Large Tubes	607 sq. ft.
" " Small "	1843 " "
" " Firebox (198 sq. ft.) + Arch Tubes (30 sq. ft.)	228 " "
" " Total Evaporative	2678 " "
Superheating Surface (Internal)	508 " "
Total	3186 " "
Grate Area	50 " "
Approx. Weight of Engine, Empty	82 tons
" " " " in Working Order	90 "
Approx. Weight of Tender Empty	36 "
" " " " in Working Order	64 "
Brakes	Hand & Vacuum Automatic

On the engine portion of the locomotive, the cylinder volume will either be 25% larger, or the steam pressure may be increased by a like amount. Alternatively, these two characteristics may be modified to produce an equal effect.

Owing to the locomotive being arranged on the limited cut-off principle, it has starting ports so arranged as to give momentarily an actual cut-off of 80%, the relative tractive efforts at the cylinders being 9.47 and 11.11 or, in other words, 17% greater. If, therefore, the ordinary locomotive has an adhesive factor of 4.5 then the Poultney Locomotive will have, on the engine portion, a factor of $4.5 \times 0.83 = 3.74$.

On the tender portion, the cylinders used are of a suitable size to make use of the steam saved by the curtailed cut-off. It is a remarkable fact that the increase in power by this method, which is gained without any extra consumption of steam, is from 20 to 30%, and, as is obvious, no alteration to the boiler is required.

There is no difficulty in obtaining a fairly high adhesive factor when calculating on a half-loaded condition. The adhesive factors on the engine in examples thus far worked out run between 3.6 and 3.8, and there is no reason why such should not be sufficient, as numerous examples of locomotives having adhesive factors of equal value are running successfully. Further it must be remembered that the 50% cut-off locomotive has a turning torque very similar to the three-cylinder engine with equal piston strokes, and connecting-rod lengths, and this allows a lower adhesive factor to be used.



Explaining the "Cut-Off"

We must now say something about this 50% cut-off, one of the main features of the Poultney Locomotive.

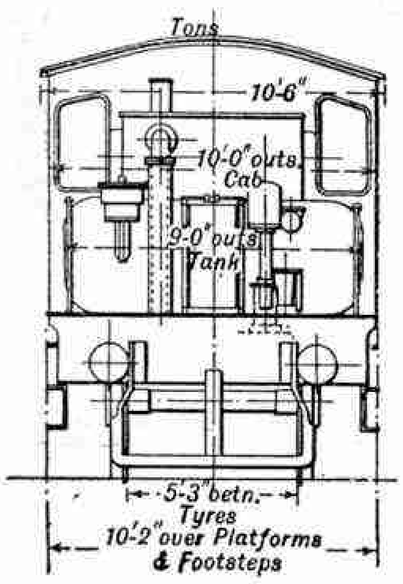
As most of our readers know, the amount of steam supplied to a cylinder during each stroke of the piston varies according to the extent of the movement of the cylinder valves. This movement is controlled by a shifting link embodied in the valve gear, and can be regulated by moving a lever conveniently situated in the engine cab. "Cut-off" is a term applied to the act of shutting off the steam supply to the cylinders, and the instant of its operation is determined by different conditions of valve-setting.

The statement that an engine works at "50% cut-off" means that steam is allowed to pass from the boiler into the cylinder whilst the piston covers exactly half the distance between one end of the cylinder and the other. It is then shut off, but the steam imprisoned in the cylinder continues to expand and drives the piston forward to the end of its stroke. If the driver places his lever to the 25% cut-off position, steam is then admitted to the cylinder through one quarter only of the piston stroke, and so on.

In the Poultney Locomotive the maximum cut-off is fixed at about 50% of the stroke. By thus restricting the maximum cut-off, the driver is prevented from working the engine at

uneconomical coal and water rates. A saving in steam is therefore effected over that required by an ordinary type of locomotive, and if this can be utilised there is obviously a potential gain in power.

Cylinder Arrangement on the Poultney Locomotive



Elevation of Cab

In the matter of boiler power, it is evident that the actual power obtainable from any boiler depends on the evaporation and on the use made of the steam generated. The evaporation per square foot of heating surface may be large, but the economic performance of the engines may be such that the power developed may be relatively low.

The idea underlying the 50% cut-off is the economic utilisation of the steam produced. The cylinders being larger—or, alternatively, the pressure higher—a given power can be produced at a relatively earlier cut-off. Thus by using the steam expansively, a less quantity is used per unit of power developed, and, therefore, a boiler of a given evaporative capacity can actually furnish more power at the engines. The accuracy of this statement has been well demonstrated in actual practice by the Pennsylvania 50% cut-off engines.

The Poultney Locomotive is thus based on principles already proved, because it is a 50% cut-off locomotive, the feature being that the steam economised in the cylinders of the engine portion is used in further cylinders on the tender. Any objections to the use of more than two cylinders have lost their force at the present time, as three and four-cylinder engines are becoming increasingly essential for the requirements of modern traffic conditions—indeed, in many instances, six cylinders have proved to be necessary.

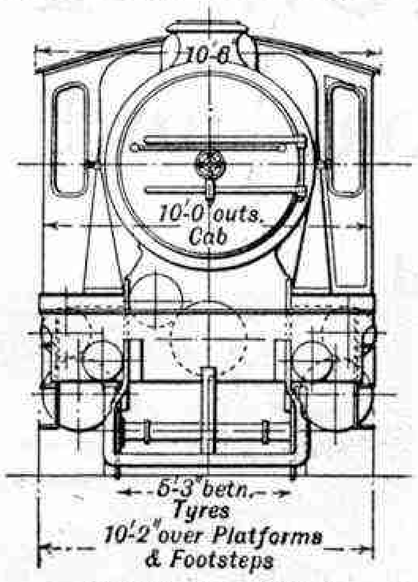
The use on the engine portion of cylinders of such size that, combined with the available steam pressure, they can furnish sufficient power to absorb a given percentage of the adhesive weight and at the same time be operated at a maximum of 50% cut-off, effects a saving in steam due to the short cut-off, less the added volume due to the increased cylinder capacity, of 30%. The steam so economised is used in the further cylinders on the tender, the volume of which up to cut-off (50%) is equal to the volume of the steam saved by the engine cylinders. In this manner a boiler of given capacity can furnish the additional power developed by the tender. The engine portion produces closely 70% of the locomotive power, and the tender the remaining 30%.

The combined heating surface of the boiler on the Poultney Locomotive is 3,718 sq. ft., and as the grate is 65 sq. ft., the ratio is about 57 to 1. Actually, the boiler factor (*i.e.*, $59372 \div 3718$) is 15.9, but when compared with a 90 per cent. cut-off locomotive using the same volume of steam per hour, this factor is $15.9 \times 0.70 = 11.1$ or, in other words, 30 per cent. less. The figure 11.1 coincides with average practice in the design of high-powered freight locomotives, and thus, any question as to the adequacy of the steam supply for engines built on this system is refuted.

The general arrangement of this particular design is well shown, and it is certainly a very practical idea to place the heater equipment on the tender, as generally the heaters are fixed on the top of the tank so that the condensate may pass to the tank through a suitable filter. This is one of several minor but none-the-less important features that in the aggregate add very greatly to the efficiency of the loco.

Heating the Feed Water

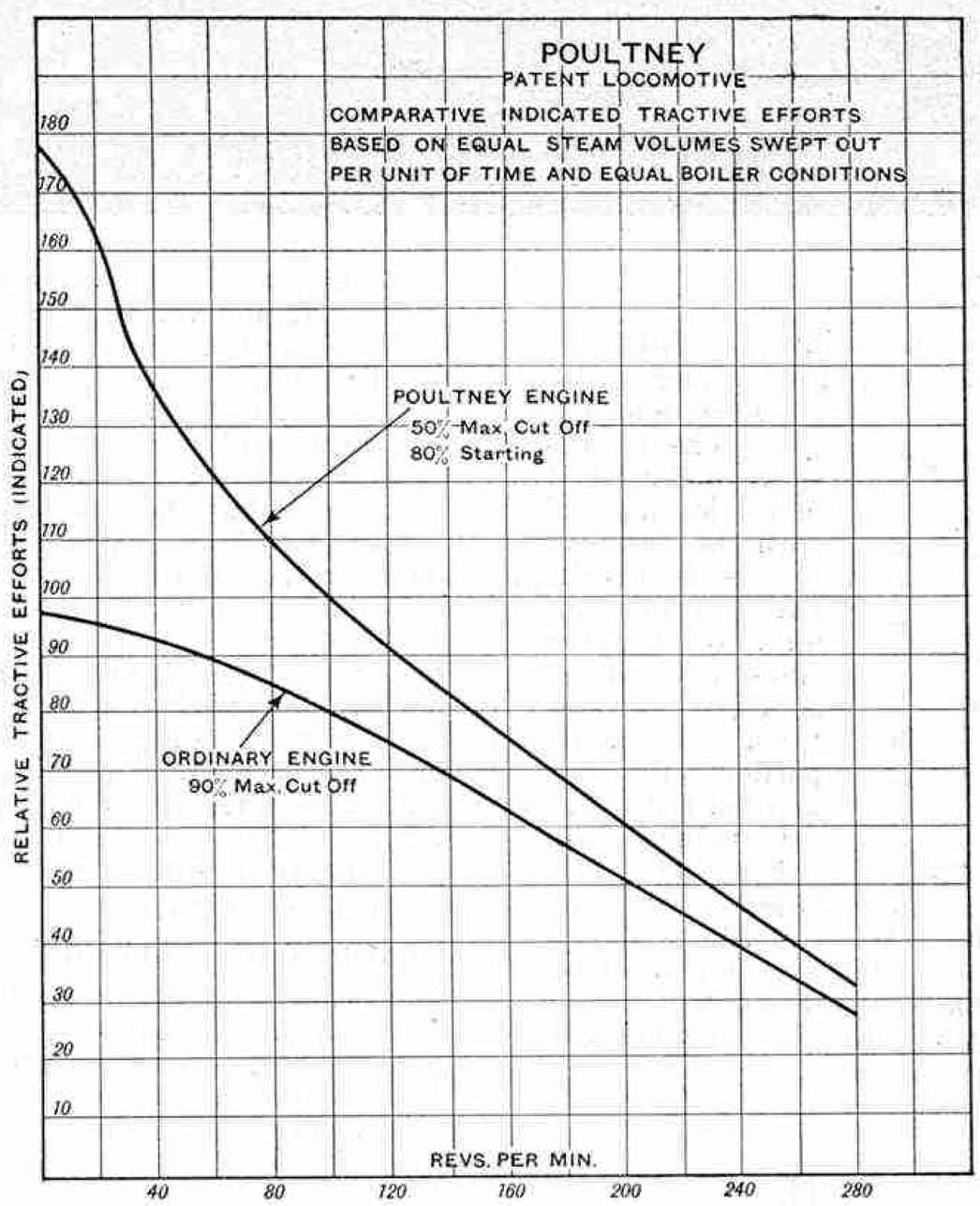
Further to improve the performance of the Poultney Locomotive, the exhaust from the tender engines is employed to heat the feed-water, and the main engine exhaust produces the required draught. This is an advantage because the hot feed lowers the demand on the heating surfaces—that is to say it reduces the heat transfer necessary and consequently lowers the fuel rate and improves the boiler efficiency.



Elevation of Front

Assuming an ordinary locomotive to cut-off at 90% in full gear (which is the longest practical admission rate, and hence that at which the greatest tractive effort will be produced) and that the value 100 represents the cylinder capacity, then the following comparative conditions will be obtained when such an engine be compared with one built on the Poultney system. For the ordinary engine the cylinders are assumed to work at a maximum cut-off of 90%. Then if the piston area be designated by 100, the steam volume is $100 \times 90 = 9{,}000$. For 50% maximum cut-off of equal power the area is 125, or 25% more, the steam volume $125 \times 50 = 6{,}250$, and the steam saving $9{,}000 - 6{,}250 = 2{,}750$. The figure 2,750 represents the steam volume—that is, the volume up to cut-off for the tender cylinders, which are therefore $\frac{2{,}750}{50} = 55$ area.

From the above, the piston area of the Poultney engine is $125 + 55 = 180$, and the percentage of work done on the tender is 30. The total volume to cut-off being the same, thus $100 \times 90 = 9{,}000$ and $180 \times 50 = 9{,}000$.



	40	80	120	160	200	240	280
3'-0" wheel	4·28	8·57	12·86	17·14	21·43	25·71	30
3'-6" ,,	5	10.	15	20	25	30	35
4'-0" ,,	5·71	11·42	17·14	22·86	28·57	34·28	40
4'-6" ,,	6·43	12·86	19·29	25·71	32·14	38·57	45
5'-0" ,,	7·14	14·28	21·43	28·57	35·71	42·86	50
5'-6" ,,	7·86	15·71	23·57	31·43	39·29	47·14	55

Speed in miles per hour with various wheel diameters at the above mentioned revs. per min.

As the engine portion represents the same power as when working with the smaller cylinders at the long cut-off, the power developed by the tender is the theoretical increase in power obtainable with the Poultney system. Alternatively, instead of making the engine cylinders larger, an equal result may, of course, be obtained by increasing the boiler steam pressure by 25%.

Arrangement of the New Locomotive

The arrangement of the Poultney Locomotive is similar in all essentials to an ordinary engine and tender, and the arrangement is as follows :—The two, or more, cylinders on the engine have a maximum cut-off of 50% as have also those on the tender.

The exhaust from the engine portion cylinders is utilised for the blast, and that from the tender cylinders is employed for heating the feed-water, which is supplied to the boiler by a pump operated by superheated steam, when the locomotive is running.

Due to the above arrangement, the engines on the boiler portion are always proportioned so that they develop not less than 67 to 70% of the total locomotive power. When the steam pressure is increased, then of the total piston area designated by the value 164, 70% should be on the boiler portion leaving 49.2 on the tender. The cylinder volumes must therefore be 1 : 2.31, the larger value being of course that representing the cylinders on the engine.

From the foregoing it will be seen that the following cylinder ratios obtain. Increasing the engine portion cylinders 25% means a cylinder ratio of 125 : 55 or 2.27 : 1. Increasing the boiler working pressure 25% means a cylinder ratio of 114.8 : 49.2 or 2.33 : 1.

We come now to the manner in which the Poultney loco combines the good points of both compound and simple types.

Ingenious Arrangement Ensures Easy Starting

It will be evident from what has been said of the 50% cut-off locomotive that in its characteristic features it is similar to a compound having 1 : 2 cylinder ratios. It also resembles the compound in that it should, when compared with an ordinary long cut-off engine, preferably carry a higher steam pressure. The reason for this is that at all times it uses the steam expansively—in fact, it cannot be operated at extravagant steam rates. In full gear the ratios of expansions are in the proportion of 2 and 1.11 and 1.25 for 50% cut-off, and 90% and 80% cut-off engines respectively.

In order to effect easy starting at all crank angles, a special piston valve has been designed. The valve is of the narrow ring type having two heads in which, on the steam side, are cut starting ports communicating with the steam ports. The relation that these ports bear to the main ports is such that actually steam is not cut-off before 80% of the piston stroke.

The starting ports in the valve are out of balance—that is to say, there is a greater port area through the valve at the front end in each direction of working. Thus when the locomotive is moving with the engine part leading, more supplementary steam is admitted at the front ports of the engine cylinders than at the back ports. Likewise, when the tender is leading, the front ports of the tender cylinders receive more starting steam. In this way quick and adequate starting is assured.

The starting ports are arranged to move over specially-formed bars in the annular ports, so that although the area of the former is considerable, their effectiveness rapidly diminishes as the valve moves to the point of cut-off. Therefore, an undue amount of steam is not admitted, and, as speed increases, the wire drawing action set up quickly discounts the auxiliary steam admitted, and the indicator cards show only a 50% cut-off in full gear operation. In practice the 80% cut-off effect is neutralised as soon as the engine speed has increased beyond about 14 revs. per minute.

The New Type is Equal to the Compound

In its characteristics the Poultney Locomotive is equal to a locomotive of the compound type but has the same freedom in running as the simple. This is made possible by the fact that the excessive back pressure present in the high-pressure cylinder of a compound is absent in the Poultney engine. More power is provided at all rates of admission than in the case of an ordinary locomotive and, by reason of having a power-driven tender, it runs equally well in either direction. The fact that the power is divided means lower axle loading for a given tractive effort, and this in turn means fewer coupled axles.

Steam and Water Connections

Compared with the usual forms of articulated locomotives, the pipe connections required for locomotives built on the Poultney system are very simple. There is required only one flexible joint subject to high pressure steam and none for exhaust steam.

The tender feed-piping is similar to that generally employed, with the difference that the feed from the heater installation is under pressure. Obviously there need be no difficulty in this, as the same arrangement as that used for the high pressure steam supply to the tender unit may be used.

As far as boiler feed piping is concerned, it is of a simpler character than that required for other well-known articulated designs, and freedom from unnecessary complications in this respect is of course very desirable.

Some examples of "Poultney" Locomotives

TYPE Engine Tender	TRACTIVE EFFORT	TYPE Engine Tender	TRACTIVE EFFORT
2—8—2+0—8—0 ...	55,000 lbs.	4—8—2+0—8—0 ...	27,000 lbs.
4—6—2+0—6—4 ...	50,000	2—6—2+0—6—2 ...	18,000
2—10—4+0—10—0 ...	50,000	0—8—2 "Poultney" tender (adaptable to existing locomotive)	17,300
0—10—0+0—8—0 ...	45,000	0—8—0 "Poultney" tender (adaptable to existing locomotive)	10,600
2—8—2+0—8—0 ...	45,000		
2—8—2+0—8—0 ...	38,500		
4—8—2+0—8—0 ...	37,000		
2—6—2+0—6—0 ...	35,000		

Some Interesting Data

As we mentioned at the beginning of this article, the principal object of the Poultney system is an increase of up to 30% in the power of an existing locomotive without increasing either the axle load or the size of the boiler. This object is achieved by the use of additional cylinders on the tender and taking advantage of the weight of the tender for adhesion. The steam demand is no more than that of an ordinary locomotive of 30% less power and therefore no larger boiler is required. To obtain this increase in power, however, the combined areas or volumes of the cylinders in the Poultney system are about 50% larger than those of an ordinary locomotive.

Although at first sight it might be supposed that the power gained by the increase in cylinder capacity might balance the steam saved by the shortened cut-off, this is not the case. An examination of the principle of the tractive effort formula based on mean effective pressure in the cylinders proves this. Cylinder clearance, pressure drop and back pressure will be ignored for simplicity, as they do not substantially affect the comparison.

The constant C for the M.E.P. varies as $\frac{2}{E+1}$ where E is the expansion ratio.

Working these values out for different ratios of cut-off we get :—

Cut-off	90%	85%	80%	75%	70%	60%	50%
M.E.P.	.947	.919	.888	.858	.8235	.75	.6666

To obtain a co-efficient for the tractive effort available at the rail or drawbar, some allowance for machinery friction must be made. This obviously varies with different types of engines, but the assumption of an average of 10% loss is customary. The above values then become :—

Cut-off ...	90%	85%	80%	75%
Co-efficient	.852	.827	.799	.772
Cut-off ...	...	70%	60%	50%
Co-efficient	...	.741	.675	.5999

It will be seen that the values for 90% and 50% are confirmed by American and Continental useage, where co-efficients of .85 and .6 are adopted, whilst those for 70 and 75% agree with the common British practice of using .75.

These conditions prevail at about 70 revolutions per minute, see accompanying diagrams which shows that an enormous increase of tractive effort is claimed at starting. This presents something of a problem to the uninitiated, as if the cut-off is restricted to 50% the engine would not be able to start. The difficulty has been ingeniously overcome, however, as already described.

It is interesting to find that the restriction of the maximum cut-off to 50% does not cause uneven turning moment as has been suggested by critics. On the contrary, it gives more even turning, as an investigation of the tangential turning effort exerted by a 90% and 50% cut-off locomotive will show. In fact, the latter is practically equal to that of a three cylinder locomotive.

The blast from the engine cylinders is quite strong enough to make steam for both engine and tender, because the steam taken for the tender cylinders goes back to the boiler in the form of heat—where it raises practically an equal amount of steam—by means of the feed water heater. The exhaust from the engine cylinders alone is used for the blast and there is therefore an even heat, which is not the case with articulated engines in which the steam from all cylinders is directed up one chimney.

Advantage of Self-propelled Tender

The objection to running ordinary locomotives tender first does not apply to the Poultney Locomotive as the tender is self-propelled and there is no tendency for it to be pushed off the road.

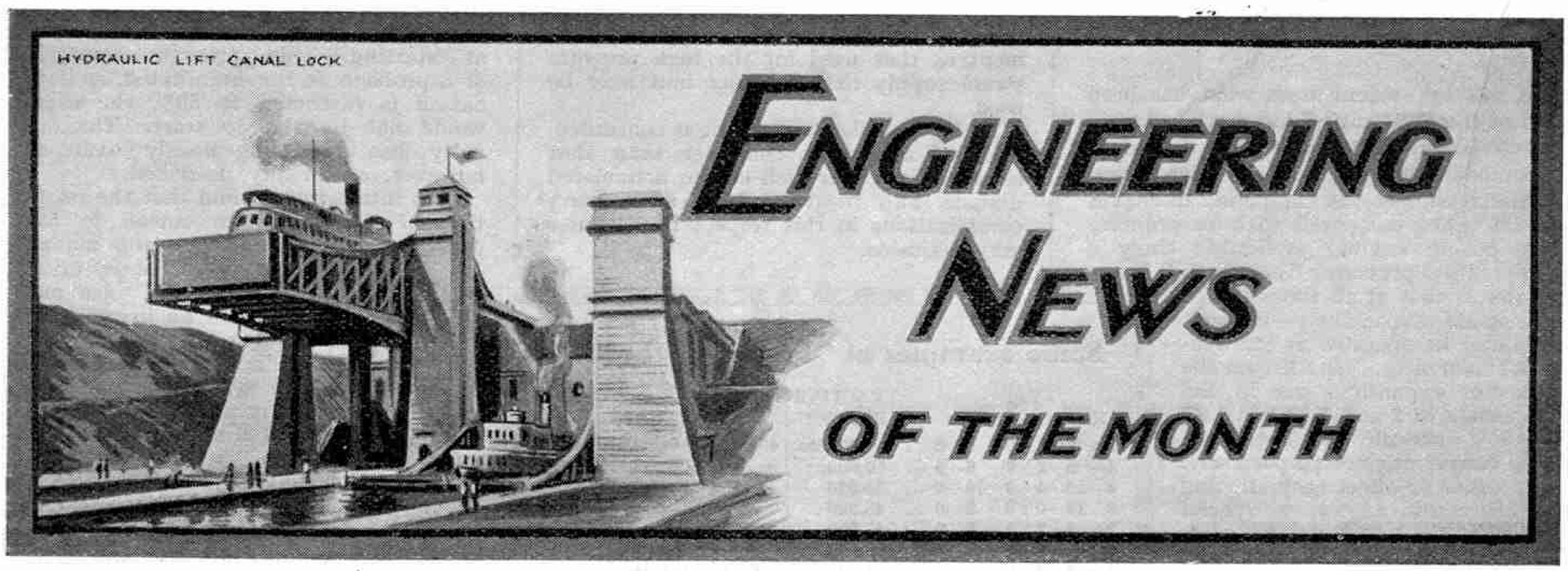
Incidentally it may be mentioned that the water level in the tank is very little disturbed when working on even the steepest grades.

No centre pivots are employed, the connection between the engine and tender units being of a type and design well established. In this, as in all other features of the Poultney Locomotive, experiments and fanciful ideas form no part in its constructive characteristics.

The "Poultney" locomotive is the most recent successful attempt to design a locomotive for heavy traffic purposes which, while conforming to the requirements of the British loading gauge and retaining the ability to negotiate comparatively sharp curves, possesses greater power than locomotives of the conventional type. Earlier efforts to solve this problem resulted in the production of the "Fairlie" and the "Garratt" locomotives.

The most powerful "Garratt" yet built attracted a great deal of attention when it appeared in the Railway Centenary Procession at Darlington in July 1925. This monster differs from the "Poultney" loco in being a "double-ender" in appearance and in reality, consisting virtually of two 2–8–0 locos each with cylinders 18½ in. in diameter by 26 in. stroke, supplied with steam generated by a boiler 7 ft. in diameter. The pioneer "Garratt" was designed and built in 1909 for service on the Tasmanian Government Railways.

The original "Fairlie" articulated locomotive had as its outstanding features a central firebox with two barrels projecting longitudinally and two smoke-boxes and chimneys, while the tanks were located alongside the boiler. Later the design was greatly modified and improved and the double-barrel boiler was abolished.



The World's Shipping Tonnage

The recently issued 1926/7 edition of Lloyds Register Book gives the usual review of nautical matters, from which it is interesting to glean Great Britain's position in relation to the other maritime nations, by comparing the tonnage statistics for 1914 and 1926.

Altogether throughout the whole world there has been a total increase of shipping tonnage of 17,268,000—the grand total in June, 1914, was 45,404,000—and of this increase the United States is responsible for 9,365,000 tons and Japan 2,260,000, while the British Dominions, France, Holland and Italy each have increased their tonnage by over 1,000,000. Great Britain's increase is only 372,000 tons.

Great Britain, however, remains the supreme maritime power. Out of a total world's tonnage of 62,672,000 she still possesses 19,264,000 and, despite the huge American increase, can still boast a fleet half as big again as that possessed by the U.S.A., which now ranks as the second maritime country. Japan is third on the list with only a few tons short of 4,000,000.

A considerable proportion of this great increase of tonnage during the past 12 years is due to the number of ships built during the war for use as military transports, and the difficulty of employing all the ships is reflected in the comparative stagnation that prevails in the shipbuilding world generally.

* * * *

Canadian Hydro-Electric Development

During the next 20 years it is anticipated that over £250,000,000 will be spent in harnessing the natural resources of Eastern Canada for the production of electric power. No specific programme has been laid down, and the figures are stated to be simply an intelligent anticipation of natural growth of the use of hydro-electric power in a country abundantly supplied with natural resources.

* * * *

Trams v. 'Buses

Considerable controversy has raged in the press for many months past on the subject of the abolition of track tramways and the substitute of either railless trolley cars or motor omnibuses. The only persons seemingly undisturbed by the problem are the operating authorities themselves. In many parts of the country corporations are operating both track tramways and motor omnibuses, and are extending both systems.

Such is the case in Sheffield, and in a recent interesting lecture the Sheffield Corporation Tramways Manager stated that his department was only awaiting a favourable opportunity to undertake considerable extensions of tram track. On the other hand, the department was also to undertake an interesting experiment by introducing a six-wheeled type of motor omnibus.

* * * *

Largest Floating Roadway in the World

The recent opening of the new floating roadway at Seacombe, on the Cheshire side of the river Mersey, will considerable facilitate the passage of vehicles across the river. Until recently all vehicles using the Wallasey ferries had to be hoisted from the river level to the shore level by means of a hydraulic lift, a method that occupied some little time and created considerable delay during rush hours.

The floating roadway is 600 ft. in length and 56 ft. 6 in. in width, and runs through a cutting in the river wall on pontoons on to a landing stage nearly 1,000 ft. in length. At low water the slope from the landing stage to the shore level will be no more than 1 in 22, and on a 29 ft. tide the roadway will be practically level from end to end. It is laid out to carry three lines of traffic.

The new roadway is the largest of its kind in the world, and is the third of its type to be built to convey the Mersey cross-river traffic.

* * * *

Diesel-Engined Train Ferry

A new train ferry has been built on the Clyde by Messrs. A. & J. Inglis for the Entre Rios Railways Company, for service on the River Parana. The vessel is 355 ft. 6 in. in length and has an extreme breadth of 59 ft. 6 in. Four sets of rails extend for almost the complete length of the ship and the bridge deck is placed on a high level in order that trains using the vessel may pass underneath.

A special feature of the ferry is that it is the first of its type to have internal combustion engines. The Diesel engines fitted each develop 700 h.p. and an additional novelty is the employment of super-chargers driven by electric motors. The vessel's maximum speed, it is estimated, will be 11½ knots.

* * * *

An official report shows that at the end of 1925 there were 588 hydro-electric power stations operating in Italy, having a combined total capacity of more than 2,000,000 nominal h.p. In addition, 95 new stations that will add 50 per cent. to the total production of power are under construction.

* * * *

A proposal is on foot to construct a new bridge over the Rhine at Dusseldorf. The estimated cost is approximately £700,000 and the German Steel Trust have offered to guarantee a loan of £300,000, contingent upon the iron and steel work necessary in the construction being ordered from the Trust.

* * * *

Marseilles-Rhône Canal

The most important engineering work completed in France within recent years is the Rove Canal, which was recently opened to traffic. It has taken 23 years to complete and forms the last section in the inland system of waterways connecting the seaport of Marseilles with the River Rhône.

The Rove Canal burrows through the Estaque ridge which stands between Marseilles and the Lake Etang de Berre, the tunnel being nearly five miles in length. It is over 70 ft. in width and has a depth of water of 13 ft. Starting at Marseilles and passing through the Estaque it enters the Etang de Berre at Martigues and leaves it again at the Port de Bouc. It then crosses the plain at the Crau and meets the Rhône at Arles, the total length being over 50 miles. In addition to securing a passage for the barge traffic of the Rhône, Marseilles will benefit by the provision of extra quay accommodation in the Etang de Berre.

* * * *

New Atlantic Liner

The liner "*Statendam*," the largest mercantile vessel to be launched since the war, which was completed by Messrs. Harland & Wolff up to the launching stage in 1924, is, we understand, to be transferred from the Holland-America line to the Red Star Line, and completed. The vessel is 697 ft. in length and 89 ft. in width, her gross tonnage being 30,000. She will be run by the Red Star Line on the Antwerp-New York service as a sister ship to the "*Belgenland*."

* * * *

A new high power broadcasting station was recently opened at Sydney, N.S.W. The station will be one of the most powerful in the world and will be able to communicate with India, America and Africa.

The Story of the Telephone

The newly-elected chairman of the North Western centre of the Institute of Electrical Engineers, Mr. W. J. Medlyn, in his inaugural address gave an interesting resumé of the history of the telephone. He traced the various developments from the first public service, in Boston, U.S.A., in 1877, followed by New York and London in 1878 and 1879 respectively, down to the present day.

The steady growth of the range of transmission from 45 miles in 1880 to 3,600 miles in 1915 was mentioned, and it was stated that the first real difficulties arose when the introduction of submarine cables became necessary. These difficulties limited communication from this country to the London-Paris service until 1925, when a regular service between London and Berlin via Holland was inaugurated. The first automatic telephone was put into operation in Kansas City in 1889 and it was not until ten years later that the first automatic switch was introduced to Great Britain. It was in 1900 that the system of using a separate battery for each instrument was scrapped, a common battery of secondary cells at the exchange being substituted.

A specially interesting portion of the address dealt with the underground cable that was opened in 1922 between London and Manchester. The length of this cable is nearly 200 miles and it contains 160 pairs of copper wires each weighing 40 lbs. per mile. Of these 56 are used for telegraphs and 104 for telephone communication.

* * * *

Boring operations in search of oil are in progress at Orallo, Queensland, where a bore has been sunk to a depth of 2,600 ft. The Commonwealth Government have advanced a further £4,000 to enable boring to be continued to the 4,000 ft. level.

* * * *

The Thames Bridges

The cross-river traffic problems of London are being examined in great detail at the enquiry now being held by the Royal Commission on the London Bridges, and many facts of which the average person is ignorant are being revealed.

One point of special interest that was elicited recently is that, although the population of London has increased by more than five times in the last 95 years, there have been added only four bridges and two tunnels to the river-crossing facilities. Between the Tower Bridge and Kingston, a distance of 21 miles, there are sixteen bridges available for road transport, exactly the same number that existed 50 years ago. Thus it is hardly surprising that the present bridges are finding the strain of carrying all the traffic almost beyond them, and one recommendation on the problem even goes so far as to suggest the provision of ten or twelve more bridges!

* * * *

Proposed Fast Service to Australia

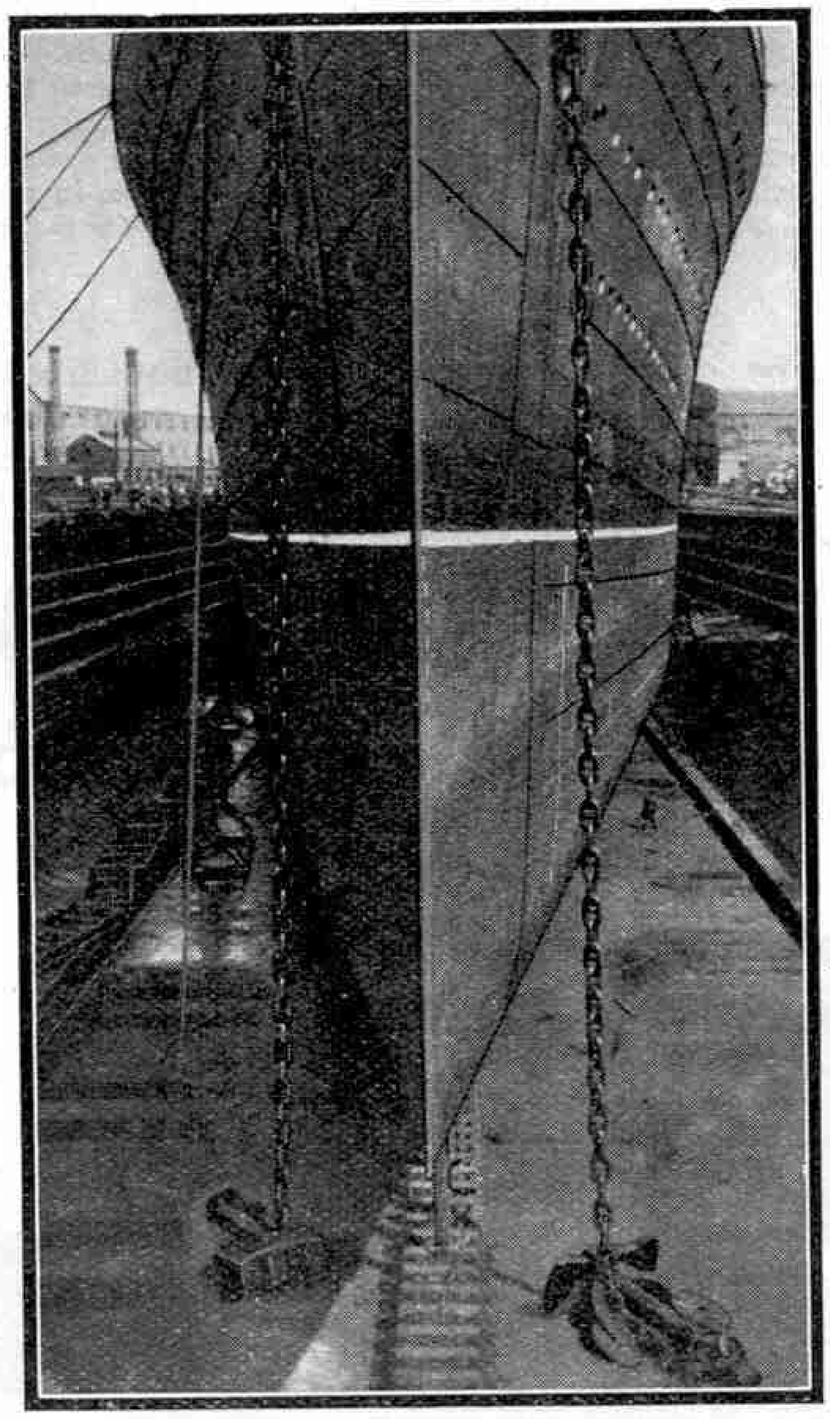
A syndicate of well-known business men have recently submitted a scheme to the Australian Government for the establishment of a regular fortnightly steamship service between Australia and Britain, calling at Bombay and Colombo on both the outward and homeward voyages. In the event of the scheme being approved, seven new liners, each of 24,000 tons, will be built and placed in service.

The new ships will be designed for a speed of 22 knots, nearly half as fast again as that of the present ships on the route, and this speed would have the ultimate effect of bringing Australia seven days nearer to Britain, while the voyage to India and Ceylon would be correspondingly shortened.

Each of the new ships will have accommodation for 500 first-class and 1,500 second and third-class passengers. The engines will be designed to use oil fuel, but arrangements will be made for coal to be used if for any reason a change is desirable. Most important of all, from the point of view of increasing Australia's trade in meat, fresh fruit and butter with India and Britain, the refrigerated space on the new ships will be exceptionally large.

It is probable that the ships will be completely built and equipped in Great Britain. The total cost of the vessels would be nearly £10,000,000, and the placing of such an order would provide work for many thousands of shipyard employees.

Below the Load Line



An interesting photograph, taken by H. Aslin of Redhill, showing the R.M.S. "Aquitania" in dry dock at Southampton. The Plimsol mark, indicating the maximum load line of the ship in salt water, is clearly seen, as are also the massive anchors

New Bridge over Zambesi

For more than 20 years the world-famous bridge at the Victoria Falls has been the only bridge crossing the River Zambesi. Now a definite proposal to construct a second bridge across the river at Sena in Portuguese East Africa has been brought forward. Although the bridge will cross the river in Portuguese territory it is essential if the development of the British Protectorates of Nyasaland and Northern Rhodesia is to go forward, and the proposal is part of the East African transport development scheme in which the British Government are giving their support to the local governments. Portugal, by its ownership of a long section of the East African coast, owns the port of Beira, upon which both Northern and Southern Rhodesia and Nyasaland are dependent for their sea-borne traffic. The British territories possess certain privileges, however, that give them the right to through transit to the coast.

The Sena bridge will be a long, low structure over a broad and shallow stream, and will consist of 26 girder stays one of which will lift to permit river steamers to pass. The length of the main bridge will be 4,150 ft. and on the Sena side of the river it will connect with a stone embankment, 1¼ miles in length, that will have three large openings across smaller channels of the river. The estimated cost is £750,000, and in addition a smaller sum is provisionally allocated to cover the cost of linking up the present railway system with the bridge, a total length of line of 33½ miles being necessitated.

At first sight it does not appear to be an economic proposition to undertake so extensive a scheme in this district, but in actual fact a big coalfield exists near the river and the new line should quickly develop a coal traffic of hundreds of thousands of tons per annum.

* * * *

Floating Docks at Rouen

The Petit Couronne marshes are to be dredged by the Rouen port authorities with a view to the construction of two, and possibly three, new floating docks. The largest of these will be capable of lifting vessels of not more than 9,500 tons displacement and 575 ft. in length and will be placed in a dock basin, access to which will be afforded by a canal 99 ft. in width and 2,295 ft. in length. The actual dimensions of the basin have not yet been decided upon in view of the decision that has yet to be made as to the number of docks to be constructed.

* * * *

New 18,000-Ton Motor-Ship

An order has been placed with a Hamburg firm for an 18,000-ton motor-ship that will be a sister ship to the "*Gripsholm*" recently described in the "*M.M.*" The new vessel's engines are designed to develop 15,000 shaft h.p. and will be of the four-stroke double-acting type similar to those of the "*Gripsholm.*" Competition for the new liner was exceptionally keen, tenders being submitted by 15 firms, drawn from Britain, France, Germany, Italy and Sweden.

The Hornby Control System

SIGNALS, POINTS, AND TRAINS CONTROLLED FROM THE SIGNAL CABIN

The remarkable development of Hornby Trains probably represents a feat of model engineering that has not been equalled since the invention of Meccano twenty-five years ago. From the day of their introduction, Hornby Trains have always represented the latest model railway practice, and their popularity has grown to such an extent that their name has become a household word. And now another new Hornby "thrill"—the Hornby Control System! Every model railway enthusiast can now arrange his layout so that he may control his clockwork trains, signals, and points by operating a set of levers in a convenient signal cabin. Below we print the second and concluding instalment of an article describing the Hornby Control System in detail. The first instalment appeared in last month's "M.M." and the complete article contains all the necessary instructions for the installation and operation of the System.

(Concluded from last month).

SO long as the Points or Signals to be operated are quite close to the Lever Frame, as in Fig. F, the wire Rodding is held in the correct position by the couplings gripping it at each end. When the length of Rodding is increased, however, Guide Brackets become necessary. Fig. G shows one of these Guide Brackets in position carrying the Rodding.

The improved Hornby Rails have two holes pierced in the sleepers as shown in Fig. G, whereas there is only one hole in the sleepers previously manufactured. The Guide Brackets are therefore pierced with three holes so that they may be attached either to the old or the new type rails.

It will be observed from the illustration that there are five smaller holes in the projecting portions of the Brackets. Any number of separate lengths of Wire Rodding up to five may therefore be carried side by side along a single stretch of Hornby Track, each length being passed through separate holes in the Brackets.

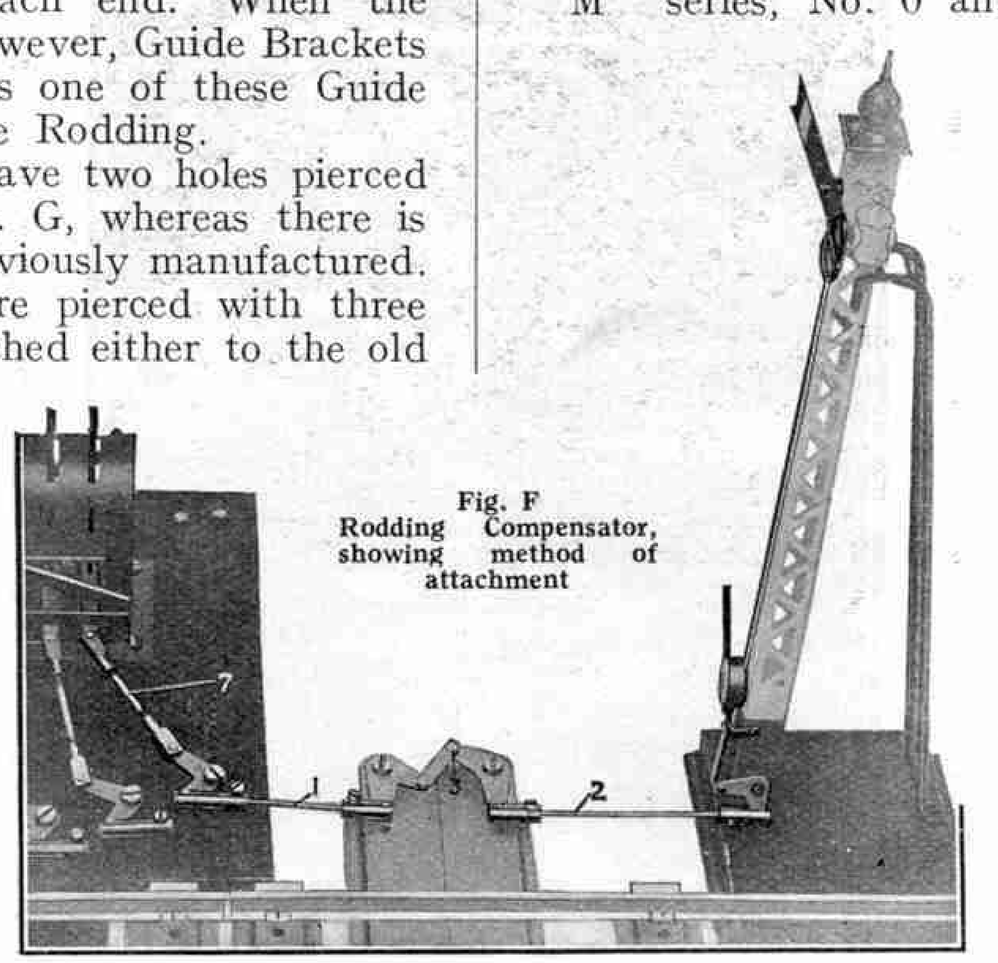


Fig. F
Rodding Compensator, showing method of attachment

Rodding Compensators

Signals operated to the right of the Lever Frame are attached in a similar manner to the Points illustrated in Fig. D (see December "*M.M.*") When they are fixed to the left of the Lever Frame, however, a Rodding Compensator, Fig. F (3), is required to convert the thrust of the rod (1) into a pull of the rod (2). The method of attaching the compensators is clearly shown in the illustration.

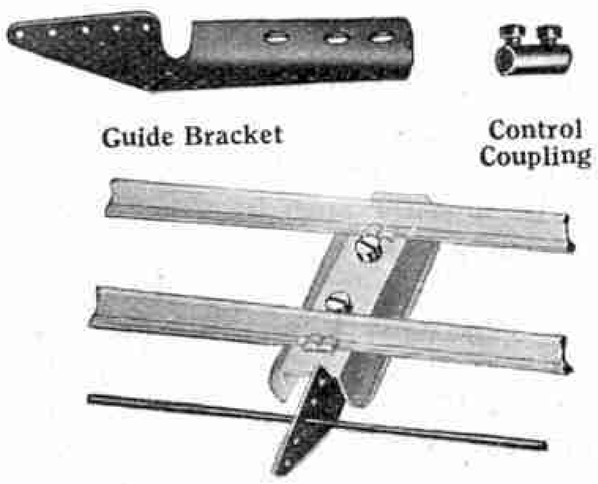


Fig. G

Brake and Reverse Rail

The Brake and Reverse Rail, Fig. H, plays a very important part in the Control System. By means of it the "M" series, No. 0 and No. 1 Locos may be braked and brought to a standstill. It should be remembered that the "M" series and No. 0 locos are not fitted with reversing gear and the No. 1 locos are reversible only from the cab.

As we have already explained, in order to stop the "M" series, No. 0 and No. 1 Locos, the projection (1) must be placed in the central position.

After any of the above locos have been stopped by means of the Brake and Reverse Rail they are started again by the brake lever in the cab.

Control Rail and its Functions

The Control Rail is shown in position on the track at (1) Fig. J. This rail is intended to be operated only with the newly-designed mechanism of the Special No. 2 Loco and the Metropolitan Clockwork and "Blue" Train Clockwork Locos.

The special importance of the Control Rail is that it enables both starting and stopping to be carried out automatically.

The ability to re-start a train from the Signal Cabin without touching either the loco or the track adds very greatly to the possibilities of traffic control and indeed permits the carrying-out of many extremely interesting operations that would be impossible in the ordinary way.

In addition, the Control Rail enables us to reverse these special locos and thus gives complete automatic control of the train from the Signal Cabin. Owners of the ordinary No. 2 type of loco may use the Control Rail for braking or reversing, but after braking this loco cannot be started automatically, but must be re-started by operat-

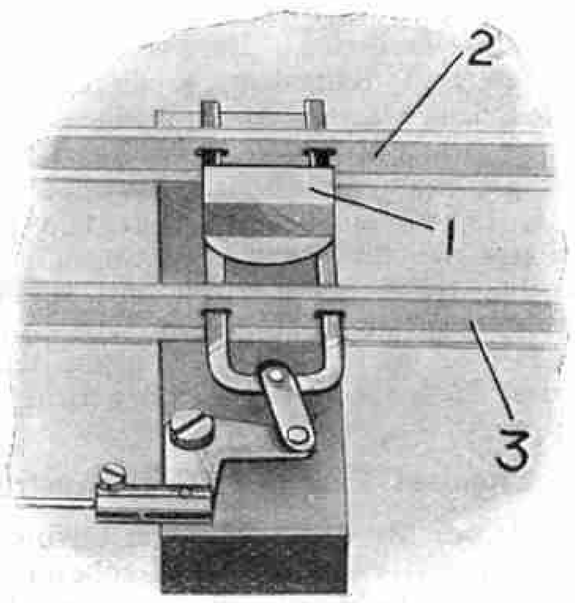


Fig. H

ing the brake lever in the cab.

In Fig. K we show the underside of the clockwork of the Special No. 2 Loco. The cam (A) when operated by the Control Rail (1) Fig. J reverses the loco, and the cam (B) stops the loco, and automatically starts it again when the Control Rail is moved to the central position.

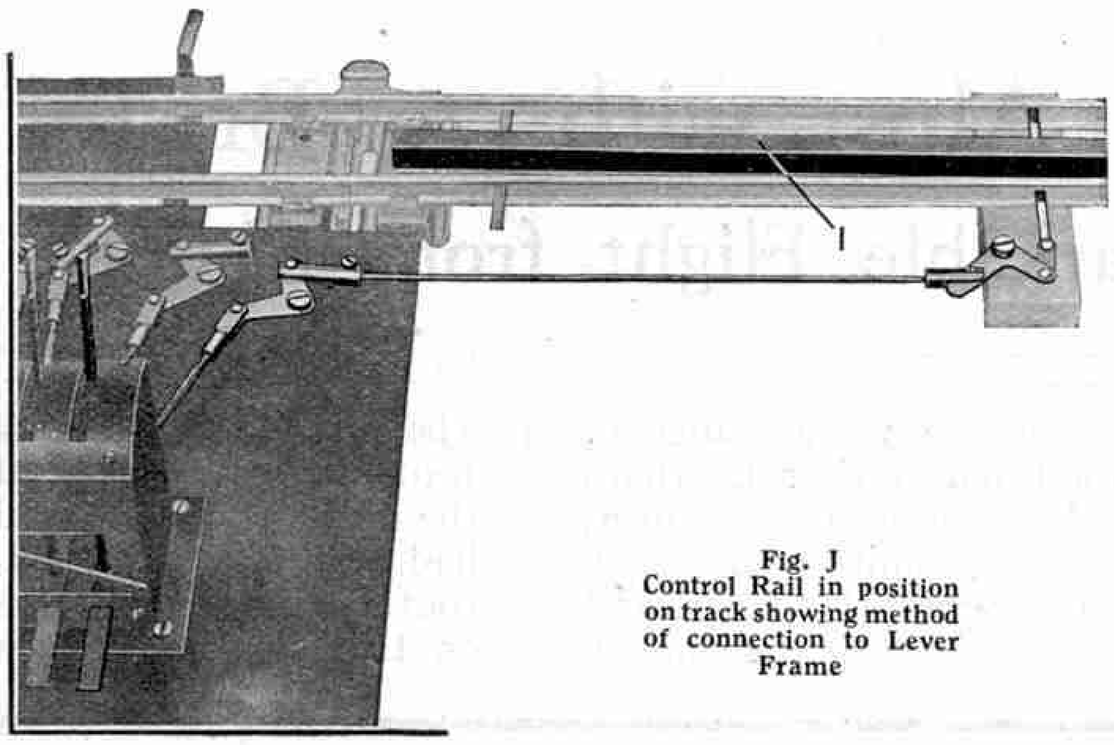
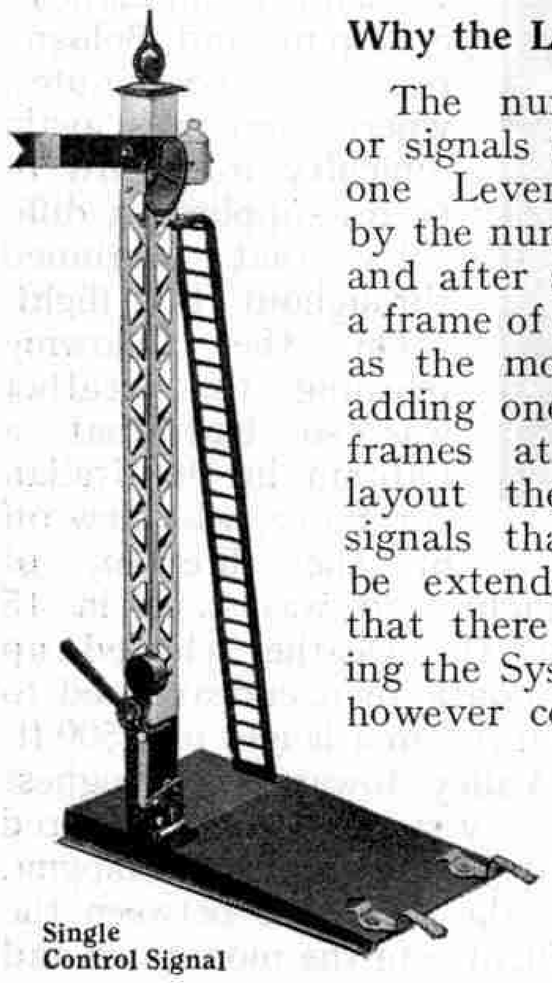


Fig. J
Control Rail in position on track showing method of connection to Lever Frame

The mechanism of the Hornby Control System works so smoothly and easily that it is possible to operate signals and points placed at a very considerable distance from the Signal Cabin. This is a feature of great importance, because it enables the Control System to be applied to layouts covering a large area.

The Lever Frame, Signals and Rodding Compensators contained in the System may all be clamped to any part of the layout by means of the clamping levers and lugs shown in the illustrations.



Single Control Signal

Why the Levers are Coloured

The number of separate points or signals that can be operated from one Lever Frame is limited only by the number of levers in the frame, and after a great deal of experiment a frame of six levers has been adopted as the most generally suitable. By adding one or more additional lever frames at different points of the layout the number of points and signals that can be controlled may be extended almost indefinitely, so that there is no difficulty in adapting the System to any type of layout, however complicated.

The six levers provided in the Frame are coloured in accordance with actual railway practice and are intended to be used as follows:—Green lever for distant signals, red for other signals; black (2 levers) for points; and white for spare lever. The blue lever is intended for the Hornby Brake and Reverse Rail and the Control Rail.

Owing to the special requirements of certain layouts, it may be desired to change the relative positions of the levers. To do this, it is only necessary to pull out the pivoting rod that passes through their centres. This may be removed quite easily by means of a pair of pliers, or even by gripping the end of the rod between two coins. The levers may then be withdrawn and after re-arrangement secured in their new positions by replacing the pivoting rod.

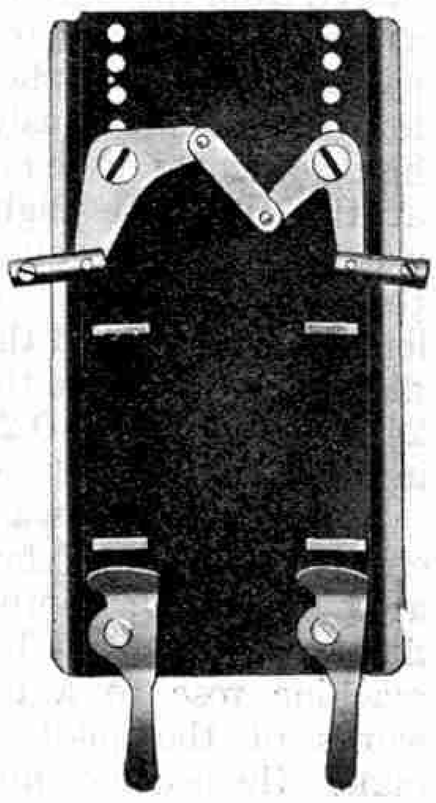
The levers are also numbered, so that their various functions may more easily be memorised. The numerals run in rotation from one to six and are printed on the top of the frame, adjacent to their respective levers.

The Hornby Control System may be adapted quite easily to any existing layout, and the foregoing description should demonstrate clearly the great increase in realism brought about by its application. In the ordinary way the points and signals situated in various parts of a layout have to be operated individually by means of their levers and, owing to the rapidity with which the train travels, it is not always easy on a "busy" line to reach the switches in time to avoid a collision or other disaster, while it is certainly difficult for one individual to operate the signals in accordance with actual railway practice. These troubles are obviated by the Control System, because all switches are controlled from one point.

Adjustment and Lubrication

No difficulty should be experienced in obtaining the best possible results from the Hornby Control System providing proper care is taken in following out the instructions already given in this article. We would conclude, however, by emphasizing the importance of the following three points:

As little play as possible must be allowed in the connections between the operating levers and the signals, brake rails and points. In the case of the latter, especially, all connections must be carefully made and the Rodding cut to the exact length required in order that the movable tongues of the points shall make proper contact with the rails when switched over to a new position.



Rodding Compensator

The set-screws in the Control Couplings must be screwed in very tightly, to obviate the possibility of the Rodding gradually pulling out from the Couplings after constant use.

Finally, it is most important to keep all the working parts well oiled, otherwise the levers will be found difficult to move, while the Rodding may become bent. Oil should be applied to the Rodding at every point where it passes through the Guide Brackets.

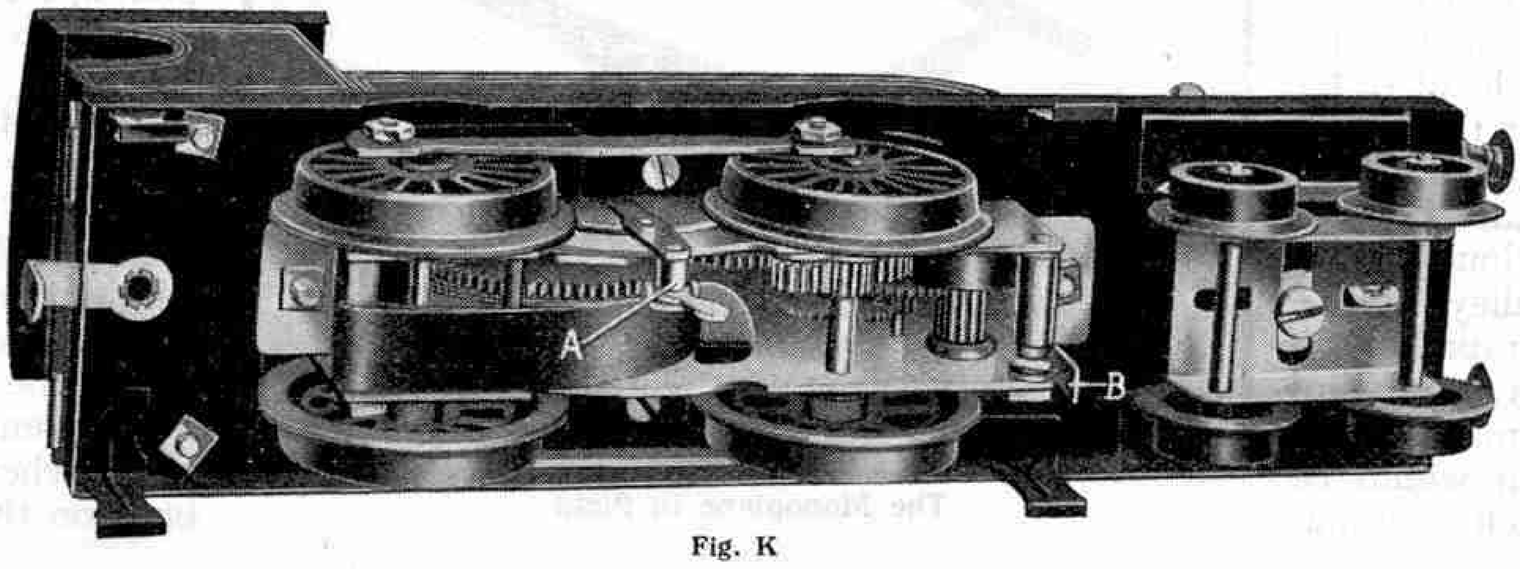


Fig. K

Over the Alps with a Bristol "Cherub"

A Remarkable Flight from Munich to Rome

A WONDERFUL flight over the whole range of the Alps was made last autumn by Herr Eberhard von Conta with Dr. Landsdorff as passenger. The machine used was a Messerschmitt monoplane, fitted with a Bristol "Cherub" Series III. engine and the flight, which is a remarkable tribute to the courage and determination of both pilot and passenger, will rank as one of the most notable ever completed by a light aeroplane.

Trouble began at the commencement of the flight, the machine being delayed at Munich owing to the fact that the official papers required from the German authorities, which papers had been applied for six weeks previously, had not come to hand at the time the flight was to start. However, these papers were at length received and the flight commenced on the 24th September at 9.20 in the morning.

The Messerschmitt Monoplane ready to start

The monoplane was headed for Innsbruck and soon encountered dense clouds, but with the engine running at 2,750 r.p.m. climbed to a height of 13,000 ft. and flew over the cloud bank. Over the Brenner Pass the machine rose to a height of 14,750 ft. when—in the words of the pilot—"unpleasant currents began to make themselves noticeable. We flew on through snow-clouds, however, and managed to keep our course to Verona until we reached Brixen. Snow and exceptionally heavy clouds prevented us flying further southwards, and we were forced to turn off by the River Drave, over the Dolomites in Austria."

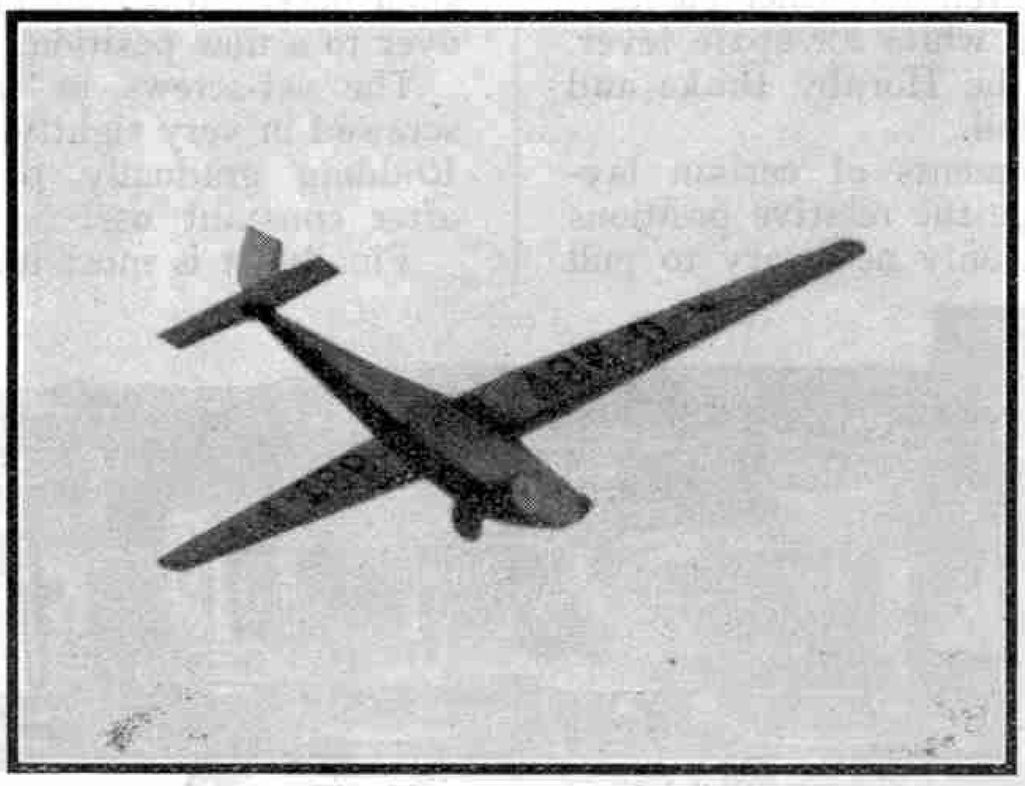
After flying for 2 hrs. 40 mins. Klagenfurt was reached, then Villach and having crossed the Karawanken Mountains the machine was headed for Verona. Thereafter the monoplane wound its way, at a height of 13,125 ft. and 5,000 ft. below a heavy cloud bank, through the Po Valley.

Darkness was rapidly approaching, and as the wind was against the machine, it was decided that it would be impossible to reach Verona. The airmen therefore landed in the olive and maize fields at Susegana, north of Venice. Here they spent the night but were not allowed to leave until permission had been obtained from the authorities at Bologna, to continue the flight. This was not received until 1.20 p.m. on the following day, when the machine was headed for Padua, which town was reached after 55 minutes' flying.

Here difficulty was experienced in obtaining petrol and only after six chemists had been tried was the pilot fortunate enough to obtain about a gallon. A start was again made at 5.10 p.m. and Bologna reached in 65 minutes, where there was again difficulty in regard to petrol supplies—a difficulty that continued throughout the flight.

On the following morning the weather was so bad that a Captain in the Italian Air Force, who flew off in the direction of Florence, abandoned his flight and was back in 15 minutes. In the afternoon the weather cleared up somewhat, and Herr von Conta then endeavoured to fly over the Appenines, which rise to a height of 6,500 ft.

Flying along the Reno Valley towards the highest peak of the range, a very heavy storm was encountered and the monoplane was compelled to return to Bologna. It is interesting to compare the difference between the time taken in the outward flight into the mountains and the return to Bologna, for while the former required 48 minutes, the return flight, including landing, occupied only 14 minutes.

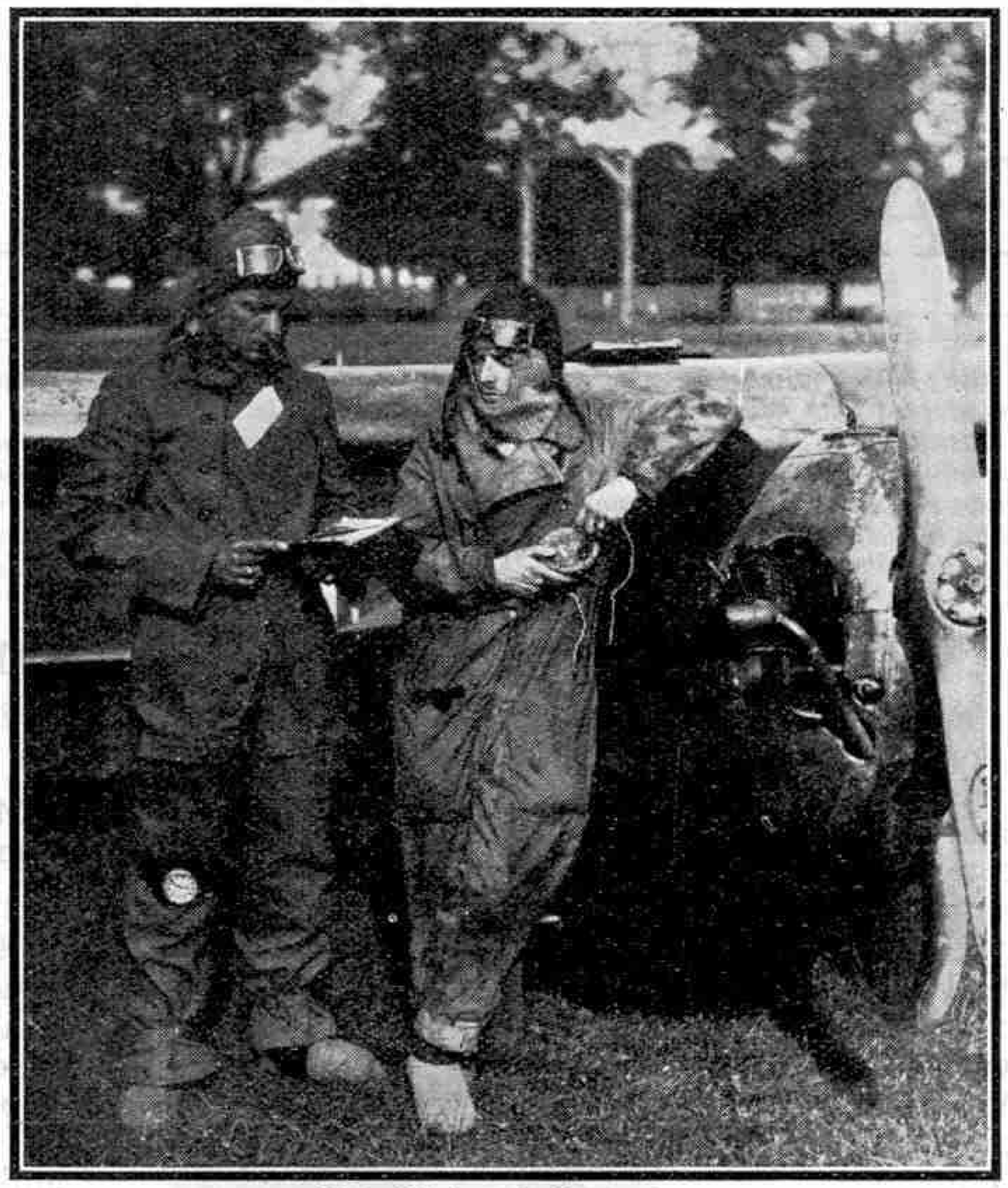


The Monoplane in flight

The Appenine Mountains are a considerable obstacle to aeroplanes, for terrible air currents are set up in their vicinity and only the most skilful pilots can negotiate them successfully. A further attempt to cross the range was made on the 27th September, and after climbing to a height of 8,850 ft. to just below a dense cloud bank, the monoplane entered the mountains at the same spot where it had turned back on the previous occasion.

At this point occurred the most alarming experience of the whole flight, for the machine was at the mercy of the winds of the valley, and was forced down to about 3,300 ft. The valley is here so narrow that it was impossible to turn, and the winds swept down with such strength that on several occasions the machine was thrown 90° from its horizontal position, and the airmen narrowly escaped being dashed to pieces on the steep slopes.

Having successfully extricated the machine from this predicament, the flight continued. Rain was soon encountered and Florence was approached in a downpour. Attempting a landing at a balloon station in the locality, the machine ran into a ditch and lost its right wheel. The damage was repaired in three hours' time, however, but in view of the pouring rain it was decided to wait until evening before landing at the small aerodrome situated in the centre of Florence, near the chief railway station.



The Pilot and Passenger

Rain and wind continued throughout the next two days, and after having waited a day the flight was continued on the 29th, although the conditions were unchanged. Flying in the rain for 28 minutes along the Arno Valley, and along the canal between Arezzo and Chiusi, the machine reached the Tiber which was followed to Rome. Here there are numerous landing places, and after having flown for two hours forty-five minutes, the machine was safely brought to earth at the Centocelle Aerodrome.

The arrival created great interest among aeronautical enthusiasts. It is rather humourous to learn that the pilot was invited to take part in the Competition for the International Cup of Italy, before it was realised that official participation was not possible owing to the event being open only for machines fitted with engines from 40 to 100 h.p., and the "Cherub" did not come within this category! The Italian authorities were so interested in the machine, however, that it was arranged for it to take part in the 300 km. (186½ miles) triangular flight on the 10th October.

For this flight seven machines started and only four completed the course, including the Messerschmitt machine, which put up a very good performance and by request was flown before military, naval and civil authorities.

Map showing the route over the Alps

After his return to Munich the pilot expressed his opinion that the Bristol "Cherub" engine is the most reliable engine with which he has ever flown. "This is not the opinion of a critic at his desk," he adds, "but the opinion of an aviator who has proved your engine throughout the Appenine flight, when it was equal to all emergencies."

After expressing this opinion of the Bristol "Cherub" engine Herr von Conta adds an interesting note about carburetters in Italy. "On account of the very great differences in the daily temperature in Italy," he writes, "it is necessary to alter the carburetters every other day on lorries, particularly on the Fiat, and also to change the jets. During the whole of my flight, however, I did not change a single jet."

It is also interesting to have Dr. Lansdorff's opinion of the British-made Bristol "Cherub." "The engine behaved magnificently during this flight," he says, "and I believe that the flight, which is a world's record performance as regards height for a light two-seater and which is the first crossing of the whole range of the Alps, is one of the greatest performances accomplished by the Bristol 'Cherub' engine."

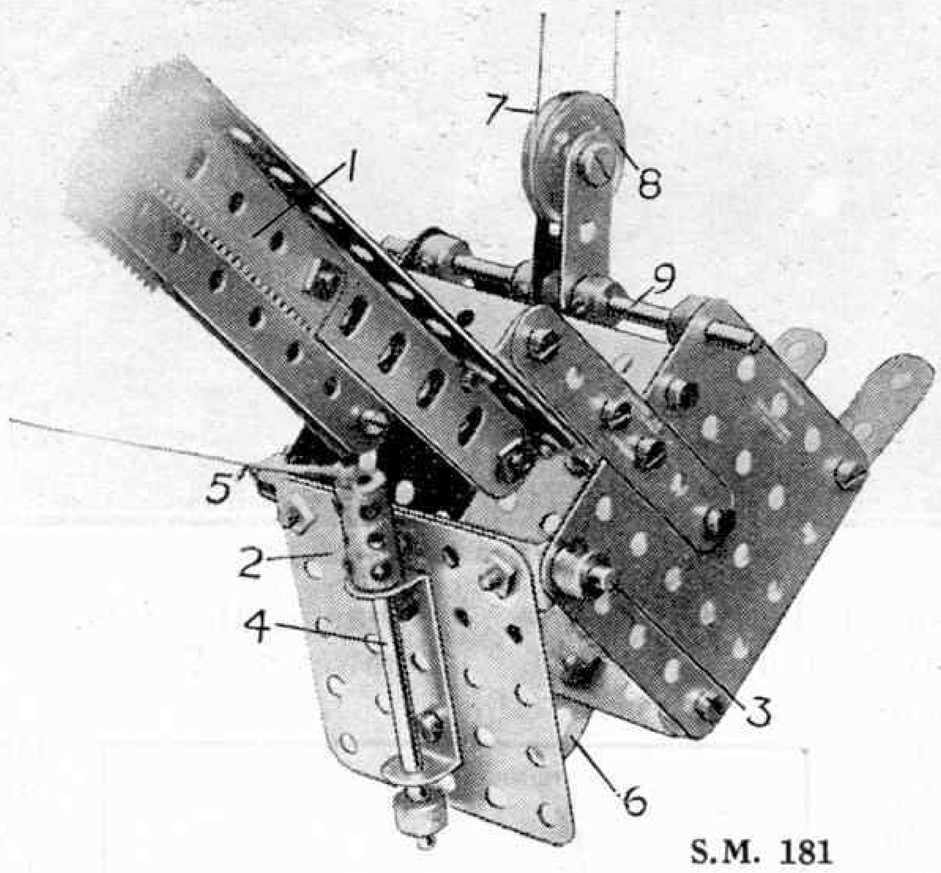
A few words about this engine will no doubt be of interest. It is of the two-cylinder opposed type of 1,230 c.c., and is made by the Bristol Aeroplane Co. Ltd., to whom we are indebted for the photographs accompanying this article. The cylinders have steel barrels and the pistons are of aluminium alloy, fitted with three rings. The connecting rods are hollow steel forgings, and the valves are of cobalt-chrome steel. The cam shaft with its four cams is machined from the solid, and the magneto is driven by spiral gears from the rear end of the crank shaft, the same spiral gears driving the oil pump located behind the starboard cylinder. The carburetter is of a special type of Zenith with hand-operated altitude control of the extra air, which control is closed automatically if the throttle is closed.

MECCANO STANDARD MECHANISMS

This article is one of a series dealing with a number of interesting Meccano movements that we have termed "Standard Mechanisms," for the reason that they may be adapted with advantage to numerous Meccano models—in most cases without any alteration, but in some few instances with slight alterations to the standard movement. We have already dealt with a number of interesting subjects, including Gear Ratios, Belt Mechanism, Pulleys, Levers, Drive-Changing Mechanisms, Brakes, Steering Gear, Screw and Traversing Mechanisms, etc. This month we reproduce some Meccano examples of the giant mechanical shovels used in Dredging, Excavating, and Conveying Machinery, and on the following page we commence the last of the thirteen Sections in which these movements have been grouped. S.M. 254, which describes the Torque Converter, has been held over pending a fuller description in a later issue.

Section XII. Grabs, Buckets and Dredging Apparatus

THE bucket illustrated in S.M. 181 is designed for use in Mechanical Shovels or other excavating machines. It is identical with that fitted to Model No. 707, which represents a type of Steam Shovel that is used to a large extent in actual practice, especially in the construction of canals, railway cuttings, and similar works. With each sweep of its arm a machine of this description scoops out of the earth many tons of mud or rock and, swinging round, deposits its load in a waiting truck, ready for removal to a more distant point.



S.M. 181

The Meccano bucket is bolted to the arm 1, which pivots from a point in the jib of the excavator. The bottom plate 2 of the bucket is hinged to the Rod 3, and is closed or opened as desired by means of a sliding Rod 4, operated by a cord 5. During the cutting stroke the Plate 2 is held in a closed position by the end of the Rod 4 engaging the aperture in a Flat Bracket 6. When the loaded bucket is moved over to the point where the material is to be dumped, its contents are discharged by pulling the cord 5. This action withdraws the Rod 4 from the Bracket 6, and so releases the plate 2.

The bucket is raised or lowered by a hoisting cord 7 engaging a Pulley 8 pivotally carried from a Rod 9. The radius of the cut is regulated by altering the length of the arm 1. This alteration is effected by rack and pinion mechanism mounted in the centre of the jib.

S.M. 182—Bucket Dredging Apparatus, or Bucket Conveyor

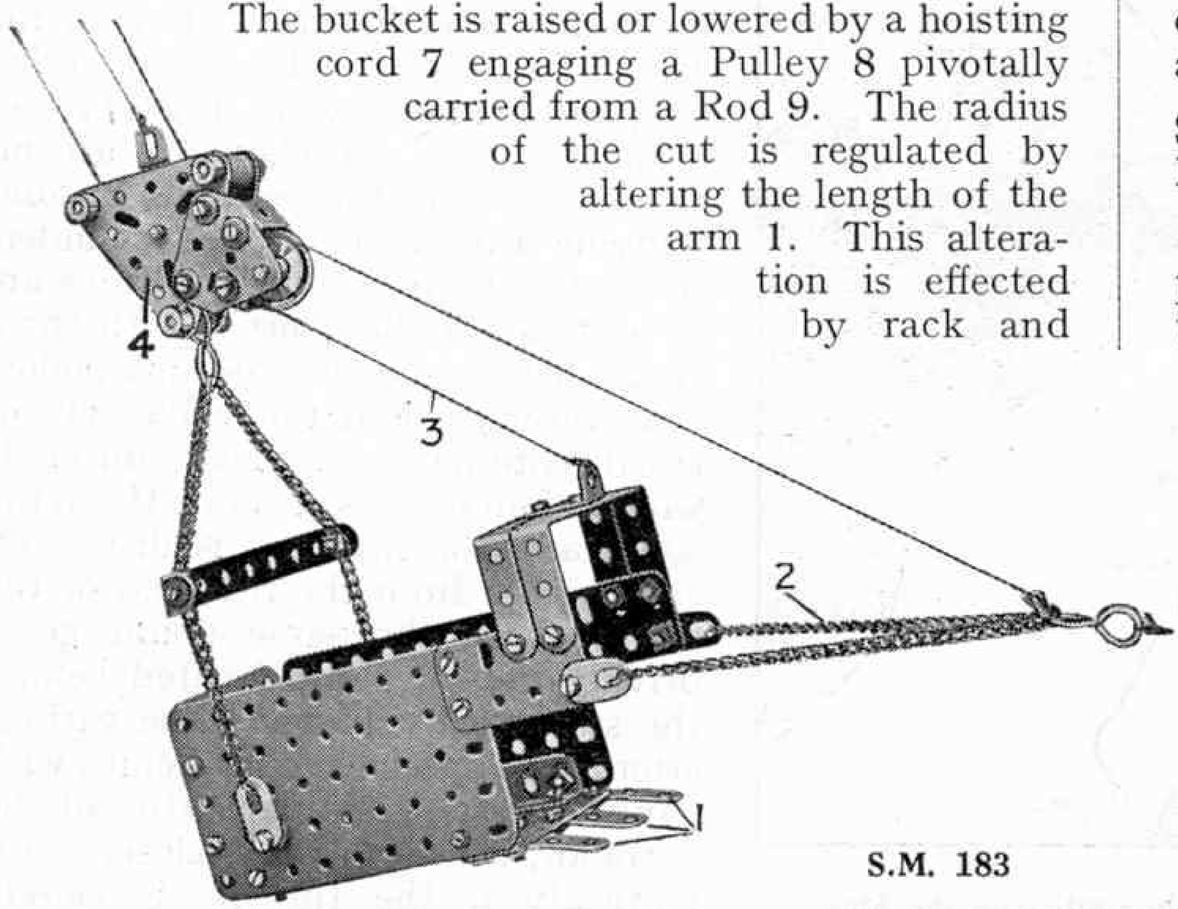
S.M. 182 illustrates a device that is used in actual practice for handling materials of a fairly pliable nature, such as mud and sand. The principle of the apparatus is frequently employed in marine dredging operations, and is sometimes adopted in elevators or conveyors for coal, slack, gravel, cement, and for loading similar materials in wagons.

It consists of a number of buckets secured to an endless chain that is driven continuously from any convenient form of motive power. In the case of dredgers, the buckets serve as shovels and dig into the face of the material to be excavated, but in conveyors they form merely receptacles to receive the material for transportation. The moving chain rapidly conveys the laden buckets away from the scene of action.

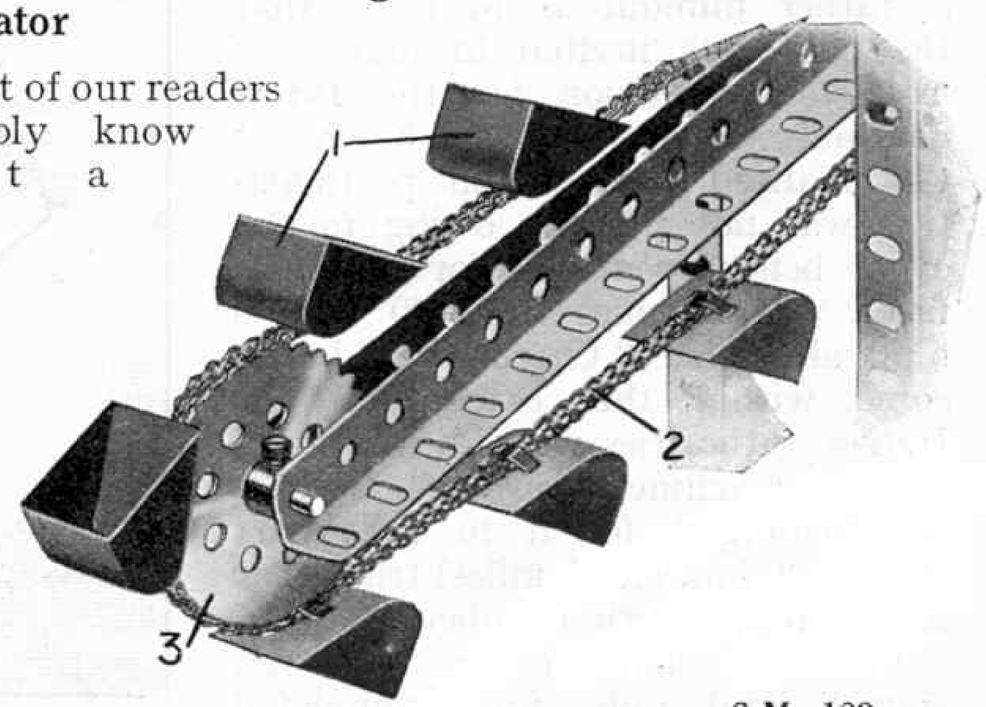
The illustration clearly shows the method by which Meccano Dredger buckets (Part No. 131) may be secured to Sprocket Chains. Any number of buckets 1 may be connected to the endless chain 2, which passes round a Sprocket Wheel 3 carried in the end of the dredger arm.

S.M. 183—Bucket for Dragline Excavator

Most of our readers probably know that a



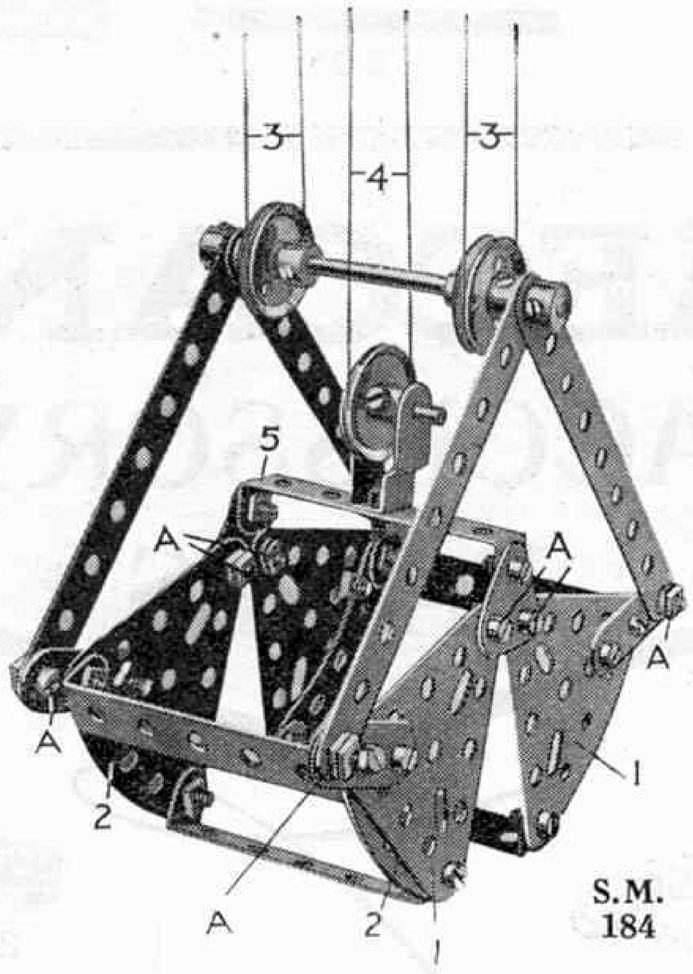
S.M. 183



S.M. 182

Dragline is designed to perform similar duties to the ordinary Mechanical Shovel, and that the principal difference between the two types of excavators lies in the fact that the bucket of the Dragline is drawn along by means of cables, with the result that its cutting stroke is directed always towards the machine, whereas the stroke of the Shovel is in a direction away from the machine. Hence the Dragline is most usefully employed in levelling or increasing the depth of a cutting or canal bed, while the Shovel is used more often to widen such works, by cutting away the perpendicular sides of the excavation.

The construction of the Meccano bucket will be followed from the illustration (S.M. 183). On the cutting stroke, the teeth 1 are drawn into the earth by means of the Chain 2, while a cord 3 sustains the bucket at the requisite angle. The apparatus is raised or lowered by means of a hoisting cord and pulley block 4.



S.M. 184

S.M. 184—Grab

A "grab" is a device used in conjunction with coalers or similar machines. It consists of two hinged jaws that may be opened or shut at the will of the operator, and is usually suspended by two separate hoisting cables. The movement of the jaws is effected by operating one or both of these cables.

Let us suppose, for example, that it is required to raise a quantity of coal. The grab is lowered in the open position until it rests upon the loose coal, when the cable that closes the jaws is hauled in. This draws together the movable sections, and the grab gathers up a huge "mouthful" of coal. It is then hoisted and swung round to the desired position, where the coal is discharged by re-opening the grab.

The jaws of the Meccano grab are constructed from $2\frac{1}{2}''$ Triangular Plates 1 extended at their bases by $2\frac{1}{2}''$ Curved Strips 2. The grab is raised or lowered by means of four lengths of cord 3, while another cord 4 passes round a 1" Pulley carried from the cross-piece 5. If both the cords 3 and 4 are hauled in or paid out at the same speed, the grab travels up or down without the jaws moving, but if one cord ceases to move, the grab opens or closes according to the movement of the other cord. The joints marked "A" are all connected pivotally by means of bolts and lock-nuts (see S.M. 263).

If the outer sides of the grab jaws are filled in with cardboard, or additional parts, the grab will pick up small loads of sand, marbles, etc. It will then form a very useful adjunct to a Hornby goods yard.

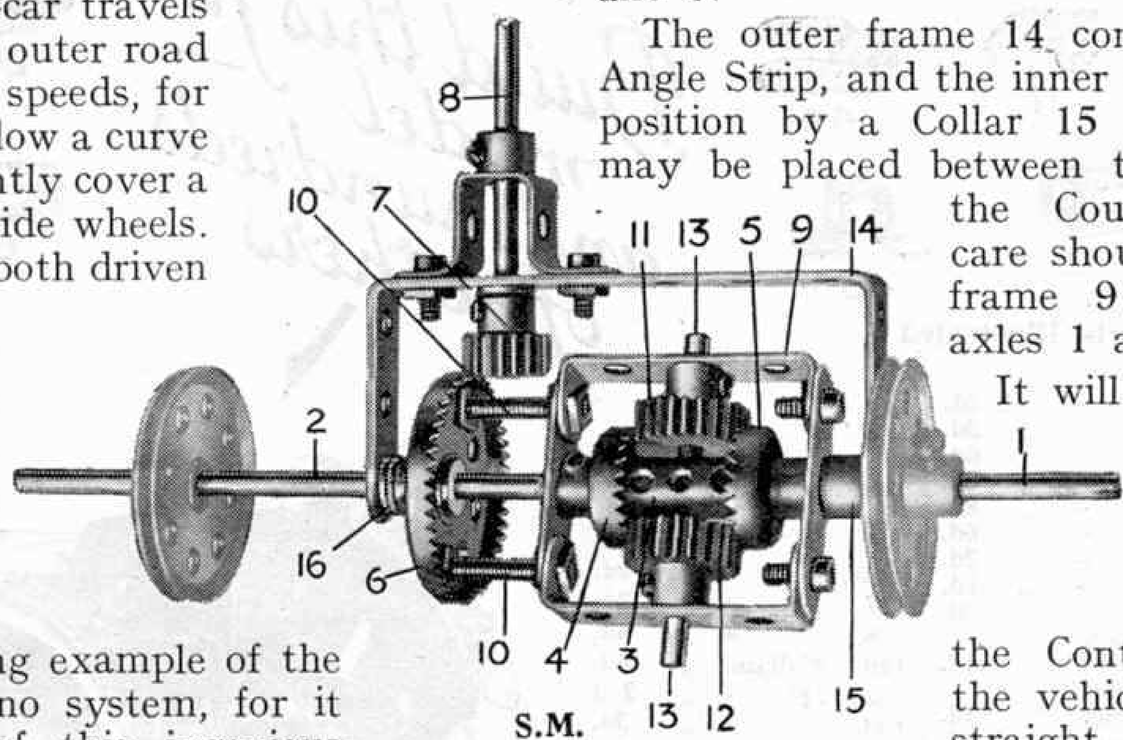
Section XIII. Miscellaneous Appliances

S.M. 251—Differential Gear

If we were to examine the tracks of a motor-car that has travelled in a complete circle we should find that the diameter of the circular path of the outside wheels is greater than that of the path of the inside wheels, the difference being equal to twice the length of the axle connecting one inner wheel to one outer wheel. It is obvious, therefore, that when a motor-car travels in a curved line the inner and outer road wheels must rotate at unequal speeds, for the inside road wheels must follow a curve of smaller radius and consequently cover a shorter distance than the outside wheels.

But the two rear wheels are both driven from the same engine, and no doubt all Meccano boys are aware that the difficulty of the variation in speed is overcome by incorporating in the drive transmission some form of *differential gear*.

The model differential gear shown in S.M. 251 is a striking example of the practical value of the Meccano system, for it demonstrates the principle of this ingenious mechanism in a clear and interesting manner.



S.M. 251

The back axle shown in the Meccano model is built up from two separate units—a $3\frac{1}{2}''$ Rod 1 and a $5\frac{1}{2}''$ Rod 2, which are inserted in the Coupling 3 and allowed to revolve freely. A Contrate Wheel, 4 and 5, is secured to each unit. A $1\frac{1}{2}''$ Contrate Wheel 6, with set screw removed, revolves freely upon the Rod 2, and is driven from the $\frac{1}{2}''$ Pinion 7 on the propeller shaft 8.

The frame 9, consisting of two $1\frac{1}{2}''$ Double Angle Strips bolted to $1\frac{1}{2}''$ Strips, revolves with the Contrate Wheel 6, to which it is secured by 1" Threaded Rods 10. Two $\frac{3}{4}''$ Pinions 11 and 12 are mounted on 1" Rods 13, for which the centre transverse hole of the Coupling 3 forms a bearing; they are thus free to revolve independently of each other, but they are engaged by the Contrates 4 and 5.

The outer frame 14 consists of a $3\frac{1}{2}'' \times 1\frac{1}{2}''$ Double Angle Strip, and the inner frame 9 is held in its correct position by a Collar 15 and Washers 16. Washers may be placed between the Pinions 11 and 12 and the Coupling 3 if required, and care should be taken that the inner frame 9 revolves freely upon the axles 1 and 2.

It will now be seen that if one road wheel revolves at a greater speed than the other the Pinions 11 and 12 begin to rotate and adjust the difference in speed between the Contrate Wheels 4 and 5. If the vehicle is running in a perfectly straight course, however, the axles 1 and 2, Contrates 4 and 5, and Pinions 11 and 12, must all rotate as one unit, since the road-wheels are travelling at the same speed.

The $1\frac{1}{2}''$ Pulley Wheels shown in the illustration are affixed to the Rods 1 and 2 and are intended for use as brake drums. They do not concern the differential movement.

(*Further Standard Mechanisms appear on page 61*)

REAL ENGINEERING PARTS IN MINIATURE

Meccano parts, a number of which are here illustrated, combine to form a complete miniature engineering system with which practically any movement known in mechanics may be duplicated.

This year Meccano has an additional attraction—the Plates, Braced Girders, etc., are beautifully enamelled in bright colours. Thus not only is it now possible for you accurately to reproduce big engineering structures in model form, but you can also satisfy your artistic taste and introduce colour into your new Meccano models

Price List of Parts Illustrated:

Part No.			
3.	3½″	½ doz.	4d.
9b.	3½″	„	8d.
11.	– –	each	1d.
12.	½″×½″	doz.	6d.
12a.	1″×1″	each	1d.
17.	2″	„	1d.
19.	– –	„	3d.
19c.	6″ diam.	„	2/6
20a.	2″	„	6d.
21.	1½″	„	6d.
22.	1″	„	4d.
22a.	1″ loose	„	2d.
23.	½″ „	„	2d.
24.	– –	„	6d.
26.	½″	„	4d.
27.	50 teeth	„	9d.
27a.	57 „	„	9d.
28.	1½″ diam.	„	9d.
30.	– –	„	10d.
43.	– –	„	2d.
44.	– –	„	1d.
45.	– –	„	1d.
46.	2½″×1″	½ doz.	6d.
50.	– –	each	2d.

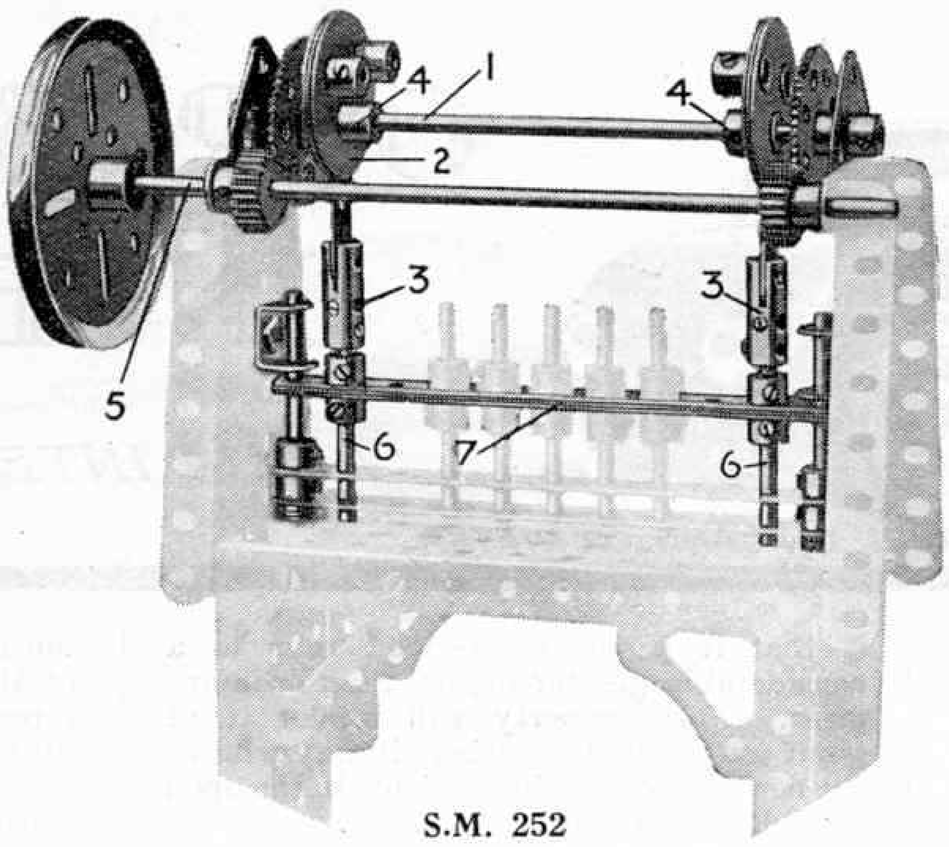
Part No.			
59.	– –	each	2d.
62.	– –	„	3d.
63.	– –	„	6d.
63a.	– –	„	8d.
63b.	– –	„	8d.
63c.	– –	„	6d.
64.	– –	„	2d.
77.	– –	„	1d.
80a.	3½″	„	3d.
90.	2½″ large radius	„	1d.
90a.	2½″ small radius	„	1d.
94.	40″ length	„	6d.
95b.	3″ ...	„	6d.
96.	1″ ...	„	3d.
99.	12½″	½ doz.	1/9
103d.	3½″ ...	„	7d.
108.	– –	each	2d.
109.	2½″ diam.	„	4d.
116.	– –	„	3d.
120.	– –	„	2d.
120a.	– –	pair	8d.
123.	– –	each	1/3

Part No.			
125.	½″	½ doz.	6d.
126.	– –	each	3d.
126a.	– –	„	2d.
127.	– –	„	3d.
128.	– –	„	4d.
129.	3″ diam.	„	6d.
132.	2¾″ „ –	„	2/3
133.	– –	„	3d.
136.	– –	„	3d.
137.	– –	„	4d.
139.	– –	„	2d.
140.	– –	„	9d.
143.	5½″ diam.	„	1/–
144.	– –	„	6d.
146.	6″ diam.	„	1/3
147.	– –	„	3d.
148.	– –	„	9d.

ASK YOUR DEALER TO SHOW YOU SAMPLES

Standard Mechanisms—*(continued)*

S.M. 252—Reciprocating Gear



S.M. 252

The Meccano Eccentric forms a valuable method by which any continuous movement may be converted into reciprocating motion. It is fitted with three separate bosses with set-screws, and its stroke, or throw, varies according to the particular boss in which the shaft is secured. The dimensions of the three different strokes available—i.e. $\frac{1}{2}''$, $\frac{3}{4}''$, and $1''$—are stamped on the face of the Eccentric under their respective bosses.

S.M. 252 shows two Eccentrics operating the tools of a punching machine. The Rod 1 is driven from the main shaft 5, and is journalled through the Eccentric bosses 4, each of which provides a throw of half-an-inch. The Eccentrics 2 are connected pivotally to Strip Couplings 3 mounted on sliding Rods 6. These carry the punches from a cross piece 7 constructed from two $5\frac{1}{2}''$ Strips placed one upon the other with their ends engaging short vertical Rods.

S.M. 253—Laminated Spring

S.M. 253

Laminated Springs—sometimes referred to as "leaf" springs—may be constructed from a number of Meccano Strips of varying lengths. The Strips are slightly bent and bolted together as shown in S.M. 253. The spring illustrated is designed for use in a motor chassis; it is connected to the framework of the vehicle by means of the Angle Brackets shown, and supports the road wheels from the Double Bracket at the end.

A similar spring in common use has both ends bolted to the vehicle, whilst its centre rests upon the axle of the road wheels. In this case, the points of suspension between the springs and the chassis should be so arranged as to permit of free lateral movement when the springs are flattened.

A further example of laminated springs for chassis suspension is shown in S.M. 115 (Section VIII.)

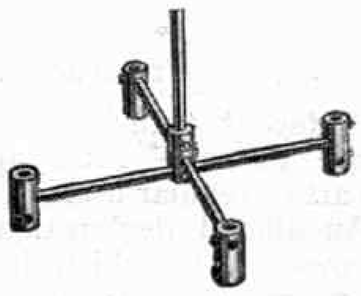
S.M. 255-259—Handles, etc.

In certain models the Meccano Crank Handle (Part No. 19) does not always represent the most desirable form of handle, and it is frequently replaced by a more convenient lever fashioned from other accessory parts. The different forms of hand wheels and levers that are used in Meccano models are too numerous to mention here, but we illustrate a few of the most common types. These should prove useful in a very large number of models and should lead Meccano boys to devise scores of others to suit their individual requirements.

S.M. 255 illustrates a hand wheel constructed from a Face Plate 18 secured by means of its set-screw to the shaft 17, which it is required to rotate. A Threaded Pin carried in one of the outer holes of the wheel 18 serves as the handle.

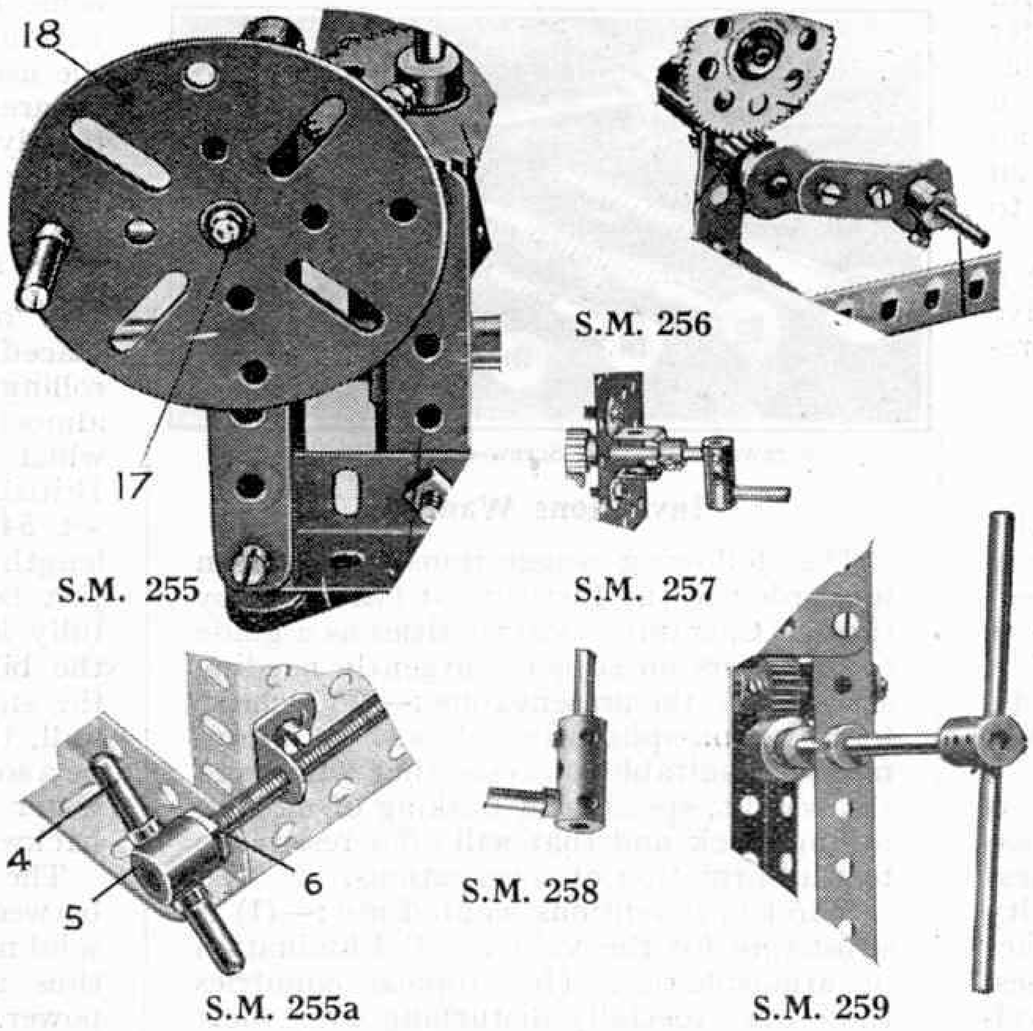
The T-shaped lever shown in S.M. 255a is constructed from two Threaded Pins 4 engaging opposite ends of the transverse bore in the Threaded Boss 5, and is intended for use in conjunction with the Meccano Threaded Rod. It is locked in position on the Rod by means of the nut 6 screwed tightly against the Boss.

S.M. Nos. 256 and 257 represent two different types of crank handles. The first is composed of two Cranks bolted together and a short Rod 1, and is designed for use where considerable leverage is required. The second is a smaller type altogether, and consists of a Coupling and $1''$ Rod.


S.M. 260

The device illustrated in S.M. 259 is intended for use principally as a sliding hand lever. The Threaded Pin engages one of the threaded borings in the end of the Coupling. If desired a second Pin may be inserted in the opposite side, to form a T-lever similar to S.M. 255a.

S.M. 259 is a double hand lever for use when great leverage is required. It consists of a Rod of any convenient size secured transversely in the end of a Coupling. Further examples of Meccano handles will be found under S.M. Nos. 5, 61, 63, 67, 72, 86, 137, etc.



S.M. 255 S.M. 256 S.M. 257 S.M. 258 S.M. 255a S.M. 259

Examples of Meccano Handles

S.M. 260—Pedestal

This detail illustrates an interesting adaptation of Meccano Couplings and Rods to form a firm base, or pedestal, for a vertical column, etc.

It will be observed that one of the horizontal Rods passes through the centre of the Coupling that is secured to the foot of the vertical shaft, and is gripped at each end in the upper transverse hole of one of the four Couplings forming the feet of the model. The other Rod passes through the lowest hole in the central column and is secured in the middle holes of its respective pair of Couplings.

The Meccanograph Table forms a useful base for certain small models.

Neat Hose Pipe Joint

Those of our readers who are fond of gardening, and who have frequent need of a hose pipe, will appreciate the simple mender illustrated, for joining two lengths of hose together.

The device consists of two nipples joined together, which fit into the ends of the pieces of hose to be connected. Two spiders carried on the joint are then hammered into the hose and the repair is complete. There are no ends to catch when the hose is dragged along the ground, and although soon made, the joint is neat and effective.

* * * *

Tramcar Safeguards

Recent tramway accidents have given rise to some little apprehension on the part of regular users of this type of vehicle. An official declaration has been issued, however, in which it is stated that the braking capacity of tramcars as a class is unsurpassed by any other form of public conveyance. Nevertheless tramway authorities are continually experimenting with the object of eliminating the danger, present more particularly in hilly districts, arising out of loss of control either through greasy rails in wet weather, or illness on the part of the driver.

A new device, known as the electrical "run-back" preventor, has been introduced on the Leeds City Tramways with the object of creating an even greater margin of safety. The apparatus works by power generated by the car's motion and is entirely independent of the overhead trolley supply. Its power is such that an out-of-control car will be slowed down to less than three miles per hour.

Full details are not yet to hand but a trial car is to be subjected to exhaustive tests, in the presence of Press representatives.

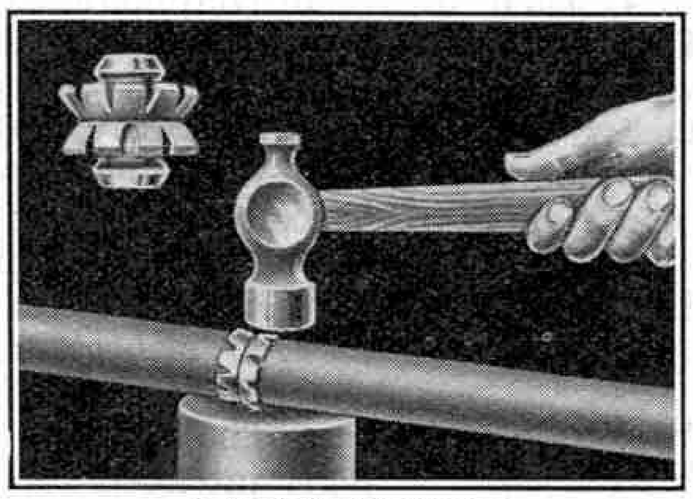
* * * *

A Remarkable Glass

The manufacture on a large commercial scale of a glass that can be filed, ground, polished, etched, coloured and perforated, has recently been commenced. This new glass, which is known as "Pollopas," is the invention of two Austrian chemists, Dr. Kurt Ripper and Fritz Pollak. It does not melt when heated but burns at a temperature of 200°C. Its weight is approximately half that of ordinary glass and this feature, coupled with a softness of texture that gives a degree of elasticity sufficient to prevent splintering, makes it very suitable for protective eye glasses, motor windscreens and all types of travelling utensils.

An interesting feature of "Pollopas" is that it passes ultra-violet rays to a considerably greater degree than ordinary glass. This property will render it of great use in sanatoria where it may remove the necessity of placing patients in the open for light treatment.

* * * *

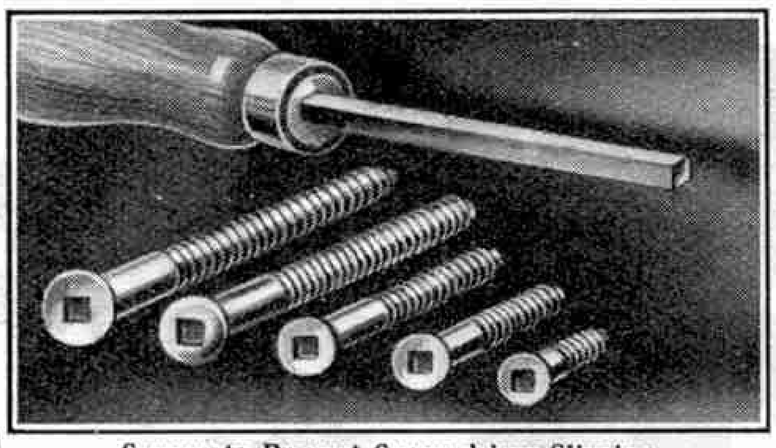


A Neat Hose Pipe Joint

Celluloid Tracing Cloth

A material that is being extensively used as a substitute for tracing cloth is sheet celluloid about .015 in. in thickness and having a matt surface on one side. It has been found specially useful for maps, diagrams and draft plans, and the necessary record data that are subject to constant alteration.

* * * *



Screws to Prevent Screw-driver Slipping

Inventions Wanted

The following suggestions have been forwarded to the Institute of Patentees by the L.C.C. tramways authorities as a guide to inventors on subjects urgently needing attention at the present time :—(1) A cheap form of non-splintering glass. (2) Tram-rails of a suitable analysis, that will stand the weight, speed, and braking of modern rolling-stock, and that will offer resistance to the formation of corrugations.

Wireless inventions wanted are :—(1) A substitute for the valve. (2) Elimination of atmospherics. (In tropical countries these are especially disturbing over short distances). (3) Duplex telephony, allowing cross talk. (4) New circuits by which the sensitivity of the amplification properties of the valve are increased. (5) Secrecy, especially required in commercial telephony. (6) Calling up any desired station at will. (The system now in use involves constant watch or pre-arranged definite time of calling up).

* * * *

Hot Water

It is always of interest to learn the origin of any invention that has been of benefit to mankind. In this connection the "*Liverpool Daily Post*" tells a good story—it deserves to be true—of the stone hot-water bottle. Mrs. Gladstone is said to have been responsible for this particular invention and she thought it out because her husband, W. E. Gladstone, the famous Prime Minister, used to wake up feeling thirsty and reach for the nearest water to hand. Mrs. Gladstone filled the bottle with boiling tea which remained fairly warm all through the night!

* * * *

Patent Screw Prevents Screwdriver Slipping

When working with very hard woods, it frequently happens that screws are unable to get an immediate firm hold with the result that the screwdriver slips, damaging not only the head of the screw, but sometimes the driver itself.

A new type of screw, with a special driver, has now been produced to overcome this difficulty. The screw is made with a square hole in the head, instead of the usual slot, and the driver consists of a square bar with tapered end which fits tightly in the hole in the screw, thus giving an almost certain grip.

* * * *

Anti-Rolling Device For Ships

A recently-designed system of bulges placed on the hull is claimed to reduce the rolling motion of ocean liners to an almost negligible degree. The system, which has been tried out on three large British steamers, consists of corrugations set 54 in. apart and running the whole length of the vessel. The upper bulge lies just below the water line when a ship is fully loaded and the lower is just above the bilge line. Both at the bow and at the stern the bulges merge into the ship's hull, thus reducing what otherwise would be a source of considerable resistance to the water at the bow, and also reducing the backwash at the stern.

The effect of the stream of water running between the corrugations is to present a solid mass of water to the propellers, which thus attain a corresponding increase of power. Approximately six per cent. is added to the ship's width by the addition of the "bulges."

New Reflector

As the result of a somewhat lengthy research, carried out in the laboratories of the Westinghouse Electric Co., of America, a new reflector has been produced. This reflector has a surface of polished chromium that is extremely hard, and does not possess the disadvantages of the ordinary silver or nickel-plated reflectors used for motor-car head lamps. The chromium surface is not affected by ordinary dust particles and may be wiped even with gritty waste or rag without affecting its reflecting qualities.

* * * *

Bullet-Proof Screen

The American Army Ordnance Department have recently placed in service a remarkable protective device for use by gunners inside "tanks." The invention consists of a steel mushroom-shaped cap pierced by long cuts placed one inch apart. The width of these openings is too narrow to afford a clear field of vision when the cap or shield is still, but when this is rotated at a high speed it is possible to stand behind it and watch the happenings in front as though looking through a window of clear glass.

The quality of the steel employed is sufficient to stop a bullet and it is claimed that it is possible to actually see a bullet being deflected by the shield.

* * * *

Motor Stop Light

An ingenious device has recently been invented, with the object of automatically signalling to those behind, when a motor-car fitted with the device, is about to stop. This is more particularly desirable in these days of front wheel-brakes, which enable a car so fitted to pull up in a very short distance with danger to following cars should they be too near or not be aware of the leading driver's intention. The new invention automatically switches on or off, a light placed in the lamp at the rear of the car with the word "stop" on the glass.

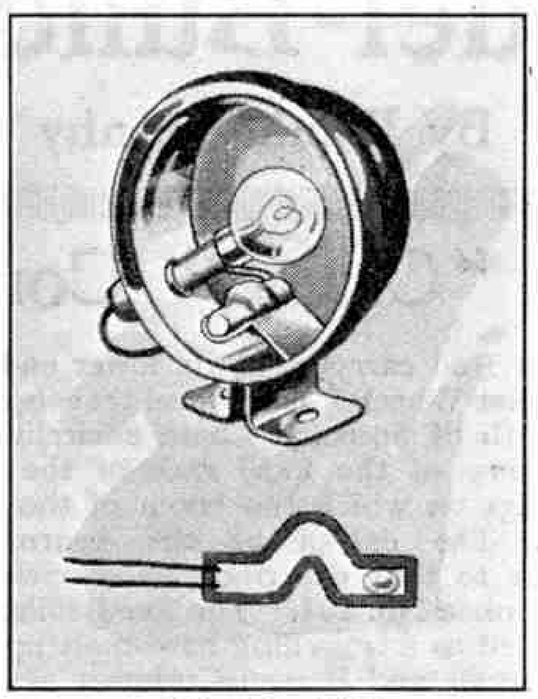
The device consists of a bent tube (shown in section in the upper illustration in the next column), containing two nickel contact wires, insulated from one another, and a globule of mercury. When the car is running the mercury is not in contact with the nickel wires, but when the car is stopped the mercury in the tube, by virtue of its inertia, makes contact with the two wires, thus lighting the bulb. When the car is started the mercury regains its former position, and the light goes out. The tube employed is so bent as to act as a damper to prevent the mercury operating the light when the car is driven over rough roads.

* * * *

Motor Roller Skates

One of the most ingenious of recently-invented mechanical novelties is a pair of motor-operated roller skates produced by a German engineer. From an engineering point of view the interesting feature of the invention is that the motive power is acetylene gas. The ease with which this gas can be produced has made it attractive for many years as a potential propellant.

In the present invention the skates are fitted with acetylene generators capable of supplying power for six hours' running at an average speed of over 20 m.p.h. An automatic system of lubrication has been fitted to the engine and the cooling system is partly by air and partly by water.



Motor Stop Light

Electric Hares

An invention of special interest to sportsmen is designed to test the speed and skill of the racing greyhound without the necessity of providing a live hare as the object of the chase. In this invention the hares are dummies controlled by electricity and sent forward at a speed that can be varied by an operator placed in a control tower. Runways varying from $\frac{3}{16}$ to $\frac{3}{8}$ of a mile are provided, and the "hare," after being in view of the dogs pursuing it throughout the race, finally disappears into the ground through a trap door.

* * * *

The Romance of the Tyre

The first practical pneumatic tyre was invented in 1888 by John Boyd Dunlop, a veterinary surgeon of Belfast. It has been said that the idea occurred to him while standing on a hose-pipe used for watering his garden.

The above illustration shows a German invention evolved with the idea of discouraging would-be highwaymen. An imitation camera-case carried under the arm contains a pistol. When a highwayman orders "Hands up" the victim is only too ready to comply, for as he throws his arms in the air the hidden pistol is fired, as shown in the inset.

As was the case with most pioneer efforts, the pneumatic tyre was at first regarded with scorn and derision. It was first used on the ordinary push-bicycle and later developed and fitted to motor-cars, until to-day it has revolutionised road transport of every kind. Behind its manufacture is a romance of technical and business skill that has at any rate built up at least one great British industry with ramifications in all parts of the world. The Dunlop factory covers 420 acres and employs 10,000 hands.

Secret Telephones

An apparatus designed to prevent telephone messages being overheard by unauthorised persons is reported to have been invented in France. The inventor, realising that hearing is interfered with by the interruptions set up by vibratory currents, found that if rapid inversions of the current are used, instead of interruptions, the harmonic composition of the telephonic current is modified. The sounds produced thus become quite unintelligible if picked up anywhere along the line. At the proper receiving end, however, the currents so treated can be re-established in proper order by inversions identical with those at the transmitting end, and the message is produced as originally spoken. The instrument has been named the "Cryptophone."

* * * *

Butter-Packing Machine

A very ingenious machine that moulds and wraps butter at the rate of 60 lb. per minute has recently been placed on the market. The machine stands 5 ft. 10 in. in height, and is 11 ft. 6 in. in length and 6 ft. in width. It not only carries out its work expeditiously and neatly, but also possesses the considerable advantages of being thoroughly hygienic because the butter remains untouched by human hand throughout. It is fed automatically into the moulding machine, which cuts the bar to the exact size, wraps it in specially-prepared paper taken from a stack, and places the wrapped pat of butter, printed side up, on a travelling rack.

* * * *

A Life-Saving Tank for Ships

A new form of life-saving apparatus for use on ships was demonstrated recently to a number of shipping experts at Bootle. It consists of a tank, both water-tight and air-tight, that can be fixed to the deck of a ship. In case of disaster at sea the passengers and crew would enter the tank, the water-tight door would be closed and, as the ship sank, the tank would be released automatically and would then float to the surface. On a large ship carrying many passengers several tanks would be required.

A special form of this tank is intended for use on submarines. In this case the entrance is underneath, and by the provision of a special exit through the deck of the submarine the crew would enter the tank from below. As soon as all were safely inside, the tank would be released and thus rise immediately to the surface.

A model ship was used during the demonstration and throughout the tests the device responded perfectly. The Admiralty are being asked to investigate the invention which, if successful, should afford a means of preventing suffocation in a sunken submarine.

* * * *

A Novel Scheme

A recent prize-winning idea for an invention suggested an automatic machine into which a photographer could drop a spool of exposed film and a shilling, receiving in exchange a key. Later, on unlocking the machine with this key, the film would be returned, developed, fixed and ready for printing.

Results of Meccano Model-Building Contests

By Frank Hornby

Overseas "Crane" Competition

A VERY fine collection of models was received from our overseas readers in Section B of the "Crane" model-building competition. The names of the prize-winners are as follows:—

First Prize (cheque for £3-3s.): Frank van Bulck, 31, Avenue Parmentier, Paris, XI. Second Prize (cheque for £2-2s.): Garthon E. Harper, 5, Oxford Terrace, Devonport, Auckland, N.Z. Third Prize (a tie; each competitor will receive a cheque for £1-1s.): J. C. Rishworth, Mettur, Coimbatore District, India, and E. H. Whitney, "Holmes," P.O., Maclear, S. Africa.

Prizes of 10/6 each: Clifford Glennie, Vancouver, B.C.; Gabriel Rockwood, Colombo, Ceylon; Nat Barry, Pilgrims Rest, Transvaal; C. Sturdee, Westmount, Quebec; S. D. Cozens, Alberni, B.C.; F. Hawke, Witbank, S. Africa.

The following competitors, who are amongst those gaining Certificates of Merit, have been selected as deserving special mention:—H. M. Denton, Smoky Bay, Australia; G. Noble, Alberton, S. Australia; E. Dutton, Henley Beach, S. Australia; J. Wood, Villieria, Pretoria, S. Africa; G. Coleman, Townsville, Queensland; E. H. Forrest, Ottawa, Canada; N. v. d. Ryden, Pretoria, S. Africa; H. R. Harris, Ficksburg, O.F.S.; J. Wray, Remuera, Auckland, N.Z.; T. Walker, Westmount, Canada; A. van Dam, Amsterdam.

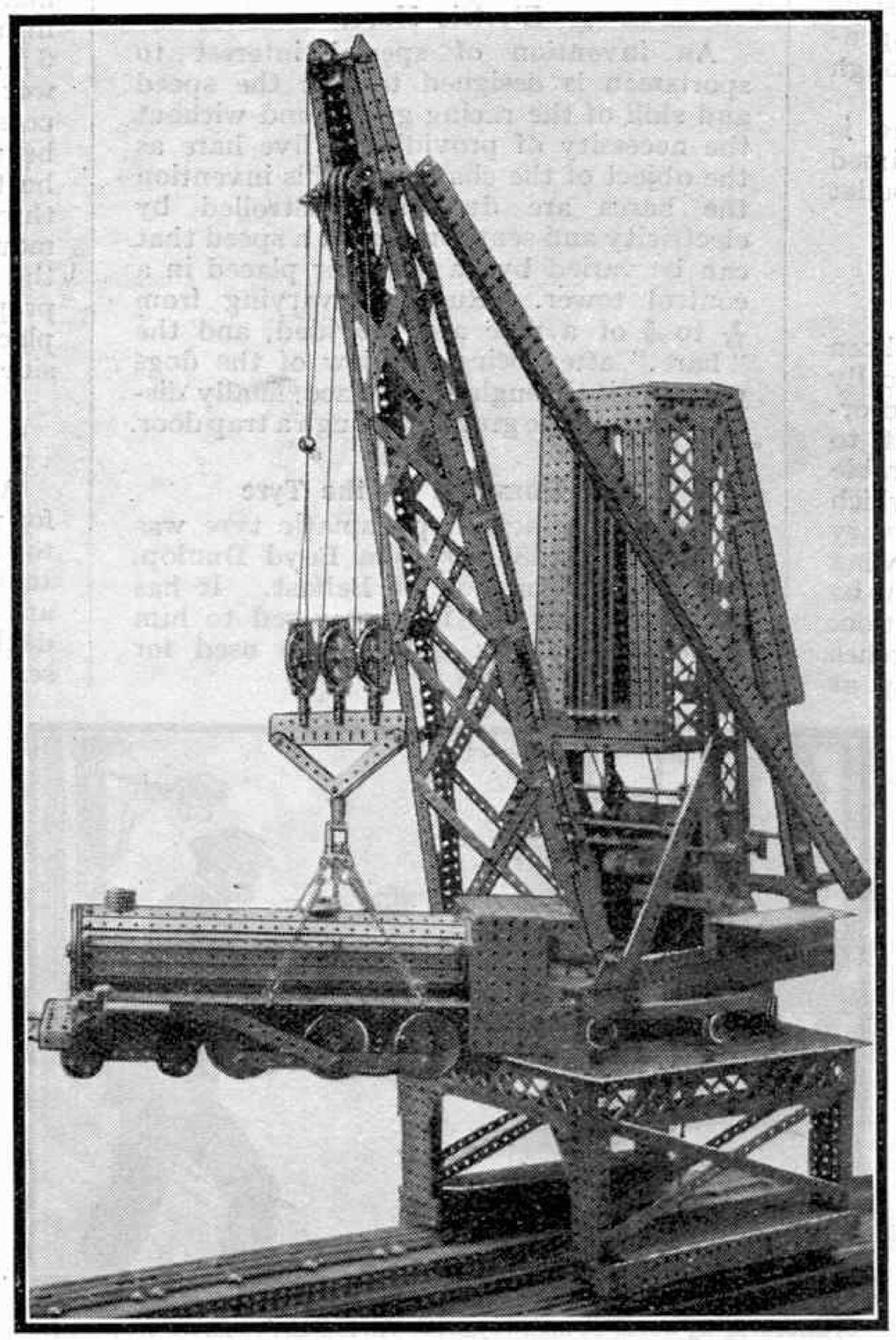
From the illustration reproduced herewith readers will observe that the first prize-winning model represents a giant hydraulic crane. The main portion of this model is capable of turning upon roller bearings mounted on a massive travelling base, and a good impression of the power exerted by the crane is obtained from the photograph, which shows it in the act of hoisting a heavy Meccano locomotive.

Screw Mechanism

A small "pilot" hook is provided for light work, and is operated by a single cord passing over a pulley in the extreme end of the jib. The main hoisting mechanism consists of six lengths of cord working between two three-sheaved pulley-blocks, and the winding drums are formed from Meccano Wood Rollers.

The elevation of the jib is effected by an 11½" Threaded Rod driven from the 110-volt Electric Motor. The rotation of this Rod imparts longitudinal movement to a Threaded Coupling connected by a transverse Rod to the lower ends of the two pivoted levers that support the jib. This transverse Rod is also connected at right-angles to two sliding 11½" Rods, which represent the hydraulic pistons employed in actual practice.

G. E. Harper's model takes the form of a Block-setting Crane driven by two Clockwork Motors. One of these Motors combines the duties of hoisting and controlling the movements of the crane trolley, while the other operates the rotating mechanism. The latter movement is effected by means of a vertical driven Rod carrying at its lower end a ¾" Sprocket Wheel. This wheel travels round a length of Sprocket Chain encircling the periphery of the fixed race of the roller bearings on which the boom of the crane rests. The design of the bearings is similar to that described under Standard Mechanism No. 101. The fixed roller race is bolted to a travelling base built up from 12½" Angle and Braced Girders.



This powerful model of a travelling Hydraulic Crane secured First Prize for Frank van Bulck

Meccano Friction Grip-Tongs

The hoisting gear is equipped with a pair of cleverly-designed friction grip-tongs with which the concrete blocks may be secured. The jaws of this apparatus each consist of a 2½" Curved Strip bolted to a 2" Strip (the two parts being overlapped two holes).

The Curved Strips are inserted between two 3½" Strips placed together to form a crosspiece, and are free to pivot about the shanks of bolts passed through their centre holes. 1½" Strips are bolted pivotally to the top of each 2" Strip, and their other ends are mounted loosely on a bolt inserted in the threaded bore of a Collar. The latter is free to slide upon a vertical 2" Rod secured by means of a Collar and set-screw to a 1" Triangular Plate bolted in the centre of the 3½" crosspiece.

A further Collar mounted on the upper end of the vertical Rod prevents the sliding Collar from leaving the Rod. A Strip attached to the set-screw of the latter Collar is bolted to the hoisting pulley block. The pull of the winding mechanism therefore tends to raise the sliding Collar, so straightening the 1½" Strips. These, in turn, push out the upper arms of the tongs, and cause the jaws to close upon the block that it is required to raise.

The addition of Angle Brackets to the lower ends of the 2½" Curved Strips provides a larger frictional surface against the blocks, and permits a more powerful grip to be obtained. The principle of friction grip-tongs will be understood more readily on reference to Suggestion No. 50 (see "*M.M.*" for July 1926).

Tie for Third Prize

It will be seen from the list of prize-winners that two competitors tied for third place. J. C. Rishworth qualified for the position with a model of an elevated dock-side crane, in which he incorporates a very good representation of Mitchell's patent luffing gear.

The jib of the crane is attached pivotally to a small carriage sliding upon rails formed from two Angle Girders placed in a vertical position in the front of the main supporting tower, and a braced lever, consisting of two 5½" Angle Girders with Cranks bolted at either end, is connected pivotally to the top of this tower and to a point situated at a short distance along the length of the jib. The elevation of the latter is altered by raising or lowering the vertically-sliding carriage. This movement is obtained by Sprocket Gear controlled by an Electric Motor.

I regret that space will not permit me to go more fully into several other structural and mechanical details of great interest that are embodied in this model. I must content myself with the statement that it forms one of the best examples of Meccano engineering that I have yet seen.

E. H. Whitney's entry represents the type of crane that proved most popular in this competition—namely, a block-setting Goliath. The proportions and general design of this model are excellent, and the different operations, comprising the traversing movement of (*Continued on page* 81)

Overseas "Utility" Competition

The entries in the Overseas Section of the "Utility" or "Meccano in the Home" Competition are of an even more varied description than those received in the Home Sections, and it is apparent that the majority can be applied to very practical purposes. This model-building competition has proved, in my opinion, to be one of the most interesting and successful contests yet published in the Magazine.

The awards are as follows :—

First Prize (Meccano products to the value of £2-2s.) : H. W. Turner, 411, St. Aubyn Street W, Hastings, N.Z. Second Prize (Meccano products to the value of £1-1s.) : T. Scheer, Markt Dn 33, Drogistery, Bodegraven, Holland. Third Prize (Meccano products to the value of 10/6) : Michael Falkof, 131, Frances Street, Bellevue, Johannesburg, S.A.

Consolation Prizes (Certificate of Merit and Standard Mechanisms Manual) : R. E. McGee, Hamilton, Ont., Canada ; C. J. Boland, Nelson, N.Z. ; A. Benham, Karori, Wellington, N.Z. ; S. F. Desai, Mota Falia, Navsari, India, ; T. C Meng, Singapore, S.S.

Special Commendation (Certificates of Merit) : M. Coughlan, St. Kilda, Dunedin, N.Z. ; R. A. Disu, Lagos ; H. & W. Fagg, Milton, Otago, N.Z. ; R. Orbell, Kanye, Via Lobatsi, Bechuanaland Protectorate ; R. O. Jukes, S. Canterbury, N.Z.

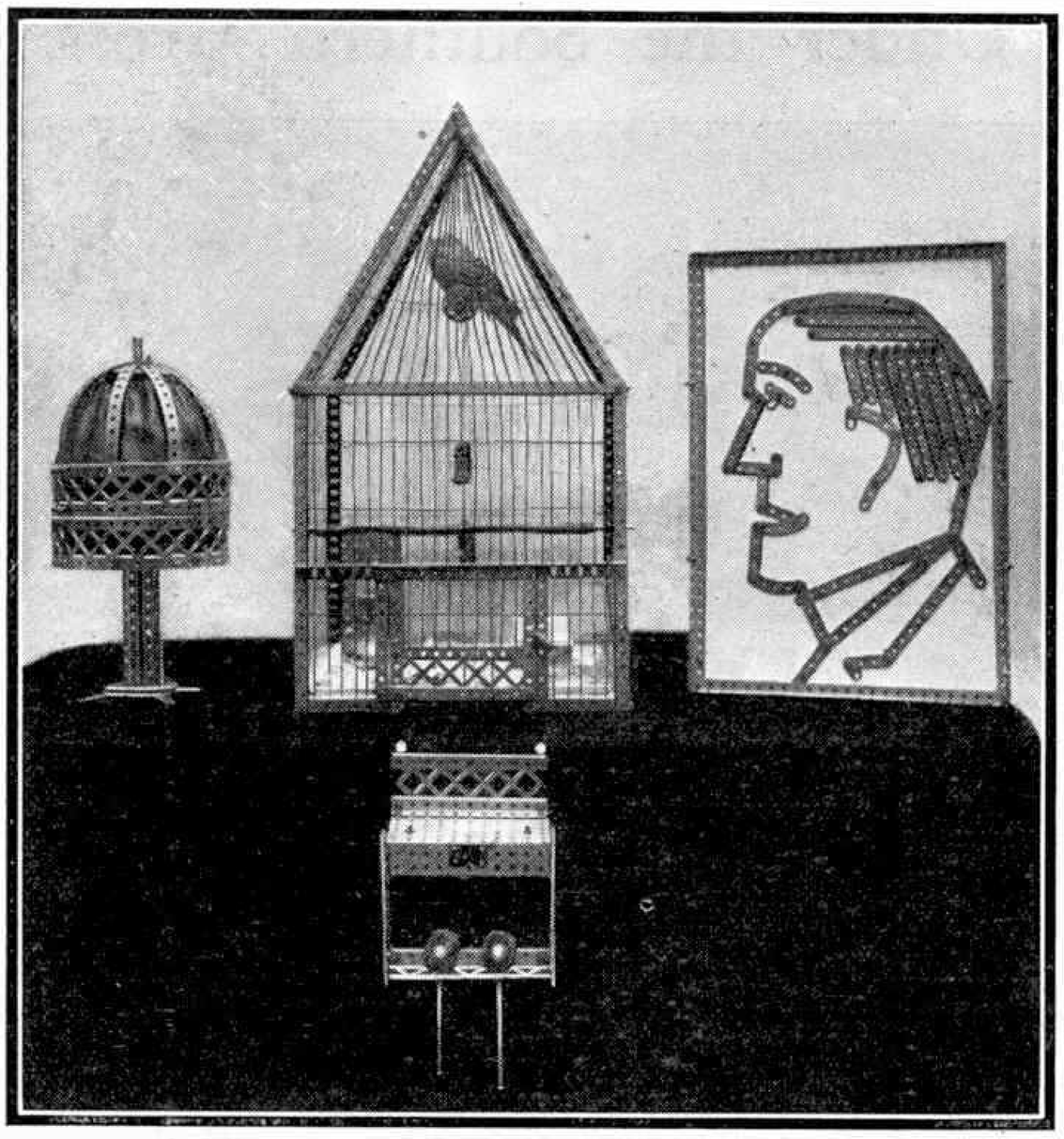
Harold Turner, who secures First Prize, sent in two models of which the most noteworthy is an Automatic Electric Switch. The object of this device is to turn on automatically an electric water heater at any desired time. Apparently Meccano performs a valuable service in Master Turner's home, for the particular heater installed therein is slow in operation, although once the water becomes hot it remains so and may be used for domestic purposes throughout the day, and the apparatus that our competitor has built obviates the necessity of rising at four or five o'clock in the morning in order to have the water hot in time for breakfast !

Starting an Electric Heater

An alarm clock is adapted to complete an electrical circuit at any specified hour instead of ringing the usual alarm bell. In circuit with the clock is a Meccano Accumulator and 4-volt Motor. The latter is harnessed to a shaft carrying two winding drums, and a cord from one of these is connected to a lever clamped to the handle of the heater switch, which in this case is of the one-way rotary type. The cord from the second drum is led upward over convenient pulleys and back again to a strip bolted to the Motor switch lever.

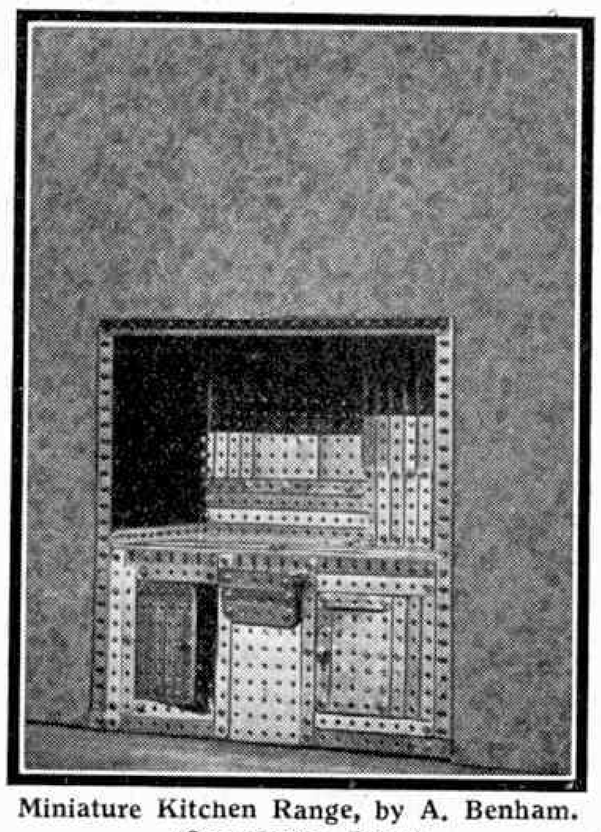
Thus, supposing it is required to start the heater at five o'clock in the morning, the alarm clock is set in the ordinary way for that hour, and at the time indicated the alarm mechanism completes the circuit. This starts up the Motor and the latter sets the heater in operation by pulling over the rotary switch. Afterwards the Motor disconnects itself automatically by means of the second winding cord, which pulls up the starting switch. The latter, of course, must be placed in the "on" position over-night.

A second model submitted by Harold Turner takes the form of an ingenious door-locking device constructed wholly of Meccano and using an Axle Rod for a key. I may mention that we have recently received scores of suggestions for different types of locks and latches made from Meccano and I hope to publish in the near future a special article concerning them.



A Collection of interesting and useful Models, sent in by T. Scheer. (Awarded Second Prize)

The larger photograph reproduced on this page shows a collection of models submitted by T. Scheer. As will be seen, it includes a table-lamp, bird-cage, pipe-rack and a novel portrait of somewhat "Futuristic" design. The portrait is particularly interesting and I hope that other Meccano boys will send in photographs or sketches of similar efforts, for the idea appears to offer much scope for ingenuity and originality of ideas. Suggestions of outstanding merit received in this connection will be suitably rewarded and will be illustrated in these pages.



Miniature Kitchen Range, by A. Benham. (Consolation Prize)

The framework of the bird-cage is built entirely of Meccano parts, and stout copper wire is used for the smaller cross-bars. Incidentally, the handsome green parakeet appears quite contented in his new Meccano home ! The lamp is illuminated by a candle supported by a 2″ Sprocket Wheel secured to the top of a vertical Rod passing through the central column of the lamp.

Interesting Entries

Michael Falkof obtained Third Prize with an Electric Fan. This model stands some 18 in. in height and has a rectangular base 12 in. × 12 in. The upper portion of the fan is mounted upon roller bearings, consisting of four Flanged Wheels running upon a Circular Girder bolted to the base, and is caused to move slowly to and fro by means of an Electric Motor and suitable crank mechanism. The latter is similar in principle to that described under Suggestion No. 63 (see the November "*M.M.*")

A. Benham's entry does not strictly conform to the conditions of the competition, in that it cannot be put to *practical* domestic use. However, one of the competition judges suggested that our readers' younger sisters would probably find it extremely useful, and with this opinion I am inclined to agree !. As will be seen from the small illustration below, the model represents a miniature kitchen range, and the novelty of the idea secured a Meccano Certificate of Merit.

C. J. Boland sent in descriptions of no fewer than six useful articles made from Meccano parts. The most interesting of these is a device for lifting out small drawers situated at a considerable distance from the ground. This should prove serviceable to shop or store assistants. A hole is drilled 2 in. deep lengthwise in the end of a pole of about 8 ft. in length and the end of a Crank Handle inserted. On this crank Handle, 2 in. from the top of the pole, a Coupling is secured by its centre transverse hole, and carries in either end a 2″ Rod at right angles to the Crank Handle. A 1″ Pulley Wheel is secured to the outer end of each 2″ Rod and is fitted with a stout rubber ring, such as those supplied for use in sewing machines. The operation of the device is simple, the upper end of the Crank Handle being inserted in a small eye-screw secured in lieu of a drawer handle, while the rubber-tyred wheels press against the front of the drawer.

R. E. McGee constructed an ingenious "perpetual" calendar in which the date shown may be altered merely by depressing a knob. The framework and operating mechanism, which includes ratchet gearing, consist of Meccano Parts, while the date cards are fashioned from cardboard strips marked with the necessary figures.

Sydney Harbour Bridge—(*cont. from page 4*)

lineal foot on each of the four tracks.

When Metal Becomes Tired

Besides "dead" and "live" weight there are various minor forces that a bridge is called upon to resist. Though these are small in themselves, in time they are capable of wearing out even the strongest material. Apart from rust and corrosion, one of these forces is that called "fatigue," and this is particularly prominent in metals that are used for the moving parts of machinery.

The usual method of testing for fatigue is to use an arrangement that alternatively stresses and releases the test bar, or to apply tension and compression alternately. Another form of this test consists of mechanically rotating a bar of metal at a high speed. One end of the bar is unsupported, and by hanging certain known weights on it near the free end, the metal is placed under tension or compression alternately. During each complete revolution the bar is subjected first to compression on the lower part and then to tension on the upper part. After many millions of revolutions, which are recorded by a cyclometer, the bar will finally break through fatigue, and its resistance and wearing powers can then be accurately calculated.

In regard to the present position of the bridge and the progress of the work, our special correspondent writes us from Sydney that there is already a great deal of tangible progress to be seen. Over 1,500 men are engaged on various branches of the work, which is being carried on simultaneously from both sides of the harbour. Huge cranes are at work and are slowly but surely transforming the foreshores and helping to erect the enormous stone pylons and abutments that will add considerably to the appearance of the bridge.

So far as the approaches on each side of the bridge are concerned, there are no very great engineering difficulties, and the fact that in each case the formation is of solid rock is probably an asset. The intention is to proceed to schedule in the erection of the big arch, each arm of which will have to be anchored back with huge land anchors as the two slowly meet toward the centre. The engineering world will probably watch with keen attention this great experiment in steel arch construction.

Unique Workshops

The arch is being fabricated in panels, and in order to enable this to be done, Dorman Long & Co. Ltd. have built huge workshops on the Milson's Point side. Incidentally, these are the largest and most up-to-date shops ever used in bridge-construction. The building of these works alone was a big undertaking, since it involved the levelling of thousands of tons of solid rock. The work that the contractors put into this, however, has been amply repaid by the efficiency and convenience of the workshops.

The shop in which will be pieced together the approach spans is 584 ft. in length by 130 ft. in width, while the other is 500 ft. by 147 ft. These will be equipped with two 120-ton and five 25-ton travelling cranes, more than thirty 8 ft. radial drills, and numerous large hammers and riveting yokes. These yokes are not simply "rattlers," but great hydraulic machines capable of handling the largest pieces of material. The Milson's Point shops will employ 400 men. The foundations, etc., will employ 500 more, while 200 men will be required to erect the steelwork. When the work is finished the shops and other machinery will be dismantled and sold, or used in other work.

To plane the sides of the huge bridge members a 66 ft. planing machine has been installed, capable of planing plates twice the length of one shop itself. This giant machine was illustrated and described in the "*M.M.*" for July, 1926.

The workshops have been erected alongside a deep-water frontage that enables vessels from overseas or from other parts of the Australian coast to bring in material for the bridge and discharge it at the bridge itself. It is an interesting fact that a Customs branch has been established at the shops, for the special convenience of the contractors in this respect.

A great retaining wall running from the Mining Museum almost to the vehicular ferry wharf has just been completed under separate contract by Dorman Long & Co. Ltd.

On the Dawes' Point side there runs a tramway along which three trucks are drawn, and these are used to carry granite from the wharves to the workings. The trucks are hauled by a cable winding round an iron drum 12 ft. in diameter, which is run by an electric motor of 120 h.p. This is capable of hauling a load of 80 tons up a grade of one in seven.

As the arch panels already mentioned are put together in the workshops, they will be placed on a punt and towed into the required position beneath the spot at which they are to be hoisted. Huge cranes capable of lifting a 160-ton load will be able to hoist the main bearings, end post and first panel. As the end post comes into position it will be anchored back by steel cables and U-bolts. When the first panels are completed on each side, the cranes will move forward on their stages on the top chords of the bridge. In this manner they will erect panel after panel until the arch almost meets in the centre. When this stage arrives, adjustment will be made by means of jacks that support struts at the back at ground level. The half arches will then be lowered and the tension on the cables gently released. A connection will be made in the centre of the lower chord—whereupon the huge arch of over 50,000 tons will become self-supporting in a three-hinged condition.

When the bridge is completed it will be in many respects the most impressive bridge in the world. Its great height will render it visible far out at sea and one can imagine how eagerly the horizon will be scanned by the passengers and crews of incoming ships for a first glimpse of the giant arch.

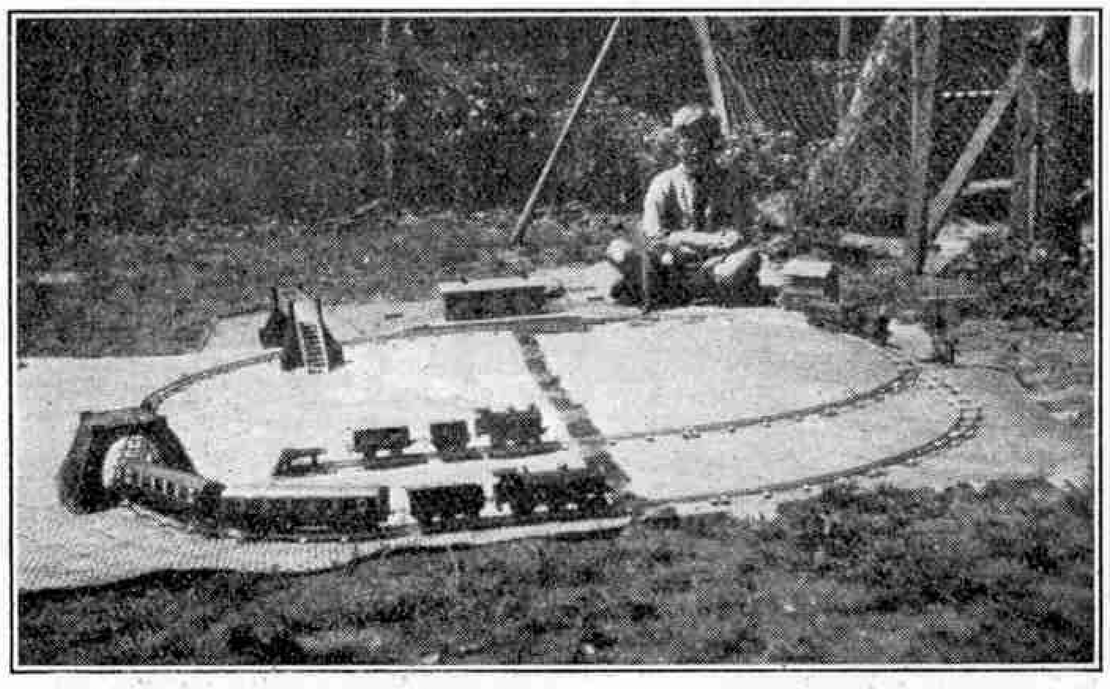
Until the bridge is actually in being, however, it will be impossible to realise its majestic grandeur and the extent to which it will dominate both city and harbour. The people of Sydney claim that theirs is the finest harbour in the world and few will venture to dispute the point. In designing the bridge special attention was given to its artistic features. It was realised that a bridge of such magnitude, to be constructed in a situation unique in its natural beauty, must be attractive in its outline and dimensions, and that decorative or architectural features introduced should be in keeping with the character of the bridge and its surroundings. It is probable that no bridge has ever been designed with such care in this respect and there can be little doubt that the great steel arch sweeping across the waterway will add a touch of grandeur to the already beautiful scene.

One can picture also the part the bridge might play on occasions of great festivals if illuminated throughout its length. In such circumstances any bridge of considerable size looks impressive, but this bridge illuminated would be a truly gorgeous spectacle.

It may be interesting to add that the heaviest member in the Sydney Bridge will have a sectional area of 2,552 sq. in. In comparison with this, the heaviest member in the Quebec Bridge has an area of 1,941 sq. in.; in the Hell Gate arch bridge 1,392 sq. in. and in the Forth Bridge 800 sq. in.

Readers will be interested to learn that in next month's "*M.M.*" will appear an article on the "man behind" the Sydney Harbour Bridge, Dr. J. J. C. Bradfield, M.E., M.I.C.E.

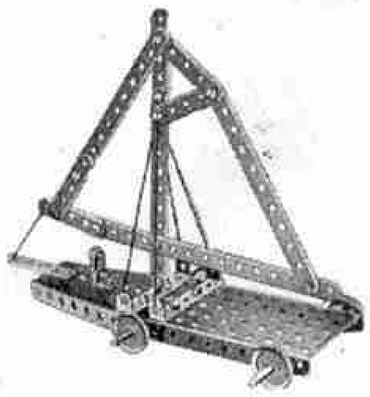
Under the Southern Cross



Our photograph shows Hugh Ridwood of Katoomba, New South Wales, who, with his sister, owns a splendid Hornby Train system and also one of the new Hornby Electric Trains.

In addition, the Ridwoods are the proud possessors of a No. 7 Meccano Outfit, Meccano Electric motors and a generous supply of all the latest parts. They have built every model in the Complete Manual and several others as well, including every one of the new models that have been published in the "M.M." Our readers will gather that to say great enthusiasm for Meccano prevails at Katoomba is to state the case very mildly !

A NEW
MODEL-BUILDING CONTEST
For No. 0 Outfit Models



The special "Outfit" Model-building Competitions published during the season 1925–6 proved so popular with our readers that we have been led to repeat some of them this year. A splendid new "No. 0" Competition is announced below, and if this meets with the same success as the earlier contests, the series will be continued up to Outfit No. 5, as before.

HOW TO ENTER

In this competition prizes are offered for the best models made entirely from a No. 0 Outfit. Models comprising parts that do not appear in that Outfit will be disqualified.

The competition offers a splendid opportunity for newcomers to Meccano-land, and to those who refrained from entering previous contests because they did not possess larger outfits. An interesting feature of the contest lies in the fact that all competitors will have at their disposal an equal number of parts.

Any type of model may be submitted in the competition providing it is the competitor's own unaided work, both in design and construction.

Entries will be divided into the following Sections :—

Section A, for boys under 12. Section B, for boys over 12 and under 16. Section C, for boys residing overseas, and not exceeding 16 years of age.

Prizes will be awarded for the three best entries FROM EACH SECTION as follows :—

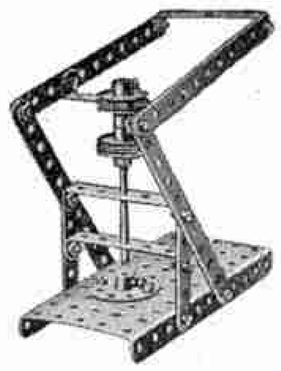
FIRST PRIZE : Meccano Products to the value of £3-3s.

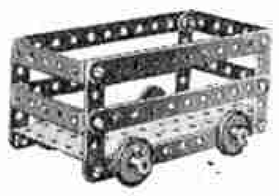
SECOND PRIZE : Meccano Products to the value of £2-2s.

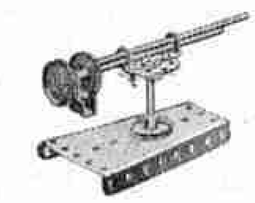
THIRD PRIZE : Meccano Products to the value of £1-1s.

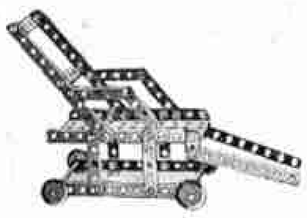
SIX PRIZES each consisting of Meccano Products to the value of 10/6.

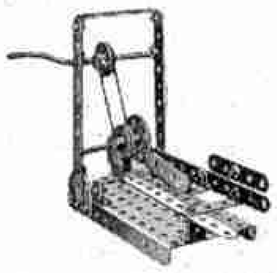
Closing dates for Sections A and B : 28th February, 1927. Overseas Section : 30th June, 1927.

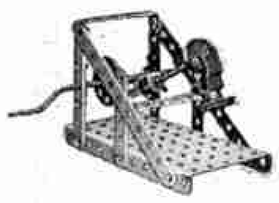


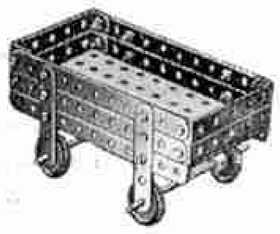


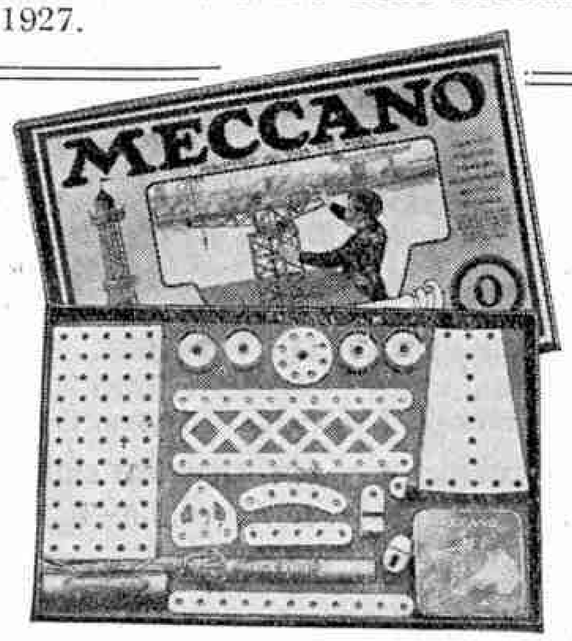


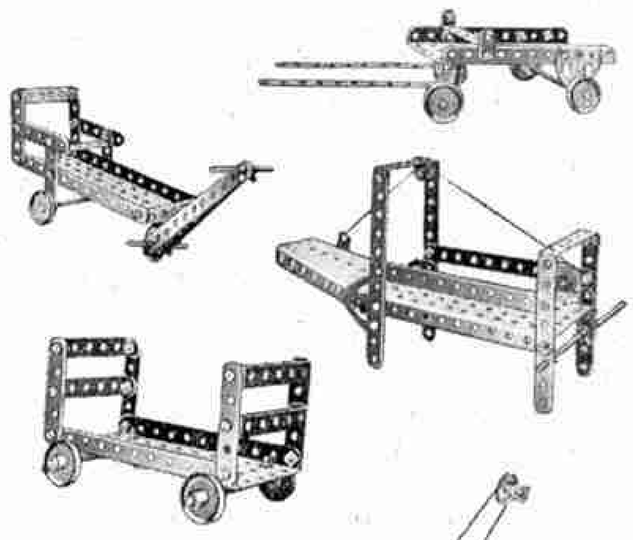


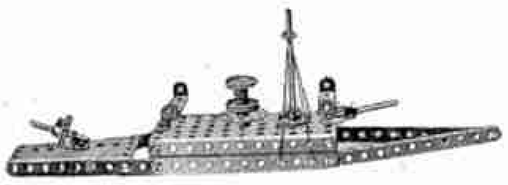


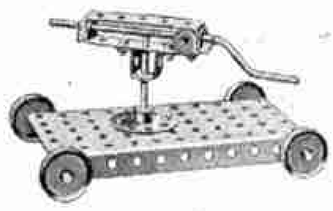


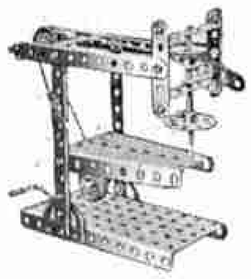


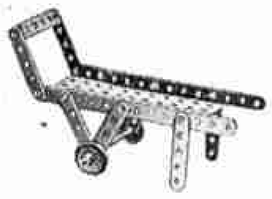


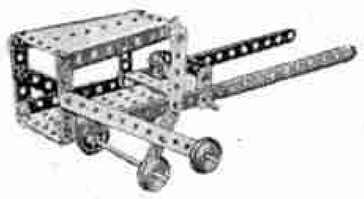


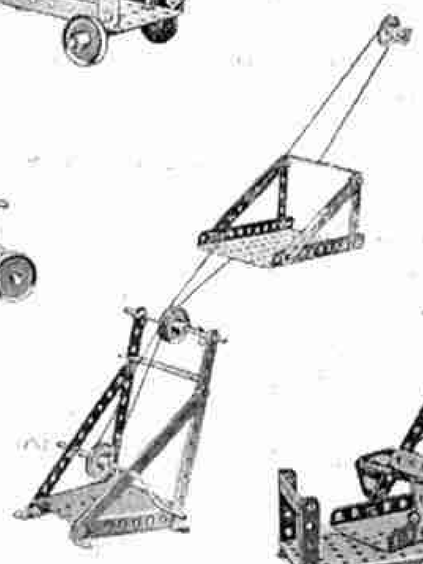












IMPORTANT INSTRUCTIONS

Readers should send in clear photographs or good drawings of their models, together with any explanations that may be necessary, although the latter should be made as brief as possible.

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 ("No. 0"), and Section in which the model is entered. Envelopes should be addressed "No. 0" Competition, Meccano Ltd., Binns Road, Liverpool.

Actual models should not be sent. A clear photograph or good drawing is all that is necessary. Photographs or drawings of unsuccessful entries will be returned if desired, providing that 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.

With the Secretary

A Happy New Year!

Once again I have the great pleasure of wishing members of the Meccano Guild and members of Meccano Clubs throughout the world a very happy and prosperous New Year. A year ago I wrote that, great as had been the progress of the Guild in 1925 I felt certain that this would be completely eclipsed during 1926. My confidence has been more than justified. The membership of the Guild has increased by leaps and bounds and many new clubs both at home and overseas have been formed and later affiliated, and are now in a thoroughly flourishing condition.

The most striking feature of the year, however, has been the astounding growth of the Correspondence Club. This has exceeded my most sanguine expectations. Applications for the necessary membership forms have poured in from all parts of the world and I have been compelled to increase my staff in order to cope with the rush.

The phenomenal growth of the Correspondence Club affords the clearest possible proof that year by year the Meccano Guild is taking a more prominent place in the lives of boys of all nationalities.

Good Resolutions

Most of us rise on the morning of 1st January with a new air of dignity and a determined set of our chins, for we are full of good resolutions! This time of the year, too, sees a certain strangeness about the Meccano offices. For instance, one rings for the office boy, and not only does he answer the summons but he comes *immediately*, and a hasty glance at the calendar helps one to gulp down natural exclamations of astonishment at the phenomenon!

I wonder what resolutions are included on each Meccano Guild member's list? I can imagine such entries as: "Remember to answer my correspondent's letters promptly!" But whatever other resolutions may be made I hope that every member will include one to *write to the Guild Secretary as often as possible.*

Photos of Clubs at Work

I am glad to say that there has been a very welcome increase in the number of photographs of club Leaders, club secretaries and club groups. In addition to these I am anxious to obtain some good photographs showing clubs actually at work, and I shall be very glad if Leaders will consider the possibility of having such photographs taken. There are of course difficulties in the way of obtaining successful photographs of interiors, especially by artificial light, but first-class results can be obtained with a little care and preparation. I feel sure that a series of photographs of this nature would be of great interest to all members of Meccano Clubs.

Passing on Smiles!

The letters I receive from secretaries occasionally reveal a little of the lighter side of club life—humorous situations that have arisen, amusing comments made by members, etc. I am always interested to read these and I should be glad if secretaries would pass on to me anything of this nature with a view to its publication in the "*M.M.*" Funny incidents are bound to crop up from time to time in the life of any club, and I am a firm believer in passing on smiles to as many others as possible!

Leaders' letters as a rule are inclined to be serious but some cheery Leaders usually contrive to include a smile somewhere in their correspondence. Just recently, for instance, a Leader gave me this description of his house: "You go into the drawing room and find a chassis in the place of a vase of flowers! Into the dining room, and visions of Meccano parts or models greet you. The bureau is littered with letters from the Guild Secretary and Meccano literature and correspondence of all kinds. This is to say nothing of the fierce-looking wireless set bristling with wires in all directions—by the way, I wonder who called it *wireless!*

Obviously this is a *real* Meccano home.

Special Merit Medallions Awarded in 1926

BIRMINGHAM (Bearwood)—C. Brimble. BLACKBURN (Holy Trinity)—A. Foster, G. Snooks. BURES—C. E. Bayes, J. C. Deaves. CREDITON (Queen Elizabeth's School)—R. Cross, M. Phillips. EXETER—R. E. Buckman, J. Burrington, E. Heath, C. Netherway, L. Nix, N. Odgers, R. Youldon. GREAT BADDOW—H. Bailes, W. Bonner. HERNE BAY—P. T. Douglas, J. Thompson, C. Wootton. HIGH WYCOMBE—H. R. Foden, A. A. Theweneti. ILFRACOMBE—H. Bowers, R. Trawin. LEICESTER (Winchester Avenue)—K. Green, D. Turner. LONDON:—BARNSBURY (Holy Trinity)—R. Clark, G. Pope, G. Randall, E. White. NEWINGTON (St. Mary)—L. Bates, J. Dodds, J. McQuirke, C. Stancombe. NEWCASTLE-ON-TYNE—A. Jennings READING—G. Allen. RHOS-ON-SEA—G. E. Mellor, R. A. Tudman. RICHMOND—A. R. White.

OVERSEAS CLUB MEMBERS.

AFRICA (Clifton)—H. Jacobsen. MALVERN (Malvern Wesleyan)—C. Dicks, P. Farrow. CAPE TOWN (Observatory)—J Barrett, H. Bolton, C. Curtis.

MEMBERS NOT ATTACHED TO CLUBS.

STOTFOLD—E. Ray. INDIA (Delhi)—K. R. Bansal.

Proposed Clubs

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

ABERAVON—A. Spencer, 6, Mount View Terrace, Aberavon, Port Talbot.

BECKENHAM—C. Price, 52, Queen's Road, Beckenham, Kent.

FALMOUTH—Mr. C. H. Bowden, 45, Marlborough Road, Falmouth.

LIVERPOOL—Waterloo—Thos. G. Mercer, 1, Sweden Grove, Waterloo, Liverpool.

LONDON—CHELSEA: E. Reid, 95, Lower Sloane Street, Chelsea, London.

LONDON—DALSTON: Mr. R. Wain, Kingsland Road, London, E.8.

ROTHERHAM—A. E. Wood, 26, Norfolk Street, Rotherham.

SEEDLEY, MANCHESTER—Mr. A. H. Holland, 22, Spring Gardens, Seedley.

SOUTH SHIELDS—Alex. Galloway, 2, Charlotte Terr., South Shields.

WEYMOUTH—W. Ravenscroft, Waterworks, Upwey, Weymouth.

CALCUTTA, INDIA—Edgar R. Shaw, 43, Free School Street, Calcutta, India.

CLUB NOTES

Southport M.C.—Football matches are played on the shore and greatly enjoyed, the two sections, "Nuts" and "Bolts," competing. Wrestling is a popular and useful feature of the syllabus. An interesting talk on "Liverpool's Civic Week" was recently delivered by the secretary. A combined Parents' Night and Exhibition was held last month with great success. Club roll: 18. *Secretary*: W. E. Williamson, 10, Delamere Road, Ainsdale

Edinburgh Castle (Bow) M.C.—Is now holding regular meetings and any boys in the district desiring to join will receive a cordial welcome. Club roll: 14. *Secretary*: E. Weedon, 173, Turner Road, Bow, London, E.3.

St. Michaels (Teignmouth) M.C.—A good increase in membership is reported, and a Magic Lantern Lecture and an Exhibition were held recently with great success. The Lecture, which was illustrated by over 100 slides, was entitled "A Holiday Trip From Lancashire to Devon." A portion of the proceeds was devoted to the purchase of new football jerseys in the club colours, blue and white. A set of boxing gloves has been purchased for club use. Club roll: 20. *Secretary*: F. Russell, 19, Bank Street, Teignmouth.

Middlesbrough M.C.—Good progress is maintained, and the club Magazine continues to improve, copies being typed and duplicated. Several interesting Debates, "Magazine" evenings and Games nights have proved very successful. The syllabus includes Football, Table-Tennis, and Competitions, and the club possesses a good library. On a recent "Paper" night some very good entries were submitted, including "The History of the Gas Engine," "Travels in Australia," "Artesian Wells" and "The Best Hunters in the World." *Secretary*: A. Bradley, 23, Laurel Street, Middlesbrough.

Collegiate Schools M.C.—A committee of four members has been formed to facilitate the working of the club. Recent meetings have been devoted mainly to preparations for an Exhibition. Mr. Booker delivered a lecture on "Battleships," which proved very successful. Further activities include a Constructional Meeting and an extremely interesting visit to the "Columbia Graphophone Works." Club roll: 41 *Secretary*: K. Walden, 18, Old Park Road, Palmers Green, London.

St. Peter Mancroft (Norwich) M.C.—Lectures by members on "Flies" and "Poison Gas" were well received. A very successful Exhibition has been held, Canon Meyrick of St. Peter Mancroft's Church judging the models. A model Biplane constructed by C. Oxbury took first prize. Several Games Evenings were well attended, and a Mock Trial is to be held shortly. Club roll: 35. *Secretary*: Lionel Harley Oates, 90, New Market Street, Norwich.

West Leeds M.C.—This recently affiliated club is developing along very promising lines. Activities include Model-building Competitions and Hornby Train Evenings, Lectures, Inventors' Nights and Papers by members. Club roll: 36. *Secretary*: B. Mather, "Lynridge," Ridge Road, Armley, Leeds.

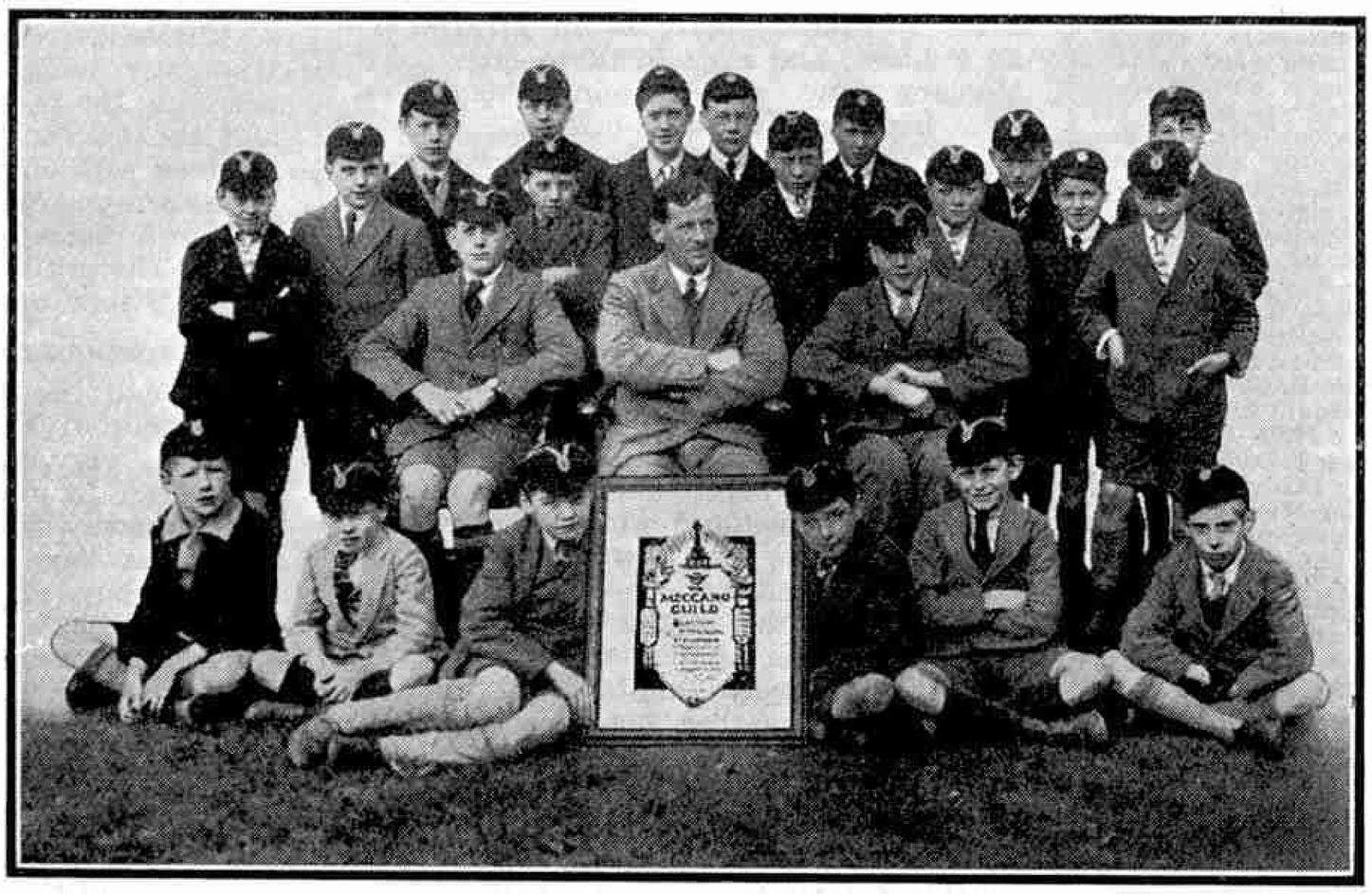
Barnet M.C.—Regular meetings are again being held, after a temporary cessation of activities. Subscriptions are accumulated and used to provide prizes in Monthly Model-building Competitions. Club roll: 8. *Secretary*: Tom Kingsmill, "Dundrennan," Hadley Road, New Barnet, Herts.

Holy Trinity (Barnsbury) M.C.—The membership shows a further increase, and sound progress is being made. A set of films obtained from the Home Cinema Library Ltd. was shown recently during the usual games hour, the club's machine being used. A visit to the Science Museum proved very interesting, though unfortunately many members were unable to attend. A fine Exhibition was very well patronised. An interesting and novel feature was the comparison of two windmill models, one made with parts taken from an original "Mechanics-made-Easy" Outfit that preceded Meccano as it is known to-day, and the other an up-to-date model constructed in the latest coloured parts. The Model Railway consisted of a double track with a branch loop and was connected at one end with the Metropolitan Electric Railway Track. There were also Cinema Shows, Scientific Lectures and—last but not least—an adequate Refreshment Stall! Visits from members of six other London Meccano Clubs were appreciated. A profit of over £5 was realised. Club roll: 40. *Secretary*: R. Clark, 77, Richmond Road, Barnsbury, London.

Garstang and District M.C.—The main activities include Table Games, Model-building meetings and Social Evenings. A committee has been elected and business meetings are held regularly. Club roll: 10. *Secretary*: J. Gardner, Moss Lane, Garstang.

Winchester Avenue (Leicester) M.C.—A Model-building Competition was held recently and keenly contested. The rule in the club is that for the construction of a large model a fortnight's time and forty marks are allowed, and for a small model a week's time and 20 marks. Successful Lectures have been delivered by K. Green on "Railway Marvels"; by the Leader, Mr. Turner, on "Roman Houses"; and by D. Turner on "Ships, Past and Present." Club roll: 19. *Secretary*: K. Green, 87, Winchester Avenue, Leicester.

Nuneaton Grammar School M.C.



Nuneaton Grammar School Meccano Club was formed in February of last year and affiliated some two months later. Since that time the club has made steady progress under the skilful leadership of Mr. A. H. Pyne, who is shown in the centre of the group. The membership is now very satisfactory and model-building on first-class lines is carried on with enthusiasm. A special section of the School Magazine, "The Edwardian," is devoted to recording the club's activities.

Louth M.C.—Regular meetings are held for Model-building and good progress is reported. It is desired to increase the membership, however, and any local boys interested should write to the Leader, Mr. T. Burkitt, 51, Aswell Street, Louth, Lincs.

Pontypool Road M.C.—Has held a dance to benefit club funds, with great success. A working committee of six members has been appointed. The secretary was recently obliged to resign owing to his studies, and a successor has been appointed. Model-building Competitions are being held regularly and prizes awarded. Club roll: 10. *Secretary*: A. W. Thomas, Tiverton Place, 122, Pontypool Road, Mon.

Rhos-on-Sea M.C.—Interesting evenings have been devoted to a conjuring display by Mr. Day, a local patron, and a recital by Captain Newman of his experiences at sea. Another nautical feature was a Lecture on Shipbuilding, delivered by another patron of the club, Mr. Pryce-Turner. A very amusing Mock Trial was held recently. The first case brought two charges against R. Boase, one of which was that of letting off fireworks to the annoyance of the players in a Rugby football match. The prisoner was found "Guilty but insane!" Another case was that of using bad language and slang to another club member, brought against J. D. Peaver. After the witnesses had contradicted themselves and each other for some time the jury brought forward the verdict of "Not Guilty, but they recommended a wash!" The club has now four divisions known respectively as "Nuts," "Bolts," "Spanners," and "Washers." The club Magazine shows a steady improvement. An Exhibition is to be held shortly. Club roll: 26. *Secretary*: G. E. Mellor, Bradda, Allanson Road, Rhos-on-Sea, Colwyn Bay.

St. George's (East Ham) M.C.—Is making good progress under the Leadership of Mr. E. E. Weffer, and the membership is improving. Some interesting Lecture Evenings have been arranged. Club roll: 18. *Secretary*: C. Jerram, 63, Boundary Road, London, E.13.

Teignmouth Congregational M.C.—Regular meetings are held for Model-building, and are well attended. A notable feature of the syllabus is Wrestling, and Gymnastics and Games are also popular. A special "Bridges" evening is being arranged. Club roll: 31. *Secretary*: D. Ford, 16, Higher Brook Street, Teignmouth.

Ashburton School (London, S.E.) M.C.—A recent success was an "Aerodrome" evening. Four tables were used, and four boys were appointed as "Foremen" to the aerodromes. Each foreman had a number of members under him and each was given a special task such as fixing the searchlights, making planes, sheds, etc. When the work was completed, marks were given by the Leader. A "Railway Evening" was held on similar lines, the work being done by boys specially appointed in "gangs." The "Fire Brigade" evening organised on another occasion was referred to in last month's Secretarial Notes. Harbour, Shipping and Factory evenings are now being planned. Club roll: 23. Leader: Miss C. R. Bolt, 131, Anerley Road, London, S.E.20.

St. Annes Park (Bristol) M.C.—Recently held an interesting evening on which a Motor Lorry model with 20 mistakes was exhibited, members being required to find as many mistakes as possible and marks being awarded. A Lecture by the secretary on "The Story of British Railways" was well received and a few chapters from "The Wonder Book of Railways" were read aloud. A simple model was constructed blindfold on another evening and a Stamp Evening and a Paper Chase were much enjoyed. Reading, Essay, Fretwork, Lecture and Games nights are planned. Club roll: 23. *Secretary*: J. Davis, 45, Arlington Road, St. Annes Park, Bristol.

Annan M.C.—An interesting visit to the works of local boiler manufacturers was held recently, and an essay competition organised in connection with the visit was won by Noel Nelson. A special Club Recruiting Campaign is being organised and prizes are to be awarded. Meetings are mainly devoted to Games, Competitions and Model-building. A stamp Section has been formed. Club roll: 18. *Secretary*: Oswald Gibbs, The Studio, Annan.

Primitive Methodist Chapel Choir (Bognor) M.C.—Has been re-organised and is now making good progress. President, Leader and secretary having been appointed. Meetings are held every Thursday evening and any local boys wishing to join should apply to the Leader, Miss A. M. Tyler, Syston Villa, Sturgess Road, Bognor. The club has also a Girls' Section. Club roll: 9. *Secretary*: S. N. Wilson, Meadowvale, Hawthorn Road, Bognor.

Skelmanthorpe Wesleyan M.C.—Good progress is reported, and the membership shows an increase. A recent Lecture delivered by Mr. Fred Lawton on "The Romance of Skelmanthorpe" was well received, and members hope to have another visit from this gentleman. Club roll: 51. *Secretary*: Mr. R. Gordon Field, Pilling House, Skelmanthorpe.

Cromer M.C.—Model-building and Railway Nights are held regularly and greatly enjoyed. An "Invention Night" resulted in some excellent models being constructed and the first prize was taken by the secretary with a Motor Chassis model, which was subsequently exhibited in the shop window of a local dealer. Club roll: 6. *Secretary*: C. Carter, Grenedahr, Holt Road, Cromer, Norfolk.

Llanyre Hall (Llandrindod Wells) M.C.—Has become affiliated and is developing along promising lines. Several good lectures have been delivered by club members, Engineering and Farming being among the subjects chosen. Club roll: 15. *Secretary*: Roger Cave-Brown-Cave, Llanyre Hall, Llandrindod Wells.

Greenock Academy M.C.—Several visits have been paid to local places of interest, including the "Greenock Telegraph" printing works. *Secretary*: James F. Swan, The Hill, Caddlehill Street, Greenock.

Derby M.C.—A Model-building Competition resulted in some very good work, most of the models being original. Several interesting Lectures have been delivered, notably on "The Forth Bridge," by Mr. W. Smellie; "Inventions Prior to the Industrial Revolution," by Mr. W. Steer; "The Mechanics of Football," discussed by the Leader, Mr. J. Critchlow; and "The Romance of Aviation," by Mr. J. B. Pullon. A Contractors' Night was held with great success. By means of a general Recruiting Campaign a steady increase in the membership is being effected. Club roll: 39. *Secretary*: P. H. Speed, 5, Findern Street, Derby.

Brighton (Dublin) M.C.—Has recently been affiliated. It is interesting to note that there is a Brighton (Australia) Meccano Club in addition to this Brighton (Dublin) M.C., but no club in the English Brighton! The activities of the Dublin Club include a Draughts Tournament, Concerts, Visits to the Museum, Art Gallery, and Zoo, Model-building and Hornby Train nights, Lantern Shows, Competitions, Conjuring Displays by the Leader, Mr. C. W. Cannon, and Lectures on "Polar Exploration by Air" and "Steam Engines." Club roll: 12. *Secretary*: W. Malone, 3, Pretoria Terrace, Harolds Cross Road, Co. Dublin.

South Africa

Malvern Wesleyan M.C.—Meetings are well attended and recent activities include Model-building, Games, Debates, Sectional and Novelty Evenings. On "Section" Evenings one section calls the programme and arranges the evening for the entertainment of the remainder of the club. The "Ranchers" gave a "Decca" gramophone Evening that was greatly enjoyed, and the "Rovers" in their turn gave a musical programme followed by refreshments. The "Ramblers" provided a jolly evening devoted to competition games and refreshments. The Leader's evening was attended by about 140 people and a great Display of Models was followed by a musical programme. A Special Debate Evening was devoted to a discussion of the question, "Should Natives Be Educated." Miss Nicholson took the affirmative, seconded by Mr. Sykes, the Leader, and Messrs. G. Wilcox and H. Prince took the negative. The hall was crowded and ultimately the negative side won by the narrow margin of seven votes. Mr. A. E. Harris, the Meccano agent in South Africa, has presented the club with a fine cup as a floating trophy for the Annual Cycle Race. Under the joint Leadership of Mrs. Learmouth and Mrs. Swart a Girls' Section has been formed. Leader: Mr. E. Sykes, c/o H. Garner, Esq., Box 54, Cleveland, Johannesburg, South Africa.

All Saints (Clifton) Johannesburg M.C.—Good progress is being made and some very fine Lectures have been delivered at the home of the Leader, the Rev. H. R. Higgs, M.A., on Paper-making Machinery, Cold Storage Plant, Alloys of Metals, Metal-plating, Gold Mining and Reef Formations, Carburetters, Gears and Gear Ratios, Levers and Battery Stamps. Model-building in the club takes three forms—Models built from Meccano Manuals, Models from designs in Lectures and Models from boys' own ideas. Meetings are conducted on Monday evenings, and local boys wishing to join should apply to the Secretary. Club roll: 25. *Secretary*: Hermann Jacobsen, 169, Loveday Street, Clifton, Johannesburg, South Africa.

Australia

Yeronga M.C.—Is the most recent addition to the list of overseas affiliated clubs, and is progressing well. It was formed originally by Allen McWilliam and Jack O'Leary, and Mr. Lionel G. Cecil promised to become Leader if a sufficient number of members could be enrolled. This task was soon accomplished, and regular meetings commenced. At present meetings are devoted in turn to Model-building, Drawing, Reading and a Concert. A short time is devoted to Gymnastics at every meeting. Club roll: 14. *Secretary*: Jack Hooker, Grosvenor Street, Yeronpilly, Brisbane, Australia.

Adelaide M.C.—Regular meetings are held and serious Model-building is relieved by Games and gramophone records. At the close of each meeting supper is very kindly provided by the mother of the Leader, Mrs. Saddler, at whose home the meetings are held. The club has its own library, Lantern Lectures are organised and a loud speaker is loaned to provide entertainment. Interesting visits to local places of interest have been arranged. Leader: Mr. J. A. Saddler, "Narbethong," 56, Myall Avenue, Kensington Gardens, Adelaide, Australia.

New Zealand

Napier M.C.—Recent activities include a visit to the Municipal Power House, a Lecture on Dunedin Exhibition and an address with demonstrations on the working of the Lewis Gun. A series of Talks on Electricity delivered by the Leader also proved most interesting. At a fine Exhibition of models the following among others were displayed:—Big Wheel, Transporter Bridge, Dutch Windmill, Dredger, Motor Chassis and Maxim Flying Machine. A fine Hornby Train layout included an Electric Train. Over 200 people visited the Exhibition and the profit was helped by the sale of refreshments, which alone realised over £4. Meccanograph designs were sold at 3d. each and patrons were keen to buy them. Altogether the Exhibition was highly successful and won favourable comment in the press. Leader: Mr. F. Drew, c/o "Daily Telegraph," Napier, New Zealand.

A Brotherhood of Boys

Why You Should Join the Meccano Guild

The really happy boys throughout the world to-day are those who have a hobby in which they take an enthusiastic and lasting interest, and the happiest of all are Meccano boys, for theirs is the greatest of all hobbies. When a boy takes up a hobby, whatever it may be, he feels a great desire to meet other boys having interests similar to his own, and to compare notes and talk things over with them. This is particularly the case with Meccano. No Meccano boy is content to "play a lone hand" for long. He very soon wants to meet other Meccano boys, to see their models and to show them his own, and to discuss plans and schemes for other and bigger models.

How the Guild Began

It is more than 20 years since Meccano began to take its place as the greatest of all hobbies, and even in those early days Meccano boys were forming themselves into little clubs and societies. These organisations steadily increased in strength and numbers but by degrees they began to realise that they were suffering from a very serious defect—they were isolated, each doing good work in its own little sphere, but knowing nothing of what other similar organisations were doing.

Presently we at Meccano Headquarters began to receive letters asking us to set up some form of central organisation to which all the individual clubs and societies might look for guidance and which would weld them all into one great body. Day by day these letters increased in number, and we realised that the desire for a central organisation was genuine and widespread. We were only too willing to do all that we could in the matter but, realising the immense responsibility and the enormous amount of work involved in taking such a step, we delayed action until we felt that we had the means and facilities for carrying out the task successfully. By 1919 we felt that we were in a position to tackle the job and in that year the Meccano Guild came into existence.

It is important to remember that the idea of a Guild did not originate at Meccano Headquarters. The Meccano Guild was organised solely as the result of urgent representations from boys all over the world. They, as Meccano boys, felt the need of attaining unity by means of such an organisation and we at Headquarters felt it our duty to do everything we could to satisfy the demand.

A Unique Brotherhood

So the Meccano Guild, the most remarkable brotherhood of boys in the world, came into being in the year 1919, with Mr. Frank Hornby, the inventor of Meccano as its president. The announcement of its birth was received with the utmost enthusiasm throughout the great army of Meccano boys of all nations, and applications for membership began to come in immediately in large numbers. Since that time the membership of the Guild has grown enormously, and a special feature of its growth has been its steadiness, year in and year out.

Objects of the Guild

The three objects of the Guild, set forth in the form of application for membership, are as follows:—

(1) To make every boy's life brighter and happier.

(2) To foster clean-mindedness, truthfulness, ambition and initiative in boys.

(3) To encourage boys in the pursuit of their studies and hobbies, and especially in the development of their knowledge of mechanical and engineering principles.

In order to join the Meccano Guild it is necessary for the form of application to be filled up, signed and witnessed. This form is then sent to the Secretary with a remittance to pay for a badge. The applicant is then duly enrolled as a member of the Guild and his badge and membership certificate are sent to him. The neat little triangular badge—its three corners representing the three objects of the Guild—and the handsome certificate are always received with enthusiasm. Most members have their certificates framed and hung in their own rooms, where they can always see them. The price of the Guild badge is 7d., or 1/- if sent overseas.

The Correspondence Club

Although the Guild was originated for the benefit of Meccano Clubs it includes to-day a very large number of "lone" members. In many cases these members live far away from a Meccano Club and sometimes far away from any other Meccano boy. It is a great joy to such members to have someone to write to who is really interested in the Meccano hobby, and it was the realisation of this fact that led to the inauguration of a Guild Correspondence Club. Through the medium of the Correspondence Club boys living in the remotest parts of the world are placed in touch with other boys of their own age and of similar interests. In most cases correspondence is carried on regularly, and results in the formation of firm friendships, although the boys may be living hundreds or even thousands of miles apart. Boys who have become acquainted through the Correspondence Club have even visited one another, each spending a happy holiday as a welcome guest in the home of the other.

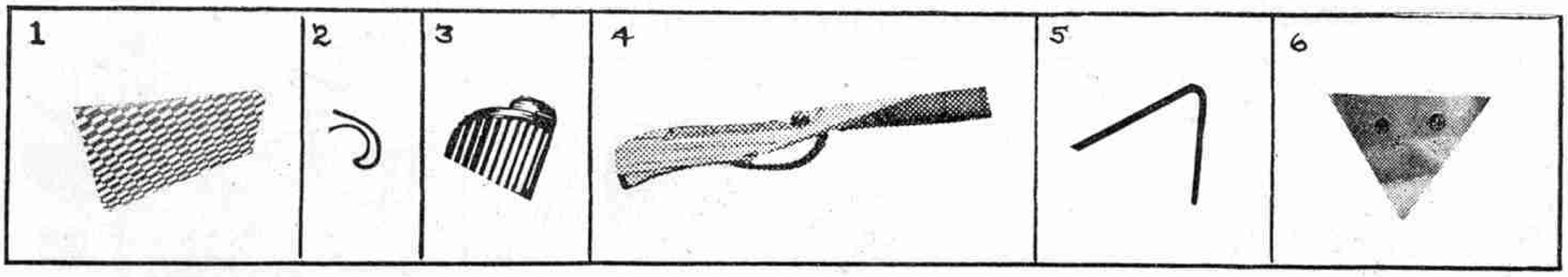
The "*Meccano Magazine*" is the official organ of the Guild, and each month two or three pages are devoted to Guild matters. The progress of the various clubs all over the world is reported briefly and photographs are published of Leaders, and secretaries and club groups. Thus, by means of the "*Meccano Magazine*," each club is kept acquainted with the progress of all other clubs.

Every Meccano boy should be a member of the Guild. As soon as he receives his badge and certificate of membership he has the right of entry into the innermost circles of Meccanoland. His pleasure in his hobby is increased enormously and he has the keen satisfaction of knowing that, instead of being an isolated unit, he belongs to a great brotherhood of boys with members in every country in the world.

Competition Page

From which Advertisements are these taken?

A Competition for Lynx-Eyed Readers



Here is a chance for every reader! Can you solve the mystery of the picture fragments shown above? Each is taken from an advertisement appearing on the pages of this month's "*M.M.*" and is reproduced slightly larger than the exact size.

All that intending competitors have to do is to start at the front cover, examine every advertisement closely and after identifying as many fragments as possible, send the list to the Editor to reach this office not later than 31st January; in the case of Overseas readers, the closing date is 30th April.

The items must be numbered 1, 2, 3 and so on, and the name of the advertiser and the article from which the fragment is taken must appear against each number.

Prizes of Meccano products to the value of £1/1/–, 15/– and 10/6 will be awarded to the senders of the most accurate solutions and, in addition, there will be eight consolation prizes, value 2/6 each.

Solutions must be addressed to Advertisement Competition, c/o The Editor, "*M.M.*," Binns Road, Liverpool.

If I Were Editor

A Chance for Our Critics!

Every year we receive many hundreds of suggestions from readers who believe that the adoption of their proposals would improve the "*M.M.*" We are always glad to receive these suggestions, and each one is considered carefully with a view to its possible adoption sooner or later. Many of the most popular features of the "*M.M.*" have been developed from the suggestions of readers and now that the size of the Magazine is to be increased permanently we shall have a better opportunity of adopting new schemes.

This month therefore we are announcing a contest entitled "If I Were Editor Of The "*M.M.*" Each competitor is required to state clearly but briefly what changes he would make, what features he would drop and what new ones he would introduce, if he were editor. This contest will be judged on the practical value of the suggestions put forward and not upon the excellence of the composition.

Essays should not exceed 500 words in length. They must be written on one side of the paper only and each sheet used must bear the competitor's name and address and age. There will be two sections, "A" for those of 16 and over and "B" for those under 16 years, and prizes of Meccano Goods value £1-1s.-0d. and 10/6 respectively will be awarded to the best essay in each section. In addition, a number of consolation prizes will be awarded to those entries which, while not of prize-winning standard, are worthy of special recognition.

Closing date 31st January. Overseas, 30th April.

Home Results

Doublets. No. 2

Much ingenuity was displayed by entrants in this word-building competition and there was very little to choose between the winning entries.

Our own solution, consisting of every day words, shows only 42 links. The winning entry, however, required only 40. This necessitated the use of one word that, while not an "every day" word, is, nevertheless, sufficiently common to be admissible. For the benefit of other competitors we append the winning solution:—COAL-foal-feal-feel-FUEL; COLD-hold-held-head-HEAT; EARL-earn-darn-dare-dure-DUKE; GRIT-grim-trim-tram-team-ream-read-ROAD; BELL-belt-bent-rent-rend-rind-RING; MINOR-manor-MAJOR; COIN-corn-core-more-mire-mine-MINT; SHIP-shop-shot-soot-moot-most-MAST; LION-loon-loan-roan-ROAR; FACE-race-rack-sack-sock-soak-SOAP.

Several competitors provided solutions possessing 37, 38 and 39 links. These however included inadmissible words such as coll, grad, grot, Dane and other proper names.

The prizes were awarded to:—1. V. Smith (Dublin); 2. G. Lesson (Derby); 3. H. Pringle (Ipswich). Consolation Prize Winners:—D. W. A. Minette (Leicester); B. Sandham (Preston); H. G. Parker (Rochester); Eleanor Ramsay (Edinburgh); J. A. Steggall (South Shields); E. Day (Shepherds Bush, W.12); G. A. K. Simpson (Torrance, Stirlingshire); A. L. Somerville (Sheffield).

19th Drawing Contest

One can well imagine that practically every steam roller throughout the country has been subjected to keen scrutiny in preparation for this competition for the name plate of almost every county council and borough council has appeared upon one roller or another drawn for the contest. The majority of the drawings show a keen respect for detail but many competitors metaphorically were "flattened out" when endeavouring to convey the impression of unyielding power and solid weight that bears itself upon one when observing a roller at work. Nevertheless the general standard was very high.

The prize list is as follows:—First Prizes: Section A, T. A. Dawson (Manchester), Section B, H. Lane (Stokesley, Yorks.) Second Prizes: Section A, C. E. Cruickshank (Insch, Aberdeenshire); Section B, R. Forrester (Carlisle). Consolation Prizes, L. B. Braithwaite (Lancaster); A. G. Glenn (Ipswich); K. J. Post (Chippenham, Wilts.); C. Bigwood (Oxford); R. Clough (Gainsborough); C. Stapley (Etchingham, Sussex); R. Higgins (Sheffield).

Overseas Results

Summer Pastimes Voting

It was interesting to observe the similarity of the voting of the overseas and home sections in this contest and with the exception of an exchange of places between motoring and swimming, the final order was the same. The following was the outcome:—

Cricket, Tennis, Swimming, Cycling, Motoring, Photography.

The First and Second Prizes were put together and divided equally between S. Dayal (Delhi) and L. Fisher (Johannesburg), whose entries were identical, both containing only one error. The remaining prizes were awarded as follows:—3. S. M. V'Jayam (Madras, S. India); 4. B. Swift (Montreal). Consolation Prizes, value 2/6 each go to L. E. Keng (Singapore) and Chand Mal (Delhi).

16th Drawing Contest

Several really excellent drawings were submitted to this contest, many of them depicting lighthouses and lightships vastly different from those that one is accustomed to seeing around our English coasts. Of these, mention should be made of the Colombo Lighthouse that closely resembles the clock towers one often finds in English market places.

Many competitors, living miles away from the sea had to depend upon illustrations from the articles on John Smeaton's engineering works, that appeared in the "*M.M.*," and some splendid drawings of the Eddystone lighthouse were submitted.

Prizes were awarded to the following competitors:—First Prizes: Section A, J. de Conte Manduca (Malta); Section B, D. Shores (Winnipeg). Second Prizes: Section A, T. S. Singh (Calcutta); Section B, J. R. Heeramaneck (Bombay).

28th Photo Contest

First Prizes: Section A, R. T. Anderson (Toronto); Section B, F. Johnson (New York). Second Prizes: Section A, F. van Bulck (Paris XI.); Section B, R. Kelly (Bay of Plenty, N.Z.)

County Cricket v. League Cricket

First Prizes: Section A, S. Evans (Sydney, N.S.W.); Section B, S. Newton (Bombay). Second Prizes: Section A, M. Richards (Paris); Section B, G. Curmi (Malta).

GAMAGES

The Meccano Boy's "Own Store"

A Good Motto for 1927
"Write to Gamages about it"

TAKE UP

CHEMISTRY

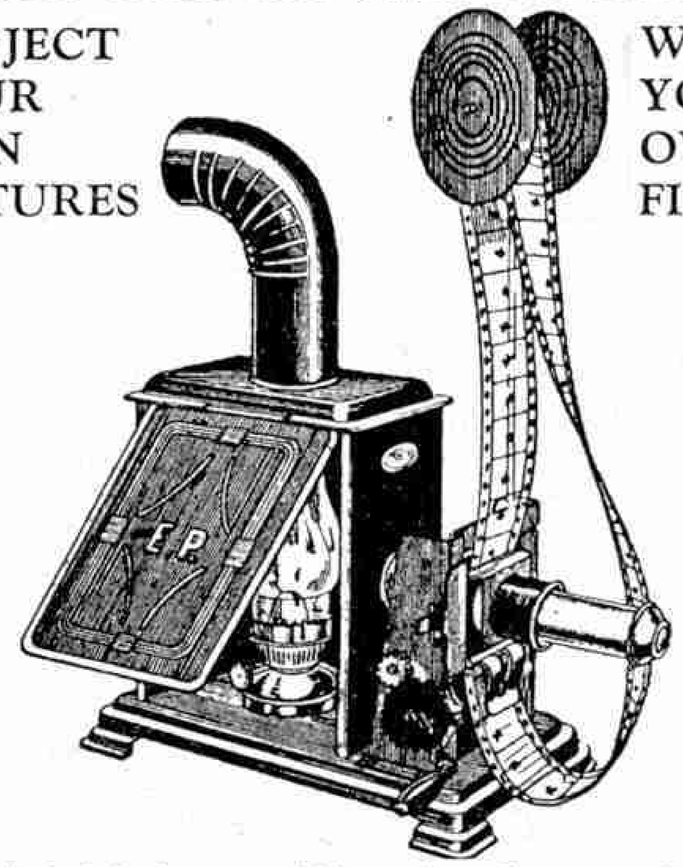
A fine Hobby for the long winter evenings and one of which you will not quickly tire. It is amusing, interesting, and very educational. The modern school boy will find it extremely useful for improving his knowledge. You have a choice of a large range of outfits if you come to

GAMAGES

You can get a very useful box containing Chemicals sufficient for 50 experiments, with instructions Other Sets **3/3, 14/6, 32/6, 52/-** Tell your chums about this and bring them along, if not, you can order by post with complete confidence. Post 6d. **5/6**

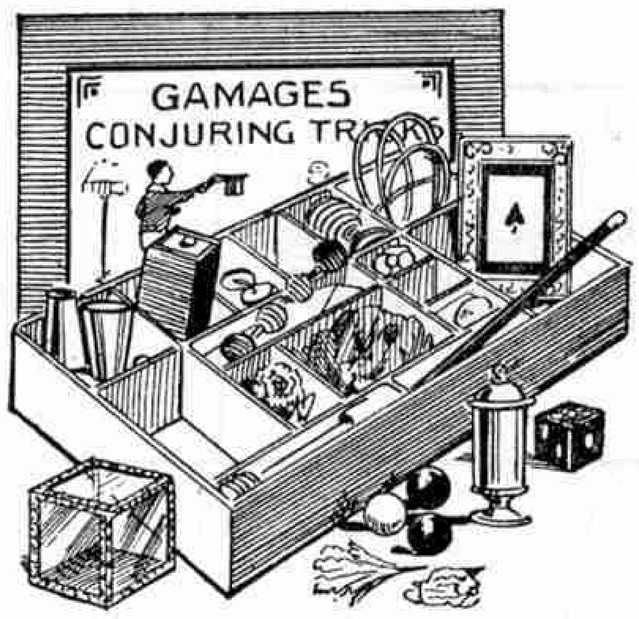
ENJOY THE MOVIES AT HOME

PROJECT YOUR OWN PICTURES WITH YOUR OWN FILMS



Just think of all the fun you could have with a Cinematograph of your own—change of films as often as you like—just the pictures *you* want shown—and save entrance money. Get this Model Cinematograph NOW—if you want to get all the fun possible this winter. 10 in. high, including the Chimney, and made to show both films and slides. Complete with 1 slide and 1 film. Extra films, 36 ft. **1/-**, 72ft., **2/-**, 150 ft. **3/6**. Coloured Circular Bands, 43 in. long, **1/-**. Shorter ones, **6d.** Extra Slides **8d.** per doz.

List of Cinematographs sent post free. **10/6**

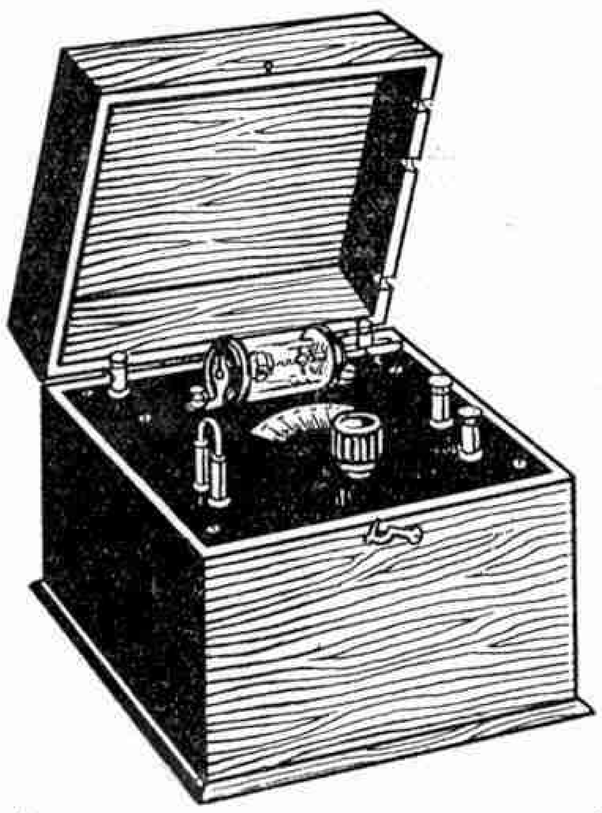


BE A CONJURER

Jolly good fun and ever so easy if you get your tricks from the right place, and don't forget to practice. The fellow who can conjure gets a wonderful time. Not only does he get the fun of the conjuring but also invitations to parties, fetes, etc., that he would never get otherwise. All the apparatus and instructions for several mystifying tricks. Post 4d.

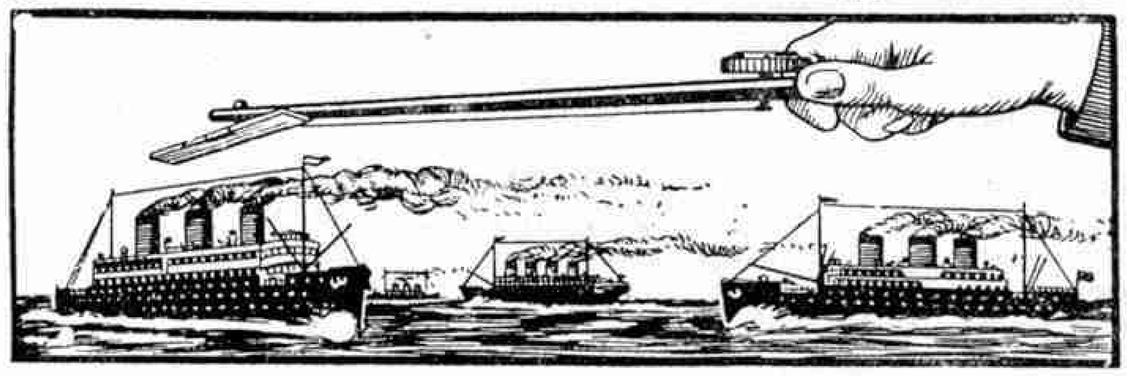
Other Sets
3/-, 7/9, 10/9, 15/9, 22/6, 35/-, 42/-, 63/-

4/6



The Motor Hydroplane "MAPLE LEAF V."

The Hull is constructed of selected Yellow Pine and has mahogany spray hood and deck fittings. Brass rudder, tiller and rack, and strong wire guard to protect the brass propeller. Enamelled in a beautiful shade of green, the hood, deck and fittings being varnished. 26 ins. long. Fitted steam engine and boiler. "Maple Leaf V." will run for 30 minutes and cover a long distance. Price **22/6**



MAGNETIC WIRELESS CONTROL BOATS

consisting of scale Model Liner, 6 ins. long, with two masts, derricks, ventilators, upper works and model wireless aerial between the masts. Finished bright colours. By means of strong polished Steel Magnet at end of Control Staff, these boats can be manœuvred without touching them, just like real ships—backwards, forwards, and turned round in their own length. In fact, all the evolutions of a real ship can be reproduced with these models. The set comprises one Boat and one Control Staff with Magnet, in box 14 × 3½ ins., with full set of instructions for use and suggestions for Games. Price, per set, Post Free **3/6**

BOYS!

Experience the Joys of WIRELESS

If you haven't them do so now and be up-to-date and here's the set you've been waiting for and at the price you can afford. Get this splendid CRYSTAL SET in a strong Oak Cabinet and Dustproof Crystal Detector, all parts are nickel plated. At the generous price of Usually sold at 20/- **10/-**

Boys! make a Clock

THE "UMAKA" CLOCK SET

Comprises the complete set of finished parts, with simple instructions, enabling the novice to make A REAL CLOCK. 5½" Polished Wood Dial. Will go for years and keep time. Interesting and instructive to all ages. Price Post Free. **7/6**

A. W. GAMAGE LTD., HOLBORN, LONDON, E.C. 1

City Branch: BENETFINKS, CHEAPSIDE, E.C. 2

January Puzzle Competition

If one may take the first few days of December as a criterion, the entry for last month's puzzle contest is likely to prove a record in the number of entries received. There was one feature, however, of those early entries that calls for comment. A number of them showed signs of having been prepared in a great hurry, presumably in the hope that early entries would receive closest attention. As a consequence, the neatness of the preparation of the solutions suffered. It is a great pity that really good work should be spoiled by slovenly preparation, especially when nothing is gained by the additional time. Remember, every entry is carefully examined and all things being equal the neatest gains the prize.

There is nothing calling for special comment in this month's set of puzzles. Each should be attempted. Prizes of 15/- 10/6 and 5/- as well as a number of consolation prizes value 2/6 will be awarded to the best sets of solutions.

The closing date is 31st January, and there will be no overseas section.

Puzzle No. 197. *Contributed by A. Sury (Madras).*

A traveller carrying 5 loaves of bread sat down to eat but was interrupted by a second traveller who had three loaves. They agreed to share their meal together but when about to start a third traveller arrived and asked if he might be allowed to join their meal, as he had nothing to eat.

They all sat down together and had equal portions. At the end of the meal the third traveller laid down eight pennies in payment for his food. How should the pennies be divided?

* * * *

Puzzle No. 198. *Contributed by P. Sutcliffe (Rochdale).*

My first is in building but not in hall,
My second's in fencing but not in the wall,
My third is in cricket but not in game,
My fourth is in vicious but not in tame,
My fifth is in sentence but not in word,
My sixth is in jackdaw but not in bird,
My seventh's in treasure but not in trove,
My eighth is in crimson but not in mauve,
My ninth is in crinkled but not in curled,
My whole is respected all over the world.

* * * *

Puzzle No. 199. *Contributed by P. Sutcliffe (Rochdale).*

A gentleman purchased a plot of land on which to build a house. The plot had a frontage many thousands of feet in length on a main road, but when the land came to be surveyed the owner decided that he wanted a square piece and must purchase some more to achieve his object. With this last purchase the area of the plot was exactly the same numeral in square measure as the distance around the plot in lineal measure. What was the smallest area of land that he could purchase to fulfil his requirements?

* * * *

Puzzle No. 200. *Contributed by R. J. Bullows (Birmingham).*

A tube containing a drawing is required to be posted urgently but as the Post Office is closed the package cannot be weighed otherwise than on a spring balance registering only up to four ounces. The package will pass into the letter box, but as it proves too heavy for the spring letter balance in the ordinary way some other means of weighing it must be found. No other scales are available.

Actually the tube weighed just under six ounces and was weighed using the four ounce spring balance. How was it done?

Puzzle No. 201. *Contributed by V. Lewis (Glam.)*

What word is that that has six letters but when two are taken from each end still has eleven.

* * * *

Puzzle No. 202. *Contributed by Herbert Gelder (Huddersfield).*

What is this?
Perfect with a head
Perfect without a head
Perfect with a tail
Perfect without a tail
Perfect with either, neither or both.

* * * *

Puzzle No. 203.

"How many marbles have you?" asked Fred's mother. "Well," said Fred, "if you add one-quarter to one-third of the number, you will have 10 more than half of the number." How many marbles had Fred?

* * * *

Puzzle No. 204.

Strike me if you will.
Treat me with disdain,
Burn me, break me, still—
Your equal I remain.
What am I?

* * * *

Puzzle No. 205.

Can you cut a square of paper into four pieces of exactly the same size and put it together again so as to form a symmetrical Greek cross?

* * * *

Puzzle No. 206.

A foe to sleep and tranquil slumber,
Add to this word the letter "S"
And mark the metamorphosis.
Plural is plural now no more
And sweet what bitter was before.

* * * *

Puzzle No. 207.

B. one day drove a flock of geese
And met with Farmer A;
Says Farmer A, "How much a piece
For this flock did you pay?"
Says B, "I paid for all I drive
Just six pounds and a crown;
And I'm going to sell them all but five,
At yonder market town;
When fifteen pence a head I'll charge
Above what they cost me;
And thus obtain a sum as large
As I gave for all you see."

How many geese did B buy? How much did he give for each? And what price did he ask?

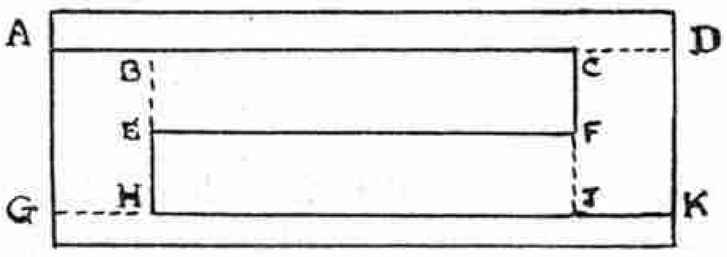
Answers to Last Month's Puzzles

No. 187. The sum reduced to figures is as given below.

```
13)8290(637
   78
   ---
    49
    39
    ---
    100
     91
    ---
     ..9
```

* * * *

No. 188. The shortest route is the continuous line from A to K as shown. When the groundsman reached D he went up to C and back to D. At G he went to H and back and from B to E and back. The dotted lines are those covered twice.



No. 189. The deciphered items on the farmer's bill were as follows:—

A horse for half a day ...	10/-
Hay for the horse ...	1/-
A'shoeing of him	2/6
A'taking of him home again	1/-
Total	14/6

* * * *

No. 190. Unconstitutionalism.

* * * *

No. 191.

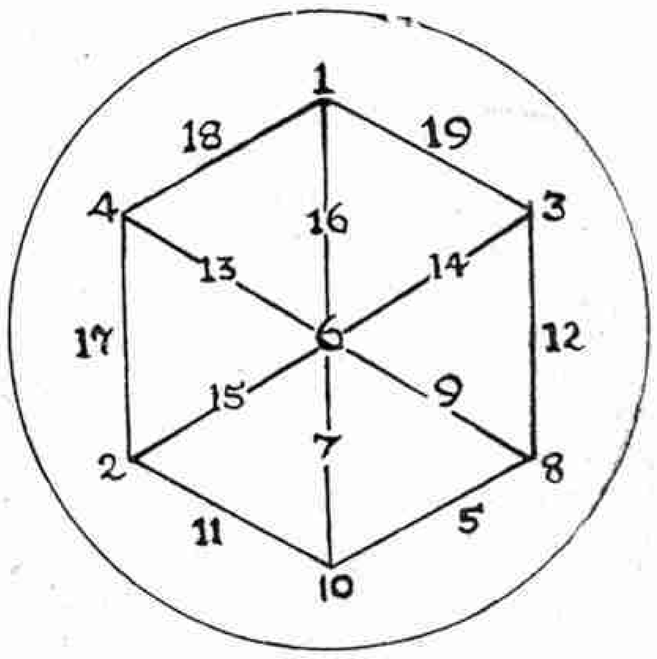
God and my right.
After us the deluge.
It is magnificent, but it is not war.

* * * *

No. 192. The route is as follows:—A-B-C-D-H-K-M-L-K-A-D-B-M-C-L-N-I-A-G-E-F-G-H-F-J-K.

* * * *

No. 193. The re-arranged figures are as shown below.



* * * *

No. 194. A River.

* * * *

No. 195. The re-arranged square is as follows:—

1	11	6	16
8	14	3	9
15	5	12	2
10	4	13	7

* * * *

No. 196.

Gin a body meet a body
Comin' through the Rye.
Gin a body kiss a body
Need a body cry?

* * * *

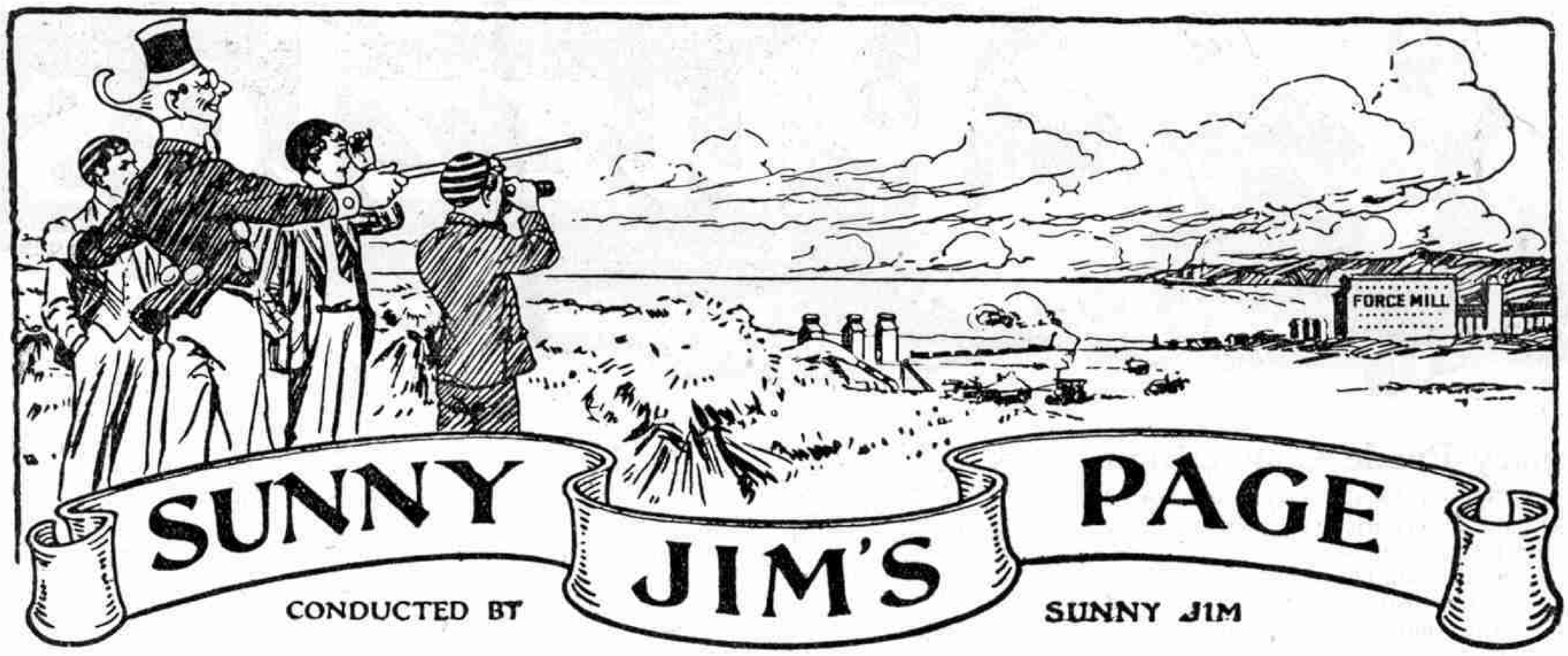
Paddle your own canoe.

* * * *

What an ass I am!
An ass I am.

* * * *

Aby see de Goldfish?
Em no Goldfish.
Ess em are Goldfish



THE "OVER THE FENCE" PUZZLE

My Dear Meccanoites,

I trust that by the time you read this you will have got over whatever discomforts you may have experienced from eating too well during the celebration of the Christmas festivities. "Boys will be boys," they say, and although we know that it is not really good for us to stuff ourselves with toothsome dainties, sometimes, on very very special occasions, we do go the limit, even though we know we may have to pay for it later. We are like the little boy in the story who, when asking for a third helping of Christmas pudding, was told to be careful as he may get indigestion. He replied, "I don't care, it's *worth* it!"

Of course none of us is likely to have been so greedy as this little glutton, but nevertheless it is good to know that now all the celebrations are over, we can come back to the good old "Force" and milk with renewed enthusiasm. We know very well that however keen our appetites may be, we cannot over-eat ourselves on "Force" and milk; not only does it give us the maximum of nourishment, but we are getting a food that is perhaps more easily digested than any other food it is possible to serve.

"Force," the original whole wheat flake food, is something we can enjoy every day of the week, and is therefore far better than those other nice things to eat that can only be taken occasionally on account of their not being suited to every-day digestions.

Now for the puzzle! I know that's what you have been waiting for! It looks weird, doesn't it? Let's see what we have to do this time. This circle can make the old rhyme—

"High o'er the fence leaps Sunny Jim,
'Force' is the food that raises him"

come to life; and, what is more exciting, *you* will draw the picture that depicts this scene.

Take a piece of paper, but make sure that it is fairly transparent. Take a pin and put it through the middle of the piece of paper and through the dot in the centre of the circle. Mark the point No. 1 at the bottom of the circle on your paper, and trace line No. 1 inside circle. Now move the paper round until the dot which you marked on it comes level with figure 2 on the circumference of the circle. Draw line No. 2. Move the dot round to 3 on the circle. Draw line No. 3 and so on. The result of your efforts will surprise you.

This is a puzzle to show your friends; it is purely for amusement and no prizes are offered. Ask them if they can find "Sunny Jim" in the circle. When they fail show them how it is done. After your friend has solved the puzzle he may find that he has learnt something he didn't know before. If this is the case you will be able to tell him all about the wonderful food you have every day, and get him to eat it too. The more "Force" we eat the fitter, stronger and healthier we all will be. Meccano boys especially should make it their duty to show others that brainy fellows are fit fellows too. The fitter your body the harder your brain can work. "Force" is good for both body and mind. It's a food that is *worth* being keen about. Ask until you get it

HIGHLY IMPROPER

Christmas Diner: "I believe it's improper to speak disrespectfully of one's elders."

Waiter: "Yes, so I believe."

Christmas Diner: "Well, then, I won't make any complaints about this fowl!"

* * * *

John, who was paying a visit to a friend in hospital began to take an interest in the other patients, and their ailments.

"What are you in here for?" he asked one.

"I've got tonsilitis and I've got to have my tonsils cut out," was the answer.

"I've got blood poisoning in my arm and they're going to cut it off," was the next patient's reply.

"Heavens!" cried John in horror. "This is no place for me. I've got a cold in my head!"

* * * *

The daughter of a certain old-fashioned Scots elder had attended a dance the previous night, much to her father's horror. When she appeared for breakfast the next morning, he greeted her with the words:

"Good morning, daughter of Satan!"

To which the maiden respectfully replied:

"Good morning, father."

* * * *

A COSTLY AD.

A farmer came to town to insert a death notice in the local paper.

"How much do you charge?" he asked.

"Ten shillings an inch," was the reply.

"Heavens! He was over six feet high!"

* * * *

Counsel: "Now sir, tell me, are you well acquainted with the prisoner?"

Witness: "I've known him for twenty years."

Counsel: "Have you ever known him to be a disturber of the public peace?"

Witness: "Well-er-he used to belong to a band!"

FROM THE LIMERICKS COMPETITION

An unskhylful rider from Rhyl,
Motor-cycled full speed down a hyl,
Thyl a sphyl at a bend
Khylled our whylful young friend,
And he now in the churchyard lies sthyl!

* * * *

A bashful young man of Hawarden,
Took a beautiful girl in the gawarden,
He encircled her waist,
But withdrew in some haste,
When she swore and forgot to say pawarden!

* * * *

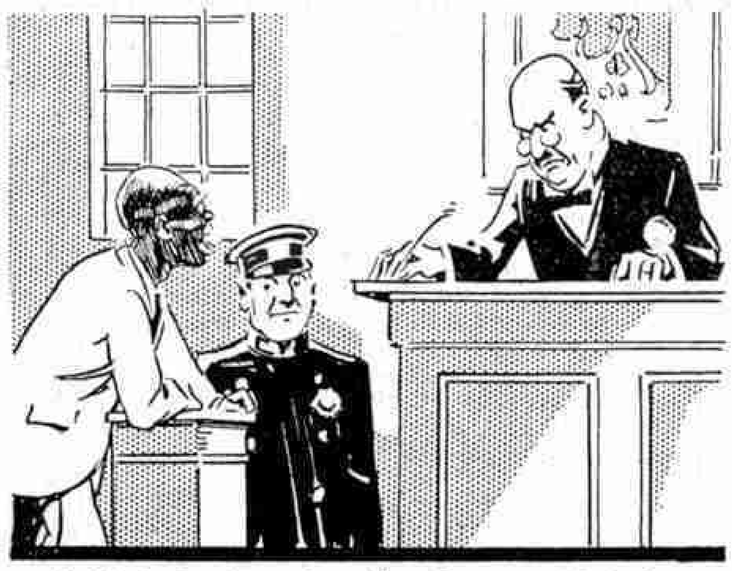
A huntsman named Reginald Vaughan,
Once blew his haughan on the laughan,
His friends were all laughing,
And scaughanfully chaughing
Because his faughan breeches were taughan.

* * * *

A jolly young fellow called Marjoribanks,
Tried making Meccano from Larjoriplanks,
When asked, "Will they shrink,"
He said "I don't think,"
I've stiffened them up with starjorithanks.

* * * *

ONE OF THEM TO BLAME



"This is the fourth time you've been here for stealing chickens, Rastus. What's your explanation?"

"Well, Judge, my onlist explization is dat me or de night wuzn't dark enough."

* * * *

Sunday School Teacher: "John, who defeated the Philistines?"

John (aroused from day-dreams): "Dunno. I don't follow none o' them third league teams."

* * * *

FOREWARNED

Little Johnny went to church, and seated himself just in front of the pulpit.

The Clergyman took as his text: "I shall come down and dwell amongst you," and he had repeated the words several times, when, without any warning, the pulpit collapsed.

The clergyman got Johnny from under the wreckage, and exclaimed: "I am so sorry! I hope you are not hurt!"

Johnny replied: "It can't be helped. You warned me often enough!"

SAFETY FIRST!

Signalman: "Hi! You ain't allowed to walk on the line!"

Jones: "I beg your pardon, but I came here to escape the motors that make the public highway so dangerous!"

* * * *

He was hardly the brightest boy in the school. In fact, his teacher thought that he would never make a really good carpenter, as he seemed to learn nothing at all about woodwork during the course of instruction.

At last came the day when this dull youth was to be examined, before being recommended for a job.

"Now," said the examiner, anxious to find out what he knew, "how would you make a Venetian blind?"

"Oh," answered the candidate, "that's an easy one to me! I should poke him in the eye with a screwdriver."

* * * *

Speaker: "Give me 22 double 2."

Telephone Operator: "2222?"

Speaker: "Yes, hurry up! I'll play trains with you afterwards!"

* * * *

Employer: "What made you so late?"

Employee: "I fell downstairs, sir."

Employer: "That oughtn't to have taken you long!"

* * * *

NO LUCK

Country Yokel (applying for a ticket at a country railway station): "Hey, mister, third-class ter London."

Booking Clerk: "Have an insurance ticket, too?"

Yokel: "Noa, I took one o' them larst time an' 'ad no luck."

* * * *

Counsel: "You say this man is a very close friend of yours?"

Witness: "Yes."

Counsel: "H'm! May I ask how long you have enjoyed his acquaintance?"

Witness: "Oh, a fortnight or so."

Counsel: "A fortnight? Then, sir, how can he be a close friend?"

Witness: "He comes from Aberdeen!"

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12 Montenegro, 1907	...	10d.
4 Ingermanland	...	2d.
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Send right now and try for the £5 or other Free Gifts. They are quite easy to get.

PEARSE'S (Dept. M.),
38, Marine Terrace, MARGATE.

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.

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25 ,,	...	1/4	50 ,,	...	3/4
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35 ,,	...	3/-	10 Ceylon	...	3d.
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FORMING A COLLECTION OF POSTAGE STAMPS

By R. Kay Gresswell

A STAMP album and a packet of stamps is a very popular Christmas present and every year many thousands of recruits are added to the ever increasing group of people known as "philatelists." There must be a large number of our readers who have been introduced to this hobby in this way during the festive season just past. We welcome you all as fellow stamp collectors, and it is mainly to you that we intend to talk this month, although what we have to say will be just as interesting to those who are not new to the hobby.

Morocco

Alsace-Lorraine

Name of Stamp.	Country of Issue.
Bayern	Bavaria
Belgie, Belgique	Belgium
Bosnien-Herzegovina	Bosnia and Herzgovina
British South Africa	Rhodesia
C.C.C.P.	Russia
C.E.F. (on German)	Cameroons
C.E.F. (on Indian)	China Expeditionary Force (usually put under India)
Ceskoslovenska	Czecho-Slovakia
C.X.C.	Yugo-Slavia or Jugo-Slavia
Danmark	Denmark
Deutesche-Reichspost, Deutsches Reich	Germany
Deutsch	German–(on German colonials)
E.E.F.	Palestine
Eesti	Esthonia
Eire, Eireann	Irish Free State
Emp. Ottomane	Turkey
Espana	Spain
Ethiopie	Abyssinia
G.E.A.	Tanganyika (late German East Africa)
Grand Liban	Grand Lebanon
Haute—	Upper—(on French colonials)
Helvetia	Switzerland
I.E.F.	Indian Expeditionary Force
Iraq	Mesopotamia or Irak
Island	Iceland
K. Wurtt	Wurtemburg
Latvija	Lettland or Latvia
Lietuva	Lithuania
Litwa Srodkowa	Central Lithuania
Magyar	Hungary
Nederland	Holland
Ned.—	Dutch—(Dutch colonies)
New Britain	New Guinea
N.F.	Tanganyika
Norge	Norway
Oesterr, Oesterreich	Austria or Austrian Levant or Austrian Crete
P.C.Ø.C.P.	Russia
Pohjois	Ingermanland
Polska, Poczta	Poland
Port Gdansk	Polish post in Danzig
Rarotonga	Cook Islands
Saargebiet	Saar
S.H.S.	Yugo-Slavia or Jugo-Slavia
Slesvig Plebiscit	Schlesvig
Sverige	Sweden
Syrie	Syria
Toga (not Togo)	Tonga
Van Diemen's Land	Tasmania

A Catalogue is Useful

Most boys and girls begin to collect stamps either by purchasing or receiving as a gift a stamp album and a packet of stamps, and to this is sometimes added a catalogue. A stamp catalogue does not seem to be a very popular book as a gift, possibly owing to the fact that it is, after all, really a dealer's price list and, of course, one does not normally give price lists as presents to one's relations and friends!

Spain

A stamp catalogue is far more than a mere price list, however, although that is the primary object of its issue by the publishers. The catalogue is the one book that the stamp collector cannot do without if he intends to make a success of his hobby and wishes to retain his interest in it. He can survive without an "A.B.C." of stamp collecting, he can even survive without an album if he uses some other form of container, such as a card index as I do, but he cannot survive for long without an up-to-date catalogue.

In his catalogue he finds full descriptions and clear illustrations of every stamp that has been issued and has done duty as a postage stamp. From it he obtains information regarding the stamps he possesses, information regarding the designs, the designers, the printers, the dates of issue and often the causes of issue and their values; from it he obtains similar information regarding the stamps he does not possess and thus learns to know what to look out for and to recognise a bargain or a good stamp when he sees it; and from it he obtains information regarding forgeries, bogus stamps, and so on.

Japan

Bulgaria

Austria

Czecko-Slovakia

Even used casually, the catalogue is a great help, but used with intelligence it becomes the hinge upon which the whole collection pivots and depends.

The first difficulty encountered by most collectors is that of identifying their stamps, which have (Continued on page 79)

"O.K." Stamps. Approvals.—BM/BNOK, London, w.c.1

100 STAMPS FREE. Send for ½d. and 1d. Approvals.—Miss Williamson, 18, Victoria Park, Dover.

100 DIFFERENT STAMPS FREE.—Send for ½d. Approvals.—Cox, 135, Cambridge Rd., Seven Kings.

100 STAMPS FREE. Ask for Cheap Approvals.—H. J. Huggins, 22, Bramfield Road, Battersea, S.W.11.

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JUNIOR STAMP COLLECTORS should try my ½d. Approvals.—S. R. Catt, 20, Brunswick Road, Ipswich.

1,000 ALL DIFFERENT, 6/-; 500, 2/6.—H. Sisley, 161, Verulam Road, St. Albans.

LARGE PARCEL MIXED STAMPS, splendid value, 1/6.—Gibbins, 6, Montpellier Road, Exmouth.

FREE. 10 Brazil, scarce issues, 1878-1906. Cheap Approvals.—Porter, 20, Sydner Road, Stoke Newington

Stamps on Approval. 1/3 Gibbons good copies, references. Collections purchased.—Barlow, 8, Sillwood Road, Brighton.

Collector's Outfit, value 3/-. Price 6d. Request Approvals.—B. Warnock, Bolton Road, Loanhead, Midlothian.

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COLLECTION 5,000 STAMPS GOING. Send for approvals. Ridiculously cheap.—A. Dargavel, St. James' School House, Leyland, nr. Preston.

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Collection of Postage Stamps for Sale. British Colonials. Send for approval sheets and list.—Duncan, 22, The Space, Petersfield.

100,000 STAMPS GIVEN AWAY THIS YEAR. I am still open to send you 100 Free, which include many B. Colonials, S. American, Chinese, etc. To applicants only for my unique ½d. stamps on approval. State if book of 500 or small sheet required.—Fleming, St. Winifreds, Christleton Road, Chester.

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*10 **Nyassa** 1901, giraffe and camels, large **9d.**
*18 **do.** 1921, zebra; giraffe; Vasco de Gama and his ship of discovery ... **1/9**
50 **Bulgaria** includ. Prisoners of War Set; pictorials and provisionals **1/4**
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35 **Uruguay 1/6** 200 **Hungary** ... **1/6**
*All unused in these. Best mounts, 1,000 **4½d.**
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SETS

		s.	d.
4	**Arabia,** 1922, ⅛ to 1½ pi., mint, cat. 2/9 ...		11
30	**Gt. Britain,** various issues, ½d. to 2/6, used ...	1	6
10	**Jamaica,** 1921, ½d. to 1/-, used (pictorial) ...		10
9	**Iraq,** 1923, ½a. to 1r., cat. 3/1	1	4
7	**Kenya,** 1922, 1c. to 50c. (not 12c.)		6
2	**Malta,** 1922, 6d. and 1/-, cat. 2/1	1	6
100	**British Colonials,** used, each different ...	1	0
250	**British Colonials,** better values, ditto ...	4	6
250	**British Colonials,** mounted, ditto	6	6
9	**Egypt,** 1923, 1 to 50m., used		6
8	**Holland,** 1923, Jubilee, 2 to 50c., used ...		10
1	**Holland,** 1923, Jubilee, 1g., used	1	3
4	**Norway,** 1922-4, 10 to 45 öre, used		4
100	**Various Foreign** only, used		6
100	**Various Foreign,** better and higher values, used	2	6

Postage extra. Approvals sent out of England. Deposit or reference necessary.

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MANY "M.M." readers send repeat orders for these famous "Mystery" packets containing 1,000 Unknown Stamps, just as received from Bankers, Shippers, Agents Abroad, etc. Includes Unused, High Values, Colonials, etc., etc., and one stamp sometimes found is worth more than the cost of the whole lot. Don't delay, but send for one or more of these Exclusive Big Value Packets to-day and have a treasure-hunt of your own.

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30 Different Gifts value 15/6 to regular small purchasers from our inimitable Approvals. No. 1. **25 Fine Bavaria** with full details of the others will be sent **FREE** if you write for a selection enclosing 1½d. part post only.

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PHIL'S PHAMOUS PACKETS

1,000 Stamps	25 British Official
300 Different	20 Italian Col.
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All **6d.** Packet, Postage 1½d.

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111 Different Mint and Used **BRITISH COLONIALS,** including Antigua, Barbados, Bermuda, Cochin, Deccan, East Africa, Fiji, Johore, Kenya, Kelantan, Leewards, Newfoundland, Sudan, Turks Islands, Victoria, Zanzibar, etc., etc. Post Free **1/1½. A WONDERFUL BARGAIN.** Don't forget we hold a large stock of the various British Colonies, and welcome enquiries from genuine collectors who are interested in these popular stamps. **A SQUARE DEAL** for everyone is our motto.—**J. & F. RYDER, 38, Clifford Street, Brooks's Bar, Manchester.**

FREE!

50 Stamps all different. No cheap rubbish. Including 1 Gulden Holland, old and new types, and Jubilee issue 20 cents. blue, to all applicants for my celebrated approvals, from ½d. each. Discount 3d. in the 1/- allowed.

BETTS,
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NEW YEAR'S GIFT!

Just for NEW YEAR I am presenting a magnificent pictorial set of **12 GUATEMALA (usually sold for 1/6)** to every genuine applicant for my latest series of "Better" Approvals (4d. in 1/- disc.) who encloses 3d. for postage and packing. Number limited, so send now! You'll be surprised and delighted.

ALIX HARLAND (Philatelist), Westcliff Terrace, RAMSGATE.

KEEP THAT SCHOOLBOY ENTHUSIASM

100 Sth. and Cntl. America, 2/6; 100 North, 2/6; 100 Asia, 2/6; 100 Africa, 5/-; 50 Oceania, 2/6; the lot with 150 European without English for 15/-. New Year packet of 300 varieties 1/-, Mounts 5d. per 1,000. Lists of everything for the collector with exchange rules free. See my last month's advt.

A. E. Witherick (estab. 1880), **M.M., Meriden St., Coventry.**

Superb Set. 50 Diff. Stamps.
Argentine Republic
Neat Collector's Outfit
(Magnifier, Duplicate Book, etc., etc.
} **FREE**

to GENUINE applicants for approvals enclosing postage and requesting Gift No. 4.

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FREE PICTORIALS FREE

20 grand pictorials including Germany (aeroplanes), Jugo-Slav (chain breaker), Mozambique (pictorials), French Cols. and other good varieties. Just send a p.c. requesting approvals and this gift will be sent by return. Beginners' Album holds 2,000 stamps, 1/3 post free.

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61, West Street, Bourne, Lincs.

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To applicants for my APPROVAL SHEETS enclosing 2d. postage ONE of the following sets will be sent FREE.

4 ARMENIA	**8 MALAY STATES**
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20 JAPAN	**10 VENEZUELA**

The six sets will be supplied for 1/3 if you ask for APPROVAL SHEETS.

FELIX SYKES, NEW BARNET.

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AT PRICES FIXED BY YOURSELF.

You require:—

12	Approval Sheets		**9d.**
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		5s.	**3d.**

Send us a Postal Order for 5/- and we will send the above, Post Free.

M. C. FLORICK, 179, Asylum Rd., London, S.E.15.

Stamp Collecting—*(continued from page 77)*

probably come to them all mixed together in one envelope. There are several ways in which they may be gradually sorted out, and if this task is found to be a difficult one to begin with, it may be encouraging to know that every other collector came up against the same difficulties when he began. After a few months' practice, however everyone becomes quite expert at being able to tell almost immediately to what country a stamp belongs.

Brazil

Amongst the stamps in your packet the majority will bear the name of the country of their issue spelled as we in this country spell it or only slightly different. These stamps offer no difficulty, for "Romania" obviously indicates Roumania; "Belgie," Belgium; "Francais," France; and so on, but in the panel on page 77 we give a list of names that may be helpful in identifying certain stamps.

Turkey

All stamps bearing portraits of Queen Victoria, King Edward or King George V. are, of course, issued by some British colony, as are most stamps bearing their value in "pence," although there are many British colonies that do not use this coinage. Stamps having a symbolical representation of a chrysanthemum flower as part of their design are issued by Japan. Most stamps bearing as part of their design a star and crescent are issued by Turkey, although it may be found also on certain stamps of Egypt.

Russia

Many stamps of Finland and Russia appear in the same designs and the easiest way in which to distinguish them is by the name of the value in certain issues. The 1900 to 1911 stamps of Finland may be distinguished from the 1883 and 1890-1905 issues of Russia by the fact that the Finnish stamps have their values in "pen." and "markka" while the Russians are in "Kon." The same rule applies to distinguishing between the 1911 stamps of both countries. The 1891 series of Finland may be distinguished from the 1883 and 1889 series of Russia by the existence of small circles in the outer parts of the designs in those of the former country.

Prussia

The principal countries that have issued stamps bearing no name of the country of origin are: Great Britain (heads of Queen Victoria or King Edward VII. or King George V.), Alsace and Lorraine (a large numeral with words "Postes Centime-s"), Austria-Hungary (portrait facing right with wreath round head, or head of Mercury facing left), Bosnia and Herzegovina (arms), Brazil (numerals), Danzig (postage dues, numerals and two crosses surmounted by crown), Spain (portraits of Queen Isabella II. facing left or right, or arms), Switzerland (postage due, three mountains and an uncoloured cross).

Switzerland

Arranging in the Album

Apart from finding the country of issue of a stamp it is necessary to find out when it was issued by that country, and to do this a catalogue is absolutely essential. It is only by doing this that it is possible to arrange the stamps in their order of issue and in sets, so that it is possible to see at a glance what progress has been made by that country in its form of stamp issues and to see any important changes in government or ruler that have taken place from time to time.

Different Kinds of Albums

It is when we come to mounting the stamps in our album that we become aware that all albums are not equally useful. Albums may be divided roughly into three classes:—printed albums allowing a page or two for each country; printed albums containing labelled spaces, one for each stamp that has been issued; and blank loose-leaf albums.

Most collectors begin with the first kind of album and we think that this is the best kind that can be used until the collection contains, say, about two thousand stamps. When it has grown to this extent it will be found that certain countries are excessively cramped while others are almost blank, and an increasing difficulty will be encountered in endeavouring to arrange the stamps in order of issue.

Austria

At this stage it becomes necessary to decide which of the other two kinds of album is to be adopted for the permanent home of the collection. The writer has had considerable experience with both kinds and he has found that for really large collections (not less than five thousands) a printed album with a space for each stamp is quite satisfactory, provided that the stamps are fairly evenly distributed throughout the various countries.

If, on the other hand, the collection is uneven so far as quantity is concerned, some countries being very strong and others scarcely represented at all, and if the collector is prepared to take a little trouble and time in arranging his stamps, the blank loose-leaf album is much more satisfactory. In this type of album the collector may arrange his stamps in any way he pleases. He may omit some, go into great detail for others, and he never needs to have any blank pages at all, since he only lays out pages for those he has some stamps for, others being inserted later when required. The only disadvantage of the blank album is that it takes a good deal of time to insert a collection in it, but since arranging one's stamps is one of the chief joys of collecting, this disadvantage should not be considered to be of any importance.

Abyssinia

While the blank album is undoubtedly the best for a permanent collection, it is very advisable that a small printed album should be used instead during the first year or two, during the time in which the collector is learning how to collect and deal with his stamps.

A General or a Specialised Collection ?

During these first few years the collector should accumulate stamps of all countries so as to obtain a general knowledge of the world's stamps, but afterwards he is almost sure to concentrate on some particular country or group of countries that appeal to him more than do the others. In this way a specialised collection is formed and one is able to make a fairly complete and detailed collection of the selected countries. It is not, of course, necessary to abandon the general collection but one's efforts can be concentrated more on the special collection, which, of course, goes into more detail as regards watermarks, perforations, shades, used and unused specimens, pairs, blocks, and perhaps proofs, trials, forgeries and so on.

Recent Issues

EGYPT

In 1925, to commemorate the International Geographical Congress that was being held at Cairo at that time, Egypt issued three stamps of the unusual size and design illustrated. The values were 5m., 10m., and 15m. and there were two printings of each value, the difference resting mainly in the shade. The stamps were printed by the Survey Department, Cairo and the method was surface printing. The paper is quite shiny on the surface. The watermark is the current multiple star and crescent and the perforation gauges $11\frac{1}{2} \times 11$.

The design shows Thoth writing the name of King Fuad. This god, whose Egyptian name is Zhwty, meaning "him of "Zhwt," the name of the district where he was first worshipped, was the god of letters, invention, science, measuring, calculation, wisdom and so on and he took part in the mythological story of the weighing of the soul. He joins with the moon as the divider of time. On account of these attributes he is especially suitable as the god to watch over a geographical congress and this is, of course, the reason for his being chosen to be depicted on this stamp.

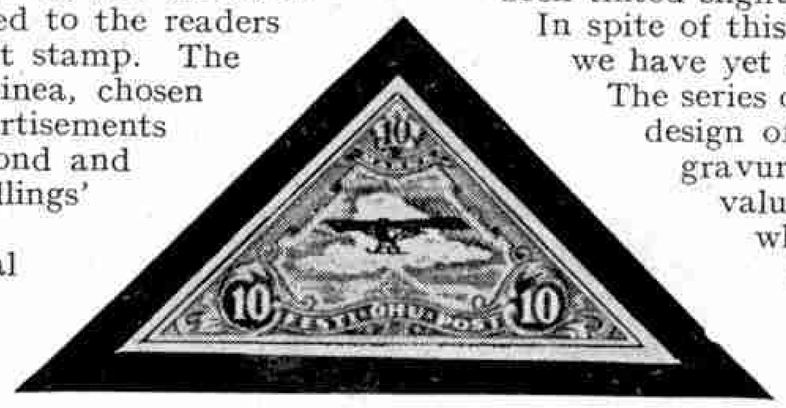
The Greeks considered Thoth to be the same as their god Hermes.

Design Your Own Stamp!

THIRD STAMP COMPETITION

There have been many criticisms of the designs of some of the stamps recently issued by various countries and more than one reader has written "I could design a better stamp myself." Well, this month these critics, and I hope all our other stamp-collecting readers, will be able to "get busy" in this direction.

Prizes in this Competition will be awarded to the readers who submit the best designs for an air-post stamp. The first prize is stamps to the value of a guinea, chosen by the competitor at time of entry from advertisements in this month's issue of the "*M.M.*" Second and third prizes of half-a-guinea and five shillings' worth of stamps, will also be awarded.



The designs must be entirely original and should be drawn in ink and filled with one or more colours, if desired. The stamps must carry the following inscriptions: (a), the name of the country of issue, which is imagined to be "Meccanoland," (b), the words "Air Post," and (c), the value in word or figure, "3d." The value may appear more than once on the stamp if desired.

We leave the choice of design entirely to each competitor, but the stamp should be drawn to occupy a rectangular space measuring about $4\frac{1}{2}'' \times 3''$, either oblong or upright. It is to be imagined that the stamp would be reduced in size when printed to about $1\frac{1}{2}'' \times 1''$, this being slightly larger than the new Egyptian air-stamp illustrated on this page.

During the last ten years a very large number of air-post stamps have been issued by the various countries of the world. Although there has been a great variety of designs yet it is not often that we meet with one that is really satisfactory in all respects. It must not be forgotten that the first essential in any stamp is for it to indicate its use and its monetary value.

This is not, however, the only essential feature of the design. It should indicate by its central drawing that its use is, in this case, connected with flying, with aeroplanes, or with airships. In addition this drawing should be both of pleasing and attractive appearance, and also of such a nature that it may be expected to impress foreign countries, into which it may pass, with the idea that the country of issue has at least a progressive and capable postal system, and that in consequence the country itself is probably also of the same nature. The advertising value of a postage stamp is very great and therefore it would seem obvions that the best use should be made of the central space of the stamp from this point of view.

We illustrate on this page several typical air-post stamps including the one that has just been issued by Egypt. This stamp was issued on the 10th March 1926 and is printed in violet by the photogravure process, there being only the one value, 27 milliemes. At the top is the inscription "Royaume d'Egypte" and various Arabic inscriptions, and at the foot the inscription "Poste Aerienne." The central design shows a large aeroplane presumably of the type used in the air-mail service, and below it we see a portion of the delta of the River Nile. The paper is watermarked multiple Crown over an Arabic "F" and the stamps are perforated $13\frac{1}{2}$ by means of a comb machine.

This stamp is of fairly pleasing appearance and the aeroplane succeeds in "standing out" from the remainder of the design. As a whole, however, it has a rather "top heavy" effect on account of the darkly coloured aeroplane wings and the tablet containing the Arabic inscription at the top, and the lightly coloured river below. A better effect might have been obtained if the river had been tinted slightly or if the aeroplane had been placed lower. In spite of this point, it is one of the best aeroplane stamps we have yet seen.

The series of air stamps issued by Morocco in 1922 to the design of J. de la Nézière was printed by the heliogravure process by the Helio Vaugirard. The 75c. value is illustrated here and it also suffers somewhat from being darker at the top than at the foot, caused by the same effects as in the case of the Egyptian stamp—the darkly coloured wings of the aeroplane and the lightly coloured land beneath. This is a fault in designing that should be avoided if at all possible, and we advise those of our readers who make an aeroplane the central feature of their design to devise carefully some means of preventing it, while at the same time not making the aeroplane merge into the background, as it does in the case of the Austrian stamp illustrated on this page.

This stamp was issued by Austria on the 1st May 1915, as the highest value of a charity series in aid of the War Orphans' Fund that had been opened. It is not really an air-post stamp, since it is intended to illustrate one of the ways in which modern warfare is carried on, in the same way as the other values (some of which were illustrated on page 503 of the August issue of the "*M.M.*") illustrate trench warfare, cavalry warfare, "big gun" warfare, and sea warfare respectively.

The Dantzig air-post stamp illustrated on this page is of very novel design, the lower part of the picture being occupied by a silhouette of the skyline of the city of Dantzig while an aeroplane soars above. This is quite an effective design and the "Flugpost" and value tablets are to be especially commended. This stamp was issued originally in 1921 and other similar designs of various sizes have been issued from time to time.

The remaining two stamps illustrated rely upon white clouds behind the aeroplanes to make them prominent. This is rather an unnatural device and in neither case does it produce a very good effect. In the case of the German stamp, the aeroplane is very poorly drawn and the edges of the clouds are much too sharp and distinct. The Esthonian stamp is handicapped from the first by the awkward shape of the space for the picture, and although the clouds are much better than in the German stamp, yet the aeroplane does not stand out with the prominence to be desired.

Quite unlike any we have already described is the design of the 35c. and 40c. values of the 1923 series of air-post stamps issued by Switzerland. This design shows the pilot's head as it would be seen by someone standing near the propeller of the aeroplane! It cannot be said that this is a pretty stamp but it has the advantages of being arresting and unusual, and these are two very important things in a stamp, although beauty should not be sacrificed to obtain them.

We advise our readers to look carefully through their stamp albums and catalogues, and then to set about designing what they think is the ideal air-stamp. They should add their name and address to their drawings and the list of stamps they wish to be sent if they win the prize. Entries should be posted so as to arrive before the 31st January.

Special Model-Building Competition

Last month we announced a new model-building competition in which special consideration will be given to models that display to advantage the coloured parts of the New Meccano. There is still time for readers to participate in this contest and we are reprinting the necessary particulars for the benefit of those Meccano boys who are unable to refer to the December issue.

Any type of model may be submitted in the competition providing it is the competitor's own unaided work, both in design and construction. No restriction is enforced as to the size of the Outfit or quantity of parts that may be used, but it is important to remember that it is not necessarily the most intricate or elaborately-constructed models that will carry off the prizes.

Models possessing originality and general constructional merit will be selected from the competition entries and will be assembled at the offices of Meccano Ltd. The final allocation of awards will then be made by placing in order of merit those models that, in the judges opinion, display the most pleasing appearance on account of the artistic skill with which the coloured parts have been employed in their construction.

Many Prizes to be Won

Entries in this Competition will be divided into the following Sections :—

Section A : for Competitors over 16 years of age.
Section B : for Competitors over 12 and under 16 years of age.
Section C : for Competitors under 12 years of age.
Section D : for Competitors residing outside the United Kingdom.

The following prizes will be awarded for the best models received IN EACH OF THE THREE SECTIONS A, B AND D.

First Prize : Cheque for £3-3s.
Second Prize : " " £2-2s.
Third Prize : " " £1-1s.

Six Prizes, each of Meccano products to value of half a guinea.

Certificates of Merit and complimentary copies of "Meccano Standard Mechanisms."

The Prizes in SECTION C are as follows :—

First Prize : Meccano products to value £2-2s.
Second Prize : " " " £1-1s.
Third Prize : " " " 10/6

Six Prizes, each of Meccano products to value 7/6.

Certificates of Merit and complimentary copies of "Meccano Standard Mechanisms."

IMPORTANT

Readers should send in clear photographs or good drawings of their models, together with any explanations that may be necessary, although the latter should be made as brief as possible.

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 ("New Meccano" Competition), and Section in which the model is entered. Envelopes should be marked "New Meccano" Competition.

Entries for Sections A, B and C must be received at the Meccano offices not later than 25th January, 1927. Closing date for Section D : 30th June, 1927.

GOLDFISH

Gold and Silver Fish 3d. to 5/- each.
Fancy Fish always in stock, including Golden Orfe, Catfish, Paradise Fish, Mirror Carp, Sunfish, etc., from 6d. each.
Vallisneria, 4d., Root Weed, 1/- Ble.
Snails, Food, Instructional Books, Rocks, etc. Aquariums from 3/6 each.
Over 10,000 Goldfish and Fancy Fish actually on view.
Send for complete Free Price List.

SPECIAL NEW YEAR OFFER.

A beautiful Cock Hartz Mountain Roller Canary on absolute full song, guaranteed, in Large New Canary Cage, Brass Top, Carriage Paid to your house 18/6.

DE VON & CO.,
127, King's Cross Road, London, W.C.1.
'Phone : Museum 0767.
Telegrams : "Oiseaux, Kincross, London."

"Suggestions" Competition

In this interesting competition, which was first announced in last month's *"M.M.,"* readers are asked to write down in order of merit the four suggestions that they consider to be the best published in the "Suggestions Section" during the twelve months January to December, 1926.

The competitor who names in correct order the four suggestions that are shown by the votes received to be most popular with our readers will receive a cheque to the value of one guinea, whilst the competitor who is next nearest to the general consensus of opinion will be rewarded with a cheque for half a guinea. Twelve other competitors who closely forecast the correct results will each be presented with a copy of "Meccano Standard Mechanisms." The contributors who sent in the suggestions that are selected as the best published during the year will also be rewarded.

Entries in this competition must be written on postcards. It is only necessary for the competitor to quote in what he considers to be their order of merit the numbers of the four suggestions that constitute his choice. Postcards should be addressed "Suggestions Competition," Meccano Ltd., Binns Road, Liverpool. All entries from readers in the British Isles must be received at these offices by 31st January.

Entries from Overseas readers will be considered separately, and must be received on or before 31st March. Postcards should be marked "Overseas Section."

Electricity—(*continued from page* 17)

to the anode, causing gas to be liberated. When the tube is again in proper working condition the regulator wire can be moved away from the cathode.

Lately a demand has arisen for X-rays of very great penetrating power in order that substances such as metals, which offer a fair amount of resistance to the rays, can be examined. This has resulted in the production of a special type known as hot-cathode tubes.

Hot-Cathode Principle

Tubes of this type were produced independently by Dr. Coolidge in America, and Lilienfeld in Germany, the hot-cathode tubes used in this country being chiefly Coolidge tubes. Their action depends on the discovery that many substances, including metals such as tungsten, and lime, emit electrons on heating, an idea that will readily be grasped if it is remembered that the filament of the valves used in wireless sets is an example. The current that lights up the valves has for its real purpose the heating of the substance of which the filament is made, thus causing it to give off a stream of electrons that passes across the grid to the anode of the valve. In a sense the wireless valve is actually a miniature cathode ray tube, but it is no use to try to obtain X-rays from it as the electrons do not strike anything with sufficient speed to produce them, the minimum voltage required for X-ray production being about 10,000. An account of one of these tubes designed by Dr. Coolidge will be given next month.

Diaries for Everybody

There appears to be no doubt that the diary habit grows year by year and a great deal of this growth is undoubtedly due to the enterprise of Messrs. Charles Letts & Co. The diaries produced by this firm for the present year cover an extraordinarily wide range. First of all we have the "Schoolboy's Diary" and its companion "The Schoolgirl's Diary," both of which contain a remarkable amount of useful information, and have special spaces devoted to recording interesting personal details of school life. Then there is the "Boy Scouts' Diary," issued with the approval of Sir Robert Baden-Powell, Bt., and crammed with useful notes for Scouts, Rover Scouts and Wolf Cubs.

The wireless enthusiast is catered for in "The Wireless Amateur's and Experimenter's Diary and Note Book," which is published jointly from the offices of "The Wireless World" and by Messrs. Letts. The contents of this diary include a list of experimental transmitting stations in Great Britain and Ireland ; wireless notes on various types of apparatus ranging from simple crystal receivers to the most complicated circuits ; a series of useful circuit diagrams and some valuable data in regard to valves, in addition of course to the diary itself. Another publication that must be mentioned is the "Motorist's Diary," published in conjunction with the Automobile Association. This is packed with useful information for the motorist, including notes on legal matters, speed limit and prohibition orders, steep hills, distances from London, motor car index marks and international records up to and including 27th July 1926.

The Story of Metals—(*continued from page* 7)

for several reasons. It magnetic, like iron and cobalt, and the addition of a small quantity of any other metal except these destroys its magnetism, so that counterfeit coins may be detected immediately by means of a magnet. The difficulties and expense of working the metal also act as a preventive of counterfeiting, while it has been found by experience that it offers greater resistance to wear than any other metal commonly used for coinage. Most important of all, it is a clean metal. It was first used for coins alloyed with copper, in Switzerland in 1850, and later its use spread to the United States and other countries, many of which now use pure nickel.

Nickel Silver

The alloy *paktong* referred to at the beginning of this article as used by the Chinese, was undoubtedly a forerunner of the so-called nickel silver. The name is misleading as far as composition is concerned, for the alloy contains zinc and copper along with proportions of nickel varying from 7 up to 35 per cent., but it came into use because of the silvery appearance of the alloy and of the brilliant polish that can be given to articles made of it. It is very largely used in the manufacture of cutlery, and in the form of wire it is of great value in the making of electrical instruments such as rheostats.

Model-Building Contest Result—

(*Continued from page* 64)

the entire structure and of the trolley, rotation of the boom, and hoisting, are all controlled from a compact and well-arranged gear-box placed centrally upon the main boom. Power is supplied by an Electric Motor mounted on the end of the shorter arm of the boom and coupled to the gear-box by means of Sprocket Chain and Wheels.

A very interesting feature of this model is formed by a reproduction of Fidler's Patent block-setting gear, and in this connection I may mention that another excellent Meccano representation of this ingenious device is included in D. R. Heeramanek's entry, which will receive a Certificate of Merit. I hope to deal fully with these two mechanisms later.

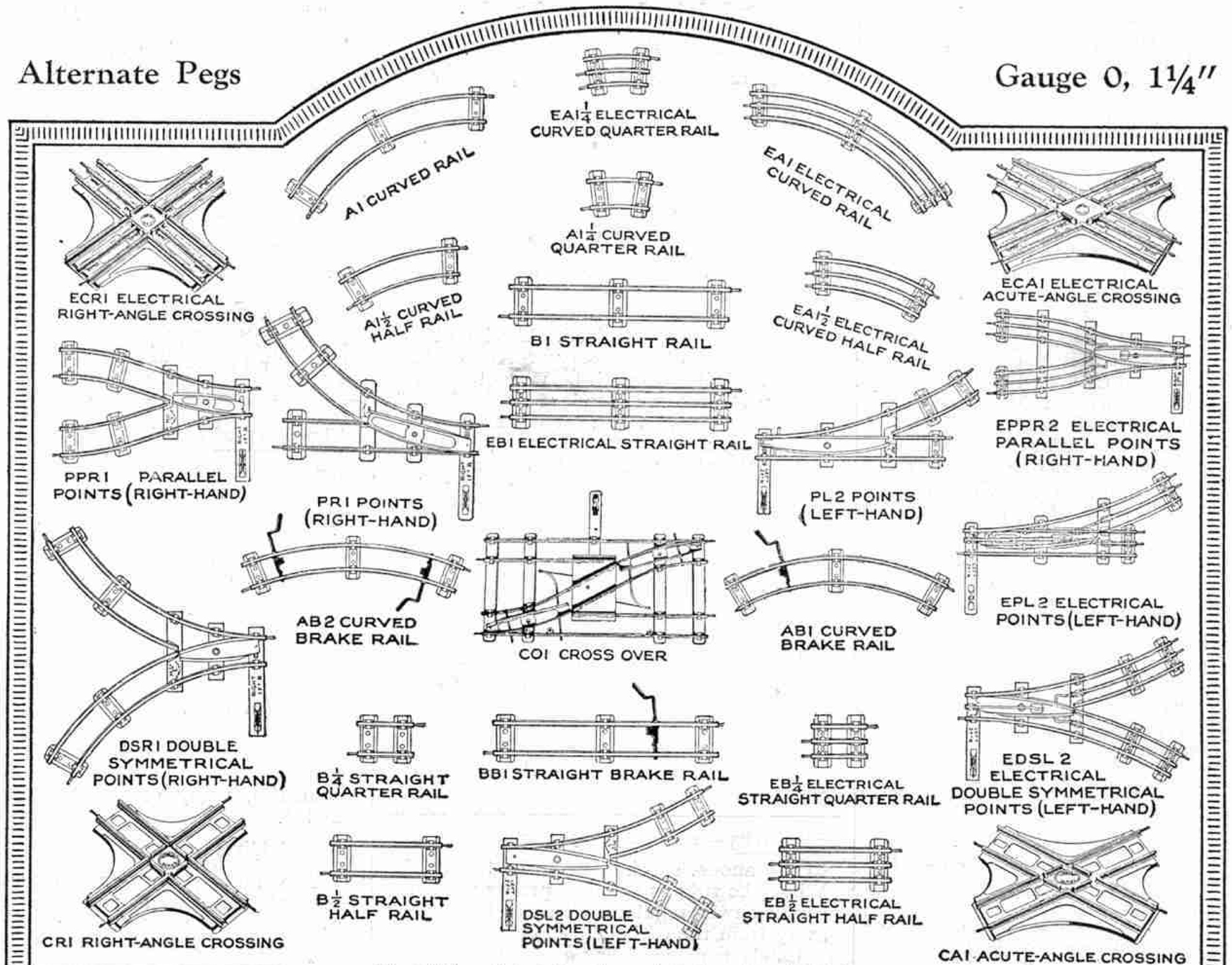
Rails, Points and Crossings

Hornby Series

Hornby Rails, Points and Crossings are built for hard wear and for smooth running. They are made of the finest materials and hold together rigidly and strongly, for real workmanship is put into them. Note the great superiority both in quality and appearance of the Hornby rails.

Alternate Pegs

Gauge 0, 1¼″



The addition of straight and curved brake rails supplied for Clockwork Trains makes possible a great deal more fun. By the use of the straight brake rail, trains may be brought to a standstill at the station platform in a very realistic manner.

Rails for Clockwork and Steam Trains

CURVED RAILS

For 1-ft. 6-ins. diameter circle

A9	Curved rails (9-in. radius)	per doz.	3/–

For 2-ft. diameter circle

A1	Curved rails (1-ft. radius)	per doz.	4/6
A1½	Curved half rails	"	3/6
A1¼	Curved quarter rails	"	3/–
AB1	Curved brake rails	each	6d.

For 4-ft. diameter circle

A2	Curved rails (2-ft. radius)	per doz.	4/6
A2½	Curved half rails	"	3/6
A2¼	Curved quarter rails	"	3/–
AB2	Curved brake rails	each	6d.

DOUBLE SYMMETRICAL POINTS

For 1-ft. radius curves

DSR1	Double symmetrical points, right	each	2/6
DSL1	Double symmetrical points, left	"	2/6

For 2-ft. radius curves

DSR2	Double symmetrical points, right	each	2/6
DSL2	Double symmetrical points, left	"	2/6

PARALLEL POINTS

For 1-ft. radius curves

PPR1	Parallel points, right	each	2/6
PPL1	Parallel points, left	"	2/6

For 2-ft. radius curves

PPR2	Parallel points, right	each	2/6
PPL2	Parallel points, left	"	2/6

CROSSINGS

CA1	Acute-angle crossings (for 1-ft. radius rails)	each	1/9
CA2	Acute-angle crossings (for 2-ft. radius rails)	"	1/9
CR1	Right-angle crossings (for 1-ft. radius rails)	"	1/9
CR2	Right-angle crossings (for 2-ft. radius rails)	"	1/9

POINTS

For 9-ins. radius curves

PR9	Right-hand points	each	2/3
PL9	Left-hand points	"	2/3

For 1-ft. radius curves

PR1	Right-hand points	each	2/3
PL1	Left-hand points	"	2/3

For 2-ft. radius curves

PR2	Right-hand points	each	2/3
PL2	Left-hand points	"	2/3

STRAIGHT RAILS

B1	Straight rails	per doz.	4/–
B½	Straight half rails	"	3/–
B¼	Straight quarter rails	"	2/6
BB1	Straight brake rails	each	5d.

CROSSOVERS

CO1	Crossover (1-ft. radius)	each	6/6
CO2	Crossover (2-ft. radius)	"	7/6
CP	Rail connecting plates	½ doz.	4d.

Rails for Electric Trains

STRAIGHT RAILS

EB1	Straight rails	per doz.	7/–
EB½	Straight half rails	"	4/6
EB¼	Straight quarter rails	"	4/–

CURVED RAILS

For 2-ft. diameter circle

EA1	Curved rails (1-ft. radius)	per doz.	8/–
EA1½	Curved half rails	"	5/–
EA1¼	Curved quarter rails	"	4/6

For 4-ft. diameter circle

EA2	Curved rails (2-ft. radius)	per doz.	8/–
EA2½	Curved half rails	"	5/–
EA2¼	Curved quarter rails	"	4/6

CROSSINGS

ECA	Acute-angle crossings	each	4/–
ECR	Right-angle crossings	"	4/–

POINTS

For 2-ft. radius curves

EPR2	Right-hand points	each	5/–
EPL2	Left-hand points	"	5/–

For 2-ft. radius curves

EDSR2	Double symmetrical points, right	each	6/–
EDSL2	Double symmetrical points, left	"	6/–

For 2-ft. radius curves

EPPR2	Parallel points, right	each	6/–
EPPL2	Parallel points, left	"	6/–
TCP	Terminal connecting plates	"	1/6

Electrical Points, Double Symmetrical Points and Parallel Points for 1-ft. radius curves are not supplied.

Manufactured by MECCANO LIMITED, BINNS ROAD, LIVERPOOL

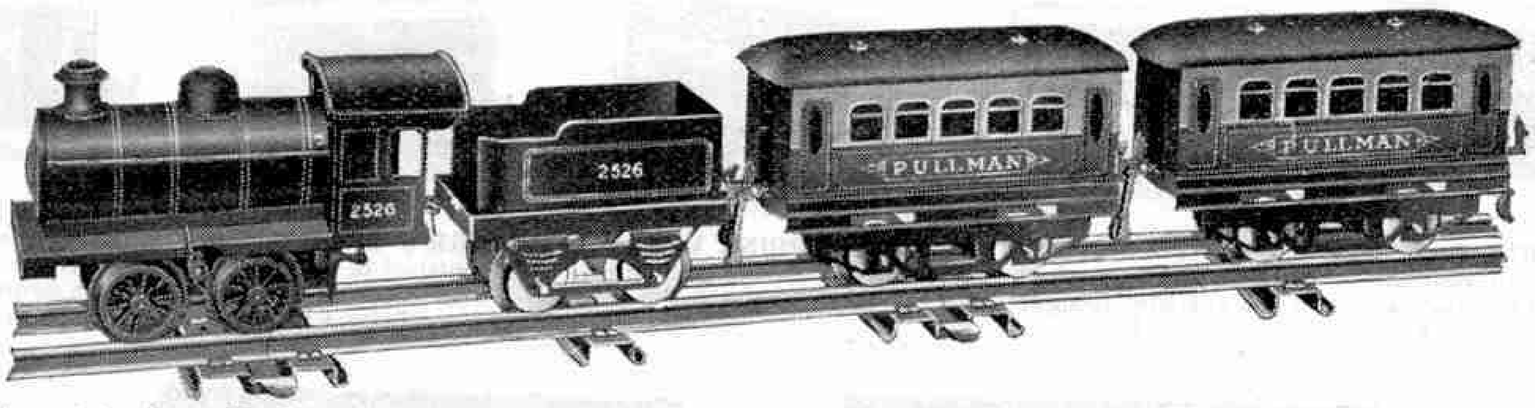
ADDITIONS TO THE HORNBY TRAINS

The range of trains in the Hornby Series, already comprehensive, has been recently extended by the introduction of several new sets. Particulars of the " M " Series and Metropolitan trains are given below.

The three trains in the " M " Series are excellent in every respect and have already become very popular. They are covered by a special guarantee.

The Hornby Metropolitan train is a perfect model of the electric passenger trains of the Metropolitan railway. It is distinctive in design, beautifully enamelled in representative colours, and is obtainable with either clockwork or electric loco.

SERIES M, No. 1 PASSENGER SET



This set contains Loco, Tender, two Pullman Coaches and set of Rails. One of the rails has a special braking device by means of which the train may be stopped from the track. Richly coloured and well finished; fitted with brake mechanism; non-reversing. Gauge 0.

Series M, No. 1 Passenger Set, complete, packed in strong cardboard box ... ... Price **7/6**

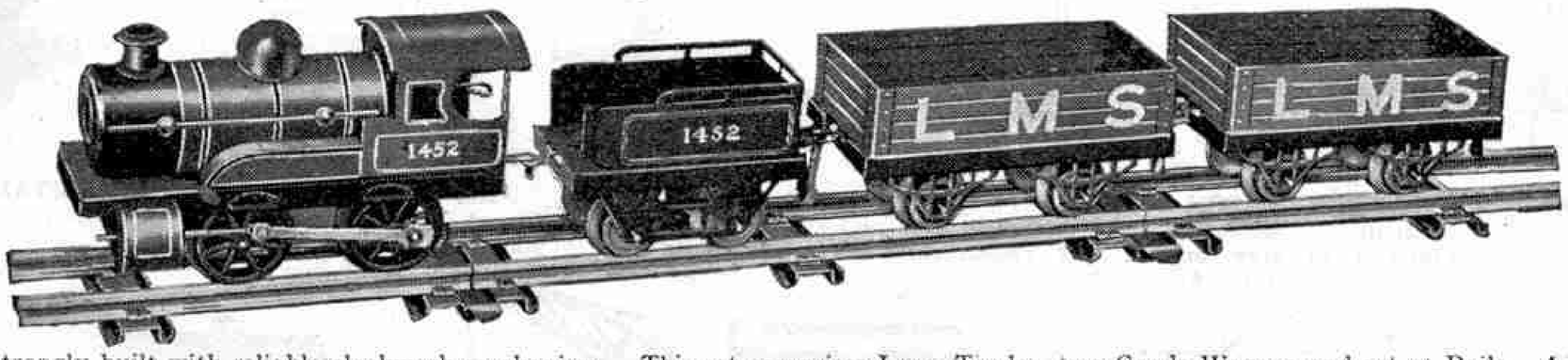
SERIES M, No. 2 PASSENGER SET

Similar in every way to the above excepting that it has three Pullman Coaches instead of two, and additional rails.

Series M, No. 2 Passenger Set, complete, packed in strong cardboard box ... ... Price **9/-**

M, No. 1 or 2 Loco ... Price **3/-** M, No. 1 or 2 Tender ... Price **9d.** M, No. 1 or 2 Pullman Coach „ **1/-**

SERIES M, No. 3 GOODS SET

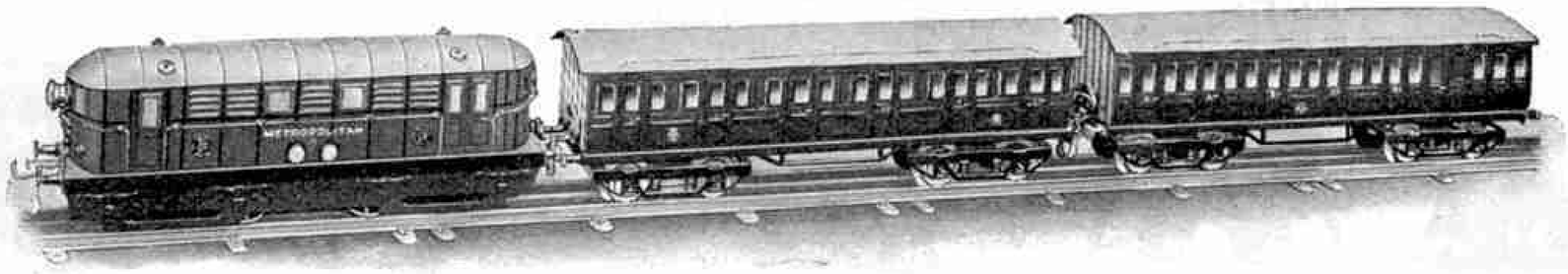


Strongly built with reliable clockwork mechanism. This set comprises Loco, Tender, two Goods Wagons and set of Rails. A rail with a braking device is included by means of which the train may be stopped from the track. The set is printed in imitation of the colours of the principal British Railway Companies' Rolling Stock. Each loco is fitted with brake mechanism. Gauge 0. Non-reversing.

Series M, No. 3 Goods Set, complete, packed in strong cardboard box ... ... Price **15/-**

M, No. 3 Loco ... ... Price **8/6** M, No. 3 Tender ... ... Price **9d.** M, No. 3 Wagon ... ... „ **1/6**

HORNBY METROPOLITAN TRAIN



METROPOLITAN TRAIN SET No. 2

Hornby Metropolitan Train Set No. 2 contains Electric Loco, Two Coaches, Resistance Controller and Electrical Rails to form a circle 4 ft. in diameter. The loco is fitted with a 4-volt electric motor which is operated from a 4-volt accumulator, or from a suitable transformer connected to the main (alternating current only). Gauge 0.

Hornby Metropolitan Electric Train Set No. 2 (4-volt motor), complete, well boxed ... ... Price **95/-**

Metropolitan Electric Loco No. 2 with motor wound for 4-volts Price **47/6**

Metropolitan Coach No. 2 ... ... „ **18/-**

Resistance Controller ... ... „ **3/6**

METROPOLITAN TRAIN SET No. 3

Hornby Metropolitan Train Set No. 3 contains a powerful Clockwork Loco, Two Coaches and set of Rails, including a Control Rail. (The functions of the control rail and all other details of the control system are described in a special folder, a copy of which will be supplied on request). The loco is fitted for Hornby Control, and has reversing gear and brake mechanism. Gauge 0.

Hornby Metropolitan Train Set No. 3, complete, well boxed, Price **55/-**

Metropolitan Clockwork Loco No. 3 ... ... „ **22/6**

Metropolitan Coach No. 3 ... ... „ **13/6**

BRITISH AND GUARANTEED

MECCANO LTD. Binns Road LIVERPOOL

ROLLING STOCK AND ACCESSORIES

Hornby Series

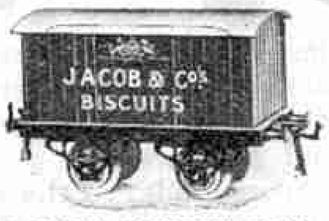
Gauge 0

There are now over 60 different train accessories—Stations, Signal-boxes, Lamps, Wagons, Level-Crossings, Foot-Bridges, Turntables, etc. Further accessories will be added to the system from time to time, and will be announced in the pages of the "*M.M.*"

All Hornby Rolling Stock and Accessories are built in correct proportion to the size, gauge, method of coupling, etc., of the Hornby Trains and all have the uniformly beautiful finish that is the great feature of these trains. With these accessories you can build up a most realistic railway system, and the splendid range of rails, points, and crossings make possible endless variety in rail layout. Ask your dealer to show you specimens of the new products that have recently been introduced.

BRAKE VAN
Finished in grey, with opening doors. Price **4/-**

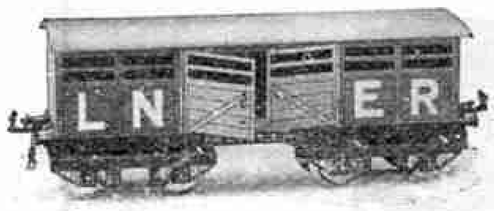
***MILK TRAFFIC VAN**
Fitted with sliding door, complete with milk cans. Price **4/6**



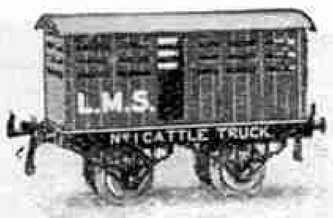
JACOB'S BISCUIT VAN
Finished in crimson lake, with opening doors. Price **4/-**

***GUNPOWDER VAN**
Finished in red, with opening doors. Price **4/-**

BRAKE VAN
Finished in grey, with opening doors. Price **4/-**



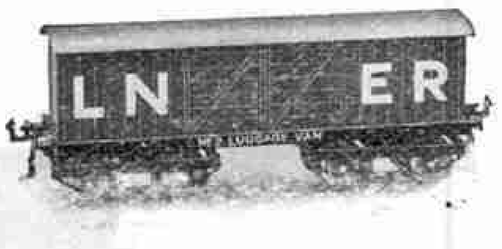
***No. 2 CATTLE TRUCK**
Splendid model fitted with double doors. Suitable for 2-ft. radius rails only ... ... Price **6/6**



***No. 1 CATTLE TRUCK**
Fitted with sliding door. Very realistic design. Price **4/-**

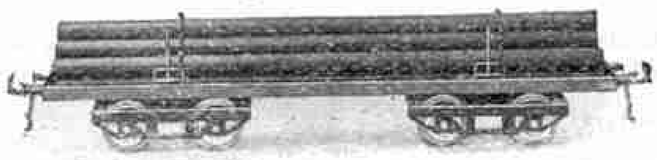
SIDE TIPPING WAGON
Excellent design and finish. Price **3/6**

CARR'S BISCUIT VAN
Finished in dark blue, with opening doors. Price **4/-**

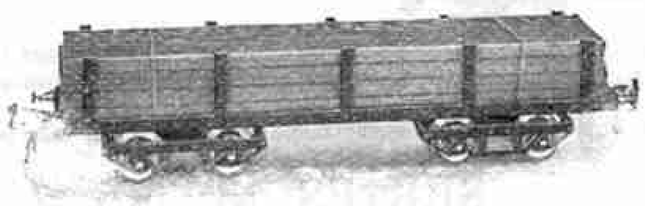


***No. 2 LUGGAGE VAN**
Finished in blue and green. Fitted with double doors. Suitable for 2-ft. radius rails only ... Price **6/6**

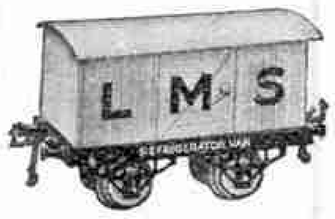
CRAWFORD'S BISCUIT VAN
Finished in red, with opening doors ... Price **4/-**



***No. 2 LUMBER WAGON**
Fitted with bolsters and stanchions for log transport Suitable for 2-ft. radius rails only. Price **5/-**

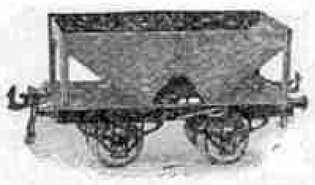


***No. 2 TIMBER WAGON**
Beautifully enamelled in green. Suitable for 2-ft. radius rails only ... ... Price **4/6**



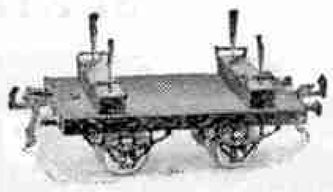
***REFRIGERATOR VAN**
Enamelled in white, with opening doors. Price **4/-**

SECCOTINE WAGON
Beautifully finished in blue, with opening doors. Price **4/-**



***HOPPER WAGON**
Mechanically unloaded. Finished in grey and black ... Price **4/-**

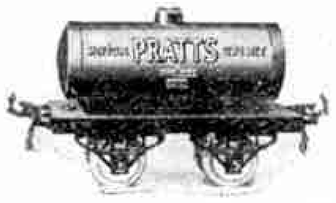
***TROLLEY WAGON**
Finished in grey and red. Suitable for 2-ft. radius rails only ... Price **6/-**



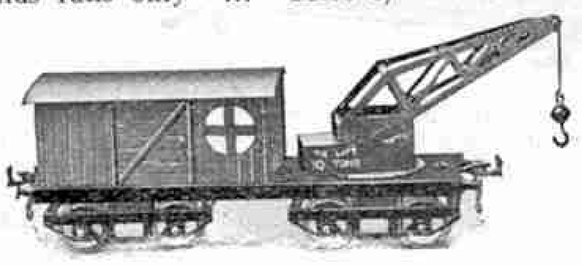
***No. 1 LUMBER WAGON**
Fitted with bolsters and starchions for log transport. Price **2/-**

ROTARY TIPPING WAGON
Finished in grey and green. Price **4/-**

MOTOR SPIRIT TANK WAGON "NATIONAL BENZOLE"
Price **3/-**

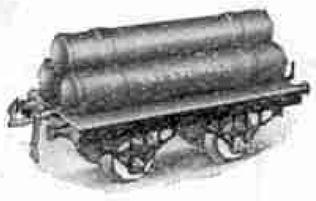


PETROL TANK WAGON "PRATTS"
Finished in green. Price **3/-**



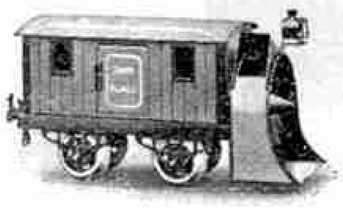
***BREAKDOWN VAN AND CRANE**
Beautifully coloured in grey and black, with opening doors. Suitable for 2-ft. radius rails only. ... ... Price **7/-**

PETROL TANK WAGON "SHELL"
Finished in red. Price **3/-**

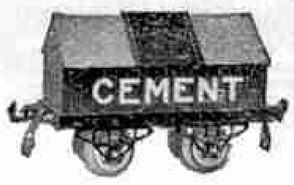


***GAS CYLINDER WAGON**
Finished in red, lettered gold. Price **3/-**

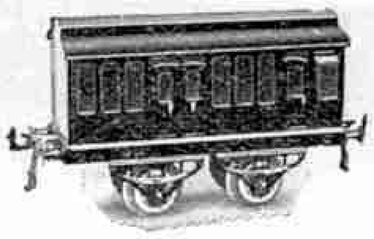
TELEGRAPH POLE
Price **2/6**



***SNOW PLOUGH**
With revolving plough driven from front axle. Price **5/6**

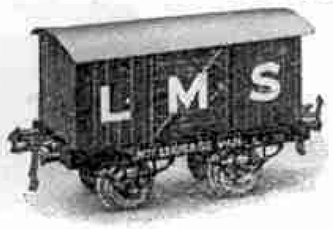


***CEMENT WAGON**
Finished in grey and black. Price **4/-**



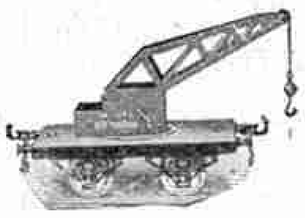
***GUARD'S VAN**
Realistic design, fitted each side with opening doors. Price **3/6**

No. 1 TIMBER WAGON
Beautifully enamelled in green. Price **2/-**

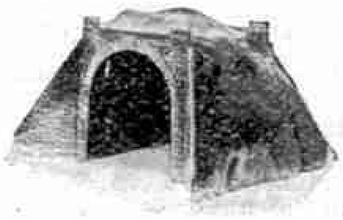


***No. 1 LUGGAGE VAN**
With opening doors. Price **4/-**

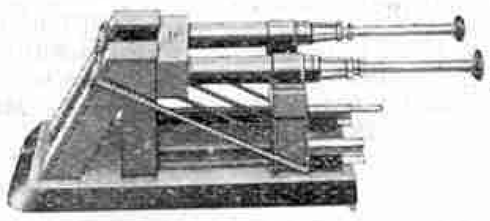
SIGNAL
Price **2/6**



***CRANE TRUCK**
Finished in grey and black ... Price **4/6**

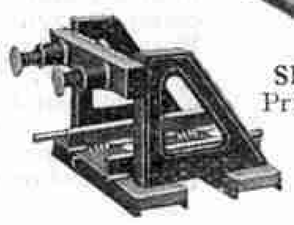


TUNNEL
Realistic and finished in colours ... Price **7/6**



HYDRAULIC BUFFER STOPS
Price **5/-**

TURNTABLE
Price **5/-**

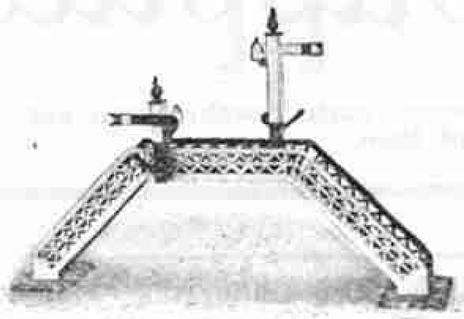


SPRING BUFFER STOPS
Price **1/6**

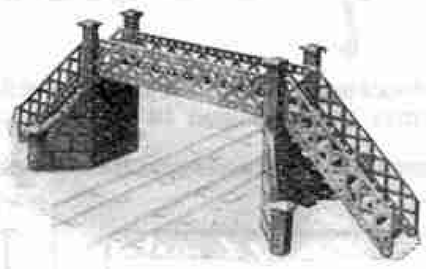
* *Lettered L.M.S., L.N.E.R. or G.W.*

ROLLING STOCK AND ACCESSORIES

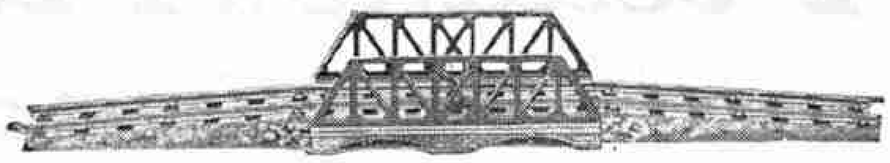
Hornby Series *(continued)* Gauge 0



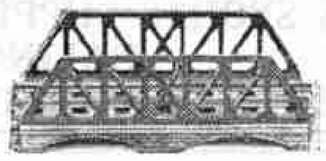
FOOTBRIDGE
No. 1. With detachable Signals Price **6/-**
No. 2. Without Signals ... ,, **3/6**
Signals only ... ... per pair **2/9**



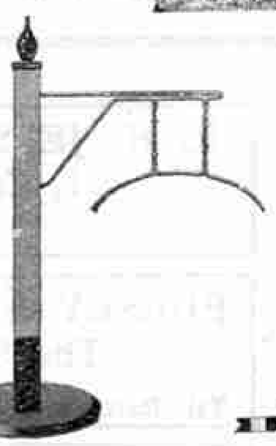
LATTICE GIRDER BRIDGE
Constructional type. Strong and well proportioned.
Price **10/6**



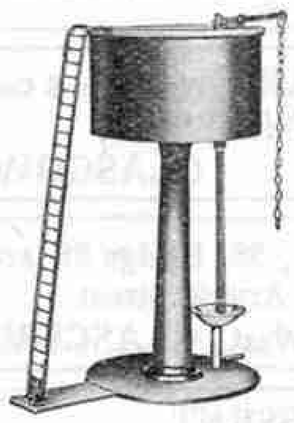
VIADUCT. Price **7/6**
ELECTRICAL VIADUCT. Price **8/-**



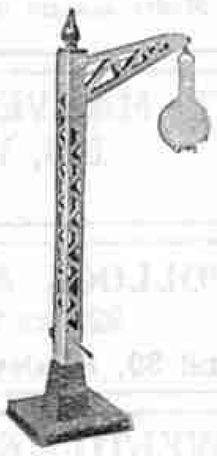
VIADUCT (Centre Section only) Price **4/6**
ELECTRICAL VIADUCT (Centre Section only) Price **5/-**



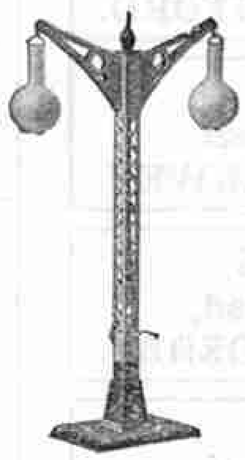
LOADING GAUGE
Price **1/9**



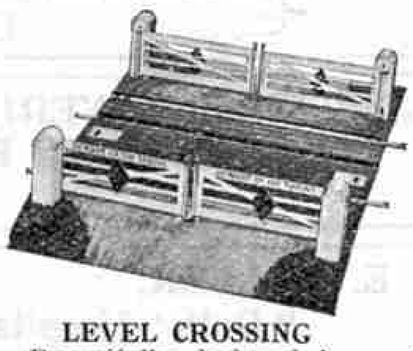
WATER TANK
Brightly coloured in red, yellow and black, 8½-in. in height, with flexible tube and pump lever.
Price **6/6**



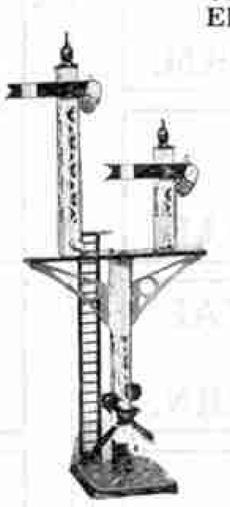
SINGLE LAMP STANDARD
A 4-volt bulb may be fitted into the globe. Price **3/-**



DOUBLE LAMP STANDARD
Four-volt bulbs may be fitted into the globes.
Price **4/-**



LEVEL CROSSING
Beautifully designed in colour. Measures 11½ × 7¼-in. with Gauge 0 rails in position.
Price **6/6**



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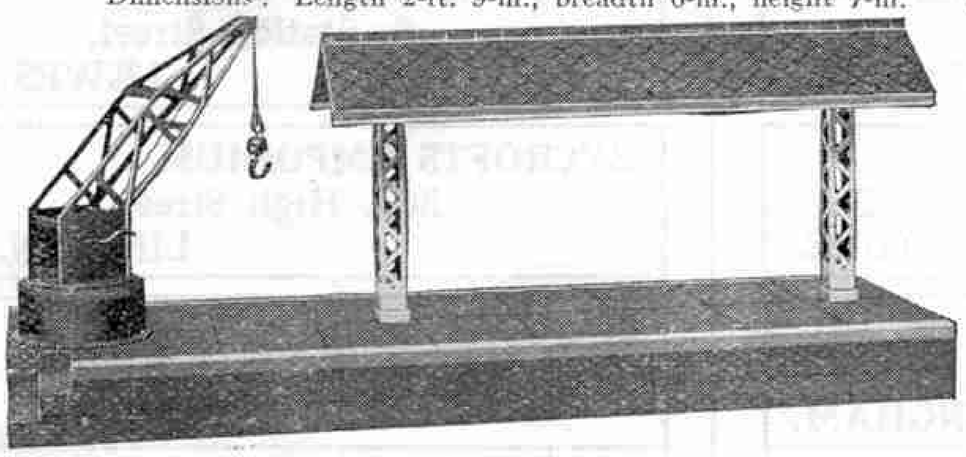

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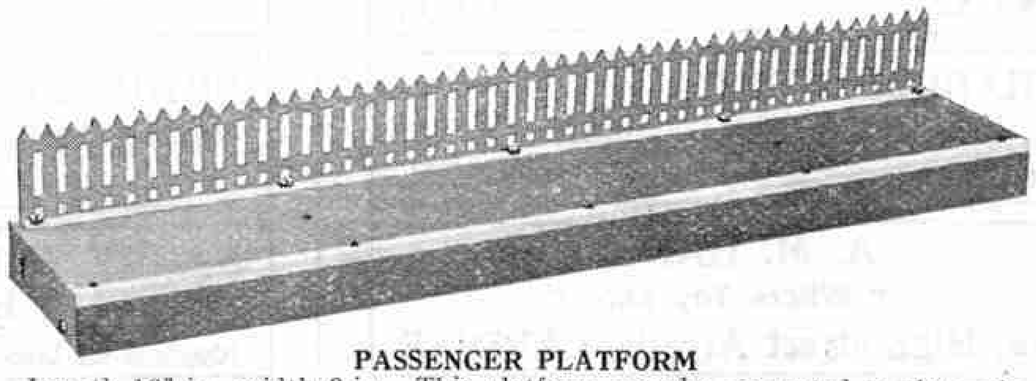
Length 16¾-in., height 6¾-in., width 6-in. The crane at the end of the platform revolves on its base. It is enamelled in bright red and is fitted with a crank and ratchet mechanism for controlling the load. The remainder of the platform and shelter is coloured in green, blue and white ... ... Price **10/-**



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Length 16¾-in , width 3-in. This platform may be connected to the main station or used separately. A length of detachable white paled fencing is supplied and this may be fastened to either side of the platform as occasion requires. The interlocking device at each end enables a number of these platforms to be joined together ... ... Price **3/6**
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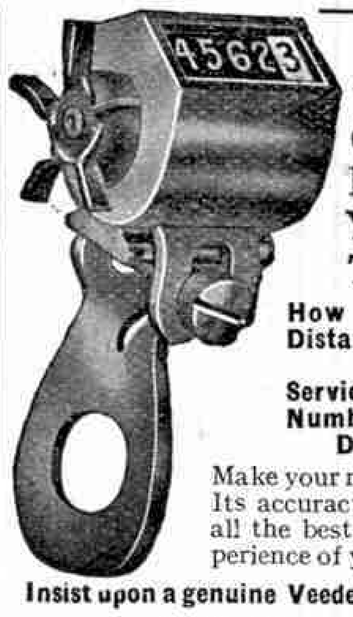

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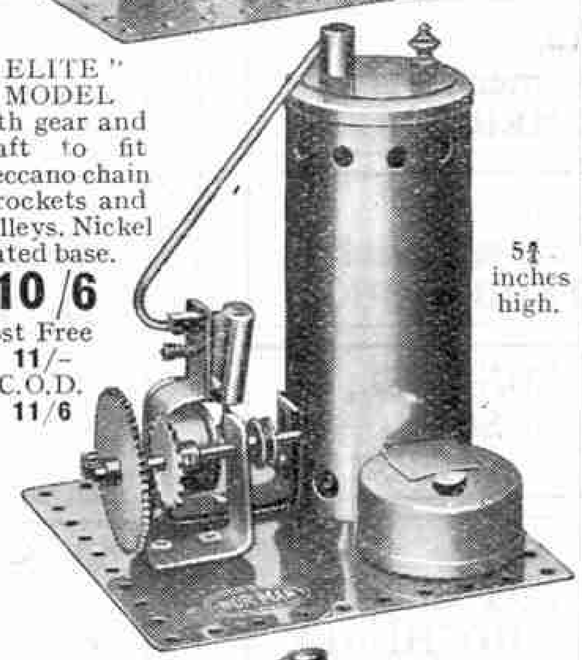

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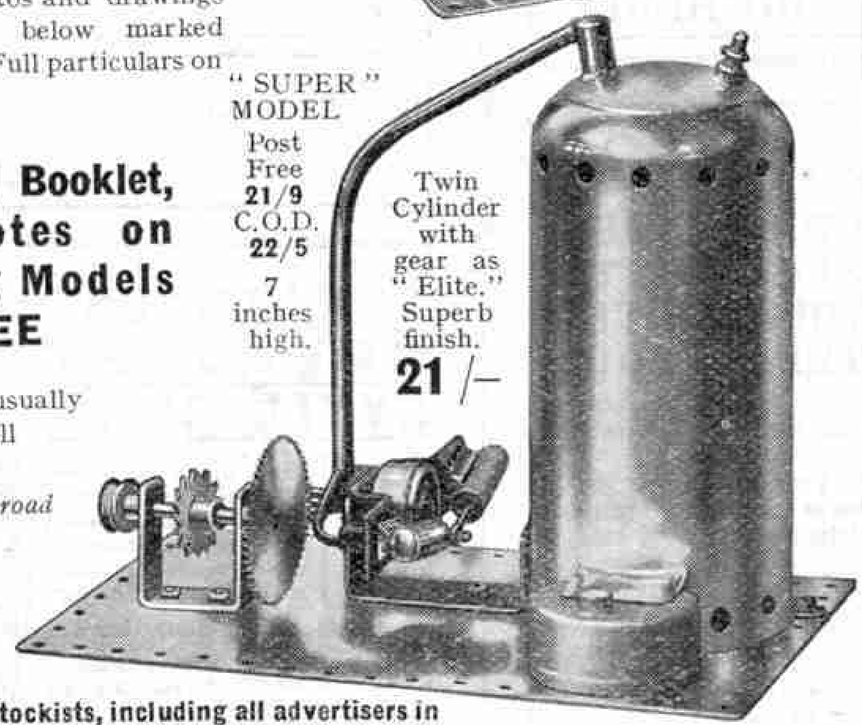

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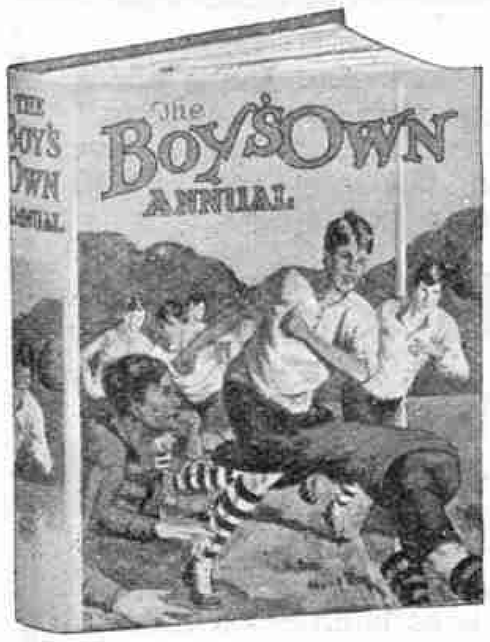

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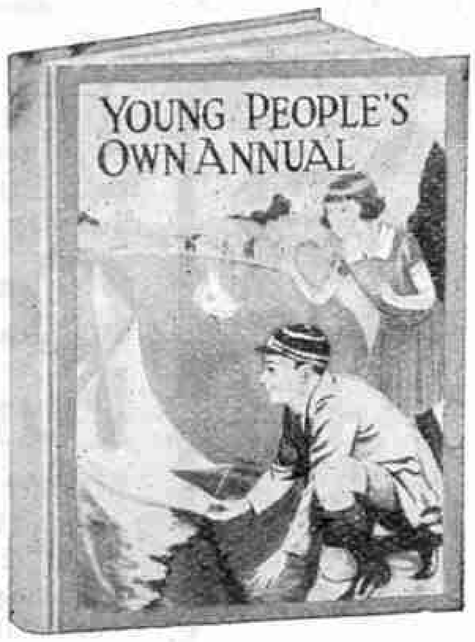

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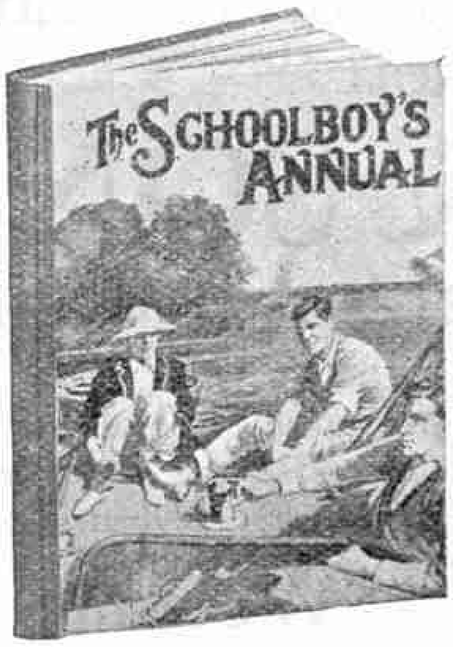

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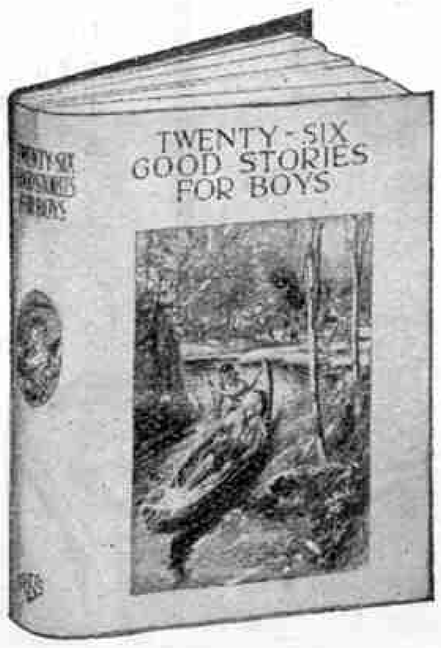

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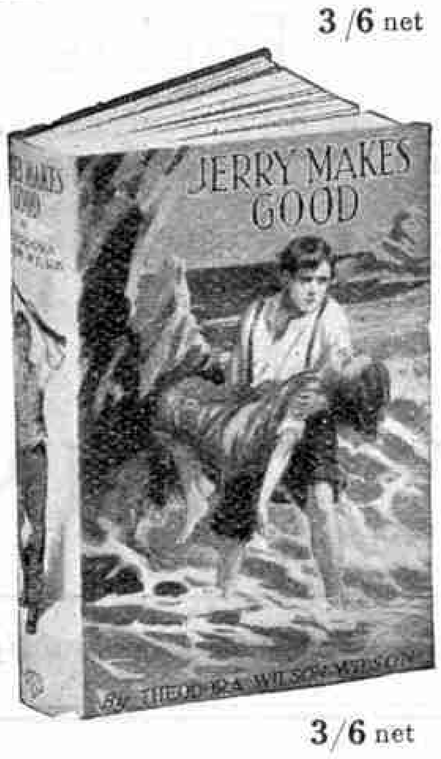

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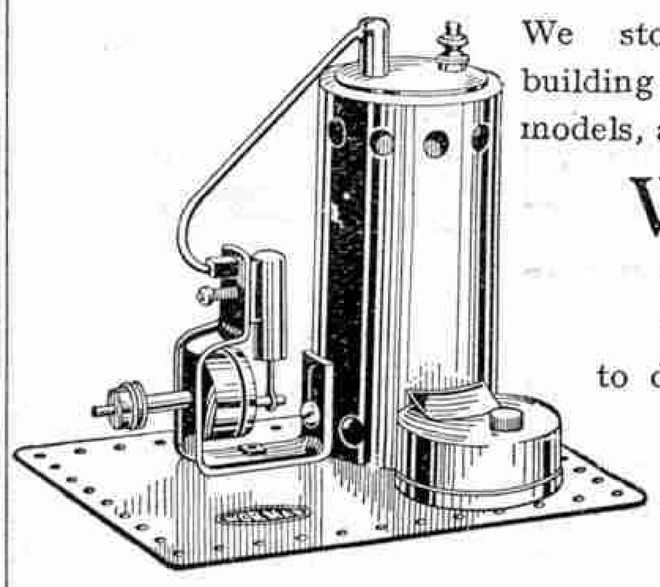

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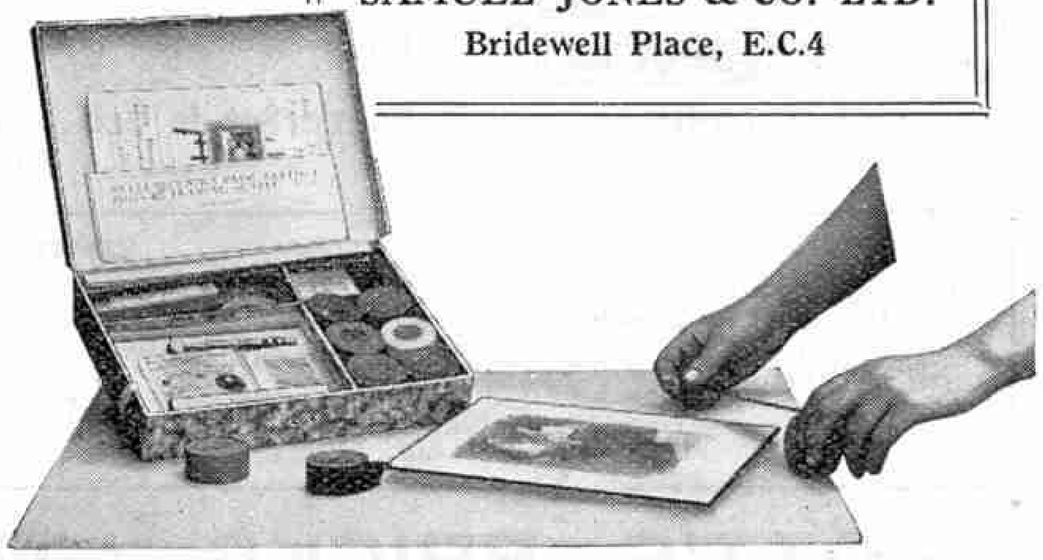

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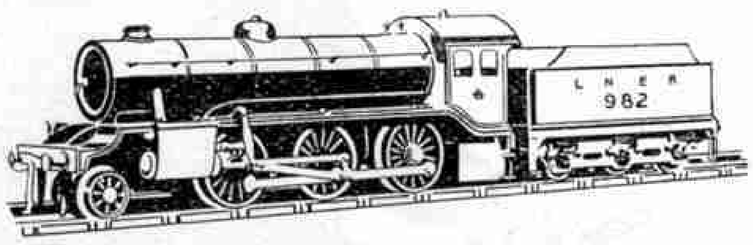

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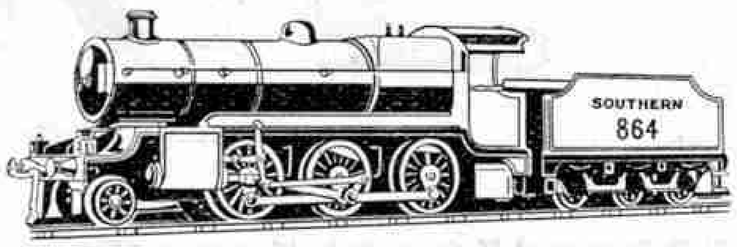

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This latest model completes our series of "Mogul" type engines, and every group of the British Railways is now represented in 0 gauge in clockwork, electric or steam. The general mechanical details are the same in this model as the other three.
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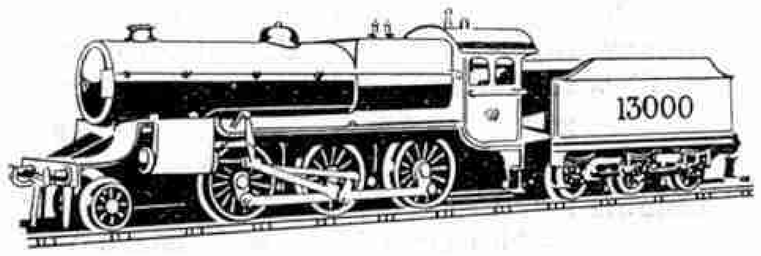

SCALE MODEL L.M.S.R. 2-6-0 TYPE LOCOMOTIVE. No. 13000.

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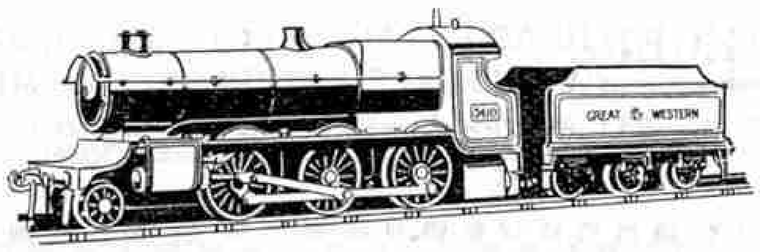

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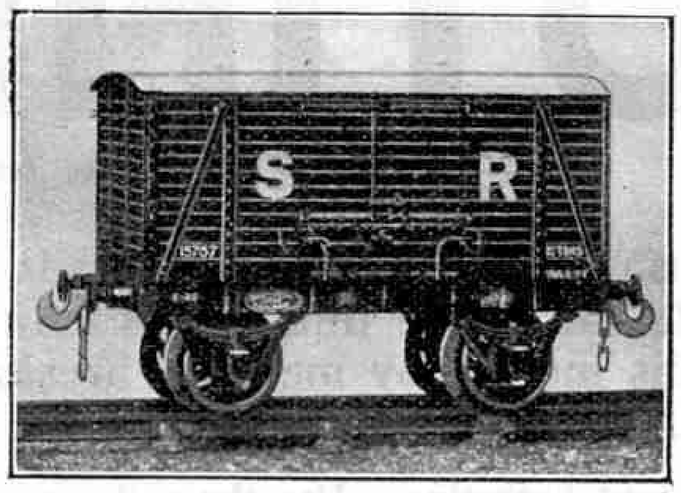

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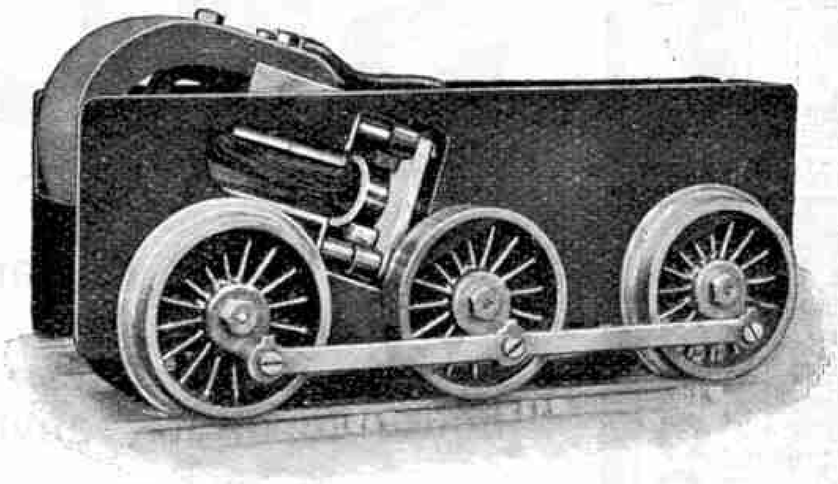

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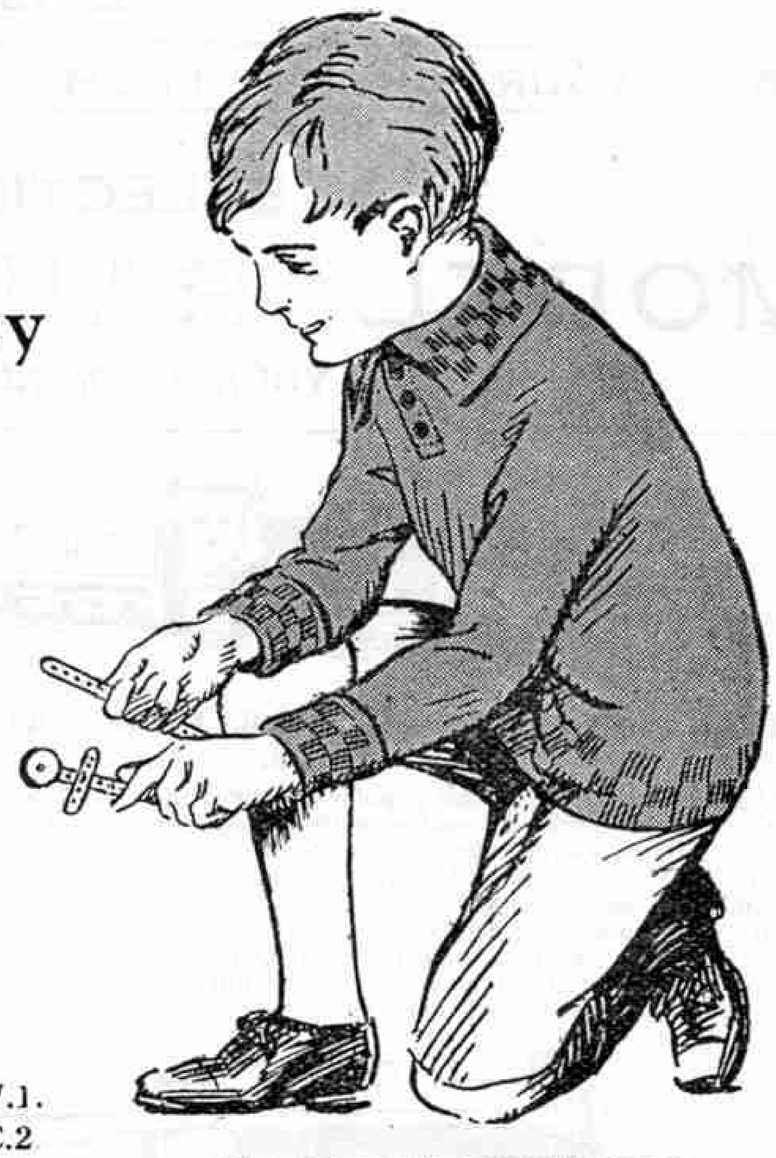

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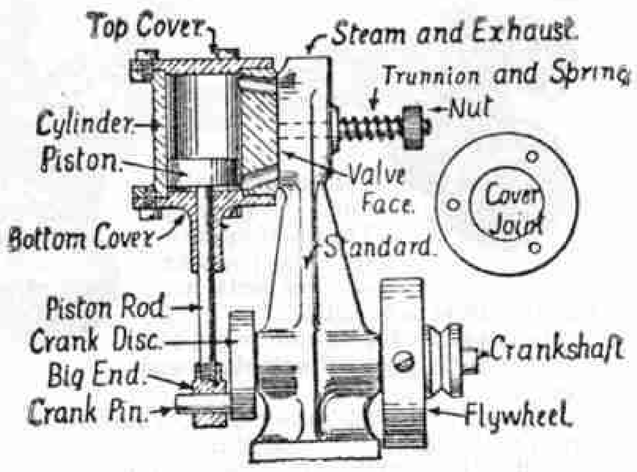

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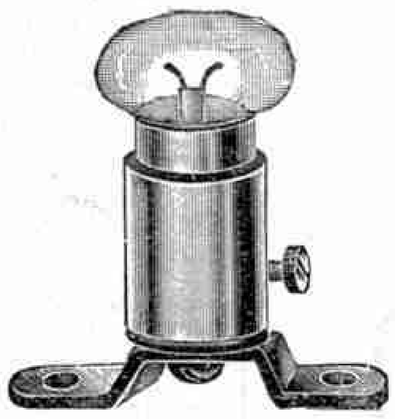

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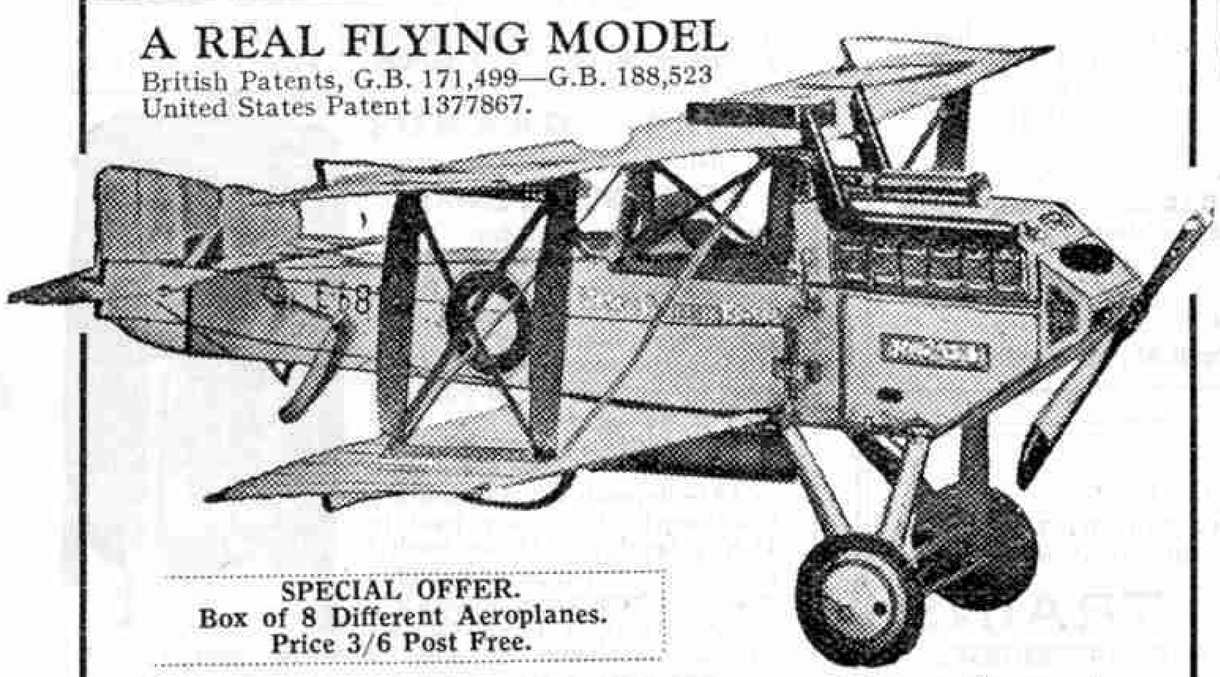

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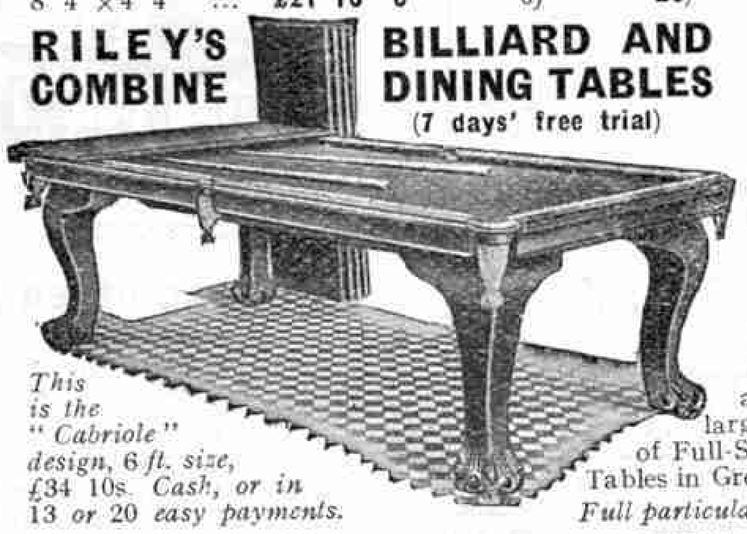

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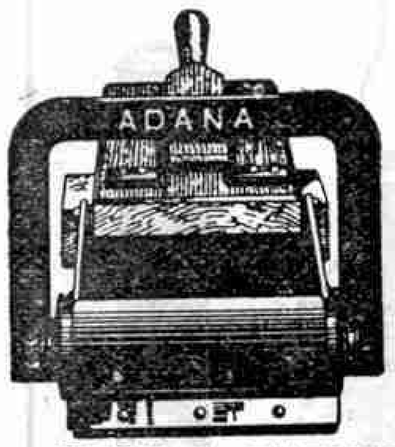

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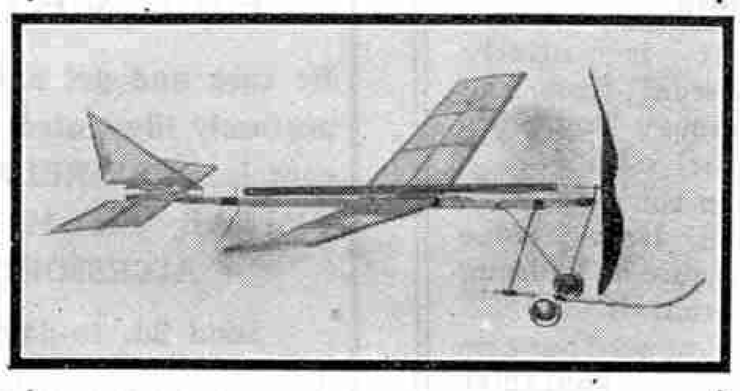

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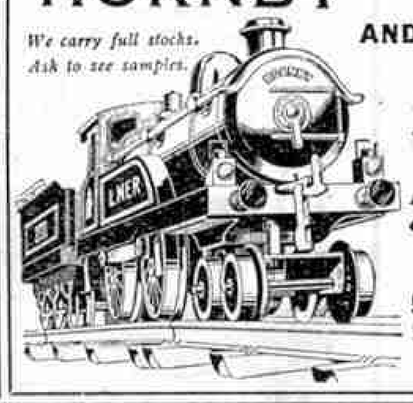

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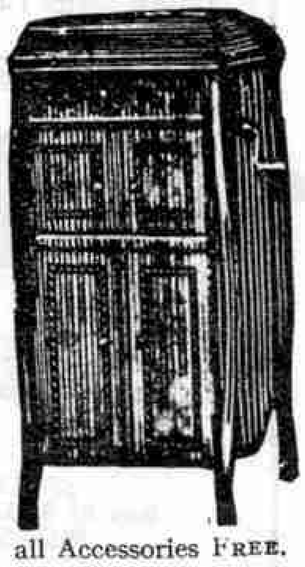

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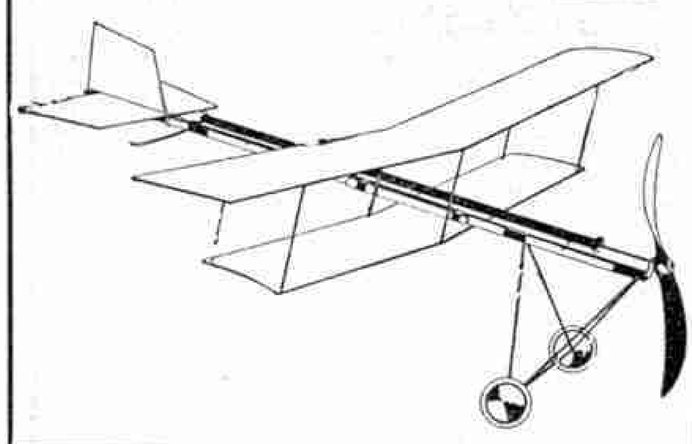

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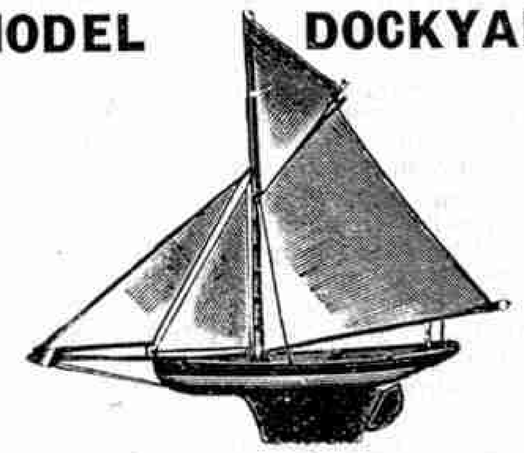

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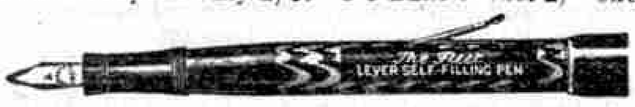

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Publication Date. The "*M.M.*" is published on the 1st of each month and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price 6d. per copy. It will be mailed direct from this office, 4/- for six issues and 8/- for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

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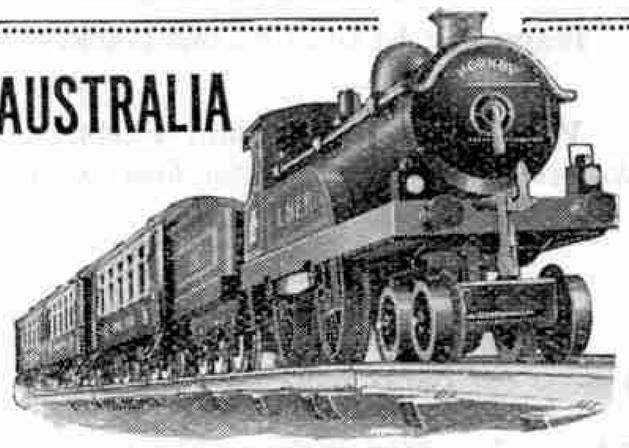

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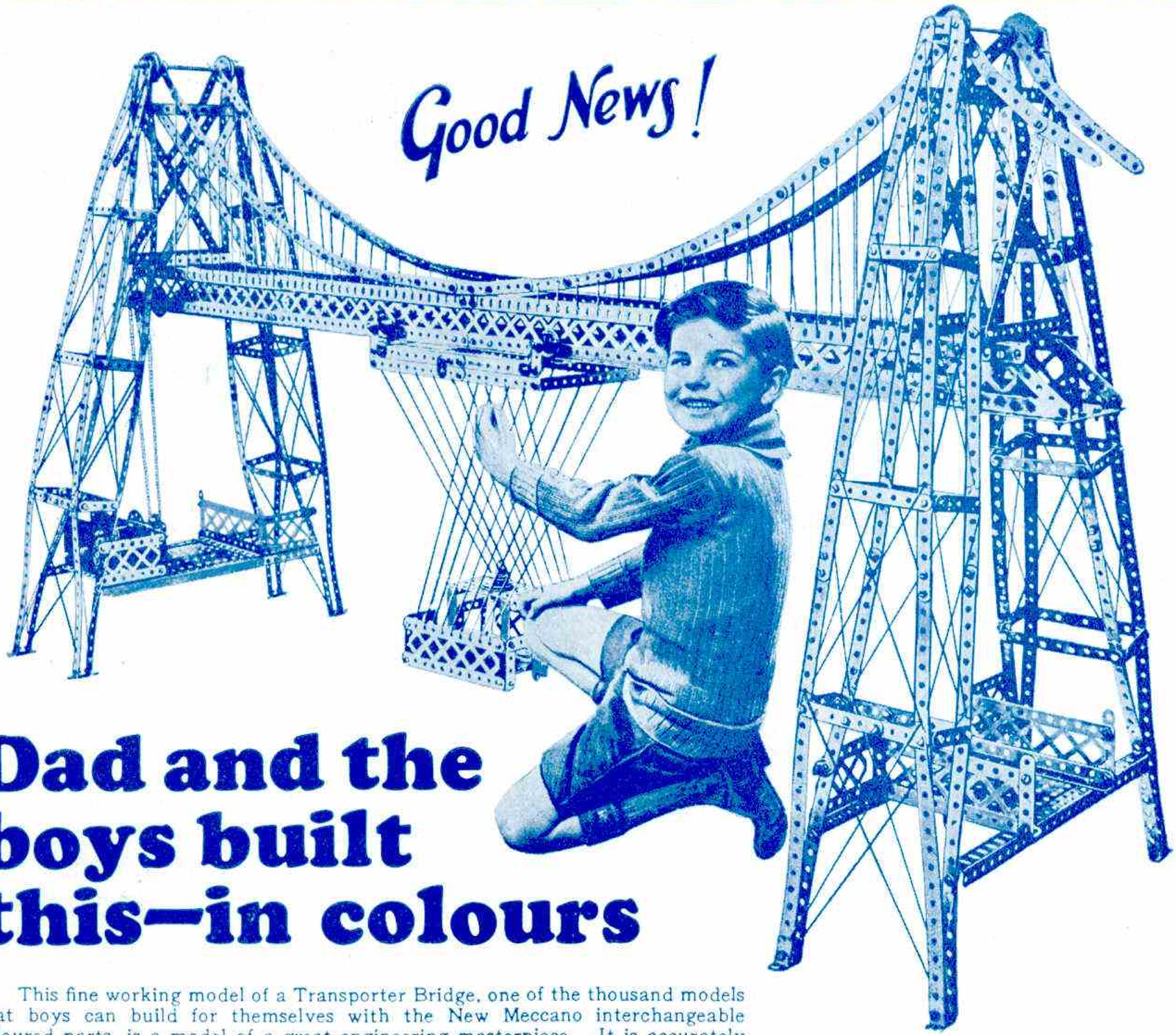

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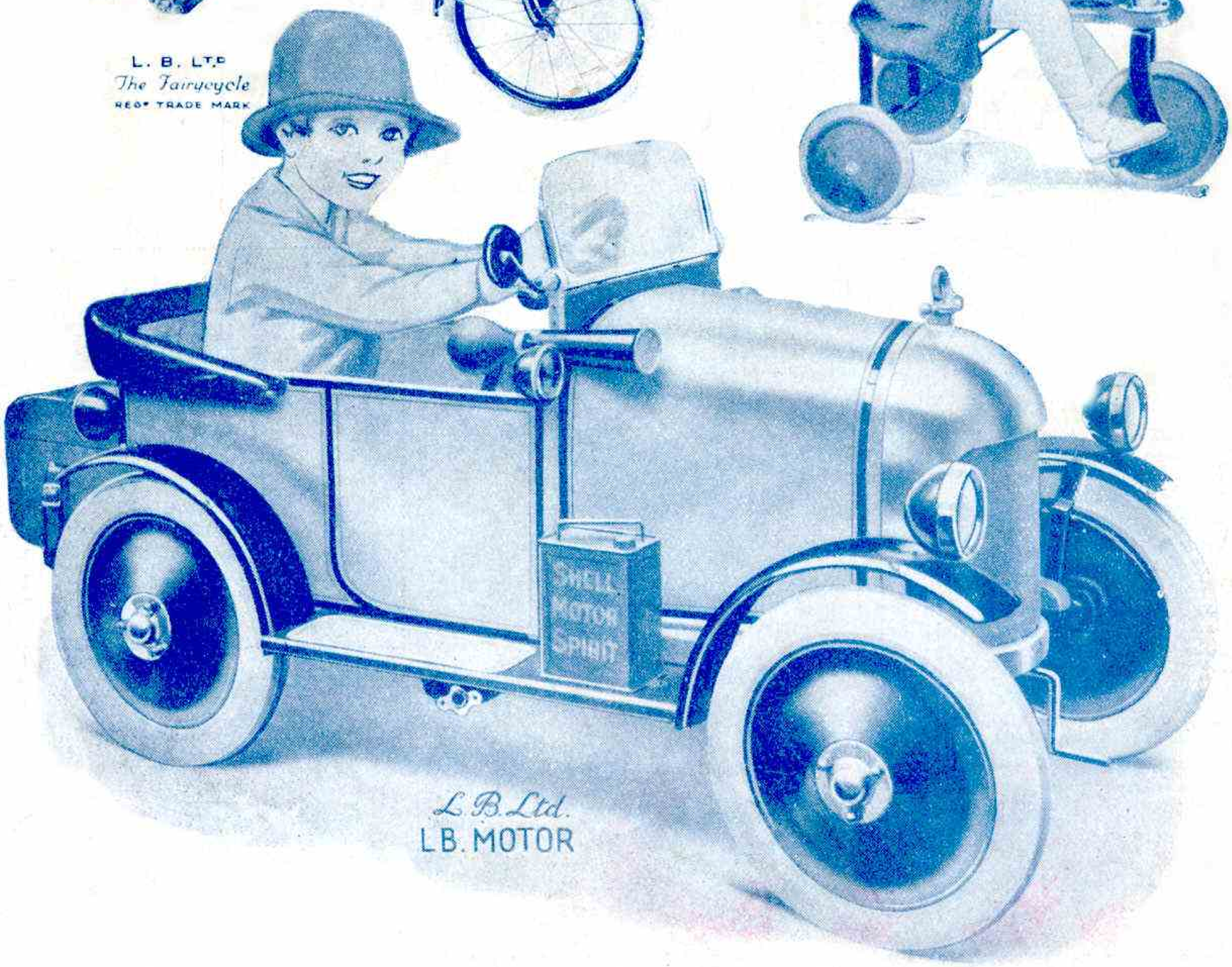

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