VOL. XVI. No. 3. MARCH 1931.

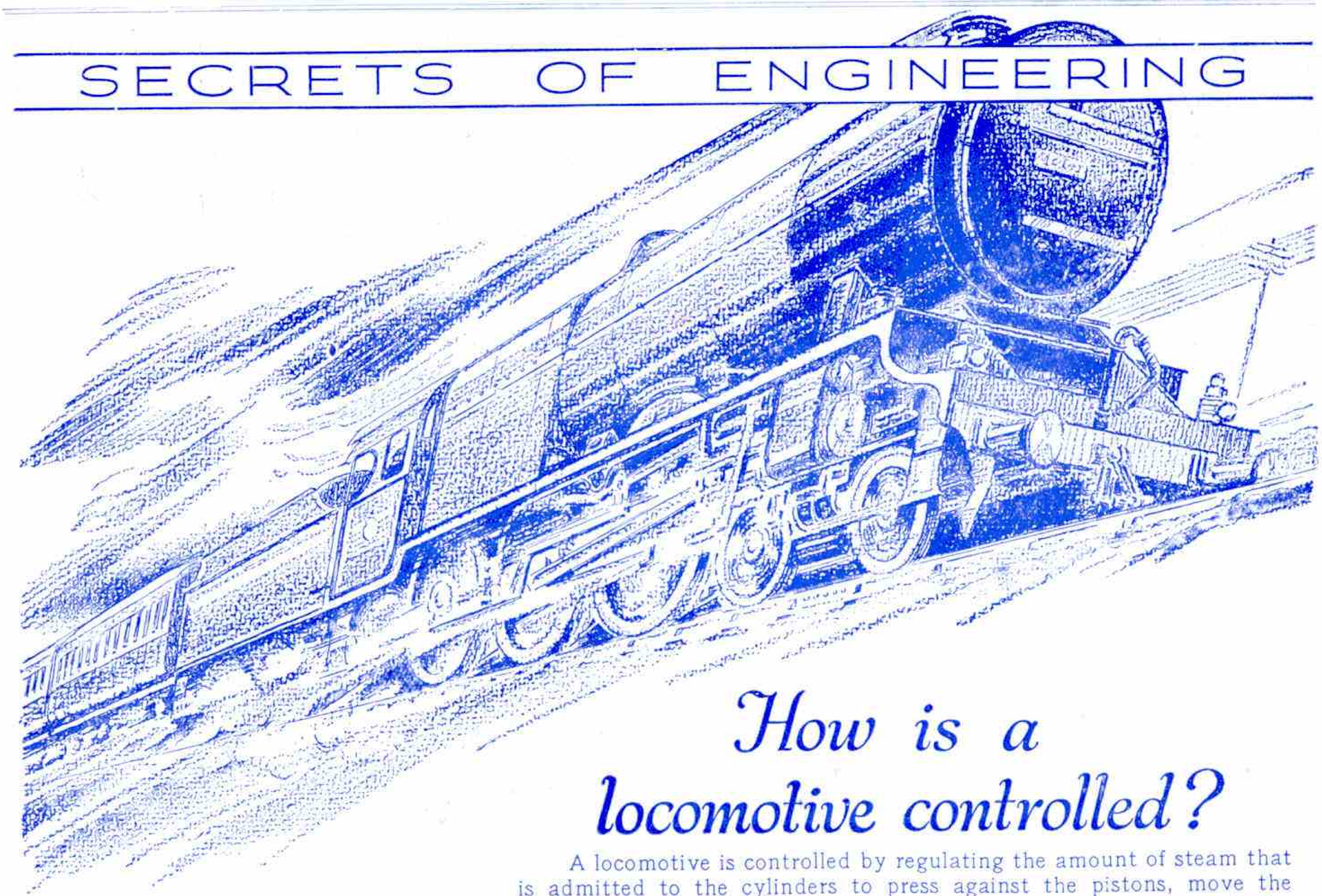
MECCANO MAGAZINE

A GREAT ARCH ACROSS THE TYNE

(see page 186)

6D.

SECRETS OF ENGINEERING



How is a locomotive controlled?

A locomotive is controlled by regulating the amount of steam that is admitted to the cylinders to press against the pistons, move the piston rods and connecting rods, and thus revolve the driving wheels. This regulation is carried out by means of Valve Gear.

The valve gear most generally used in recent locomotives is the Walschaerts. How does it work? This is not easy to explain, but by building the Meccano model of this gear shown here, the principle is made clear, and all difficulties vanish. There are other valve gears in use, and these also may be reproduced in Meccano. All these models work—they can be manipulated so as to show the different valve movements for different conditions of working.

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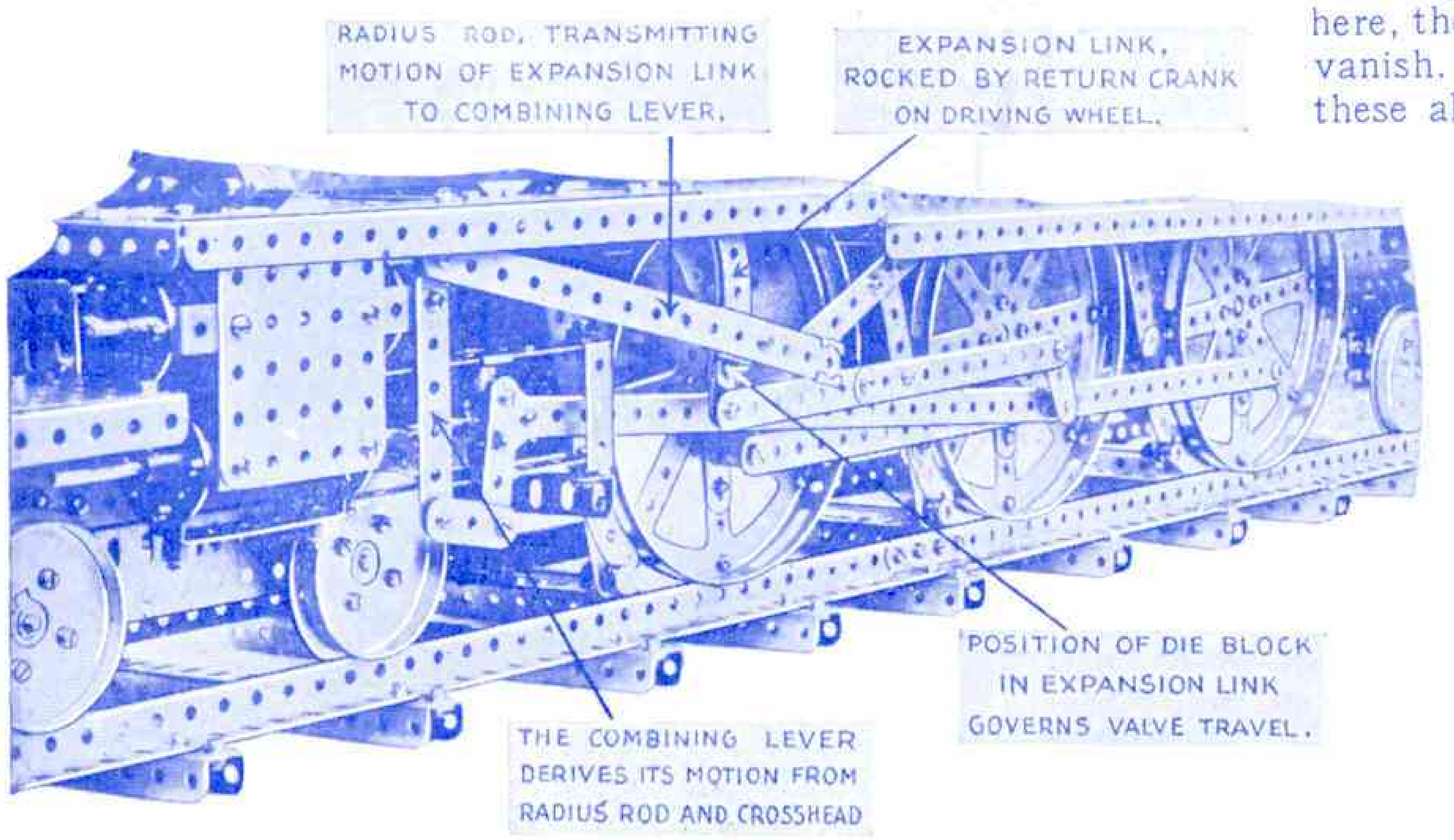

MECCANO

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MECCANO LIMITED — OLD SWAN — LIVERPOOL

NEXT MONTH: THE FUTURE OF ROADLESS TRACTION. PUBLISHED: 1st APRIL

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March, 1931

With the Editor

Scientific Prediction

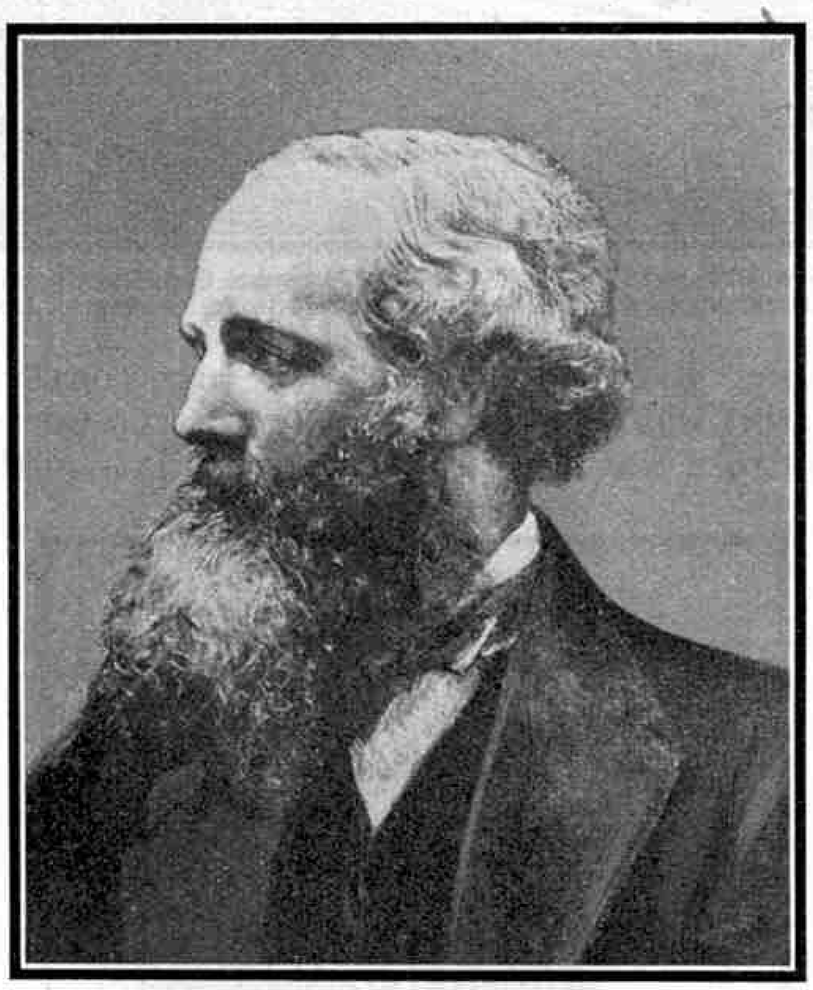
The article entitled "*Exploring the Solar System*" on page 202 of this month's issue describes two striking examples of prediction, one of which proved to be correct and the other to be wrong. J. C. Adams, a young Cambridge student, and a Frenchman, Le Verrier, after prolonged calculations came to the conclusion that there was an undiscovered planet outside the orbit of Uranus. They stated exactly where this planet was to be looked for and in due course the planet Neptune was discovered in the position that had been calculated. The other prediction was that of Sir George Airy, the Astronomer Royal, who asserted that telegraphic communication across the Atlantic by means of a cable was a mathematical impossibility. Few predictions of this kind have been so swiftly and so completely proved false.

The history of science contains many instances of prediction, true and false; and of the former one of the most outstanding is the prediction by Clerk Maxwell of the existence of electro-magnetic waves. James Clerk Maxwell was born in Edinburgh in 1831. As a boy he was not remarkable for ability, and his nickname at the Edinburgh Academy was "Dafty"! His great genius soon began to show itself, however, and his subsequent career was one of ever-increasing brilliance, culminating in his appointment as first Professor of Experimental Physics at the University of Cambridge.

As the result of a long series of experiments the great English investigator Faraday came to the conclusion that electrical action and interaction between two bodies at a distance was conveyed through the ether by lines of electric force. These lines appeared to spring into existence in the ether surrounding a conductor when a current passed through it, and the problem arose as to whether they travelled outward at a definite speed, or were set up instantaneously. Clerk Maxwell took up the study of this problem from the mathematical standpoint, with far-reaching results. He came to the conclusion that the electric influence would travel outward in a series of waves in the ether, and he called these waves electro-magnetic waves, for they would produce magnetic as well as electrical effects. He predicted that they would be of the same nature as light waves, and would travel at the same speed.

Clerk Maxwell began to work out his theories in 1855, and by 1873 they were generally accepted. It was not until 1885, however, that his prediction was completely verified by Heinrich Hertz, the famous German physicist. Hertz not only produced electro-magnetic waves and detected their effects at considerable distances, but also showed that they could be reflected and refracted in exactly the same manner as waves of light, and that they travelled at the same speed. Unfortunately Clerk Maxwell did not live to see the verification of his wonderful prediction, for he died in 1879 at the early age of 48.

By way of contrast to this great work of Clerk Maxwell we may recall a prediction resembling that of Sir George Airy in its swift falsification. This was the prediction of Dr. Dionysius Lardner that steam navigation between Liverpool and New York was impossible. Dr. Lardner was a man of recognised scientific attainments, and was a Fellow of the Royal Society. In a speech made at a meeting in Liverpool in December 1835, Lardner admitted that it was quite practicable to establish steam communication with the United States by making the Azores an intermediate stage, but asserted that the project of making a voyage direct from New York to Liverpool was "perfectly chimerical." They might as well talk, he said, "of making a voyage from New York or Liverpool to the moon"!



James Clerk Maxwell.

At the time of writing news has just reached me of Captain Malcolm Campbell's wonderful achievement at Daytona Beach, and this provides yet another interesting example of a prediction that has been proved to be wrong. When the late Sir Henry Segrave attained a speed of more than 200 m.p.h. many experts predicted that greater speeds would be impossible because of the difficulties that would be encountered in overcoming wind resistance, and in keeping the wheels of a car on the ground. Sir Henry Segrave himself showed the prediction to be false when he created a new record of 231 m.p.h., and now this has been raised to 245 m.p.h., by Captain Campbell, who in one run is believed to have attained the amazing speed of 260 m.p.h.

Protecting the Pedestrian

Although modern vehicles do not yet travel at speeds comparable with that of the "*Blue Bird*," traffic has been greatly speeded up in recent years. The result has been that the poor pedestrian, who cannot walk very much more quickly than he did 50 years ago, now seems to be always getting in the way of some vehicle or other! As a rule obstacles to progress are thrust violently to one side, but even the greatest advocate of speeding up would hesitate to suggest that the ordinary citizen should suffer this fate at the wheels of the fast-moving juggernauts of the road.

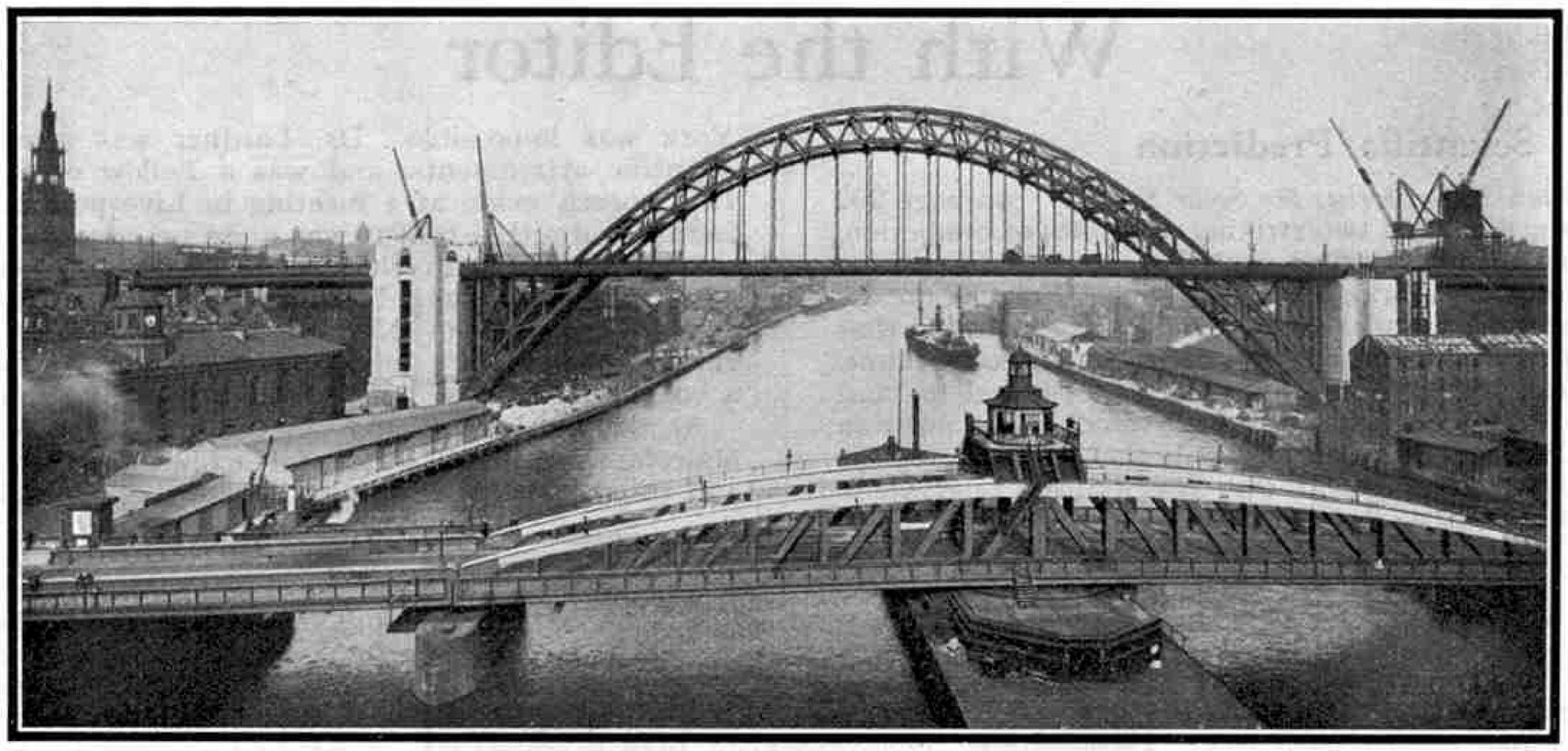
In these circumstances it is not surprising to find that in Paris special arrangements have been made to enable pedestrians to cross the increasingly busy streets in the centre of the city. Instead of being allowed to wander at their own sweet will across the road, foot passengers are now compelled in their own interests to flock across at regular intervals in places that are marked by lines of brass studs. Any citizen of Paris who thinks that "Safety First" is a cowardly slogan, and shows his enterprising spirit by trying to cross the road at any place he chooses, is violently reminded of the forces of progress by the nearest policeman, who hustles him back to the pavement and demands his name and address.

If after all I have said about predictions I may venture upon one myself, I should certainly say that the methods that have been adopted in Paris—and also, I may add, in the United States—will become necessary in other parts of the world. It is probable that the next step will be the introduction of automatic signals that will control the movements of foot passengers in exactly the same manner as those now erected at busy crossings regulate vehicular traffic. To a certain extent, this is already the case, for before venturing from the pavement at busy corners, pedestrians have learned to watch for the green light of existing signs.

A Great Arch Bridge across the Tyne

One-Third the Scale of Sydney Harbour Bridge

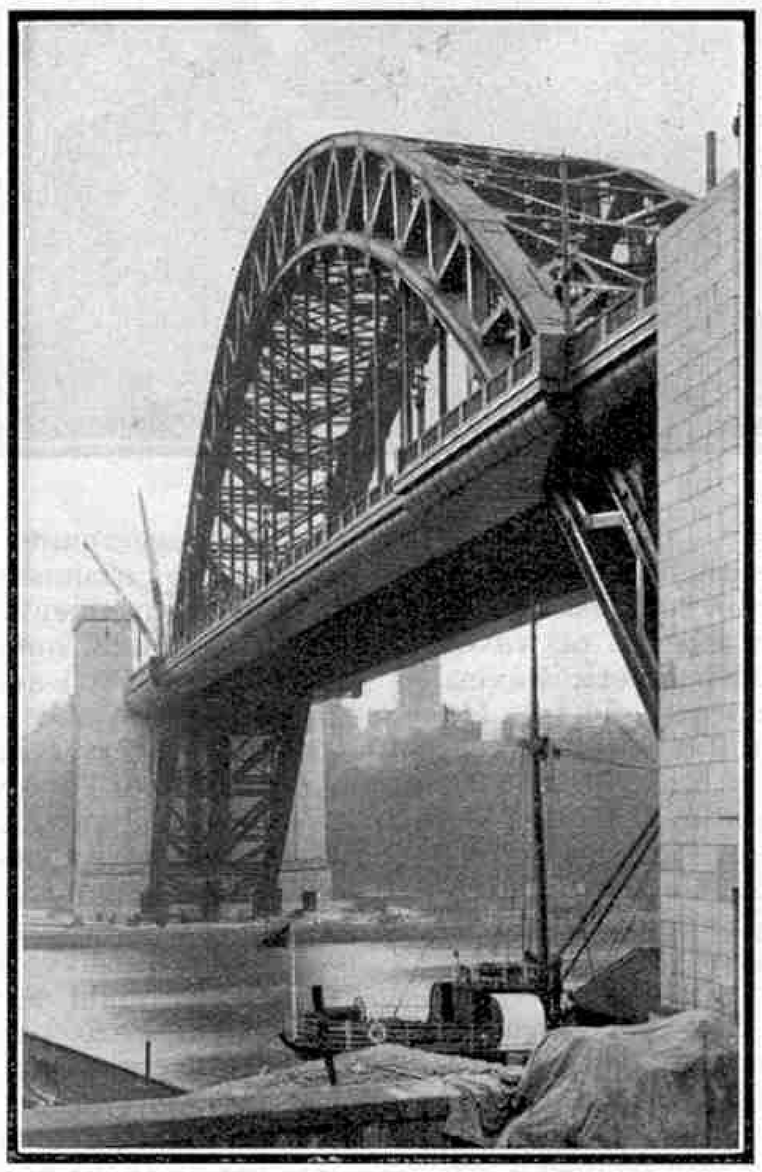
OUR cover picture this month shows the magnificent Newcastle-Gateshead high level road bridge across the River Tyne. There have been bridges across the Tyne for more than 1,800 years. The first was built by the Romans somewhere about A.D. 120, and it appears to have consisted of a timber roadway carried on stone piers resting upon piles driven into the bed of the river. In 1320 another bridge was built, on which houses and shops were erected. An exceptionally severe flood terminated the career of this bridge, and it was replaced in 1871 by a nine-arch bridge, which in turn was superseded by the present swing bridge. In the meantime the Robert Stephenson high level road and rail bridge had been built and opened by Queen Victoria in 1849.



The new Arch Bridge linking up Newcastle and Gateshead. The bridge crosses the River Tyne in a single arch 531 ft. in length. For this and the other illustrations to this article we are indebted to the courtesy of Dorman, Long & Co. Ltd.

During recent years the cross-river traffic has increased enormously, and the necessity for improved facilities resulted in the decision to build the bridge with which we are now concerned. The contractors were Dorman, Long and Co. Ltd., who manufactured and fabricated the steel at their Middlesbrough Works. Readers of the *"M.M."* will remember that this firm are now engaged on the erection of the arch bridge across Sydney Harbour. It is interesting to learn that in design and method of construction the new Tyne Bridge reproduces, to a scale of about one third, the immense Australian structure.

The new bridge consists of a single span, and it accommodates two tramway lines, four lines of vehicular traffic, and two footways. Although the total length of the approach spans on the two sides of the river is 719 ft., undoubtedly the most imposing section of the bridge is the arch itself. This is 531 ft. between the centres of the abutment pins, and is the largest arch in the country. It rises to a height of 170 ft., and supports a roadway that is 93 ft. above high water of spring tides and gives clear headroom for shipping of 84 ft. 6 in. The total length of the arch and the bridge spans is 1,250 ft. They contain about 8,000 tons of steel, 4,000 tons being required for the arch and the deck of the main span.



Another view of the bridge. The crown of the arch is 170 ft. above the level of the river, and the deck allows a clear height for shipping of 84 ft. 6 in.

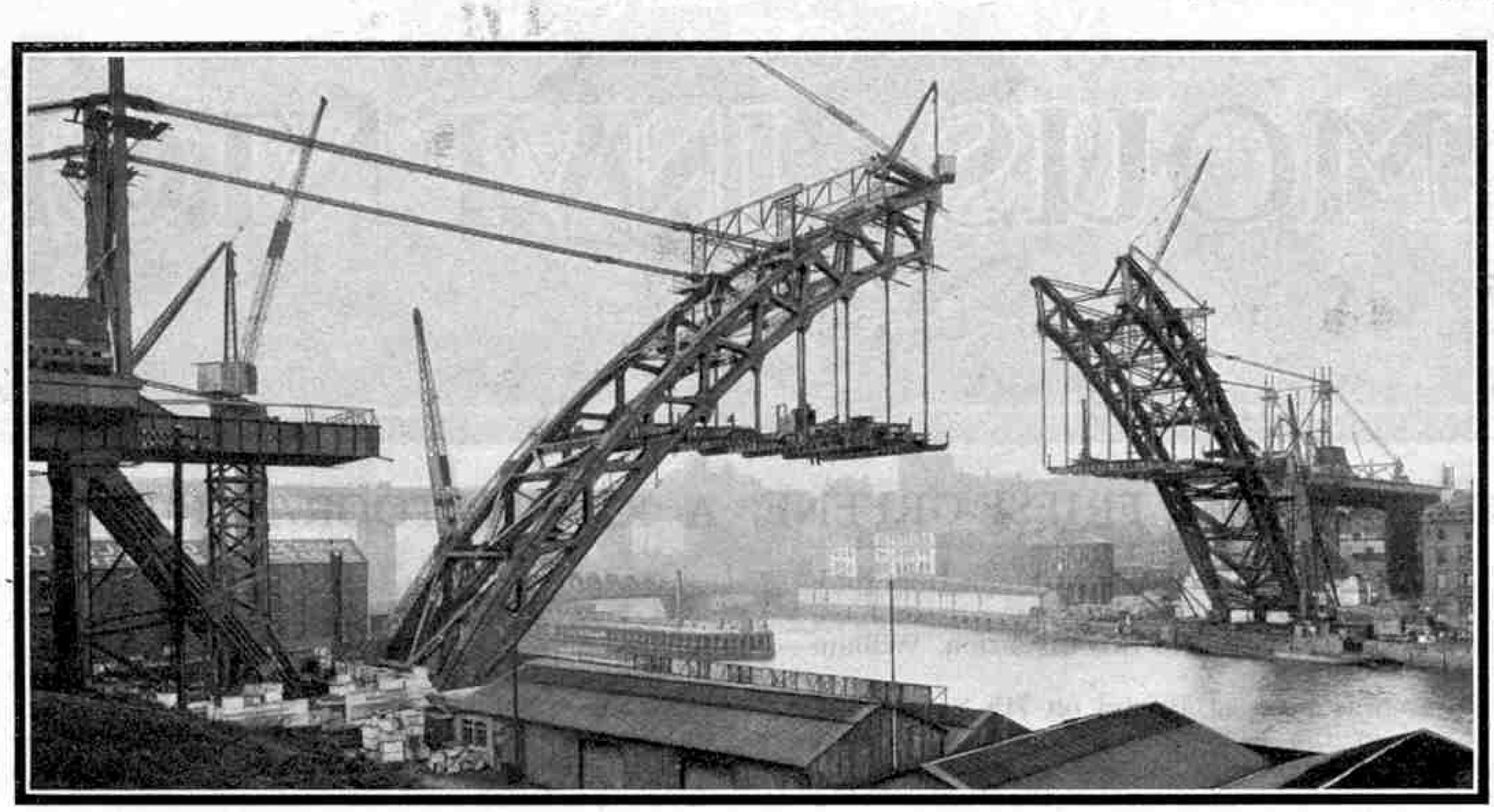
The arch consists of two crescent-shaped ribs that are 45 ft. apart and have a depth of 20 ft. 3 in. at their centres. It is of the two-hinged type. The pin at each hinge is laid in a horizontal bearing, and is covered by a semi-circular bearing formed in the main ribs of the arch. Thus the ends of the arch rest on the pins, and if a crane of sufficient size and strength to raise the arch were available, this could be lifted off its hinges.

The total width of the bridge is 56 ft. The carriage way has a width of 38 ft., and there are two sidewalks, each 9 ft. in width. The deck was built as the arch itself was erected. The road surface consists of wood block paving on concrete. It rests on buckled steel plates, supported by cross joists and longitudinal stringers laid upon the cross girders of the deck, the whole being suspended from the arch trusses by hangers consisting of two channel steel members. The sidewalks are carried on cantilever brackets, and their full width is maintained at the points of intersection of the arch and the deck by balconied portions carried round the steelwork.

The bridge has been designed to carry the standard Ministry of Transport load with an ample margin

of safety. This takes into account the stresses imposed by the passage of tramcars on the double track, but the engineers have also made allowance for the heavy traffic that is likely to develop in this busy industrial area, and the structure is safe for exceptional loads of 100 tons on four wheels.

The handsome abutment towers at the ends of the bridge contribute greatly to its attractive appearance. They are steel-framed structures faced with granite. The facing gives them the appearance of heavy masses of masonry balancing the steelwork of the bridge, and they certainly seem sufficiently substantial to withstand the thrust of the arch. In reality this is taken by the abutment pins, of course. These are 1 ft. in diameter, and the heavy bearing castings in which they are carried are bedded on granite slabs. These in turn are attached to concrete blocks that are continuous with caissons sunk to the solid rock at depths varying from 60 ft. to 80 ft. below ground level. There are two caissons to each abutment. The excavation necessary in sinking them was carried out under compressed air. The air locks and working chambers were subsequently filled with concrete, thus completing the erection of solid monoliths, each weighing about 9,000 tons, for the support of the abutments.

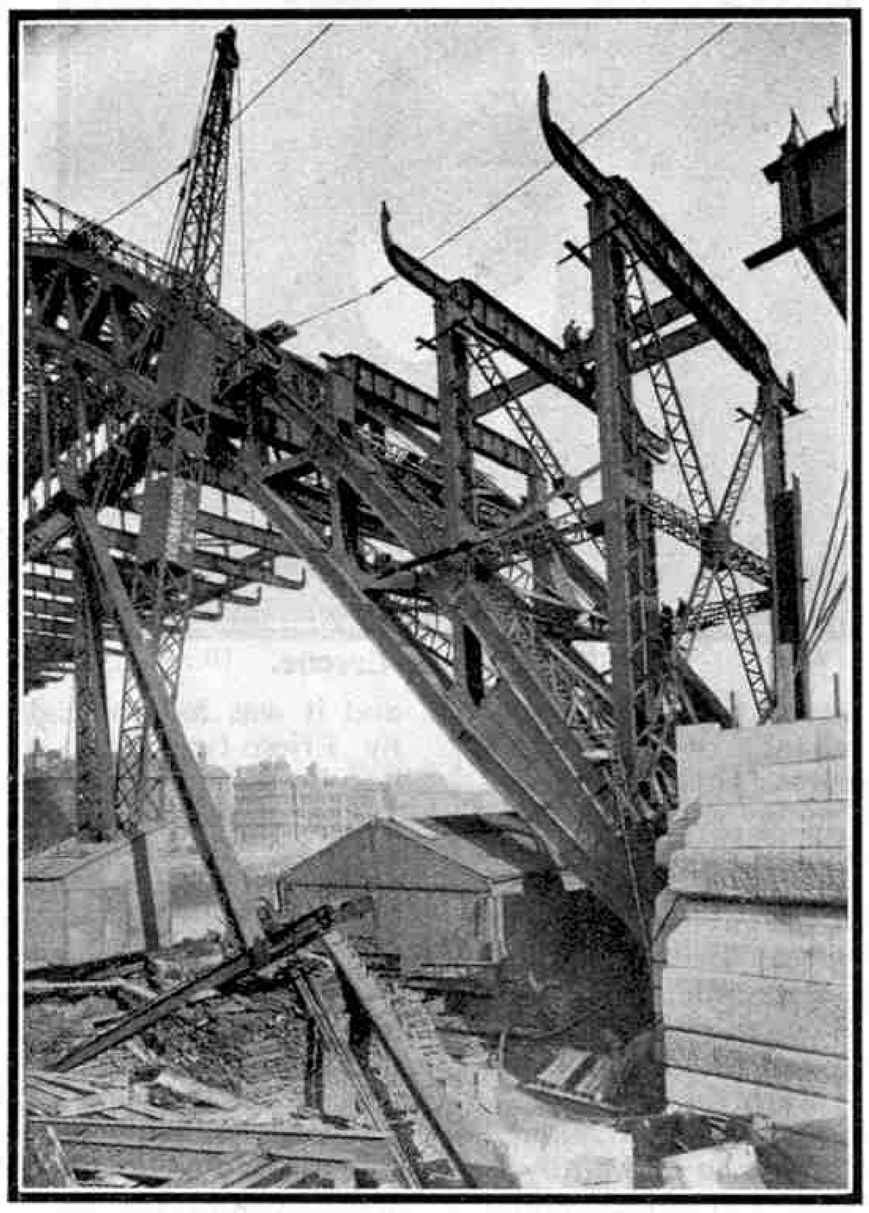


The arch nearing completion. The photograph shows clearly the cables used to support the arch during construction.

The abutment towers are about 100 ft. in length and 60 ft. in width. From the ground level to that of the deck of the bridge they are about 90 ft. in height, and they are continued upward in the form of towers at the sides of the bridge that rise to a height of about 40 ft. above the deck. Staircases and lifts are incorporated in them in order to allow passengers from the quays to ascend to the roadway above, and a considerable proportion of the floor space available will be used for warehousing purposes.

The approach spans are supported by octagonal steel columns, each 70 ft. in height. They were erected on the banks in lengths of 40 ft., and were gradually moved forward on rollers toward the sites of the abutment towers as more and more steelwork was riveted on behind. It is interesting to learn that the hauling was carried out by means of hand winches, as this method gave a more sensitive control of their movements than would have been possible if hydraulic or any other type of machinery had been employed.

This section of the work was both interesting and spectacular in character, for the steelwork of the approach spans moved forward toward the abutment towers at a height of 70 ft. above the streets and buildings on the lower slopes of the river banks. This work, and the sinking of the caissons for the abutments, necessarily preceded the erection of the arch, and when the time came for this to be commenced, there was a platform of sufficient strength to carry a light railway along which the necessary materials could be transported.



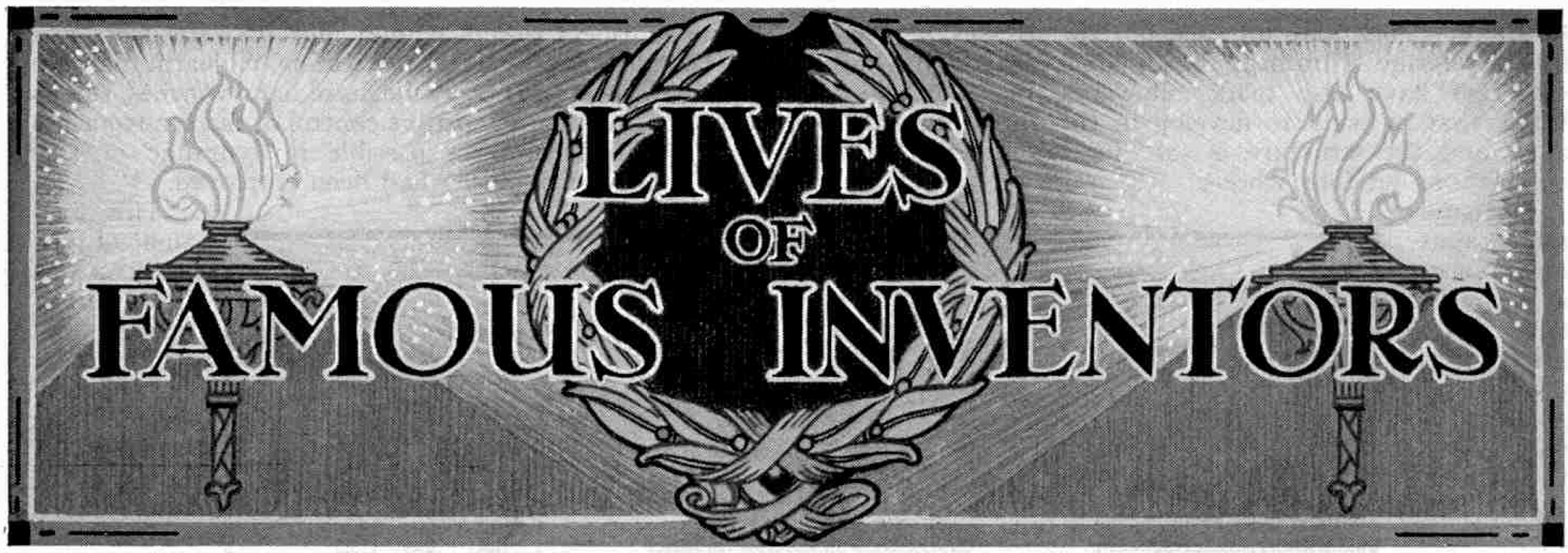
The foot of the arch on the southern bank of the river. The struts that support this section of the deck are seen under construction.

The erection of the steelwork of the arch presented many features of great interest. In order that the bridge could be erected without offering the slightest hindrance to traffic on the river, no staging could be employed to support the steelwork during building operations, and the lifting of material from barges was not allowed. It therefore became necessary to devise a method for building the two sections of the arch outward from the banks, and the ingenious means that were adopted are believed to be novel in this country.

In the very early stages of the work the ribs of the arch were supported on a cradle, but as the work proceeded the weight was transferred from the cradle to cables connected to the top boom. The cables were carried back over temporary masts erected at the river ends of the approach spans and were secured to the webs of these. The ropes employed were of wire, and their number was continuously increased as the arch grew outward and placed greater strain upon them.

On each side, cranes erected on cross girders were employed in the actual work of erection. These lifted the steel members, which on

(Continued on page 258)



XVII.—WILLIAM FRIESE-GREENE, A KINEMATOGRAPH PIONEER

LAST month we dealt with the early work in kinematography carried out by Augustin Le Prince. This month we have to deal with another great pioneer of this invention, William Friese-Greene.

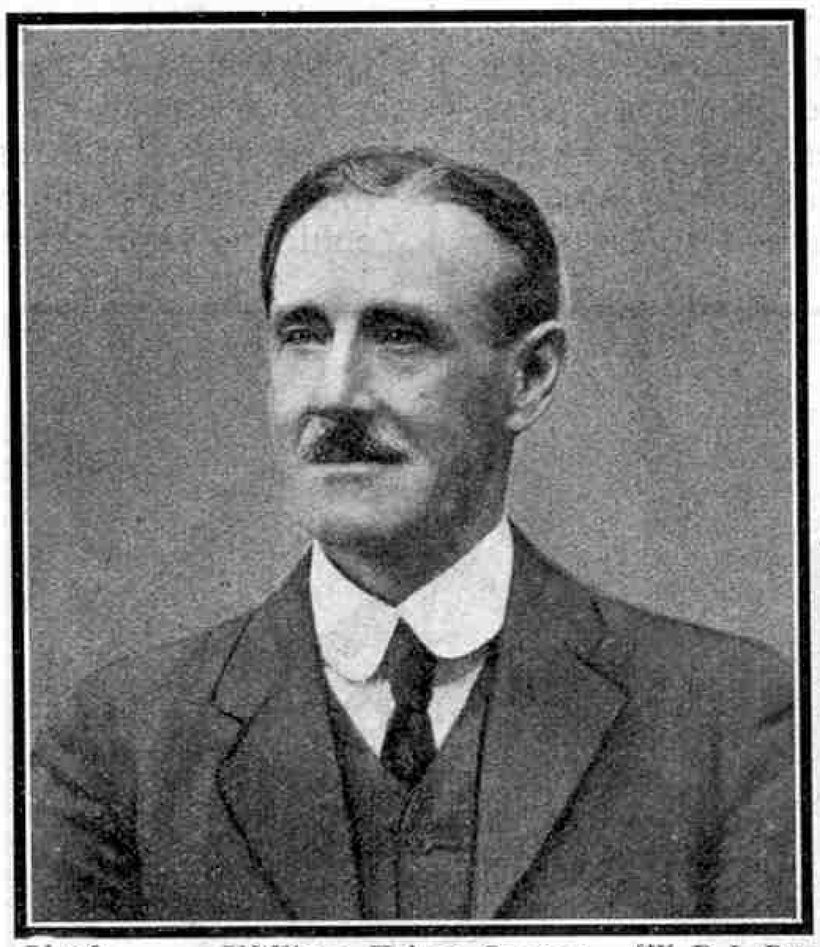
William Friese-Greene was born at Bristol on 7th September, 1855, and was educated at the Blue Coat School in that city. He became interested in photography, which was then in the early stages of its development; and, under the tuition of a son of Fox Talbot, the inventor of a number of photographic processes, he became an expert photographer. Readers will remember that Le Prince also learned photography under one of its pioneers, Louis Daguerre, inventor of the daguerreotype process.

During 1882 Friese-Greene became associated with Arthur Roebuck Rudge of Bath, who was well known locally as the inventor of a projection lantern that he called the "Bio-Phantoscope," and with which he claimed to be able to project moving pictures. The photographs shown by means of this lantern were made on glass plates each measuring 5 in. by 4 in.; and apparently they consisted of series of photographs of "still" subjects, each picture depicting a successive movement. When one picture had been shown, an oscillating shutter operated by a cam arrangement closed over the plate, and re-opened when the next plate had been substituted. The shutter was in two parts and opened and closed from the centre.

Friese-Greene became greatly interested in the lantern, and as he studied it he discovered a number of ways in which it could be improved. He realised that one of the greatest drawbacks to the efficiency of the apparatus was the pause that occurred between each picture and the next, while the change of plate was being effected. He endeavoured to overcome this jerkiness of projection by causing each new picture to be superimposed upon the previous one before this was completely removed from the lantern. After the death of Rudge, Friese-Greene continued to experiment with the lantern, and in 1885 he gave a demonstration before the Photographic Society of Great Britain. The improved lantern was operated by turning a handle, and the pictures were projected on to a screen. The subject of the pictures shown was a human face, the expression of which changed as the successive plates passed through the lantern.

Two years later Frieze-Greene repeated the demonstration, this time in the window of his photographic studio in Piccadilly, London. The exhibition proved an enormous attraction, and so great were the crowds that gathered in front of his shop window that they interfered with traffic, and eventually the police ordered him to cease the demonstrations. The great interest shown by the public made Friese-Greene feel more confident than ever that a successful future awaited the perfect motion picture.

He next turned his attention to devising a camera for photographing moving pictures, and during 1888 he produced one capable of taking photographs in series on sensitised paper ribbons of various lengths up to 50 ft. Each picture was $2\frac{1}{2}$ in. by $1\frac{1}{2}$ in. in size, and the margin was perforated with circular sprocket holes so that the ribbon could be fed continuously through the apparatus. The camera was made to his instructions by a model-maker named Chipperfield, of Clerkenwell Green. There were many defects in this first camera, and shortly afterward Friese-Greene produced an improved apparatus.


Photo] **William Friese-Greene.** [*W. E. L. Day*

Celluloid had by this time become commercially available, and Friese-Greene sought the co-operation of Alexander Parker, a Birmingham manufacturer, in an endeavour to produce a celluloid film. After many experiments he succeeded, and Chipperfield was commissioned to make a new camera in which celluloid film could be used. This camera, which was patented in 1889, had two lenses side by side, but it could be used as a single-lens apparatus by closing the aperture of one of the lenses. When it was used as a stereoscopic camera, that is with both lenses in operation, the two pictures were photographed simultaneously, and as each picture was about 3 in. square, the celluloid film used must have been about 7 in. in width. The large size of the photographs also meant that for every successive pair of pictures the film had to travel slightly more than three inches.

When the camera was operated at the rate of 10 sets of pictures per second, the film travelled at the least 2 ft. 6 in. per second, as compared with a travel of 1 ft. 6 in. per sec. in the modern motion picture camera. Unlike the sensitised paper ribbon previously used, the celluloid film was not perforated at the margins, and it was fed through the camera by an arrangement described by Friese-Greene as a "lever" movement. With this camera he photographed his first moving picture on celluloid film during January 1889, and six months later, in association with an engineer named Mortimer Evans, he patented his apparatus under the title of a "Camera for taking pictures at a rapid rate." Later he purchased Evans' share of the patent.

Sufficient film for 300 exposures was carried on a "feed spool" from which the film passed to a second spool on which it was rewound; both spools being driven at the same speed from a main shaft. In travelling from the first to the second spool the film passed through a plate that held it flat while each exposure was made. When an exposure had been made the intermittent shutter closed over the lens aperture. A roller between the aperture and the second spool then turned once, and in doing so drew down the exposed portion of the film, a movement that brought the next unexposed portion into position. The roller contained a spring and was wound from the main shaft. An escapement tooth on the edge of the roller rested against a revolving cam that once in every revolution permitted the roller to turn and draw down the used film. While an exposure was being made the first spool was releasing sufficient film for the

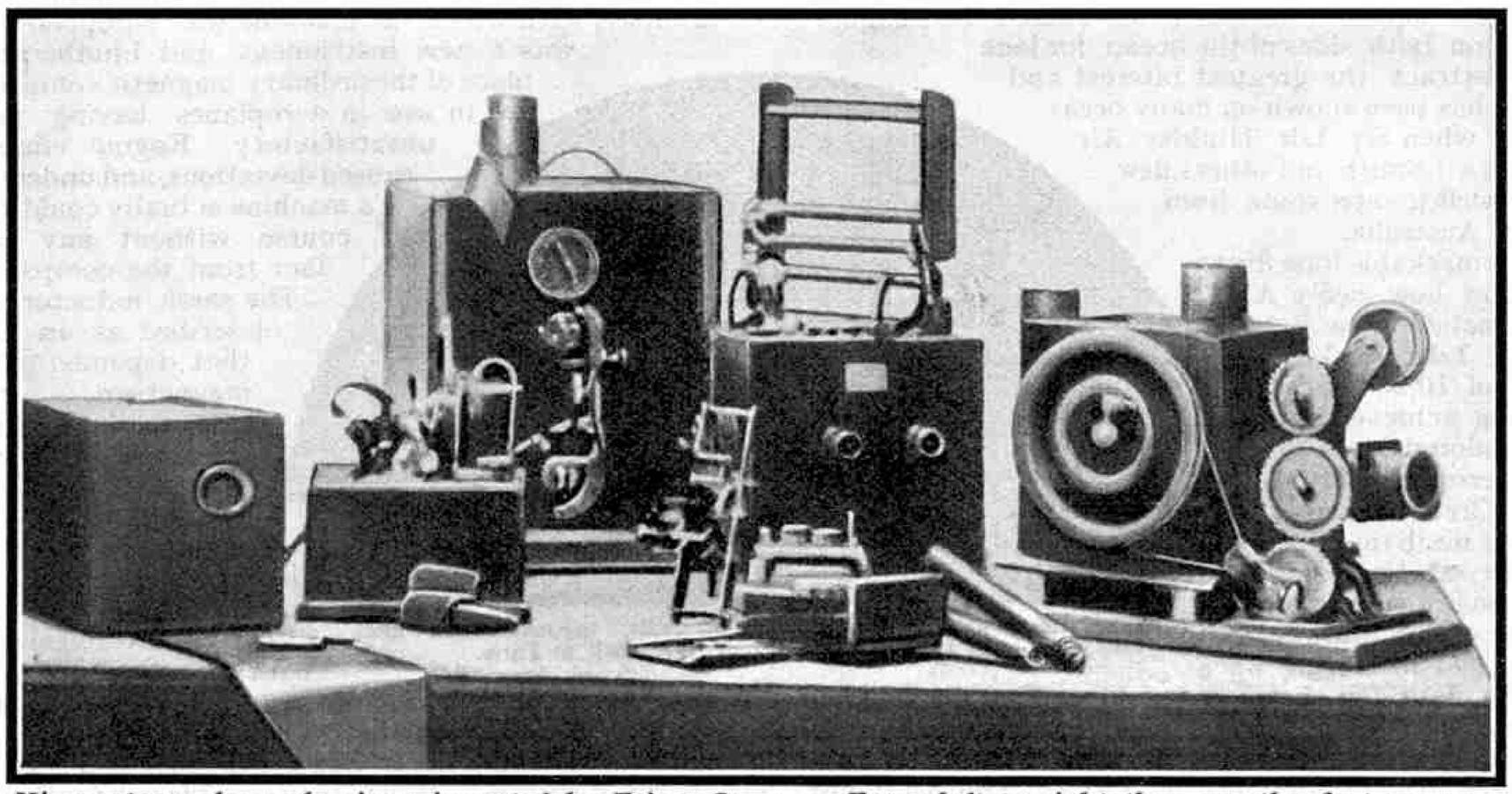
next exposure, and the used portion carried down by the roller was being wound on to the second spool. A similar cycle of operations took place when the positive film was projected.

The claims that Friese-Greene made for his camera were received with curiosity and considerable doubt by the photographic world, and in this connection the following extract from an article entitled "A Startling Optical Novelty," which appeared in the "*Optical and Magic Lantern Journal*" of 15th November, 1889, is worth quoting.

"It would doubtless seem strange if upon a screen a portrait (head) of a person were projected, and the picture slowly became of an animated character, opened its mouth, and began to talk, accompanied by an ever-changing countenance, including the formation of the mouth as each peculiar sound is uttered; or if, instead of one head, two were produced, and an argument gone through with all the turns and twists of the head incidental to such. It would also appear curious to have a street scene depicted on the screen, and for the spectators to witness the various horses and vehicles running past in all directions, persons walking to and fro, and dogs running along, all at varying speeds and with life-like motion, and not go past in a gliding manner —all this not as silhouettes, but with all detail.

"Strange as all this may seem, it is now an accomplished fact, and the optical lantern will shortly be considered a *sine qua non* as a recording instrument. . . .

"The instrument is pointed at a particular moving object, and by turning the handle several photographs are taken each second. These are converted into transparencies, and placed in succession upon a long strip, which is wound on rollers and passed through a lantern of peculiar construction, and by its agency projected upon the screen. When the reproduction of speech is also desired, this instrument is used in conjunction with the phonograph."



Kinematograph mechanisms invented by Friese-Greene. From left to right they are the first camera, made in 1888; the improved camera made shortly afterward, and the stereoscopic camera produced in 1889. On the extreme right is the projector used to show the films.

The phonograph had been invented 11 years previously by Edison in America, so that Friese-Greene was one of the earliest, if not the first, to conceive the idea of "talking pictures." During 1889 he sent a detailed description of his camera to Edison, inviting his co-operation in producing talking pictures. In reply, Edison asked for working drawings of the camera, but though these were sent, nothing further was heard from him on the matter. Probably the many subjects of investigation upon which Edison was then engaged crowded out further consideration of the British invention.

Friese-Greene strove hard to bring about the adoption of his camera, but he was unable to convince people that it was anything more than an interesting novelty. He endeavoured to persuade the Government to adopt the camera for military photographic purposes, but although they briefly examined it, they showed no real interest in the matter. He had devoted all his time and a great deal of money to perfecting the invention, and as time passed he gradually became involved in debt. In February 1891 his home and most of his early apparatus was sold in order to pay off debts, and later he was imprisoned for a short period in Brixton Gaol because he could not pay certain bills.

In spite of his troubles Friese-Greene did not lose heart, and when he was again free he turned his attention to other matters in an endeavour to rebuild his fortune. He found time to continue photographic research, however, and in particular he devoted a good deal of time to experimental work on the colouring of motion pictures. This problem had been investigated earlier by a British engineer named Robert Paul, who had become interested in the subject of moving pictures and had established a studio on the outskirts of London. Paul engaged a number of artists to colour the small pictures that make up a film, but the work was slow and exacting, and as a result proved very costly.

Subsequently mechanical methods were introduced, and films up to about 600 ft. in length were coloured by means of aniline dyes applied by the rollers of a machine through which the films were passed. The work still involved considerable time and money, however, and the undoubted popularity of the coloured film induced Friese-Greene to seek some quicker and less costly means of attaining the same object. He began by introducing a three-colour process that consisted of photographing the subject with three cameras mounted close together, and equipped with red, green and violet light filters respectively. The cameras were operated simultaneously and at the same speed. In order to show the film in colours on a screen, three projectors were used, each equipped with one of the three colour filters. The three projections were superimposed upon the screen, and resulted in a picture that reproduced the colours of the original fairly well. In spite of its merits the process was not received with any enthusiasm by motion picture promoters.

Friese-Greene then experimented with two filters, blue-green and red-orange, and he gave his first demonstration of this process in 1898. During that year also he obtained a British patent for "producing motion pictures in colour," and in 1900 he exhibited some of his results before the Royal Photographic Society of Great Britain. He continued his research, and in 1905 he perfected his first two-colour process. In this process the moving pictures were photographed through a camera in which the two colour filters revolved in front of a single lens.

In addition to his work on coloured motion pictures Friese-Greene continued to experiment with his stereoscopic camera. He had undaunted faith and tireless energy, and he was always devising something new in the hope of regaining his former prosperity. None of his inventions brought him the anticipated success, however, and there were occasions when he and his family were in want of the bare necessities of life. Ideas came to him so rapidly that as soon as he had developed one invention sufficiently far to enable it to be demonstrated, he abandoned it to give his attention to some new project; and thus many of his inventions never reached a practical stage.

During the later years of his life Friese-Greene was employed by a colour photographic company. He died suddenly on 5th May, 1921, while addressing a meeting in London connected with the motion picture industry.

The pioneer work of Le Prince and Friese-Greene was continued by other experimenters and inventors. Among these later workers was Jean A. Le Roy, a photographer in America. Le Roy began experimenting in 1875, and in the autumn of the following year he produced a projection lantern by which a series of 200 "still" pictures in the form of lantern slides were passed through a mechanical carrier attached to the apparatus and projected in succession upon a screen. The subject was a boy and a girl dancing a waltz, and each photograph was posed separately.

The apparatus was noisy and cumbersome, and Le Roy set about devising a better one. Finally, in 1894, he produced his "Marvellous Cinematograph." This machine was worked by hand, and perforated film was used, this being passed from one spool to another by a sprocket mechanism. With this apparatus he gave many moving picture exhibitions at theatres and clubs in America. Unfortunately Le Roy failed to apply for an American patent within two years of completing his projector, and as a result his unprotected invention became public property.

The "*Spirit of St. Louis*"

How Lindbergh Found his Way Across the Atlantic Ocean

ONE of the most interesting and remarkable feats in the history of aviation undoubtedly was Colonel Lindbergh's celebrated lone flight from New York to Paris. Under any circumstances an attempt to fly across the Atlantic Ocean calls for great courage, and success can only be attained by those who possess skill and experience, for the slightest slip or accident may have a fatal ending. In long flights over land there usually is a possibility of making an emergency landing without serious injury, but at best to be forced down at sea is a dangerous experience and in most cases the chances of rescue are slight.

Of all Atlantic flyers only Lindbergh had the boldness to set out alone and to rely entirely upon himself and the merits of his machine. It was this aspect of his flight that stirred the imagination of the public on both sides of the ocean, for lone flyers invariably attract the greatest interest and admiration. This has been shown on many occasions, and notably when Sq. Ldr. Hinkler, Air Commodore Kingsford Smith and others flew alone on the now well-known route from Great Britain to Australia.

The first of the remarkable lone flyers who set out to show how easily Australia could be reached in a light aeroplane was Sq. Ldr. Hinkler, whose lone flight of 10,355 miles was an outstanding achievement. Sq. Ldr. Hinkler piloted an Avro "Avian" light aeroplane fitted with an 80 h.p. "Cirrus" engine. He acted as his own mechanic, spending a considerable time at the conclusion of each flight in making preparations for the next stage of his journey, but nevertheless succeeded in setting up a record time of 15½ days for the distance from London to Port Darwin. His reception on his arrival was a testimony to the courage with which he faced the task that he had set himself.

In many respects Air Commodore Kingsford Smith's flight was even more remarkable than that of Sq. Ldr. Hinkler. It occupied only 10½ days, and thus set up a new record that showed a considerable improvement upon the one that had resisted all attacks for more than two years. The pilot in this case was more accustomed to large multi-engined machines than to light aeroplanes, for his wonderful flights across the Pacific and Atlantic Oceans had been made in the "*Southern Cross*," a Fokker machine fitted with three Wright "Whirlwind" engines. On his flight to Australia he employed an Avro "Avian Sports," the "*Southern Cross Junior*" fitted with a D.H. "Gipsy" II engine. His skill and experience enabled him to average nearly 1,000 miles a day, and from start to finish he appears to have experienced no difficulty.

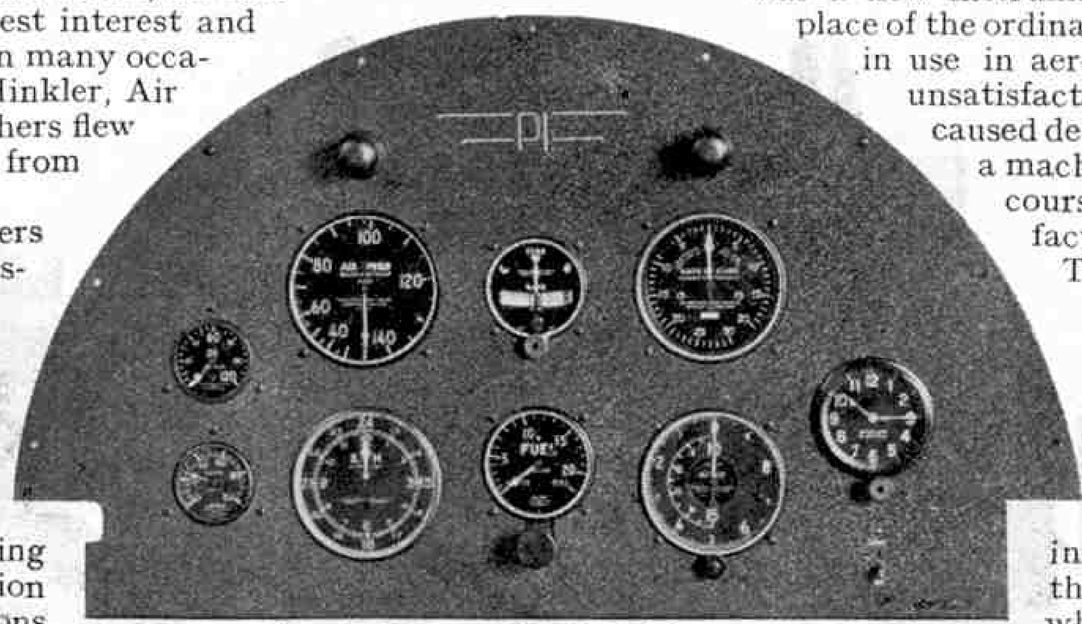
A Remarkable Flight to Australia

Another remarkable instance of a single-handed flight was that of Miss Amy Johnson, who made a gallant but unsuccessful effort to set up a new record for the same journey. The fortunes of "the female Lindbergh," as she came to be known, were followed with breathless interest by people in all parts of the world.

The men who perform great deeds of any kind invariably set out with a belief in their own ability, but this is usually based on thorough knowledge. Lindbergh was no exception to the rule. He began his career by making himself familiar with every side of flying, and he learnt how to look after a machine and to keep its engine in the best possible condition. In his early days as a pilot he spent a considerable time in giving short flights in various American towns, and the experience of flying under all conditions that he gained in this manner created in him confidence in his own powers. His Ryan monoplane, the "*Spirit of St. Louis*," was equipped with a complete range of up-to-date and reliable instruments, and he himself was a competent pilot, who thoroughly understood the machine and its equipment. His confidence was not misplaced. Although for long periods he was lost in the clouds and darkness, and was entirely out of sight of both land and sea, he succeeded in flying straight to his mark, landing at the aerodrome at Le Bourget only 33½ hours after leaving New York.

The interesting illustration we reproduce shows the instruments with which Lindbergh's machine was equipped. Many readers will immediately recognise the majority of these, for they are essential aids to flyers. One of them tells a pilot his speed through the air; another shows the height above the ground at which he is flying; and from the remaining instruments he may learn how many gallons of petrol there are in his tanks, the number of revolutions per minute that his engine is making, how quickly he is climbing, or if he is banking at the correct angle when making a turn.

Lindbergh made good use of these instruments, but for finding his way across the ocean he relied chiefly on the earth inductor compass with which his machine was equipped. At the time this was a new instrument, and Lindbergh employed it in place of the ordinary magnetic compass, the forms then in use in aeroplanes having proved somewhat unsatisfactory. Engine vibrations sometimes caused deviations, and under certain conditions a machine actually could be turned from its course without any indication of the fact from the compass.



The instrument board of the "Spirit of St. Louis," the machine in which Colonel Lindbergh flew from New York to Paris.

The earth inductor compass may be described as an electric generator that depends only on the earth's magnetism. In the ordinary generator powerful electro-magnets are employed to give the magnetic field in which the armature of the instrument rotates, but in this interesting instrument the field is simply that of the earth, the lines of force of which run practically north and south.

The miniature generator is equipped with a commutator and collecting brushes. The brushes are two in number and are on the opposite sides of the commutator. They may be rotated so that they lie on a line running north and south, east and west, or in any other chosen direction. When they are placed on the north and south line, the strongest current the instrument produces passes through the circuit to which they lead. But if they lie east and west no current is generated, for in that case the coils of the rotating armature with which they are connected by means of the commutator are not cutting the lines of force.

Flying with Aid of Earth Inductor Compass

Suppose that an aeroplane equipped with the earth inductor compass is flying east and west, and that the line of the brushes is the same as the longitudinal axis of the aeroplane. No current is then produced and the needle of the galvanometer connected in circuit with the generator remains at zero. If the pilot of the machine now turns to the north or to the south, current immediately begins to flow and the needle moves to one side or the other. It is easy to maintain an east and west course, therefore, by simply flying in such a manner that the needle of the galvanometer is kept at the zero mark.

The position of the brushes may be altered, and dials on the controller enable a pilot to adjust them to make any angle with the axis of his machine. For example, if a flyer wishes to proceed north-east he sets the brushes at the necessary angle of 45° to the direction in which he wishes to fly, in such a manner that so long as he maintains his north-easterly course the brushes will lie upon the east and west line and no current will be produced. If he finds that the needle of his galvanometer moves from zero, he knows that he has deviated from his true course.

The manner in which the generator is driven is very interesting. The armature is supported on gimbals in order that it may remain level when the aeroplane rolls and pitches. To it is connected a small windmill that is fitted above the fuselage in such a position that it encounters the air stream produced by the movement of the aeroplane. This cannot suffer from lack of wind, for so long as the machine is in flight there is sufficient to keep it turning at a good speed, and by means of universal joints the movement is communicated to the armature.

FAMOUS TRAINS No. XXXV

"The Gold Coast Limited"

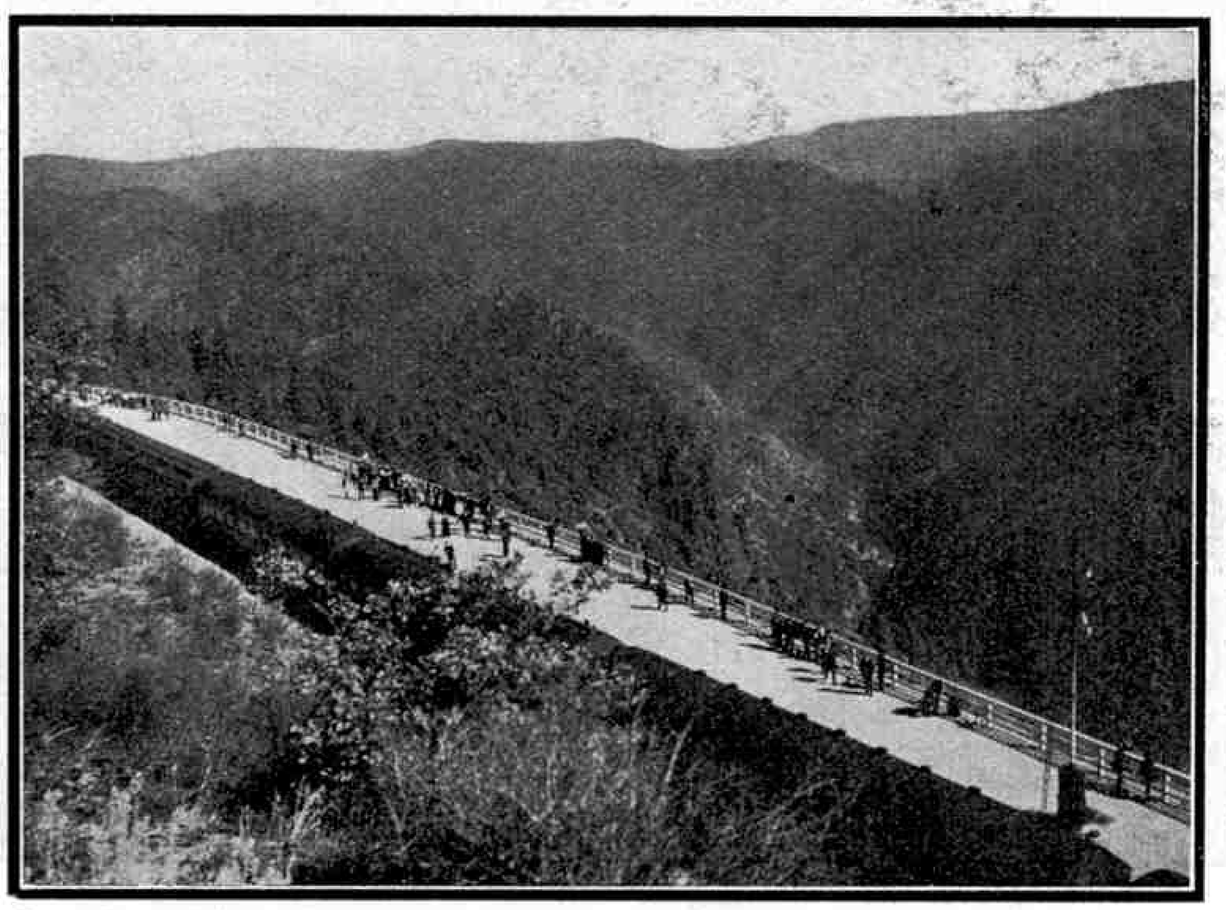
By Southern Pacific across the Sierra Nevada

By Edward T. Myers

THE Southern Pacific Railroad is one of the most interesting of the railway systems of the United States, although less has been written about it than about many of the other great lines. It originated in a single line of railway running from Sacramento, the capital of California, to Falsom, a distance of about 22 miles. This was the first railway in California, and its construction was due to the enthusiasm and ability of a young engineer named Theodore D. Judah. It represented the first step towards the realisation of his vision of a railway crossing the entire continent. In conjunction with Dr. D. W. Strong, Judah prepared a scheme for a "Pacific Railroad" and submitted it to the United States Government with a view to obtaining financial support, but without success. In spite of this setback Judah and Strong continued their efforts to arouse interest in the scheme, and in 1861 a company was formed in California under the title of the "Central Pacific Railroad." The public did not respond, however, and less than £30,000 of the required capital of £1,700,000 was raised.

The "*Overland Limited*" crossing Great Salt Lake, Utah. For this and the other photographs illustrating this article we are indebted to the courtesy of the Southern Pacific Railroad.

In the following year, seeing that there was no hope of carrying through the scheme by local efforts, Judah again approached the Government. This time he was successful, and an Act was passed authorising the construction of the first trans-continental railway. According to this Act the Californian company were to build the western half of the line, and the eastern half was to be dealt with by another company. Work on the Central Pacific Railroad was commenced without delay, and in spite of the great engineering difficulties that were encountered almost from the beginning, the line was steadily pressed forward to completion. Judah had the satisfaction of seeing his scheme adopted and in progress, but he did not live to see it finished. He died in 1863 at the early age of 37, before the line had climbed the mountains.



American River Canyon, where the "*Gold Coast Limited*" stops for five minutes to enable passengers to admire the view.

One of the most serious difficulties with which the engineers of this line had to contend was the extreme hardness of the granite rock of the mountains, the Sierra Nevada. The gunpowder that they used at first proved of little avail, and it was not until they adopted nitro-glycerine that the obstinate rock was conquered. The preparation of this dangerous substance was carried out by Chinamen. On one occasion, as the result of either faulty methods or carelessness, a considerable quantity exploded, blowing up the building in which the mixing was being done, and with it all the Chinamen engaged in the work.

The snowfall on these mountains is extremely heavy, and indeed it is said that the snow reaches as great a depth here as at any place in the Northern Hemisphere. During the winter of 1889-1890, for instance, the snow on the level ground was from 20 ft. to 25 ft. deep. In the valleys it drifted to depths as great as 200 ft., and in one or two exceptional cases it reached the almost incredible depth of 500 ft. It was reported in a San Francisco newspaper in January 1890, that between Truckee and Summit 150 line repair men were digging trenches in the snow from 8 ft. to 12 ft. in depth, in order to free telegraph wires that were strung on poles 22 ft. in height! It is interesting to note that Truckee is the place where many of the most effective "Far North" cinematograph pictures are taken. In order to protect the line the engineers had to construct a vast series of snowsheds between Emigrant Gap and Andover, a distance of about 28 miles. Within this distance there are 20 miles of sheds almost continuous, and these form what is familiarly known as "the longest house in the world."

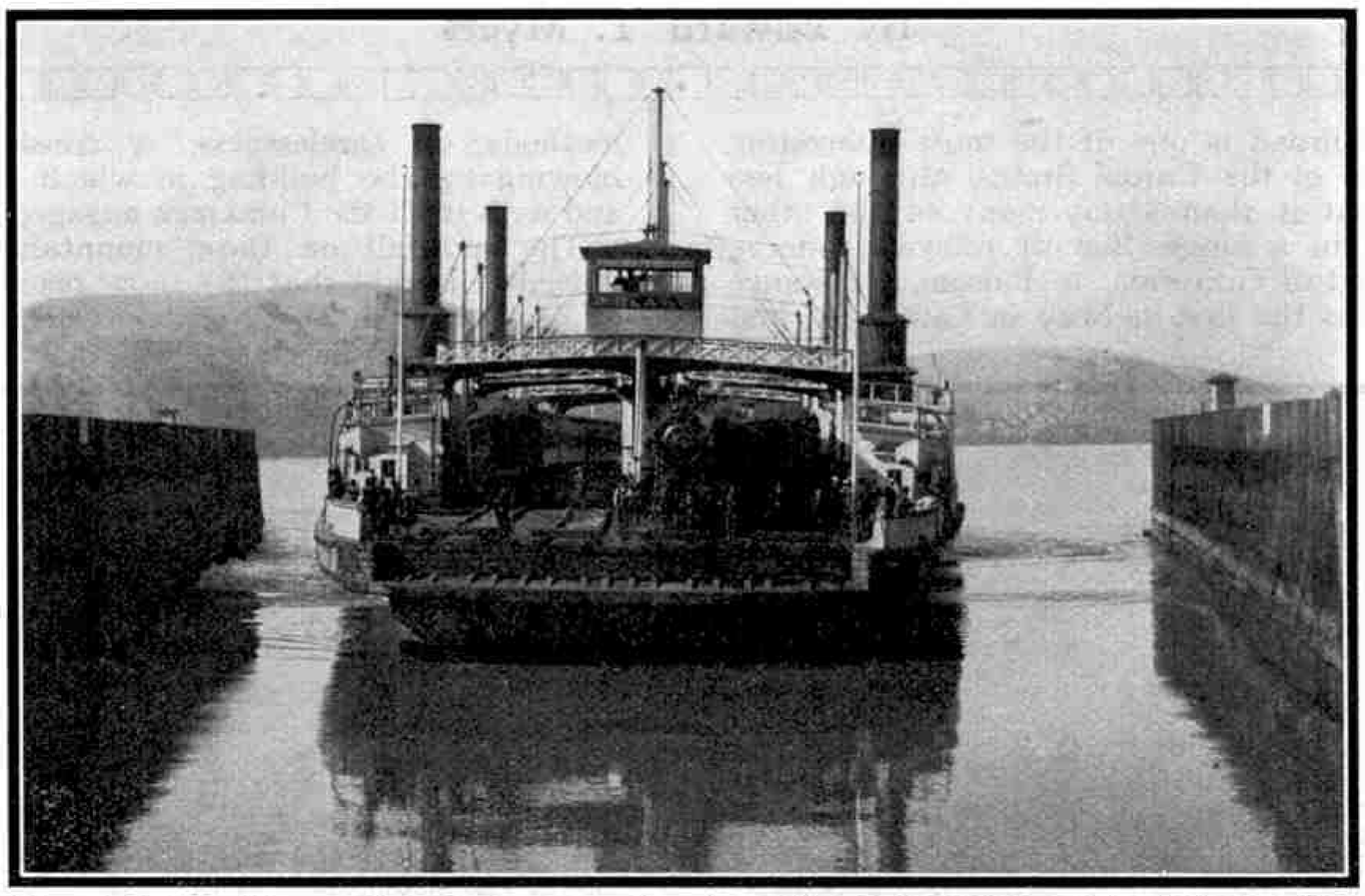
The Central Pacific Railroad has now become the Sacramento division, one of the ten divisions forming the Southern Pacific Railroad. The other divisions are San Joaquin, Los Angeles, Coast, Western, Stockton, Atlantic, Mount Shasta, Portland and Tucson.

There are many notable engineering features along this great railway. The Los Angeles division has a curve five miles in length, one of the longest in the world. On the San Joaquin division is the famous "Tehachapi Loop," by means of which the line rises 4,000 ft. in 46 miles. The loop consists of a double circle in the form of a spiral, and it passes through 18 tunnels with a total length of 8,240 ft. The line crosses and re-crosses the Tehachapi Creek seven times. On this loop may be seen the unique spectacle of a train of 56 vehicles hauled by three powerful locomotives, forming a complete circle with the leading engine on the upper level immediately above the last car on the track beneath! The Shasta division is remarkable for its curves; in fact it really consists of a string of "S" loops. It has been calculated that

a train travelling between Ashland and Gerber turns round completely seventy-six times!

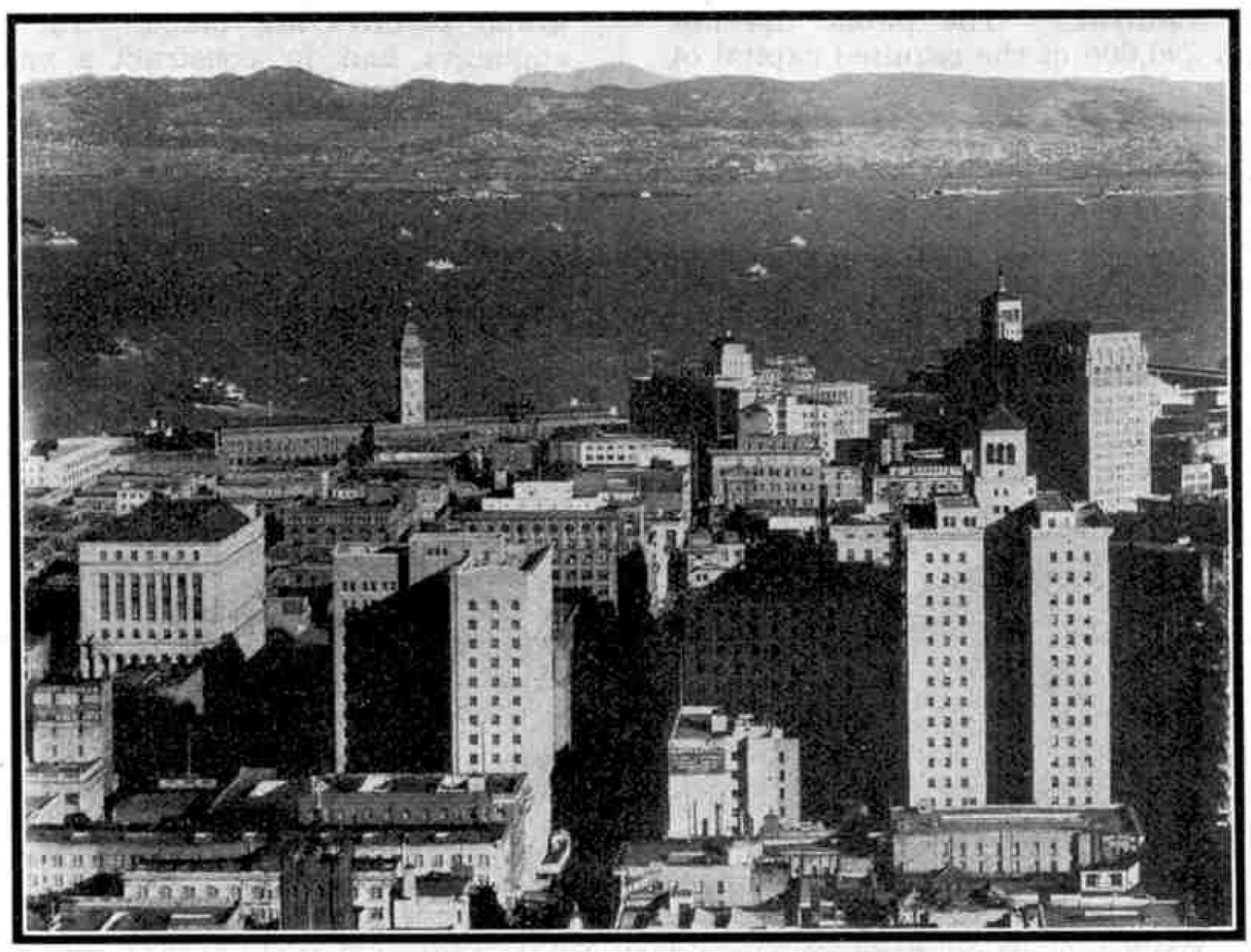
In order to gain some idea of the characteristic features of the trans-continental railway that has resulted from the pioneer efforts of Judah and Strong we will make a journey by the "*Gold Coast Limited.*" This splendid train runs between Chicago and San Francisco, and Chicago and Los Angeles; and although it is not so famous as the "*Twentieth Century Limited*" of the New York Central Lines, its route is much more interesting. On this journey we shall travel over three railway systems, the Chicago and North Western, the Union Pacific, and finally the Southern Pacific.

Chicago is one of the greatest railway centres in the United States, and it includes terminals of over 40 railway systems. We commence our journey from the Chicago and North Western railway station. This is in two storeys. On the first floor are ticket offices, baggage desk, etc., and a small waiting room and a bookstall; while on the second floor we find large waiting rooms, a restaurant, another bookstall, and various railway exhibits. Along one side of the waiting rooms there are doors leading to the train room. We pass through a door and soon find our train gate, where the gateman inspects our tickets and Pullman checks. The ticket, by the way, is almost a yard in length, and there is one section for each of the railways over which we travel.



The "*Solano,*" one of two ships employed on the train ferry service between San Francisco and Oakland, now superseded by the Martinez-Benicia Bridge.

As we walk along the train to our car we notice that the train on the other side of us is the "*San Francisco Overland Limited*"; this is bound for the same destination as ourselves, but is an extra fare train. At the rear of our train is an observation car terminating in an open platform from which a splendid view of the scenery is obtained. The car is divided into two sections. The observation section has long wide windows and comfortable chairs, all the latest magazines, and a small writing room; while the other half of the car is divided into smoking room, buffet, barber's shop and bathroom. The number of Pullman cars varies, with the season, from five to ten; above that number the train is divided into two or more sections. There is also a dining car that remains with us throughout the journey, and a baggage and several express cars, the number of which depends of course upon the number of Pullmans on the train. Probably the total number of cars never falls below eight on this particular train.



Looking over the "skyscrapers" of San Francisco across the bay.

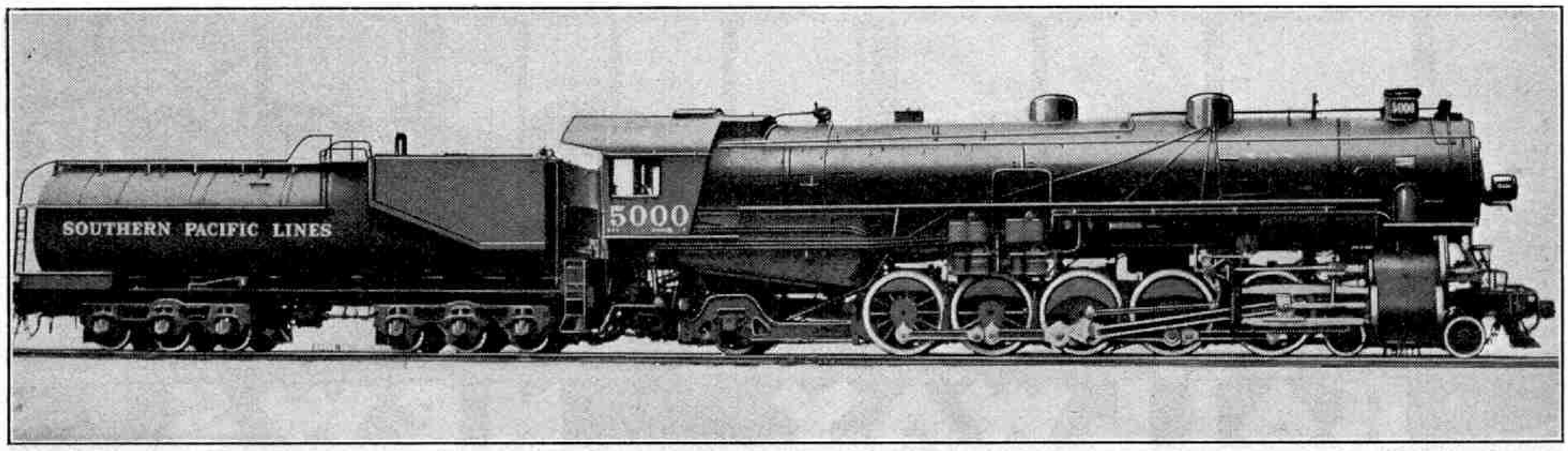
Our train pulls out at 8.30 p.m. with a slight jerk, and we may be tempted to put out the lights in our compartment in order to get a glimpse of the locomotives and buildings near the tracks. Soon we find that we are, as it were, one storey above the street level, and occasionally as we pass a trolley car the sparks from the trolley, which is on a level with our eyes, are dazzlingly brilliant. Presently along come the conductors; the Pullman conductor, who looks after the Pullman Company's interests, and the train conductor who represents the railway. They take our tickets and give us a receipt for them. By this time it is probably nearly 9 o'clock, and we are pretty sleepy after our excitement; so we ring for the porter, who comes to make up our berths. During the night we cross the beautiful Fox River Valley, and when we wake up at 7.45 we shall have crossed most of Iowa.

At 9.5 a.m. we arrive at Council Bluffs, Iowa, where we cross the Missouri river. Here we leave the Chicago and North Western Railroad, but before doing so we must mention the system that has guided us all night. This is the automatic train control that shows the driver whether the track ahead is clear or not, and at the same time prevents the train from exceeding the speed limit. The mechanism consists of a small panel board in front of the driver, which shows either a red or a green light according to the condition of the track ahead. When the red light comes on, a whistle automatically warns the driver of the fact, and if he does not heed the signal the brakes are automatically applied, thus stopping the train. If he wishes, he may proceed with caution, provided that he pulls a small lever at his side every so many minutes, thus keeping him on the alert. On the front of the locomotive, just in front of the leading wheels and a few inches above the track, is suspended a coil of wire known as an "electric ear." This picks up electric impulses and transmits them to a box on the top of the tender, where they are amplified. The amplified impulses operate relays that control the signal lights and the mechanism that automatically applies the brakes if the engine exceeds the pre-arranged speed. The track is divided into blocks in the usual manner.

At 9.30 we arrive at Omaha, Nebraska, after crossing the Missouri River on a steel girder bridge; and we are now 488 miles from Chicago. We have averaged about 44½ m.p.h. during the night and are now at a height of 1,033 ft. above the river, having risen 443 ft. since we left Chicago. We pull out of Omaha at 9.50.

The scenery for the greater part of the day is now miles and miles of barren prairie with tumble weed rolling after the train. For the benefit of those who are not familiar with it, it may be said that tumble weed is a round-shaped plant that dries up in the dry season, and breaks loose from the stock and rolls round with the breeze. All the land we shall see to-day will be covered with brown dried-up grass, and we shall pass many small farmhouses, which look none too prosperous and have little land around them under cultivation. We continue to climb to still higher altitudes, and towards the end of the day we come to low rolling hills.

At 4.45 Central Standard time we arrive at North Platte, and set back our watches one hour as we are now entering the Mountain Time belt. North Platte is 769 miles from Chicago and at an altitude of 2,802 ft.; here is one of the aerodromes of the trans-continental air mail route. We leave at 3.50, and as we cross the North Platte River on a steel girder bridge we shall get a glimpse of the aerodrome. At 9.45, Mountain Time, we arrive at



Southern Pacific 4-10-2 three-cylinder express locomotive No. 5000. It is 101 ft. 1 in. in length, weighs 682,400 lb., and has a hauling capacity 25 per cent. greater than that of any locomotive previously built for the Southern Pacific Company.

Cheyenne, 995 miles from Chicago and at an altitude of 6,060 ft., having climbed 3,258 ft. since we left North Platte, and covered 226 miles at an average speed of 37 m.p.h., a good performance considering the weight of the cars and the gradient. At Cheyenne a change of engines is made, the tanks under each car are filled with water, the brakes are tested, and the journal boxes on each axle are oiled. We are now in the heart of the Rocky Mountains. We may have had a "double header" from North Platte, but we are certain to have one onward, as there is plenty of climbing ahead.

We leave Cheyenne at 10.10, and about 11 o'clock we reach the highest point on the journey, at Sherman, 8,013 ft. above sea-level. From there we lose height until about 3 a.m., when we begin to gain again. During the night we cross the Continental Divide at 7,107 ft.

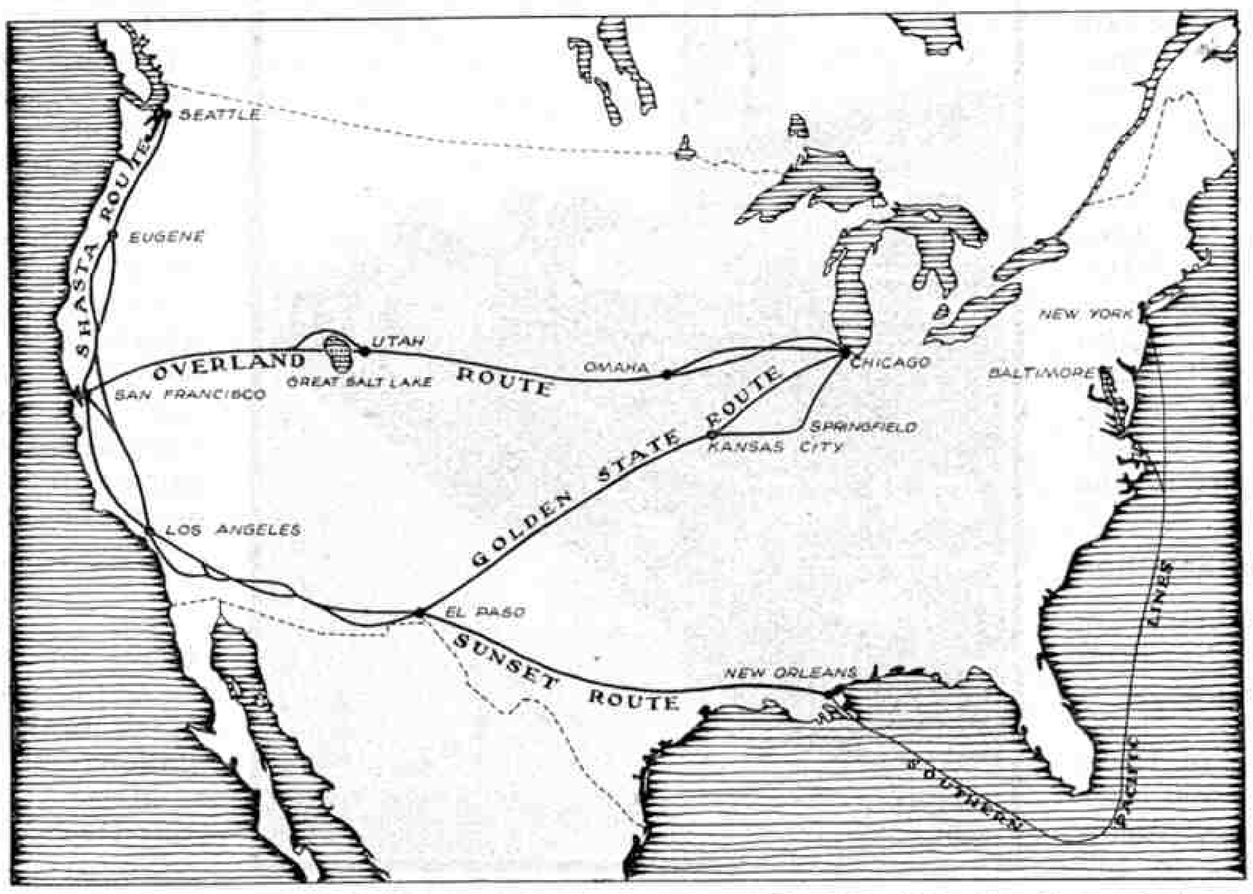
In the morning when we wake up and look out of the window we find ourselves in a wonderful region, with great snow-capped mountains in the distance. The train is moving very slowly, for the gradients are up and down and very steep. Somewhere between 8 and 9 o'clock we shall pass through the Aspen Tunnel, 5,900 ft. in length and at an altitude of 7,183 ft. To-day may be considered our most interesting day, particularly if we come from a flat country. Our next scheduled stop is Evanston at 10.40. We are now 1,402 miles from Chicago and 914 miles from Omaha, and at an altitude of 6,745 ft. We have averaged about 38 m.p.h. since we left Omaha 24 hours ago.

At 1.25 we arrive at Ogden, Utah, for a stop of 35 minutes or longer. Here our train is divided into two parts, one for Los Angeles and our section for San Francisco. A new observation car and diner are added to the Los Angeles section, the San Francisco section keeping the cars with which we started. New Pullman sleepers are added to our section. In the busy season the train may go in two sections to San Francisco and two to Los Angeles.

As we step off the train at Ogden we notice the porters busy filling their little brown and yellow buckets with ice, which they put in tanks to cool the drinking water in each car; and workman in overalls inspecting and oiling the journal boxes. We make our way toward the subway that carries us under the trains to the station, where we can send postcards or telegrams to our friends. On our return we find that most of our train has disappeared, but it has only been taken away by a shunting engine for more cars to be added to it. Back it comes, and we find our way to the observation car.

At Ogden we leave the Mountain Time belt and enter the Pacific belt, which means that we set our watches back one hour. Ogden is at a height of 4,298 ft.—a big drop since morning—and about 1,478 miles from Chicago. We now leave the Union Pacific for the Southern Pacific Railroad. After leaving Ogden we soon find ourselves surrounded by the Wasatch Mountains, and in 15 minutes we reach the beginning of the Great Salt Lake "Cut-Off," where we "go to sea by rail." The cut-off extends to Lucin, a distance of 102.9 miles, crossing the northern arms of the Great Salt Lake. This line, which was opened in 1903, saves 43.8 miles, avoiding the curves and gradients of the original line around the northern side of the lake. The track is laid for 72 miles on land and 30 miles on rock "fills" and heavy trestlework. Our train will average about 30 m.p.h. on the trestlework and from 30 to 35 m.p.h. on the rock fills. This entire region, with its wide expanse of water, now grey and still and then blue and sparkling, and with its weird mountain peaks, exercises a strange fascination upon the traveller seeing it for the first time. It will be about 4 o'clock when we leave the lake, and the train will pick up speed to probably 50 m.p.h. For a while we continue to ascend, and then about 7 p.m. we shall be on the down gradient.

We shall want to be up by 7.30 a.m. in order to see the view of the American River Canyon, where the train stops for five minutes. We are now in the Sierra Nevada Mountains, and in this district they are covered with magnificent pines. If it happens to be late Spring or early Summer we may expect to see numerous small forest fires, as pine needles are very inflammable and liable to cause serious outbreaks. After leaving the American River Canyon we come to Dutch Flat where, it is said, the railway track is laid upon gravel bearing gold at about eight dollars per cubic yard. Dutch Flat is 3,390 ft. above sea level, and at one time this was the most extensive "placer" mining district in the world. In 1852 gold to the value of more than 65 million dollars was taken, and from that year up to 1861 the yearly average of gold was about 51 million dollars. It seems very strange, and indeed sad, that this district, once so full of life and feverish energy, should now be deserted.

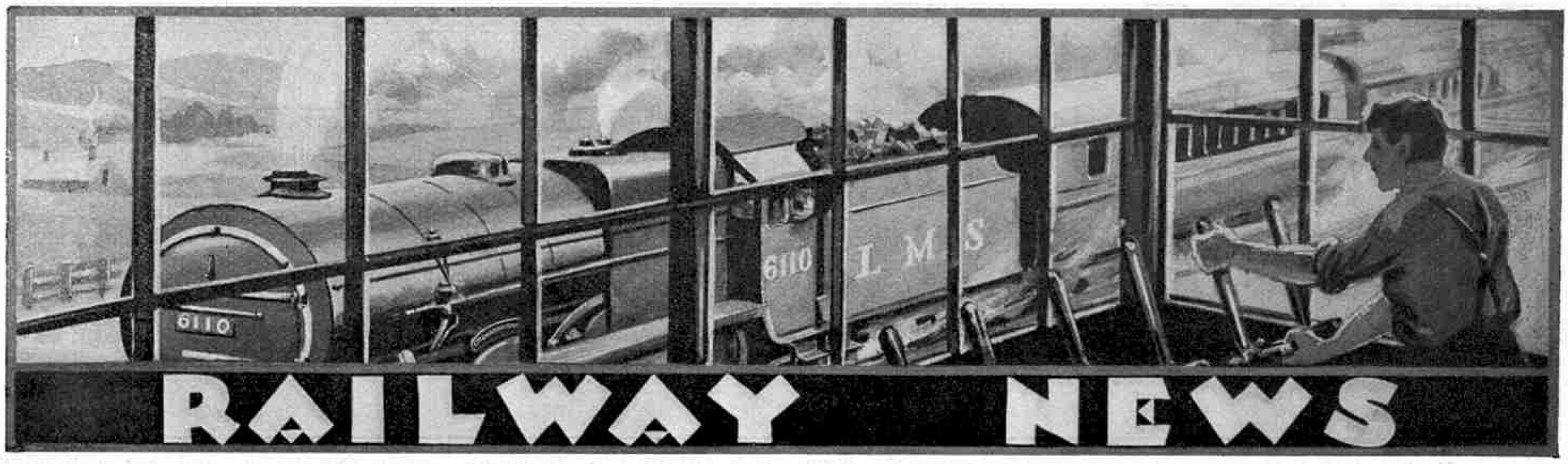


The great railway routes from Chicago to the Pacific Coast, and from San Francisco to New Orleans where connection is made with Southern Pacific steamships to New York.

At 10.50 we arrive at Sacramento, the capital of California, 2,171 miles from Chicago and at an altitude of 30 ft. We continue to the pier at Oakland, and from here cross to San Francisco by the train ferry. This ferry is the largest of its type in the world. There are two ferry boats, the "*Contra Costa*," which has six tracks, and the "*Solano*," shown in our photograph, which has four tracks. Quickly we are across. The ferry comes alongside, and a large hinged apron, upon which are fixed the tracks on which the trains run on to and off the boat, is let down into place.

Looking back over the swift sequence of events since we left Chicago, we can say with confidence that we have had a wonderful journey by a wonderful train.

EDITOR'S NOTE: Since the writer of the article made this journey the Martinez-Benicia Bridge spanning Suisun Bay in the upper reaches of San Francisco Bay has been opened for railway traffic, and has superseded the train ferry service.



L.M.S. Locomotive News

Twenty of the new 2–6–2 passenger tank engines have been allocated to the London district and some are now stationed at Kentish Town. They are fitted with condensing apparatus to enable them to work on the Metropolitan line.

The new batch of 0–8–0 standard freight engines now building at Crewe will be numbered from 9600 upward. Ten more of the standard 2–6–0 mixed traffic tender engines are on order at Crewe.

Further engines of the "Precursor" class have been adapted to work on the Midland division. They are:—No. 5225, "*Candidate*"; No. 5270, "*Marmion*"; and No. 5276, "*Titan*."

As the former L.N.W.R. 0–8–0 freight engines of the "G" class go into the works for general repairs it is usual to fit them with a new boiler with a Belpaire fire-box and superheater. These and other minor improvements qualify them to enter the "G1" class. Many engines have been so treated.

Among the numerous engines recently withdrawn from service are the following old L.N.W.R. locomotives:—No. 5041, "*Lynx*," of the 2–4–0 "Precedent" or "Jumbo" class; No. 5117, "*Polyphemus*," of the 4–4–0 "Renown" class; and Nos. 5197, "*Mammoth*"; 5198, "*Niagara*"; 5201, "*Egeria*"; and 5253, "*Clive*." The four last named are of the 4–4–0 "Precursor" class.

Dock Extension Scheme at Southampton

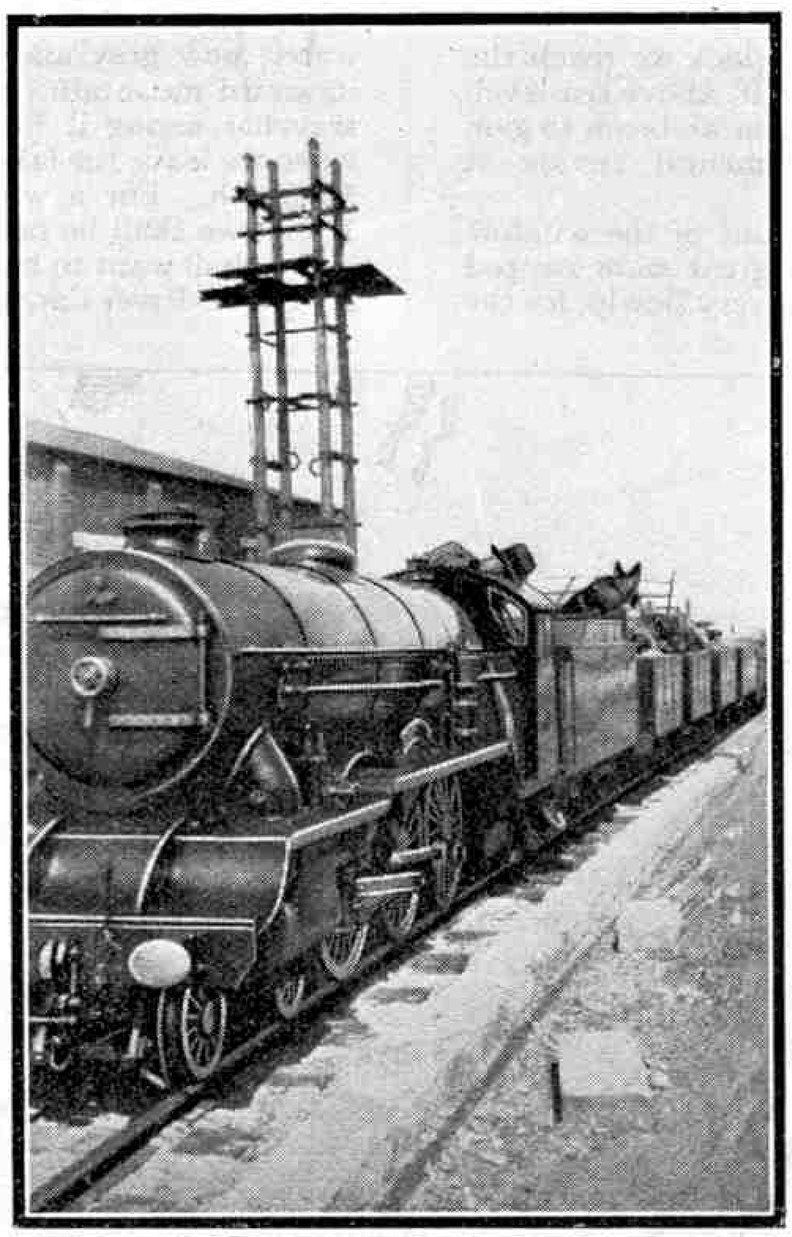
A great dock extension scheme involving a total expenditure of £13,000,000 has been commenced by the Southern Railway at Southampton. The scheme has been divided into sections. The first of these involves the construction of 3,500 feet of quay wall with a depth of water alongside 45 feet, and the reclamation of 187 acres of muddy foreshore. This portion of the task will cost about £3,000,000. As much as 3,500,000 tons of material will have to be deposited on the area to be reclaimed, and within the next two years this will be available for sites for factories, workshops and other buildings.

Later additional quays 3,500 ft. in length will be constructed. These will have 40 ft. of water alongside. Work on them will begin shortly, and it is expected that this portion of the scheme will be completed within the next five years.

An interesting feature of the work will be the building of the world's largest graving dock. This will be 1,200 ft. in length and 135 ft. in width at entrance and will have a depth of 45 ft. The new graving dock will be constructed primarily to accommodate the liners to be constructed for the Cunard Steamship Company.

Flower Trains on the G.W.R.

To many railwaymen March is the month of flowers, for the busiest time of the outdoor season is about the middle of this month. Then 3,900,000 narcissi, daffodils, anemones, tulips, violets, and other flowers, packed in 13,000 boxes and weighing 65 tons, will arrive nightly at Paddington for the Covent Garden market alone, and large consignments will be handled in other big centres.



One of the 4-6-2 locomotives of the 15 in. gauge Romney, Hythe and Dymchurch Railway. This interesting line, which was fully described in the "M.M." for September, 1927, is 14 miles in length.

The traffic comes from the Scilly Isles, Cornwall, Devon, and the Channel Islands. Usually it commences at the beginning of January, but this season a start was actually made early in December. The blooms are cut and picked while in bud, and reach perfection on their journey to their destination. The traffic is of a highly perishable nature and is conveyed by express passenger, or perishable goods train, for delivery within 24 hours of despatch. During a normal season 4,100 tons of flowers are dealt with, this weight representing 820,000 boxes and a total of about 246,000,000 blooms.

Poppet Valve Experiments on G.W.R.

Ten new 2–6–2 tank engines are now building at Swindon. They will be similar in every detail to those of the recent "51" series, and will be numbered 6100 to 6109.

The G.W.R. has decided to experiment with poppet valves, and one of the two-cylinder 4–6–0 engines will shortly be fitted with valves of this type.

Engine No. 6005, "*King George II*," has been fitted with an indicating shelter in order that a series of tests may be carried out. The G.W.R. dynamometer car is also being used in the experimental runs and numerous readings from the gauges and other instruments in the car are being taken. The tests will give information in regard to cylinder pressures, tractive effort, coal consumption, speed, oscillation and many kindred matters.

Two more engines of the 4–4–0 "County" class have been scrapped. These are No. 3817, "*County of Monmouth*," and No. 3835, "*County of Devon*." All engines of this class are to be scrapped when their cylinders are worn beyond repair.

Engine No. 4001, "*Dog Star*," has just been through the shops and received "Castle" type cylinders with outside steam-pipes, but the cab has not been altered. In recent months several "Stars" and "Castles" have had the spring gear compensating beams removed and each spring made independent. This accords with the practice in the newest "Kings."

The Transport of Milk

Some enlarged and improved glass-lined tanks for the carriage of milk are shortly to be put into traffic by United Dairies Ltd. Each tank will have a capacity of 3,000 gallons.

Messrs. Nestlé have laid a pipe line from the Dairy at Ashbourne to their railway siding there, for the purpose of filling glass-lined tanks with milk for transport.

Heavier Rails for the C.N.R.

Orders have been placed for 34,000 tons of 130-pound steel rail for use on the main lines of the Canadian National Railways between Montreal and Chicago. This rail, the heaviest ever used on Canadian railways, is now being rolled and steps have been taken to standardize both the rail and the rail fastenings that will be used with it.

The order now placed will provide for the laying of approximately 170 miles of train line rail in Canada, between Fredericksburg and Crafton and between Toronto and Hamilton, while 76 miles of the new 130-lb. rail will be laid between Port Huron and Chicago. The new rail will eventually be employed over the entire route of the International Limited between Montreal and Chicago.

The G.W.R. "Cornish Riviera Express," headed by Locomotive No. 4082, "Windsor Castle," approaching Westbury. The line curves abruptly into this station, necessitating severe application of the brakes and a reduction in speed from the "70's" down to some 30 miles per hour.

New Locomotives for the S.R.

Recent new construction at Ashford works has included five 2–6–0 mixed traffic engines of the "N1" class. These are numbered A 876 to A 880. They have 5 ft. 6 in. driving wheels, and three cylinders 16 in. in diameter by 28 in. stroke.

Ten 2–6–0 engines of the "U" class, having two cylinders and 6 ft. driving wheels, are now in hand at Ashford. They will be followed by 15 of the "N" class, which are similar to the "N1" class but have only two cylinders.

Eastleigh works have recently built 15 three-cylinder 2–6–4 tank engines, with 5 ft. 6 in. driving wheels, for freight traffic, and also 20 of the 2–6–0 tender engines with 6 ft. driving wheels.

During this year five more of the 2–6–4 goods tank engines are to be built, and also ten 0–8–0 shunting tank engines.

It is not intended to put on order at present any large express engines, as the electrification of the main line from London to Brighton will release for use elsewhere a considerable number of express engines of the "King Arthur" and other classes.

The extensive programme of passenger stock authorised for 1930 is nearing completion and it is anticipated that the whole of the 300 new corridor coaches and 16 restaurant cars then sanctioned will be completed in time for this year's summer services, when no doubt they will be kept fully employed.

The new wagon programme provides for 2,300 trucks of various descriptions, including 15 refrigerator vans, and in addition there will be 10 covered scenery trucks, 30 corridor luggage vans and 50 general utility vans.

Worms by Rail

The L.N.E.R. report that large numbers of worms are being conveyed by passenger train in Norfolk. Lug-worms found beneath the surface of the wet sands at Wells-on-Sea are packed in boxes and conveyed to Yarmouth, Lowestoft, and Southwold, where sea anglers use them for bait. Approximately 10,000 worms a week are conveyed during the winter months.

The L.M.S. "Ro-Railer"

It was reported in the "*M.M.*" for January this year that the L.M.S. Railway were experimenting with a coach that could run both on the railway and on an ordinary road. This novel vehicle—the "Ro-Railer"—has since been completed and is now being tested in service.

The vehicle may be changed at will from road to rail or vice versa at any place where a road or yard adjoins the railway. No special equipment other than that incorporated in the design of the vehicle is required, except that at the point of exchange the ground must, for a distance of a few yards, be made up to the level of the tops of the rails.

The Irish Mail express picking up letter bags while travelling at full speed.

The change-over may be effected in under five minutes and has, under test conditions, been performed in two-and-a-half minutes.

The first machine, which is now being tried on the L.M.S.R., is a passenger vehicle, but the system is applicable to practically any type of motor vehicle, either passenger or goods, and to tractors and truck trailers.

On the road the "Ro-Railer" differs very little in appearance from an ordinary road vehicle. It has seating capacity for 26, and on short tests, speeds of 50 m.p.h. have been obtained. We hope to include a full account of the new type of vehicle in next month's issue.

L.N.E.R. "No. 10000" Again in Service

The L.N.E.R. high-pressure compound express locomotive "No. 10000" is now in service again and is stationed, as before, at Gateshead. During its recent visit to the works at Darlington it was thoroughly overhauled. The high-pressure cylinders were reduced in diameter from 12 in. to 10 in., and several minor alterations and adjustments were made.

Mr. H. N. Gresley, the designer of this remarkable locomotive, has stated that, when stationed at Gateshead previously, it worked express trains from York to Edinburgh and back, involving a daily run of about 420 miles. Engines of the "Pacific" type in the same "link" required washing out after running 1,000 to 1,500 miles, but the new engine ran 5,000 miles without washing out. When opened up the boiler was found to be exceptionally clean and the tubes were in good condition.

Smart Running by G.W.R. "Mogul"

In the course of a lecture given recently at Paddington on "*Locomotive Development on the G.W.R.*," Mr. W. A. Stanier made reference to the 2–6–0 mixed traffic locomotives of the "43" and other series. He described them as extremely useful engines, and went on to say that they were sometimes employed on services for which, with their 5 ft. 8 in. driving wheels, they were not really suited, even on some occasions being used on important fast expresses.

Mr. Stanier gave an interesting instance of the capabilities of these engines that had come under his own notice. He was travelling up to London one day behind an engine of the "Castle" class, and when speeding along at 76 m.p.h. he heard a rapid clanking sound. Looking for the source of it, he saw at the head of a train on the up "slow" line one of these 2–6–0 engines, which was smartly overtaking the train on which he was travelling.

It may be added that during the tests made a few years ago by the "Bridge Stress Committee," these 2–6–0 engines of the G.W.R. were used a good deal, and one of them, running light, attained a speed of 85 m.p.h.

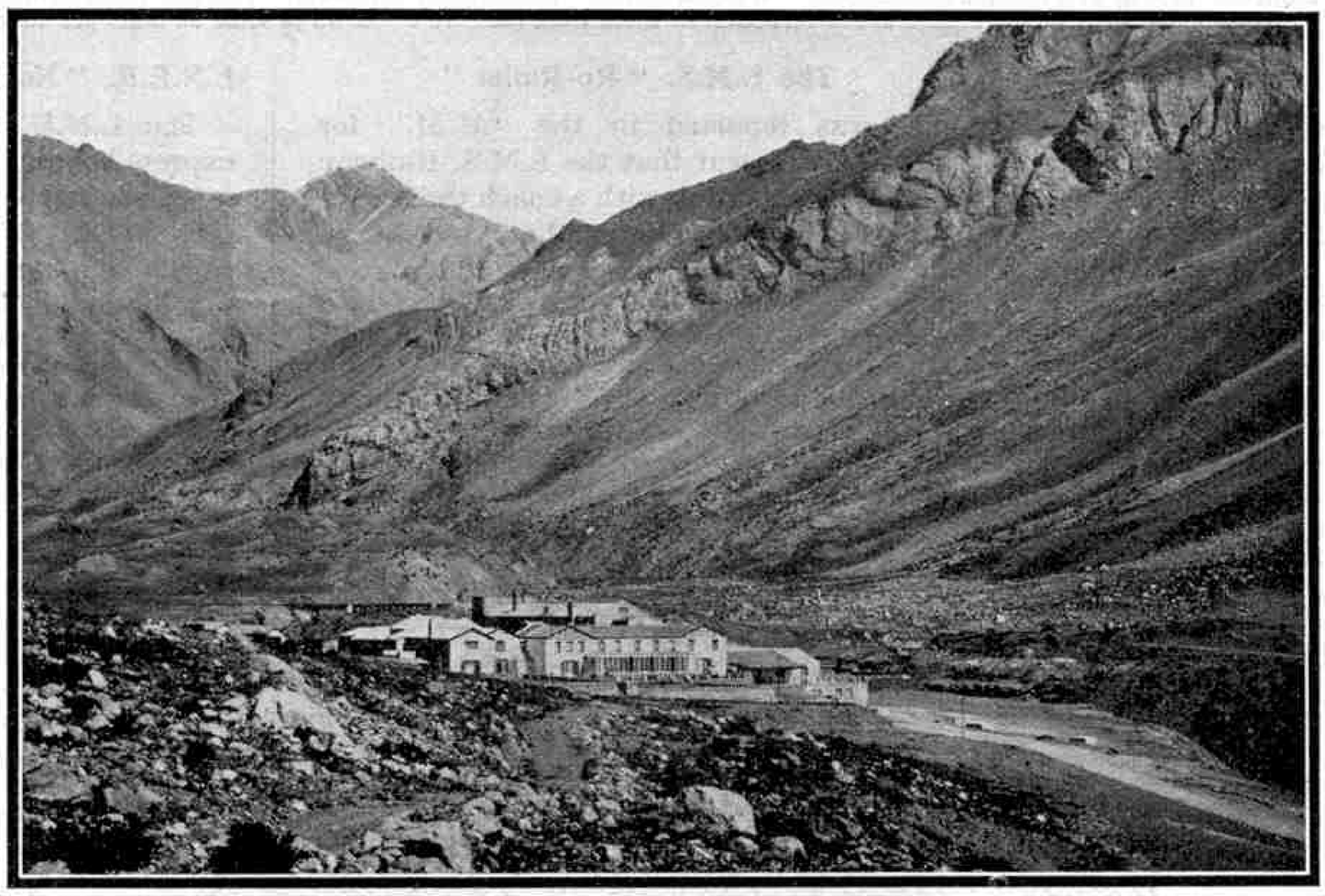
Across the Andes by Rail

Daring Engineering Feat in South America

By Harold J. Shepstone, F.R.G.S.

RAILWAY engineers rightly regard as among their most conspicuous triumphs the construction of the Trans-Andine Railway, which connects Buenos Aires, on the Atlantic, with Valparaiso, on the Pacific. This is the first transcontinental railway to be built in South America. It crosses the mighty Andes range of mountains, to surmount which necessitated the erection of hundreds of bridges, miles of tunnels, and scores of long snow and avalanche sheds to guard the track; so that it is easy to realise that its construction called for the highest skill, determination and daring on the part of its builders. Indeed, it proved a 37-years' job, and involved an expenditure of millions of pounds and the sacrifice of many lives.

The railway virtually follows a straight line across the continent, and is some 888 miles in length. Compared with the 3,000-mile track of the Canadian Pacific it looks insignificant, but it was nevertheless a far more difficult feat. It meant the carrying of a track up and over one of the loftiest mountain ranges in the world, where the engineers had to pit their skill and strength against the eternal snows, which were conquered only by piercing the summit with a two-mile tunnel.



A railway hotel in the heart of the Andes. This photograph gives some idea of the wildness of the country through which the Trans-Andine Railway passes.

In order to grasp fully the natural obstacles that confronted the builders, some reference to the country through which the railway runs is essential. Starting from Buenos Aires, the line runs for 650 miles over the Pampas to Mendoza. The Pampas is a gradual rising plateau, and from this region comes the bulk of Argentine's enormous wheat, wool, and hide exports. Mendoza lies 2,470 ft. above sea level, and here rise the Andes—the great barrier that runs the whole length of the continent, and which has made peoples, changed customs and languages, set natural and political boundaries, and made historic the building of the first South American transcontinental railway. For a distance of 156 miles from here the track lies among the mountains, the remaining 82 miles being across the rich central plain of Chile to Valparaiso.

From Mendoza the railway follows the old Andean trail into the heart of the mountains. For centuries this has been the highway between the Argentine and Chile, but it is only passable in summer, being blocked by heavy snow-drifts in winter and rendered dangerous to travellers by blizzards.

Leaving Mendoza, the river of that name is crossed and re-crossed by seven bridges, and then ever upward climbs the railway like a huge serpent; now crawling along the edge of some steep precipice, then over yawning chasms by neat steel bridges, or piercing its way through the mountain side by laboriously cut tunnels. So the journey continues till Punta de las Vascas is reached at an altitude of 7,709 ft.

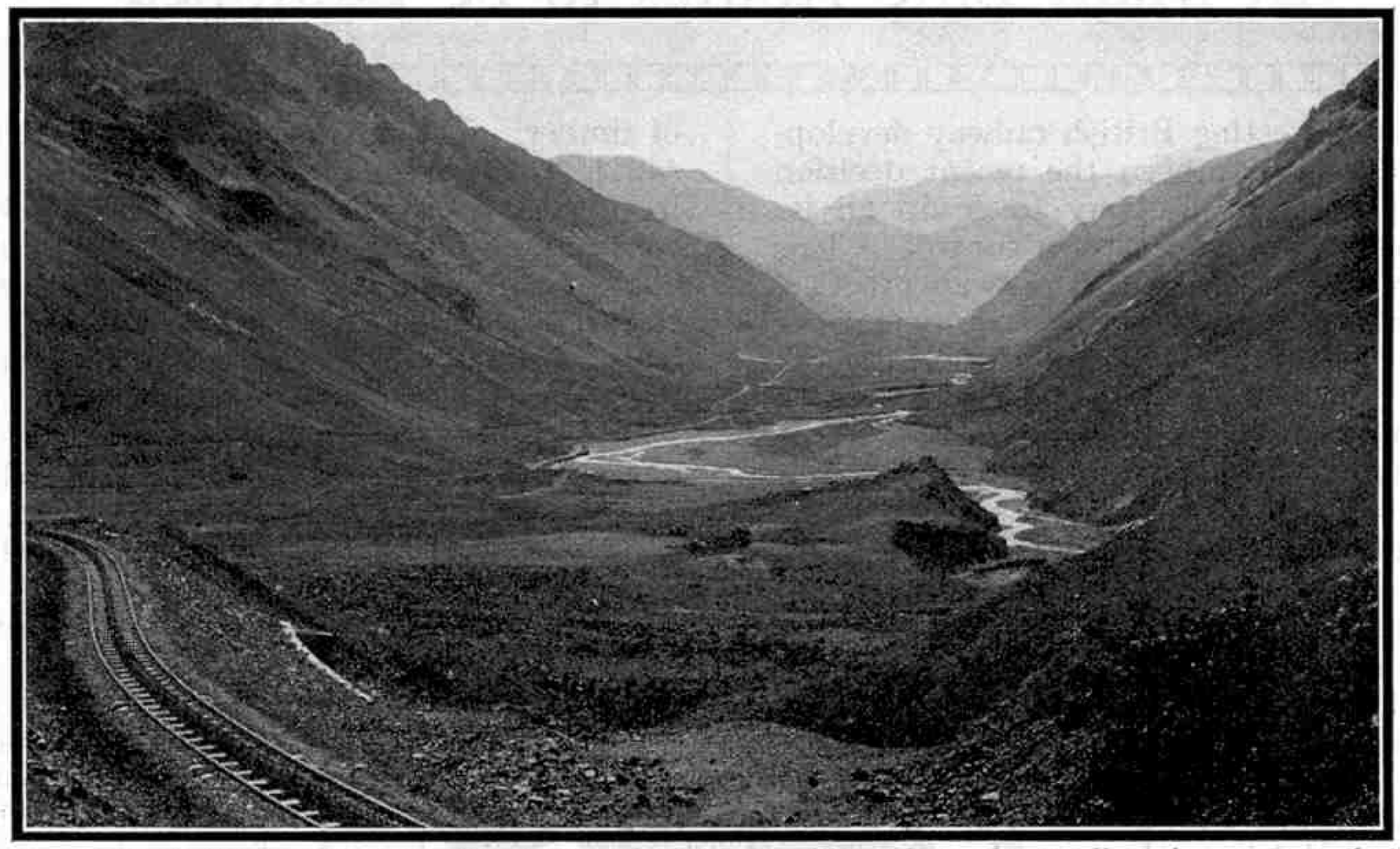
From this point the gradient is so steep, over 1 in 40, that the cog and rack system is employed. The powerful triplicate teeth of the engine grip the third or rack-rail, which safeguards and expedites the running of the trains. Soon one is in the heart of the mountains, among the grandest mountain scenery in the world. In the distance the hoary extinct volcanic peak of Tupungato is detected, and then the promontories of the cathedral-like ridge of Los Penitentes come into view in seared dignity, followed by a glimpse of the mighty Aconcagua, the highest peak in the whole range, its head towering some 23,000 ft. above sea level. It is a wonderland of colour, crowned by towering peaks in a mantle of snow.

The old trail crosses the mountains by the Cumbre Pass at an altitude of 12,796 ft. But at an elevation of 10,500 ft. the engineers called a halt, and then pierced the summit by a tunnel just over two miles in length. It was at once a difficult and an arduous feat, necessitating the toil of an army of brave men for several years in a region of eternal snow and frightful blizzards. Indeed, this tunnel in the Andes lies 1,500 ft. higher than the highest carriage road in Europe—that over the Stelvio Pass—and more than 3,500 ft. higher than the Mount Cenis, St. Gotthard and Simplon passes.

When the tunnel was first proposed, many shook their heads and declared the feat impossible. The engineers stuck to their task, however, and in the end, after terrible hardships and many disappointing delays, they won. The tunnel is virtually a replica of the

Simplon, though the conditions were entirely different. Here, close upon two miles above the sea, the air is rare, and at first the men suffered from mountain sickness, while during the winter months the cold was intense. Sudden blizzards would spring up and bury the shelters feet deep in snow.

In this rarefied air and intense cold the men worked summer and winter. Operations were commenced simultaneously on each side of the mountain, the men meeting midway, more than 2,000 ft. below the summit. As in the case of the Simplon, the pathway was laboriously bored by powerful drills driven by compressed air. In the heart of the mountain, amidst the roaring flare of gasolene torches, the drillers toiled in almost furnace heat compared with the atmosphere outside.



A section of the line through the Valley of the Paramillos where the gradient is so steep that it necessitates the use of the cog and rack system.

Never was a tunnel driven where such varied rock was encountered. First came a hard volcanic sandstone very much fissured with veins of felspar. Then this would change to a reddish claystone, to be followed again by enormous veins of conglomerate and almost pure felspar. The rock, with the exception of the red claystone, proved very difficult to drill; indeed, the drill-bits were always slipping and jamming, causing endless trouble. The conglomerate was even worse to drill, sometimes as long as 20 hours being required to drill a round of holes for the explosives.

The famous "Christ of the Andes," a bronze statue erected in celebration of peace between the republics of Argentine and Chile.

As soon as the rock was excavated masons followed, filling the wooden forms with Portland cement 2 ft. in thickness. Continual watchfulness was necessary to guard against loose pieces of rock coming down unexpectedly and injuring the men. Such accidents did occur, from time to time, and then the unconscious form was wrapped in blankets and carried away to the shelters, where a doctor was always ready to give immediate attendance.

The whole undertaking was carried out by English engineers. Altogether an army of 1,640 men were employed, 640 on the Chilean side, and 1,000 on the Argentine side. With the exception of a few Spaniards, Italians, and Englishmen, the labour was entirely Chilean. The work was carried on in eight-hour shifts, night and day without a stop, from one month's end to another. The only stoppage was for two days when the headings met on 27th November 1909, nearly four years after the work had been put in hand. How carefully the calculations had been made is evident from the fact that the difference in the two levels was only three-quarters of an inch, and the sections were only $2\frac{3}{4}$ inches out of line.

The men were housed in special shelters at each end of the tunnel. The whole camp was covered with corrugated iron and, to the visitor, presented a strange spectacle. Owing to the long winter a large amount of covered-in space was necessary for storage purposes, and the various buildings and sheds were all connected together by passages. The snowfall on the mountains here is not particularly heavy, considering the high altitude; but owing to its light powdery character, and the fierce winds that usually rage, the snow is soon piled up into drifts 20, 30 and 40 ft. in depth.

Once through the tunnel, the engineering wonders of the line are by no means exhausted. From the Chilean end of the tunnel right down to Los Andes, the laying of the steel rails demanded all the resources of the engineer. Here again the cog and rack system is employed, owing to the steep gradient. Before Los Andes is reached the track crosses no fewer than 118 bridges; passes through 24 tunnels of varying length and through innumerable snow and avalanche sheds. These last are necessary to keep the line clear of the snow (Continued on page 199)

Automatic Train Control on the G.W.R.

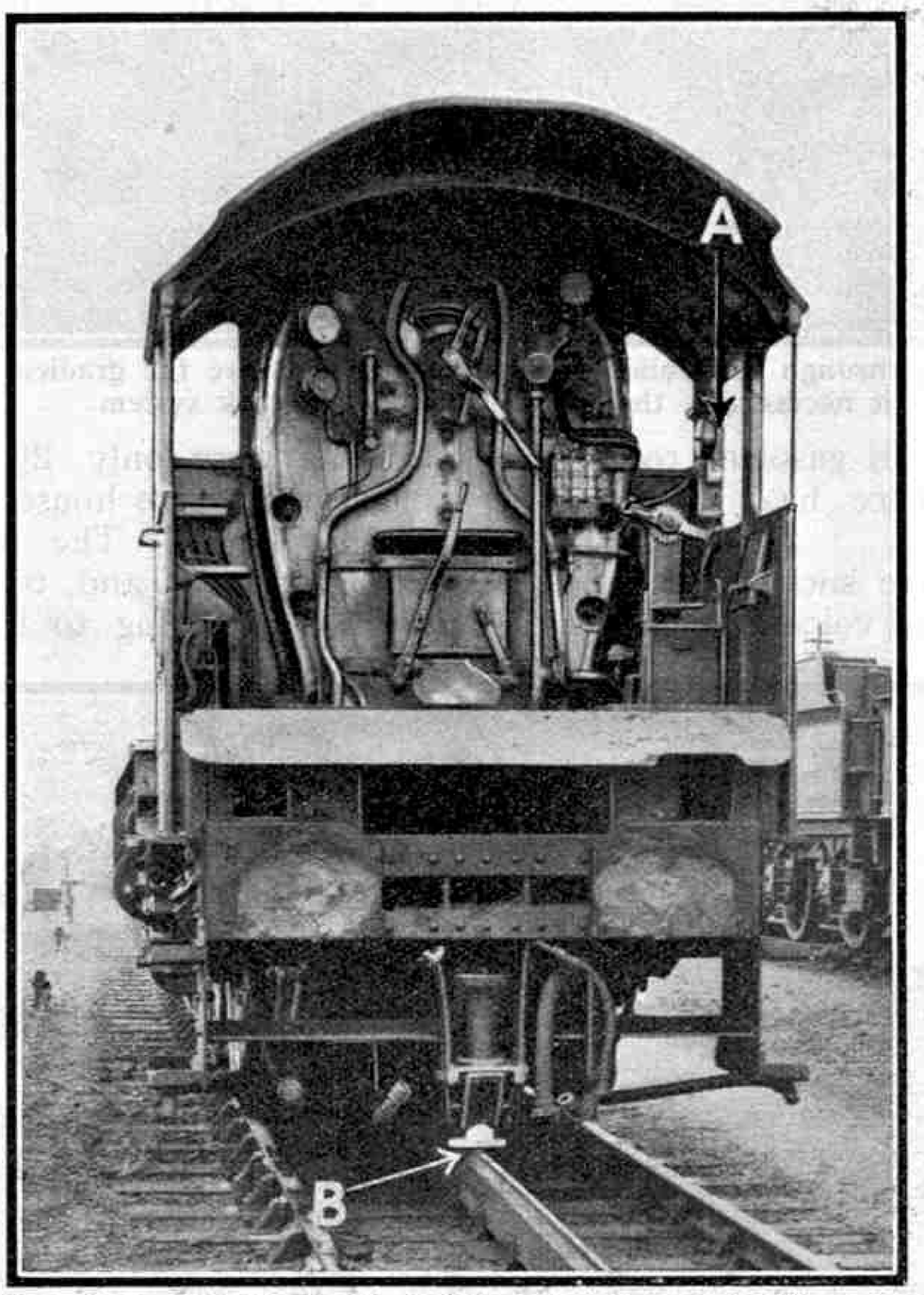
All Main Line Routes to be Equipped

ONE of the most interesting British railway developments of the year has been the recent decision of the Great Western Railway to equip all its principal main lines for automatic train control. This marks a great step forward in British railway practice.

The G.W.R. scheme involves the equipment of 1,758 miles of track and 2,000 locomotives with the company's system of automatic train control at a total cost of £208,000. This system gives audible warning to the driver of the state of the signal, and, in the event of a danger signal being passed, automatically stops the train before it reaches the next signal. The company already have 372 miles of track and 334 engines fitted with this device, which was first installed experimentally on the Henley branch, and later extended between Paddington and Reading, and on other branch lines. In 1929 it was carried through to Swindon and Oxford, and between Paddington and High Wycombe, and it is now proposed to extend the system from Swindon to Plymouth, Weymouth and Swansea; Oxford to Wolverhampton; High Wycombe to Wolverhampton; Worcester to Hereford and Newport; Birmingham to Gloucester; and Swindon to Gloucester and Newport. The areas covered by these extensions are shown in the accompanying sketch map.

The primary object of the automatic train control system is to give audible warning to an engine driver in the engine cab when his train is approaching a distant signal in the "danger" position and, in the event of this warning being disregarded, automatically to apply the brakes so as to ensure the train being pulled up before it reaches the next "stop" signal. Another and distinctive audible indication is given also on the engine when the distant signal shows "line clear." The value of this latter indication is that it facilitates the running of the train when the signal cannot be seen during fogs and snowstorms. The audible signals given are the sounding of a siren indicating "signal at danger," and the ringing of a bell indicating "line clear."

The apparatus fixed on the permanent way for operating the audible signals is an immovable ramp about 40 ft. in length fixed between the running rails, consisting of a steel inverted T-bar mounted on a baulk of timber. The ramp at its highest point is 4 in. above rail level, and is connected electrically with a switch in the signal box. This switch is attached to the lever controlling the distant signal. The apparatus on the engine comprises a contact shoe, an electrically controlled brake valve and siren combined, and an electric bell. This contact shoe is fixed on the centre line of the engine and projects to within 2½ in. above rail level. It is capable of being raised vertically, and being in line with the ramp it is lifted 1½ in. whenever a ramp is passed over, and this lift opens a switch attached to the shoe.



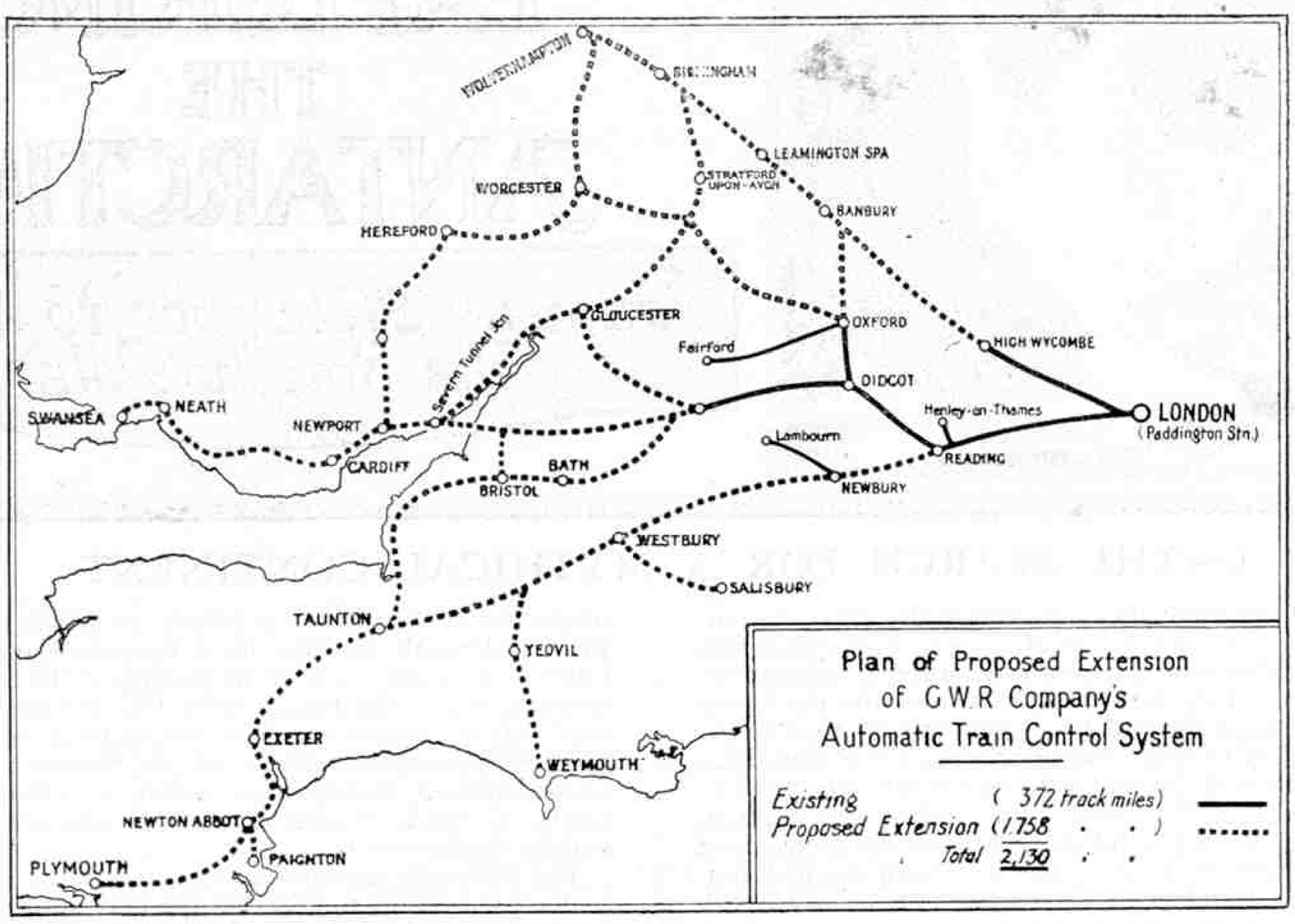
The cab of a G.W.R. locomotive fitted for automatic control. The electric bell apparatus is shown at A, and at B the special shoe on the engine is seen making contact with the ramp between the running rails. Our photograph is by courtesy of the Great Western Railway.

Additional interest is given to this decision of the G.W.R. by the publication of the report of the Automatic Train Control committee, appointed in November 1927 by the Ministry of Transport. After passing in review the various systems of automatic train control, the committee state that some action is desirable for increasing security against accidents due to the failure of enginemen to observe or correctly interpret signals. They express the view that the G.W.R. ramp system is so far "the only fully developed method for providing the dual 'warning' and 'clear' effect at distant signals, which can be recommended as meeting railway requirements in Great Britain." They are satisfied that the 20 years' experience on the G.W.R. shows this type of ramp contact control to be sufficiently reliable under all conditions for general adoption.

In connection with two-position distant signals on mechanically-signalled routes, the committee said that these track and engine elements may be utilised to give direct indications, by providing an audible warning to a driver in his cab when he is approaching a distant signal, on each occasion that the engine plunger rises over the fixed ramp. "This simplest form of 'location' warning would be of service to remind enginemen of the necessity for observing the signal, provided that the warning continued to sound until stopped by the driver. A more effective 'location' warning is obtained by adding a partial application of the power brake. This secondary or automatic control effect, when air is used to actuate the audible warning, can be obtained at practically no additional cost. Provision should be made for the engineman to forestall and cancel both

effects. It is considered that fogging service would still be required with this simple form of 'location' warning."

The report states also that there are directions in which enginemen may be assisted to carry out their duties of observation of and obedience to outdoor signals. These are, first, to improve sighting facilities from the cab by designing and constructing locomotives and glasses so that steam and smoke may be cleared from the line of vision; and by positioning signals so that having regard to their background, height, etc., they will most readily come into line with the view obtainable from the engine cab. Second, to increase the illuminative and penetrative power of signal lights themselves.



In regard to signal lights, the report says that electric beam light signals with high illuminative power and correct focussing have met with approval wherever they have been adopted, and during the past three winters they have never failed to be visible at a sufficient distance even in bad fog. Indeed, so much reliance is now placed on them that fogging services are not called for at such signals. Little has been done to improve the ordinary long-burning oil lamp that is in common use, however, and until sufficiently cheap current is generally available this lamp will still have to be relied upon.

Electro-Hydraulic Transmission—

(*Continued from page 210*)

used at all when the gear is being worked.

When heaving in a cable, the heaviest strain comes on the gear when actually "breaking out the anchor." If the flukes of the anchor are well bedded in the bottom or caught under a rock, the strain may become so great as to bring the capstan up "all standing." This does not matter with steam gears. With gear directly driven by electric motors, however, if the man controlling it is not quick, the circuit breakers will be thrown off or fuses will blow; if they did not do so something would burn out. With a "V.S.G." driven capstan, the man can keep his hand wheel at "heave in full speed" the whole time. As the strain on the cable increases, the oil pressure in the "V.S.G." system rises; and the automatic control on the A end at once reduces the pump's stroke. This reduces the speed of the B end, at the same time increasing its torque to a maximum. Should the strain become so great as to risk overloading the electric motor driving the A end, all stroke is taken off the pump, but it continues to revolve, holding the B end with maximum torque on it. Immediately the strain on the cable eases slightly, the B end starts revolving again slowly, and speeds up as the anchor breaks out of the ground.

Much the same thing happens when warping a big ship by means of a hawser on a "V.S.G." worked warping drum. Until the ship begins to move through the water, a heavy strain comes on the hawser; but once she starts moving the strain on the hawser eases up. The "V.S.G." automatically slows down the drum for the heavy pull, and thus avoids the risk of carrying away the hawser, whatever the men attending it may do in the way of backing up or surging it.

Fig. 1 represents an 18-ton boathoist used for hoisting in or out a warship's heavy steam boats by means of a derrick. In this instance it will be noticed that the A and B ends are combined together with a common valve-plate between them. The features of the "V.S.G." that enable it to accelerate very rapidly under light loads, and to adjust itself quickly to a heavy one, are extremely useful when hoisting in a heavy boat in a seaway. The boat is hooked on alongside with the slings quite slack, so as to allow her to rise and fall freely to the waves. As she rises on a sea, the slings are hauled taut at full speed, so that just before the sea leaves the boat the full weight will come on to the derrick without too heavy a jerk. When the full weight comes on the slings, the "V.S.G." at once automatically reduces to the normal speed for the load.

It has been remarked that, for certain kinds of cargo handling, seamen may prefer handy hydraulic ship cranes to any form of cargo winch and derrick. Such cranes hitherto have been worked by water pressure supplied by a powerful central hydraulic pumping engine in the engine room. One of the latest ideas is to have hydraulic cranes, but to dispense with the big central pumping plant and to work each crane or group of cranes by a small electrically-driven "V.S.G." pump. By this arrangement any crane or group can be switched on at a moment's notice; a large amount of hydraulic piping throughout the ship is done away with, and the use of oil instead of water tends to prolong the life of the rams and cylinders of the cranes.

In addition to its marine uses already described, "V.S.G." is used also in ships of the Navy for hauling aft heavy trains of mines on the minerails when minelaying; for the training, loading and ramming gear of heavy guns, and for many other purposes. Ships like the "*Nelson*" and the "*Rodney*" carry about 60 "V.S.G." units of various sizes for transmitting power varying from 3 H.P. to 200 H.P. Small-sized pumps are used in submarines to provide pressure for raising and lowering the periscope and working the large flooding and vent valves and other hydraulically-operated gear; and a small rotary transmission type is used to work the small geared type steering gear.

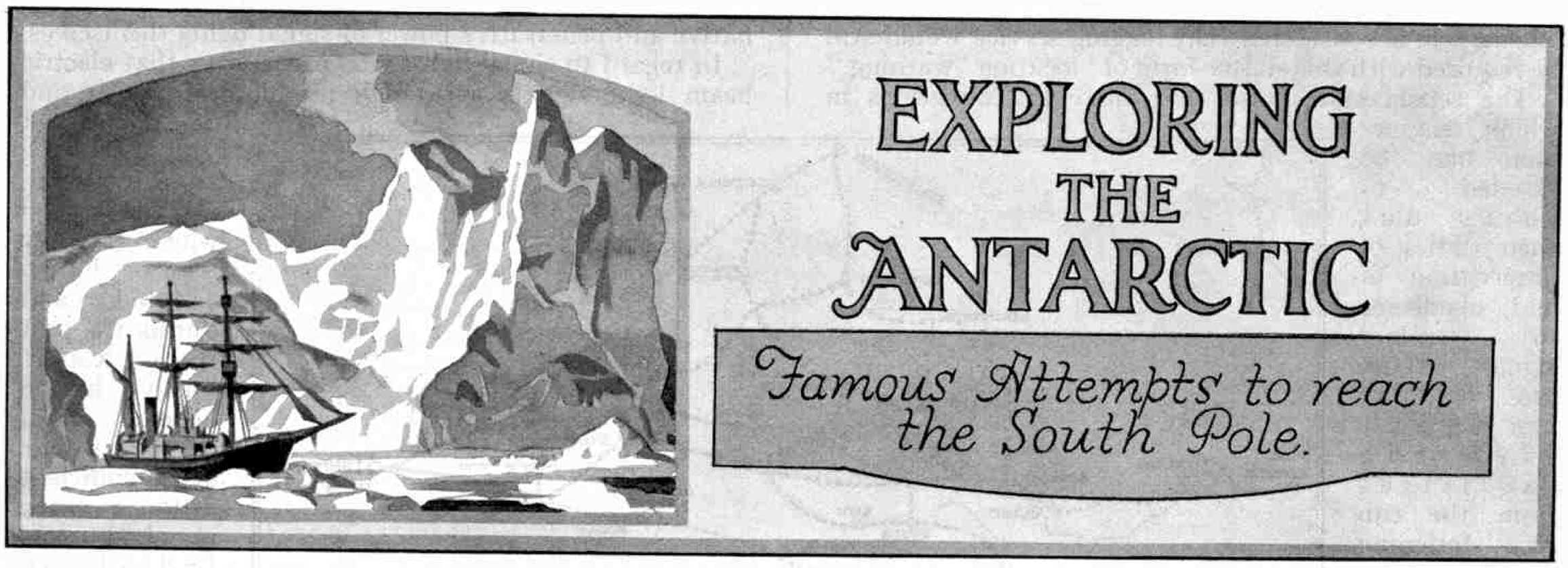
Across the Andes—

(*Continued from page 197*)

that collects upon the sides of the mountains, to be ultimately precipitated upon the track.

The bridges invariably cross deep chasms through which turbulent waters rush after the melting of the snows. They vary in length from a few feet to 100 ft. and more, consisting as a rule of a single span.

The first stopping-place after emerging through the tunnel on the way to Valparaiso is Juncal, where the railway company have erected an hotel. It is in the mountains here where there is a remarkable statue, known as the "Christ of the Andes." It was erected in celebration of peace between the two Republics of Argentine and Chile. It is a bronze statue of Christ, and was cast in the arsenal at Buenos Aires from cannon. The figure, which is 26 ft. in height, stands on a huge pedestal, which bears this inscription:—"Sooner shall these mountains crumble into dust than Argentines and Chilians break the peace, which at the feet of Christ the Redeemer they have sworn to maintain."



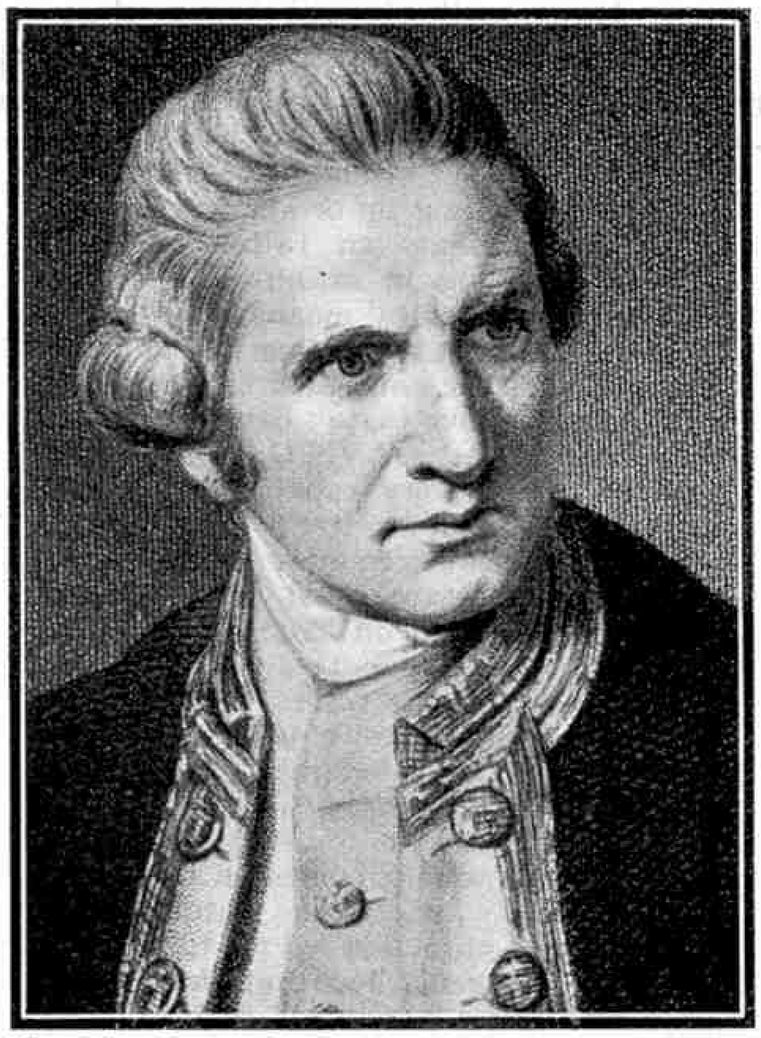
I.—THE SEARCH FOR A MYTHICAL CONTINENT

A SHORT time ago the story of exploration in the Arctic regions was told in the pages of the "*M.M.*" The North Pole was conquered only after many generations of heroic adventure. The daring and resource of the men who penetrated into the frozen North will never be surpassed, but it was equalled by that of the explorers who attempted to solve the mysteries of the Antarctic, the blizzard-swept region at the opposite end of the world. The South Pole was reached in December 1911, and as the result of wonderful heroism and dogged endurance many of the problems of the frozen land in which it is situated have been worked out.

It is more than a thousand years since man first began to push northward into Arctic regions, but no really determined efforts to enter the Antarctic were made until the later years of the 18th century. Then Captain Cook tried to penetrate the barrier of ice that surrounds it, and formed the conclusion that near the Pole there was a great tract of land from which came the immense icebergs that prevented his further progress southward.

After Cook's voyages interest in the far south died away for a time, and during the 19th century the Arctic claimed the chief attention of Polar explorers. One expedition after another pressed northward, solving the problem of the North-West Passage, and gradually approaching the North Pole. In the south a few whalers and sealers in search of new hunting grounds made interesting discoveries. Good work was done also by several expeditions, particularly by one led by James Clark Ross, a hero of the Arctic. Ross discovered in the south new land, now called Victoria Land, and was the first to see Mount Erebus, the famous active volcano, 13,000 ft. in height, that rises from an island covered with snow and ice.

The real revival of Antarctic exploration did not come until the end of the century, however, when de Gerlache, a Belgian, visited the land known to exist south of Cape Horn, and spent a winter in those inhospitable regions. It is interesting to note that one member of his crew was the Norwegian Roald Amundsen, who was destined to be the first to reach the South Pole itself.



Captain James Cook, the pioneer of Antarctic exploration, who proved finally that the mythical Antarctic Continent did not exist.

The example of de Gerlache was quickly followed by explorers of other nations, and in a wonderful series of voyages and sledge journeys more was learned of the Antarctic in a few years than had previously been revealed during several centuries. Among the men who took part in these great adventures were Captain Scott, Sir Ernest Shackleton, Roald Amundsen, and the Australian Sir Douglas Mawson. Both Scott and Shackleton made gallant attempts to reach the South Pole. Scott finally succeeded in doing so, only to find that Amundsen had forestalled him by a few days; and Scott and four companions perished on the way back to their winter quarters.

One reason why the Antarctic remained comparatively unknown for so long is that it is separated from the rest of the world by a belt of stormy waters, hundreds of miles in width. The only place where it was approached regularly by sailors was off Cape Horn at the tip of South America, for it was necessary either to round the Cape, or to make the perilous passage of the Straits of Magellan, in order to reach the Pacific from the Atlantic. The mountainous seas and icy winds so often encountered in sailing round Cape Horn were regarded with dread, and those who reached the Pacific Ocean without mishap were usually too thankful to have found safety to think of penetrating into the even wilder and colder regions farther south.

The Antarctic appears so inhospitable and unattractive that it is scarcely surprising to find that the first ship to make a discovery of importance only sailed southward by accident. This happened in 1599, when the "*Good News*," a yacht of 150 tons commanded by Dirk Gerritz, became separated from the rest of a Dutch squadron while passing through the Straits of Magellan, and was driven far to the south by tempestuous winds. She reached a latitude of 64°S., and there the involuntary explorers discovered a mountainous snow-covered land, which is now believed to be one of the group of islands known as the South Shetlands. Gerritz and his crew were unfortunate on making their way North again, for they were captured by the Spaniards, who then claimed the Pacific Ocean as their own.

Although the "*Good News*" was the first vessel to approach the Antarctic circle, explorations in southern waters had been made some years previously. In 1567 the Governor of Peru despatched an expedition, under the command of his nephew, with orders to look for a great continent which, for some mysterious reason, was then believed to exist round the South Pole. The search was unsuccessful, and it was resumed in 1605 by Pedro de Quiros. He discovered land in the following year, but this was one of the islands of what is now known as the New Hebrides group, which is nearer to the Equator than to the South Pole!

The story of the fabled Antarctic continent for which these early explorers searched so persistently is very curious. Belief in its existence was widespread for more than 200 years, and geographers were so sure about it that they went to the length of giving it names. It was variously called "Southern Ethiopia," the "Austral Continent," and "Terra Australis Incognita." One writer said that it was equal in area to a quarter of the whole globe, and added that it had the great advantage of not being near "Turks or Moors, or others of the nations which are accustomed to disquiet or disturb their neighbours." Others imagined that treasure of all kinds would be found on it. They were firmly convinced that the supposed continent was as wealthy as Mexico, Peru and other American countries from which gold had poured into Spain for many years; and they looked forward with great eagerness to the time when it would yield its riches. Continued failure to find it did not shake belief in the existence of the continent, and it was even asserted that one sailor had actually

landed on it and found it to be inhabited by a civilised and well-clothed white race!

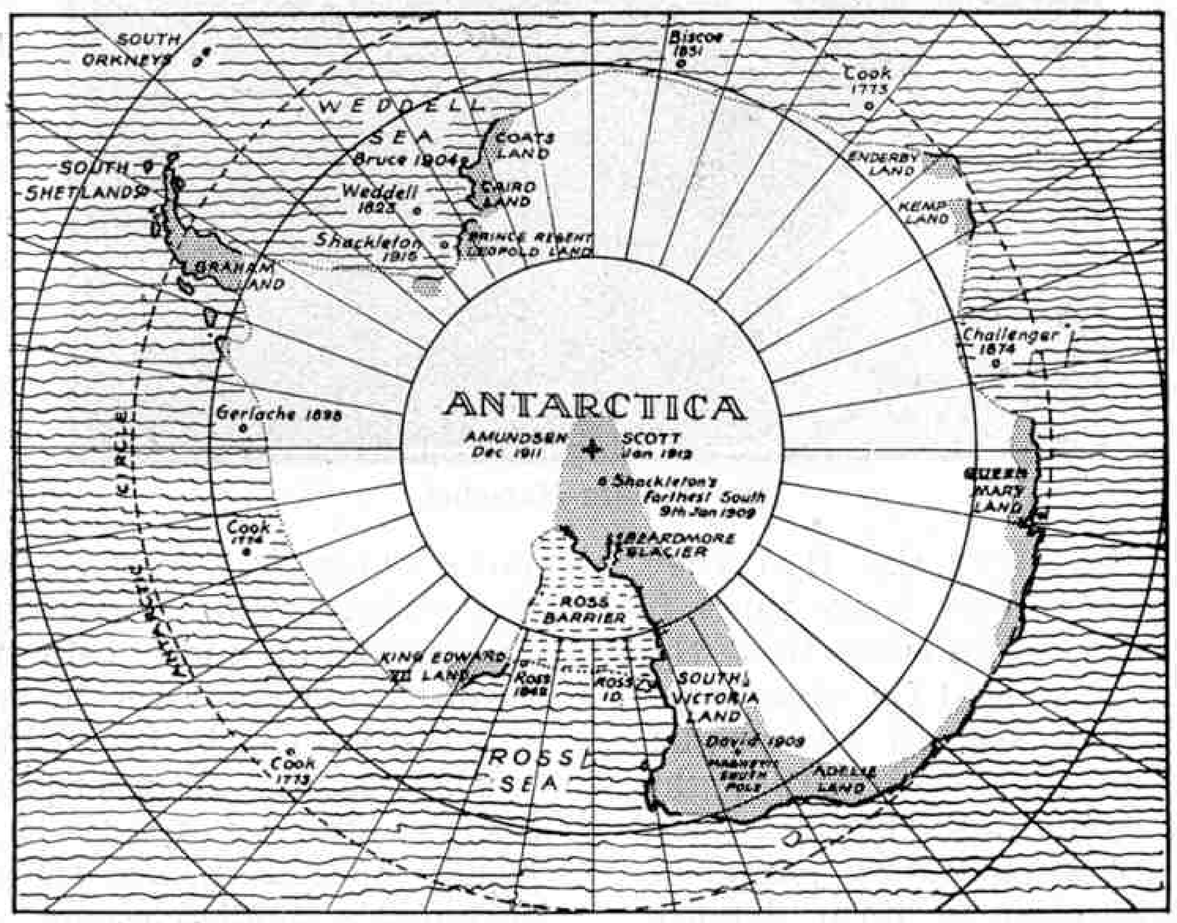
The idea of a southern El Dorado was not confined to credulous sailors, for it was widely believed that an immense southern continent was necessary in order to balance the masses of land in the Northern Hemisphere, and so prevent the world from toppling over! Every island discovered in the Pacific by early explorers was immediately claimed as part of the Antarctic continent, and old maps show New Zealand, and even Australia, as fragments of a great land that extended far northward into the Pacific Ocean.

In spite of repeated disappointments the belief was not finally exploded until the second half of the 18th century, when Captain Cook was sent out to settle the question. Cook had already established a great reputation as a navigator and explorer by his voyages in the Pacific Ocean. In his barque the "*Endeavour*" he had visited many islands in that Ocean and had passed along the entire eastern coast of the Australian continent, where he discovered Botany Bay. He had also sailed completely round the north and south islands of New Zealand, and had proved that they at least were not part of Antarctica.

In polar regions. Passing through loose pack ice when approaching land in high latitudes. In order to force a way through the ice, advantage is taken of every opening or "lane" that presents itself.

Cook took up the search in 1772, and in the early days of the following year he sailed southward from the Cape of Good Hope with the "*Resolution*" and the "*Adventurer*." In the stormy seas to the south of the Cape he and his men suffered severely. Many icebergs were encountered, and on one occasion the two vessels nearly collided with a mountainous mass of ice half-a-mile in circumference. Ice clogged the rigging of the ship, and snow and sleet, accompanied by fog, made navigation difficult and dangerous. Cook carried on until 17th January, 1773, when the way southward was closed by an immense icefield in latitude 67° 15′ S. After sailing along the edge of the pack he returned to warmer regions.

In December of the same year Cook left New Zealand in the "*Resolution*" on a second attempt to find the Antarctic continent. This time he looked for it in the southern waters of the Pacific Ocean, possibly thinking that, as most of the supposed fragments of it reported during the previous 200 years were really islands in that Ocean, he would have a better chance of reaching his objective there. He sailed almost directly southward, making his way through the "Roaring Forties" into the even stormier waters of higher latitudes. His men patiently endured hardships equal to those encountered on their previous voyage. Cook himself seemed inspired by the prospect of important discoveries, and he did not turn his vessel northward until he had reached the high latitude of 71° 10′ S. There the pack was so dense and so thickly strewn with enormous icebergs that he judged it dangerous to continue. The size of these icebergs appears to have impressed Cook very greatly. He was probably accustomed to those of the Arctic, for he had spent a considerable time in surveying the coast of Newfoundland; and the greater size of the flat-topped Antarctic bergs astonished him.



Map of the Antarctic continent, the explored portions of which are indicated by shading. It will be seen that by far the greater part of the continent has not yet been visited and awaits exploration.

"At four o'clock in the morning," Cook wrote in his diary on 30th January, 1774, "we perceived the clouds over the horizon to the south to be of an unusual snow-white brightness, which we knew announced our approach to field ice. Soon after it was seen from the topmasthead, and at eight o'clock we were close to its edge. It extended east and west far beyond the reach of our sight. In the situation we were in, just the southern half of our horizon was illuminated by rays of light reflected from the ice to a considerable height. Ninety-seven ice hills were distinctly seen within the fields, besides those on the outside—many of them very large, and looking like ridges of mountains rising one above another till they were lost in the clouds. The outer or northern edge of this immense field was composed of loose or broken ice close packed together, so that it was not possible for anything to enter it."

Cook made other determined efforts to penetrate through the ice in order to discover if the supposed Antarctic continent were really as large as had been previously imagined. He was not satisfied with merely sailing southward in two or three places, but he actually completed a circuit of the globe in very high latitudes. During his voyages he discovered several islands, including Georgia, which is now an important centre of the whaling industry; and he sailed for many miles over the supposed position of the Antarctic continent, thus proving that if any land did exist in the far South it was so near the Pole as to be frozen over.

Captain Cook is undoubtedly the great pioneer of Antarctic exploration. Previous voyagers in these unknown seas had been timid and easily deterred, but Cook pressed southward with astonishing skill and courage, and he only gave up when navigation became practically impossible on account of ice. He wrote in his account of his voyages that "within the Polar circle the sea was so pestered with ice that the land is thereby inaccessible. The risk that one runs in exploring a coast in these unknown and icy seas is so very great that I can be bold enough to say that no man will ever venture further than I have done."

In this prophecy Cook was wrong, for within 140 years of his own attempts to penetrate the ice that surrounds the Antarctic continent, this had been thoroughly explored in several quarters, and two parties of adventurers had actually reached the Pole itself. For many years after Cook's return to more genial climates practically no effort was made to penetrate further into the mysterious region whose boundaries he had touched, but rapid progress was made when the search of whalers and sealers for better hunting grounds revived interest in the Antarctic. The story of the heroic exploits of these men and of those who pioneered the way for them will be told in further articles in this series, and next month we shall deal with the voyages of the explorers who penetrated the heavy pack ice to find the real Antarctic continent.

Exploring the Solar System

How the Ninth Planet was Discovered

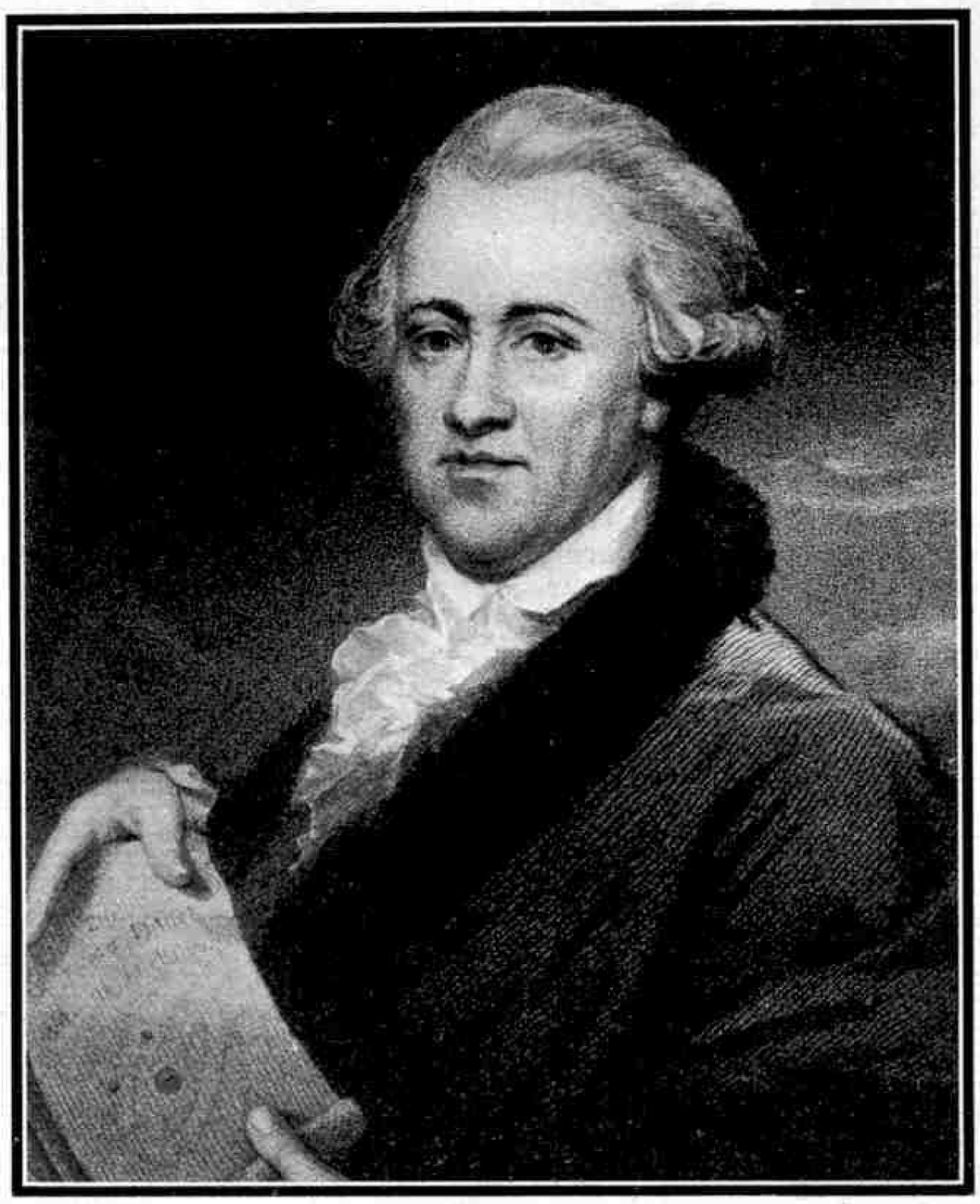
OPINIONS differ as to whether what are commonly spoken of as the "good old days" were really good or bad compared with the present day. It is at any rate certain that the people of, say, 500 years ago had one form of thrill that has vanished and will never return—that of the discovery of new lands. To-day few regions of the Earth remain entirely unexplored, and those are small and of comparatively little importance. It is true that many large areas still remain to be explored in detail, but their main features have been mapped out with scientific accuracy. Never again will the world be thrilled by the announcement of the discovery of a new, rich and populous continent.

Although the people who lived in the time of Magellan, Diaz, Columbus and Cabot had the advantage of us in this respect, we have the more than adequate compensation of being able to explore the marvels of the Universe around us. New terrestrial continents may be denied to us, but in place of them we are able to range through space, finding a new star here, a new nebula there; and last year astronomers made the great discovery of a ninth planet in the Solar System of which our Earth is a member.

The Solar System consists of the Sun and the planets that travel round him in oval, almost circular paths. Our own Earth, of course, we cannot see; but five of the Sun's family of planets are such conspicuous objects in the night sky that they have been known for ages. From very early times it was recognised that these five were different from the other heavenly bodies that were visible at the same time. Their peculiarity was that they seemed to wander through the sky, appearing on each successive night in positions slightly different from those they occupied on the previous night. The other sparkling points of light, on the other hand, appeared to form definite groups, and were to be seen night after night in the same positions relative to one another. On account of their strange behaviour these five objects came to be called "planets," the name being derived from a word of Greek origin meaning "wanderer."

The Greeks named the five planets then known after five of their gods, Mercury, Venus, Mars, Jupiter and Saturn; and these names are still in use. The Moon was formerly regarded as a planet, for she also wanders in the planetary manner. Until 1781 these six and the Earth were thought to be the only members of the Sun's family, apart from those transitory visitors, the comets. In that year, however, Sir William Herschel, the famous astronomer, made the wonderful discovery of another planet.

Herschel was born in Hanover in 1738 and was trained for a musical career. At the age of 14 he was a member of the Court orchestra, and subsequently a member of the band of the Hanoverian Guards. When the French invaded Hanover, early in the Seven Years' War, Herschel's regiment was badly defeated, and although Herschel was not wounded he was compelled, as a result of the confusion following the fighting, to spend most of the night in a ditch. The misery and general discomfort of the whole affair so disgusted him that he deserted and escaped to England, where he arrived practically penniless. His outstanding musical ability soon enabled him to make a living, and it was not long before he had acquired a considerable reputation. Ultimately he became a concert director in Bath, which in those days was a town of great importance as a centre of wealth and fashion.



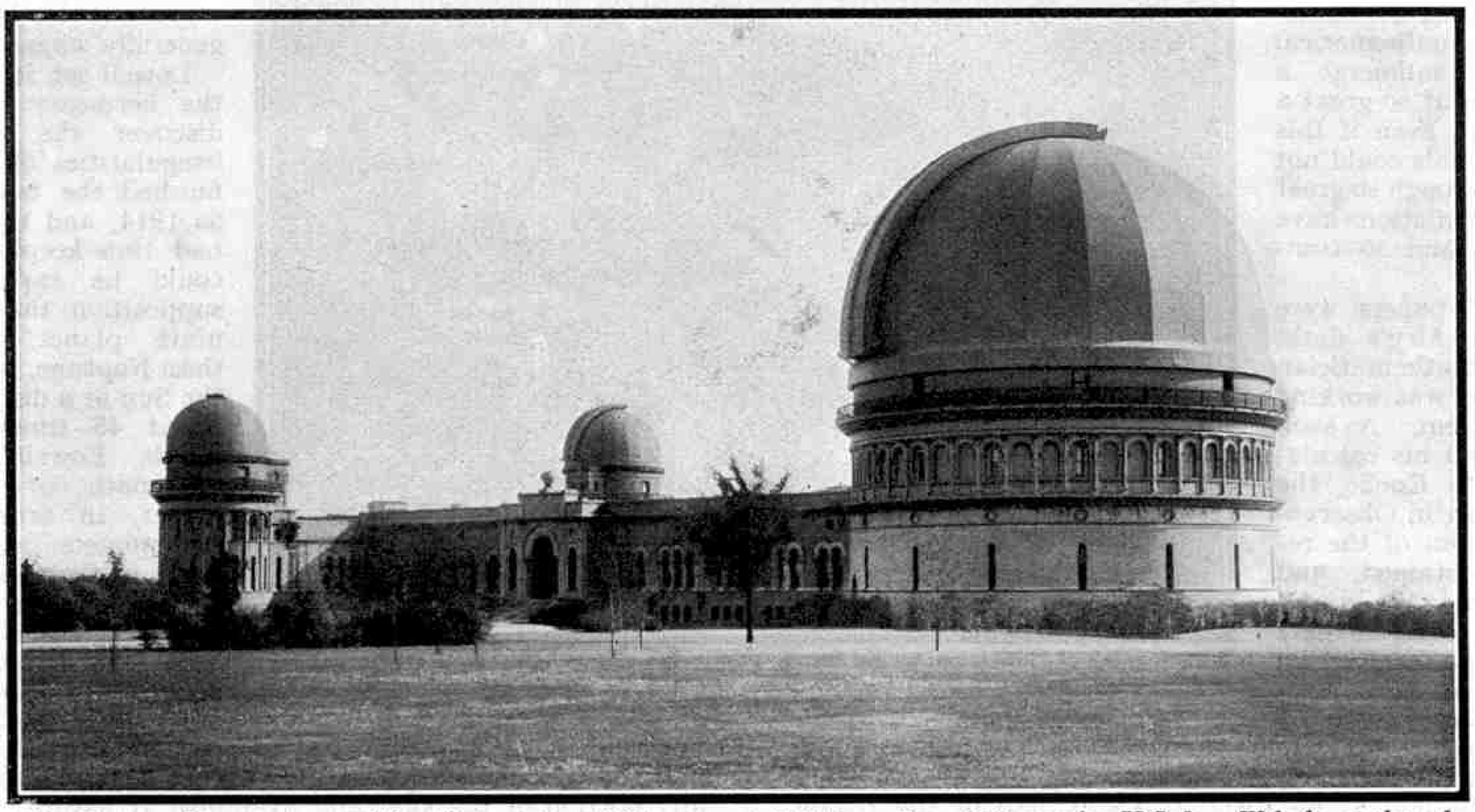
Sir William Herschel.

Herschel was always mentally restless; he was never satisfied with his knowledge of any particular subject, but always wished to know more about it. This disposition led him to take up the serious study of mathematics with the object of understanding more fully the theory of music; and through mathematics he was led to astronomy. In this last subject he found his real life work.

The reading of descriptions of the wonders of the heavens did not satisfy Herschel, but only made him keenly anxious to see these wonders for himself. He obtained a small telescope, and what he saw by means of it so aroused his enthusiasm that he made up his mind immediately that he must have the largest and most perfect telescope that could be obtained. In those days telescopes of even moderate size were extremely costly, and an instrument such as Herschel desired was far beyond his means. There was only one thing for it—he must make a telescope for himself. He promptly set to work. Every spare moment was devoted to the

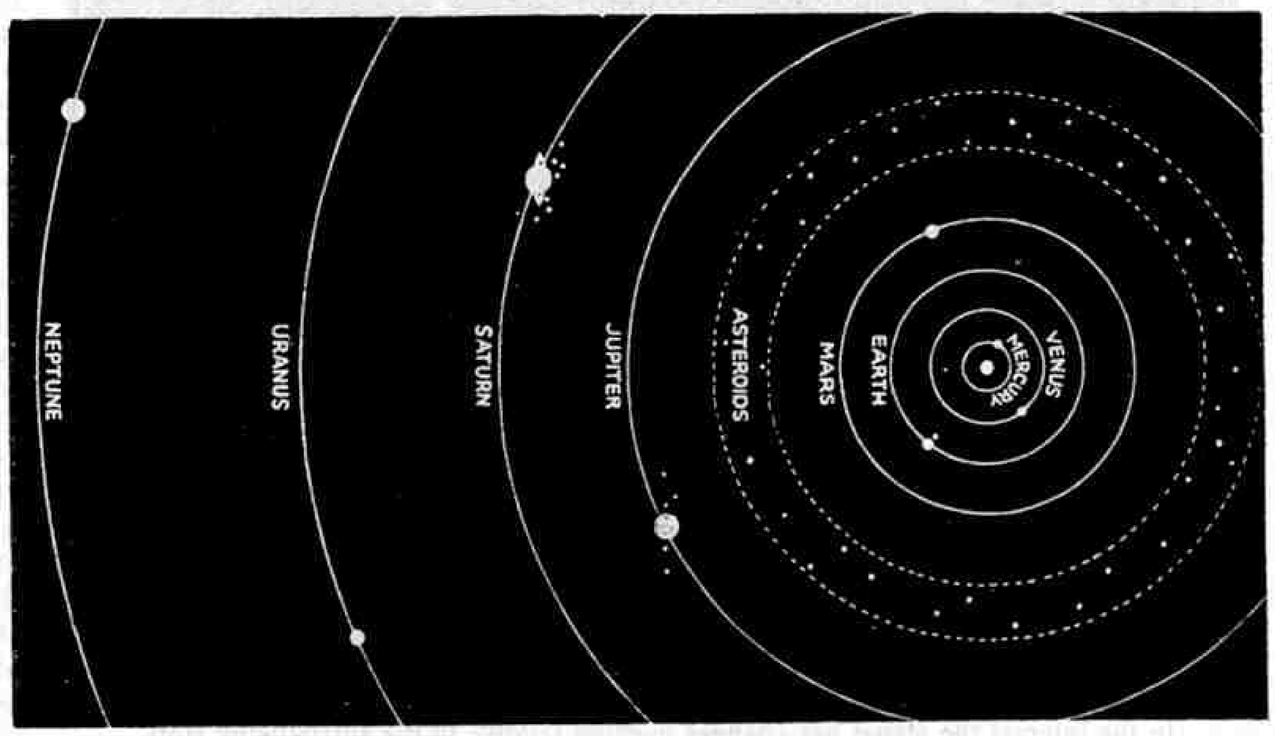
task, and often he worked far into the night. Innumerable failures followed fast one upon another, but his determination never faltered; and ultimately he succeeded in producing an instrument with the then large aperture of 5 in. Even this did not satisfy him, and subsequently he made an even larger one.

In 1781 Herschel, armed with a reflecting telescope of 12 in. aperture, was able to realise his great ambition to begin a systematic survey of the heavens. He set himself to examine all the stars above a certain magnitude or apparent brightness. On 13th March 1781, he noticed an object that immediately attracted his attention by reason of the fact that it differed in appearance from the other stars that he was examining. When viewed through a telescope of moderate size the planets have the appearance of tiny discs; whereas the stars, even when viewed through the very largest instruments, present only points of light. Herschel's keen eye had noticed that this object showed a distinct disc, and he realised that it was of a different nature from the stars.



The Yerkes Observatory of the University of Chicago, at Williams Bay, Wisconsin, U.S.A. This is equipped with the largest refracting telescope in the world, having a 40-in. objective.

His first idea was that he had found a new comet, and he watched it night after night as it changed its position among the stars. Presently sufficient observations had been made to enable the path or orbit of the stranger to be calculated. It was then clearly shown that the path did not resemble in the least the elliptical path of a comet, but was of the nearly circular type characteristic of the planets. Thus, after the lapse of centuries, was discovered a new planet pursuing a course outside the path of Saturn. Great excitement prevailed in the scientific world, and Herschel found himself famous. The new planet, which was given the name Uranus, is less than either Jupiter or Saturn, but nevertheless it is about 74 times the size of the Earth. It is so far away that to the naked eye it appears only as a very dim speck of light.



The planets and their courses round the Sun. To the eight here shown must now be added Pluto, discovered in January 1930.

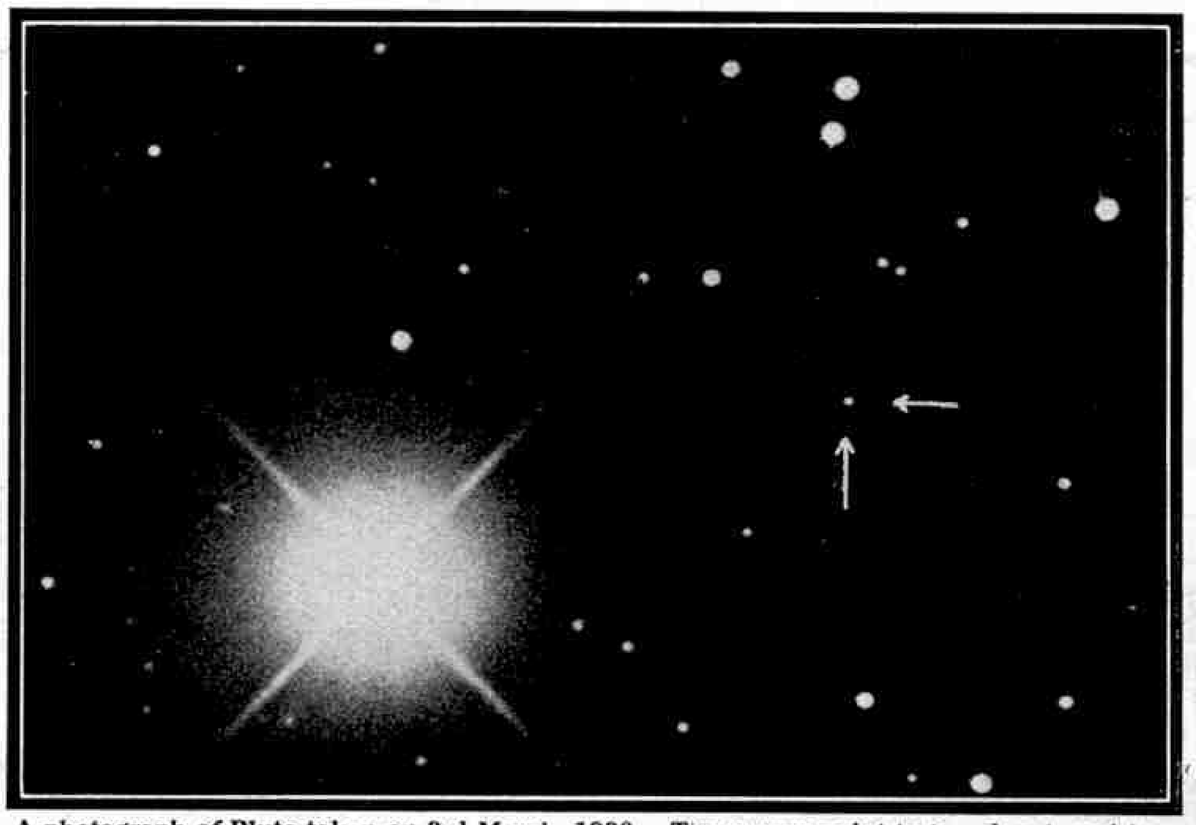
The discovery of Uranus created a great sensation among scientists, but 65 years later an even greater sensation was caused by the discovery of still another planet. In this case the excitement and enthusiasm was not due so much to the actual discovery of the planet as to the manner in which the discovery was made. Herschel discovered Uranus by direct observation; the next planet was found as the result of calculations made long before the planet had been observed, or was definitely known to exist.

The movements of Uranus were watched and recorded with the greatest care, with the object of preparing accurate predictions of its position at any future date. After a while it was noticed that Uranus was behaving very badly for a planet—it was not keeping time. The errors in position were very minute, but they were quite sufficient to worry the astronomers. As the result of the work of the astronomer Kepler, and of Sir Isaac Newton, mathematicians are able to calculate the positions of the planets for years ahead. Kepler showed that the time taken by a planet in travelling round the Sun depends upon its distance from the Sun; and Newton showed that the movements of the planets were the result of gravitation; the Sun attracting the planets, and the planets attracting the Sun and each other.

When the calculations of the movements of Uranus proved to be in error, it was suggested that the discrepancies might be caused by the gravitational pull of an unknown planet outside the orbit of Uranus. In 1843 J. C. Adams, a young student at St. John's College, Cambridge, commenced the laborious task of determining mathematically whether the vagaries of Uranus could be caused by an undiscovered planet, and if so, where that planet was to be found. After two years of labour Adams completed his tremendous task, and in October 1845 took his papers to Sir George Airy, then Astronomer Royal, with a view to having

a search made for the supposed planet in the position indicated by his results. Unfortunately Airy seems to have paid practically no attention to Adams. He pushed the papers into a drawer and forgot them.

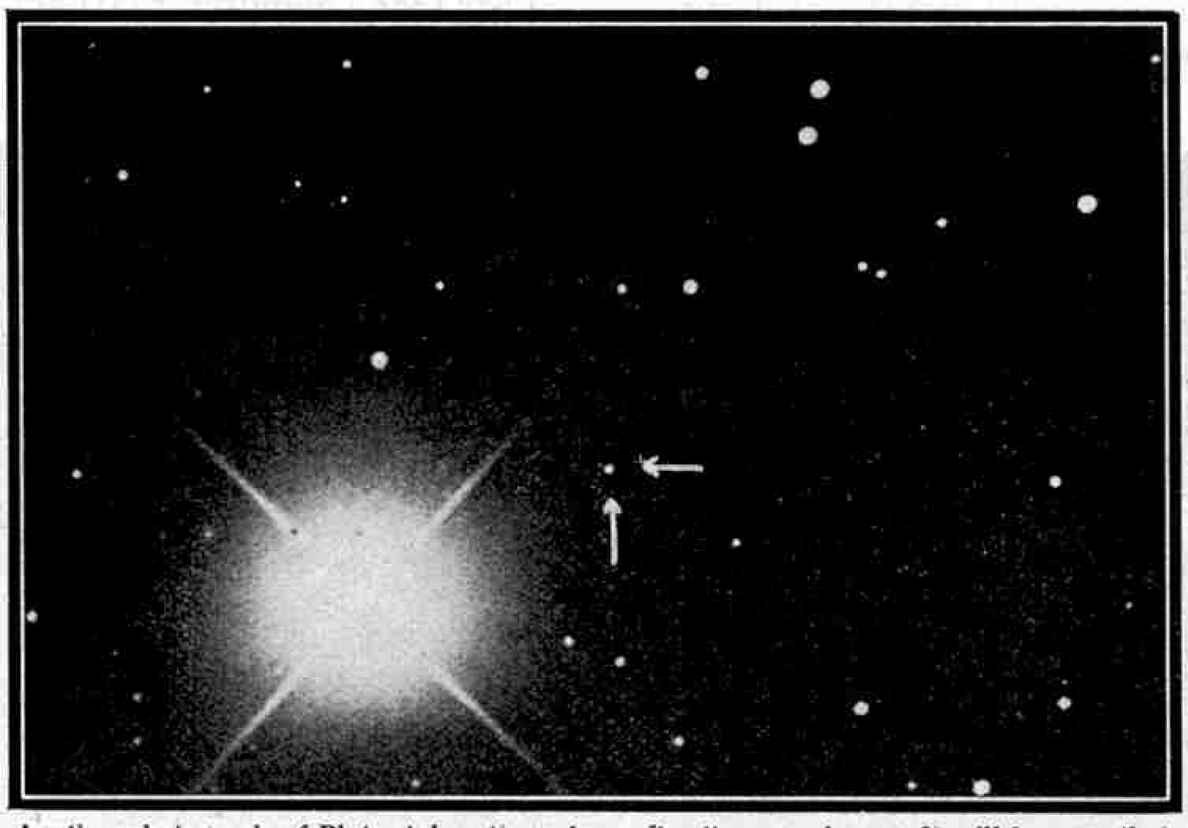
This curious indifference on the part of Airy seems to have been typical of the man. He was a brilliant scientist, but in some ways he was very erratic, and liable to come to entirely wrong conclusions and to stick to them obstinately. In this connection we may recall Airy's confident assertion that trans-Atlantic telegraphic communication by means of a cable could not be achieved. He stated dogmatically that it was a mathematical impossibility to submerge a cable successfully at so great a depth; and that, even if this were possible, signals could not be transmitted through so great a length. Few predictions have been so rapidly and so completely falsified.



A photograph of Pluto taken on 3rd March, 1930. The arrows point to the planet, and the large star on the left is Delta Geminorum. This and the companion photograph below are reproduced by courtesy of the Royal Astronomical Society.

While Adams' papers were lying useless in Airy's desk, a young French mathematician named Le Verrier was working on the same problem. As soon as he had finished his calculations he wrote to Encke, the director of the Berlin Observatory, informing him of the results he had obtained, and asking him to have a careful search made of a certain part of the sky. Encke received Le Verrier's letter on 23rd September, 1846, and instructed one of his assistant astronomers, named Galle, to commence the search that very night. The circumstances were remarkably favourable. Galle had at his disposal a star map of the region in question that had been made only a short time before, and he had a first-class instrument with which to make his observations. On that night he found a small object that aroused his suspicions because it was not marked on his map. He watched this object carefully on subsequent nights, and finally determined beyond doubt that it was the planet for which he had been instructed to search.

In the meantime Sir George Airey came across an account of Le Verrier's calculations in regard to the bad time-keeping of Uranus, and immediately he remembered the papers that Adams had left with him so confidently nine months before. Quickly Airy found up the papers, and saw that the result Adams had obtained was practically the same as that reached by Le Verrier. There can be little doubt that Airy was conscious-stricken at the realisation of his unpardonable neglect. At any rate he lost no time in asking Professor Challis to commence a search for the predicted planet with the aid of his large telescope at Cambridge. Challis immediately set to work, but he was heavily handicapped by the fact that the star map used by Galle had not yet reached him, and a special map had to be made for the purpose. The result was that Challis found the planet, but not until the 28th September, five days after the discovery by Galle.



Another photograph of Pluto, taken three days after the one above. It will be seen that in the interval the planet has changed position relative to the surrounding stars.

Although Adams was thus deprived of the credit of this great achievement, it is now generally agreed that the honour of the discovery of this planet, to which was given the name Neptune, should be divided between him and Le Verrier.

It is often said that history repeats itself, and a remarkable example of this repetition occurred last year. It is 85 years since Neptune was discovered, and as the planet takes 165 years to make a complete circuit of the Sun, it had been watched, by the beginning of last year, through rather more than half its course. During that period enough had been seen of it to show that as a timekeeper it was little, if any, better than Uranus. Its irregularities were of such a nature that they could not be accounted for by the influence of any known body, and at last astronomers came to the conclusion that there must be still another planet, outside the orbit of Neptune.

Among those who were interested in the problem was Professor Percival Lowell, an American astronomer, who became famous as the result of his observations of the markings on Mars, our nearest planetary neighbour, which bore some resemblance to canals. At one time many astronomers considered that these objects actually were artificially-constructed waterways, but this idea is now very generally abandoned.

Lowell set to work to make the necessary calculations to discover the cause of the irregularities of Neptune. He finished the task as long ago as 1914, and showed that the bad time-keeping of Neptune could be explained on the supposition that there was a ninth planet, much smaller than Neptune, travelling round the Sun at a distance from it of about 45 times that of the Earth. Lowell also calculated the path of the supposed planet, in order to provide astronomers with a definite guide in their search for it.

It might be thought that to-day it would be easy, with such definite information, for a planet to be discovered, because our telescopes are far more powerful than those employed by Herschel or Galle. In addition, photographs revealing far more than the eye can see can be taken of any portion of the sky, and examined at leisure. In reality the task of finding the suspected planet was even more difficult than that of discovering Neptune, on account of the small size of the body and its enormous distance from the Earth.

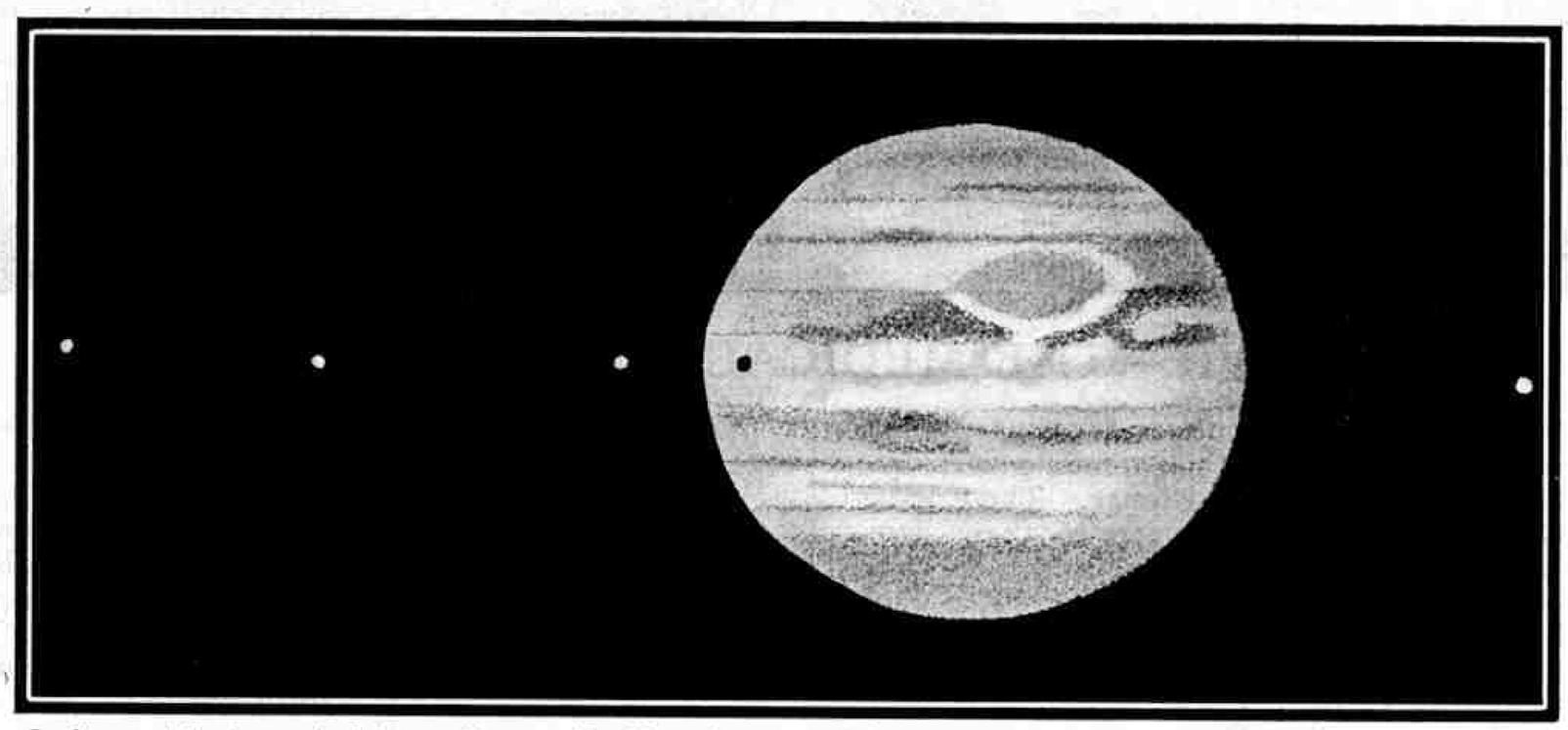
The search was commenced at the Observatory at Flagstaff, Arizona, founded by Lowell in 1894. The work was not done by visual observation, but by taking a series of photographs of the portion of the sky where the planet was thought to be, and examining these minutely in order to ascertain if any of the points of light recorded on them showed a tendency to wander. On 21st January, 1930, a member of the staff of the Observatory found what was described as "a very promising object," which appeared to occupy different positions on photographs taken at different times. Attention was immediately concentrated upon this object. Further photographs were taken, and it was watched with the utmost care through the fine 40-inch reflecting telescope at Flagstaff. Eventually it was definitely determined that the tiny speck of light was almost exactly where Lowell had predicted, and was following the course that he had calculated for it. It is sad to think that Lowell himself did not live to see the search completed, and to share with Herschel, Adams and Le Verrier the distinction of having found a new planet.

The announcement of this wonderful discovery was made on 12th March, 1930, and immediately there arose the question of a name for this new member of the Solar System. Eventually it was decided to name it Pluto. This is a very suitable name, for in Greek mythology Pluto was the brother of Jupiter and Neptune, and the son of Saturn. It is interesting to note that the name appears to have been suggested independently on both sides of the Atlantic, by Professor Pickering in America and by a young lady living at Oxford in England.

An interesting figure in this thrilling story is the assistant who detected the tiny mark on the photographic plate that provided the first suggestion that the search had come to an end. This was

Mr. C. W. Tombaugh, a young man who only a short time previously had been employed on farm work at his home in Iowa, U.S.A. Tombaugh became interested in astronomy at an early age, and he was so keen on observing the stars that he built himself small reflecting telescopes, which he mounted with the enthusiastic assistance of the other members of his family. Ultimately he determined to devote his life to astronomy, and secured a position on the staff of the Flagstaff Observatory, where he had the good fortune to be instrumental in bringing Lowell's work to a triumphant conclusion.

Pluto will never be seen by the majority of the inhabitants of the Earth, for it is so small and so distant that a powerful telescope is necessary to see it. Our own Earth is at the enormous distance of 93,000,000 miles from the Sun, but Pluto is nearly 40 times as far away. Its actual distance from the Sun varies from 2,800,000,000 to 4,600,000,000 miles, and its orbit is so vast that the planet takes 250 years to make one circuit round the Sun. In common with all the other planets, Pluto shines by light reflected from the Sun; and the tiniest star that can be seen with the naked eye is 1,600 times as bright as this planet.

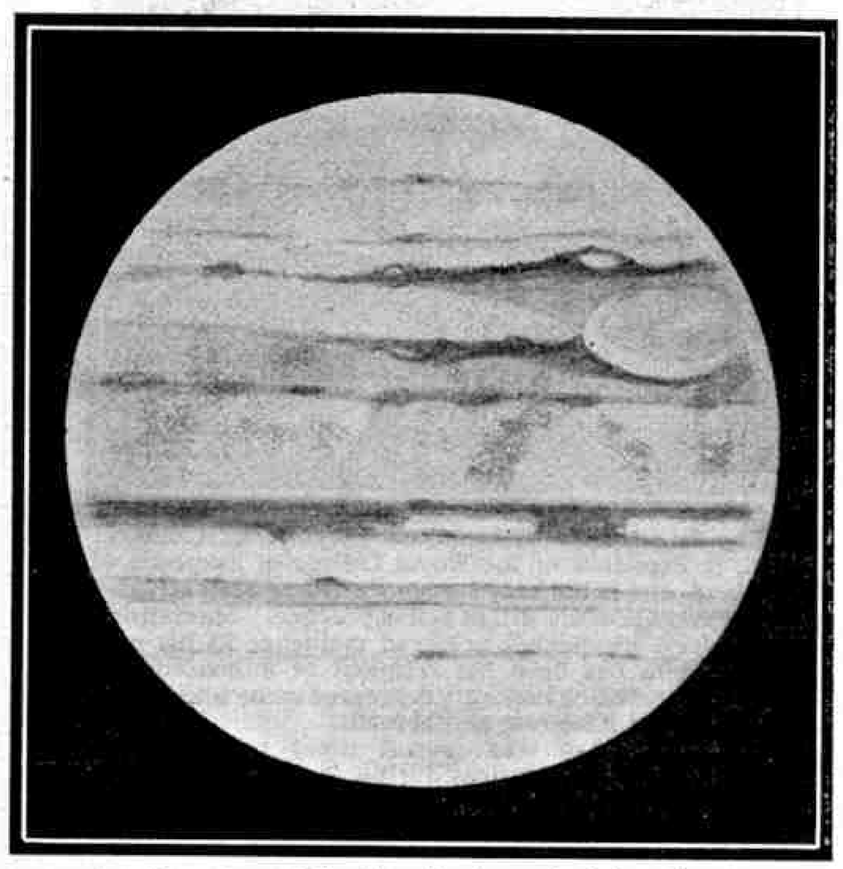


Jupiter and its four principle satellites. The black dot on the left of the planet is the shadow of the third satellite from the left. The peculiar oval-shaped marking is the mysterious Red Spot, which has been observed for some 300 years.

The region in which Pluto pursues its lonely course is so remote that to a person living on the planet the Sun would appear as an ordinary star. The planet is practically in darkness, and it has been calculated that the temperature on it is 380°F. below the freezing point of water. It is utterly impossible for life, as we know it, to exist there; for even if there is any life-supporting oxygen on the planet, it must be in solid form and of no use for breathing.

In one respect Pluto has proved a surprise to astronomers. We have already mentioned that, although the orbits of the planets are really oval, they are nearly circular. The orbit of Pluto, on the other hand, is definitely oval and very far from being circular. It also has the peculiarity that it crosses the path of Neptune, and therefore there are times when Pluto actually follows a course inside the orbit of its nearest neighbour.

Another rather surprising feature about Pluto is its small size. Previously the planets were divided into two groups according to size, the four nearest the Sun being known as the minor planets, and the other four as the major planets. The Earth is the largest of the minor planets, and its diameter is 7,900 miles. The smallest of the outer planets is Uranus, with a diameter of 33,247 miles; and Jupiter, the largest, is 84,846 miles in diameter, and is 1,300 times as large as the Earth. Although Pluto appears to be associated with these giant major planets, it is not much larger than Mercury, the smallest of the minor planets. It is not yet possible to say exactly how large it is, but its diameter may range from 3,100 miles, the diameter of Mercury, to 4,200 miles, the diameter of Mars.



Another view of Jupiter, the largest of the planets.

One of the most interesting problems with which astronomers have been confronted is that of how the planets came into existence. The theory most generally accepted at the present time is that the planets were created as the result of the near approach to the Sun of a gigantic star. It is supposed that the attraction of this star raised great tides in the mass of the Sun, just as the Moon raises tides in the oceans of the Earth. The tide raised on the side of the Sun away from the intruding star probably was comparatively small, but on the near side a tremendous wave of matter must have been raised, and it is believed that this formed a mass of white hot gas, spreading for millions of miles out into space. It extended so far that it became detached, and the pull of the giant star as it passed away set the gas whirling round the Sun. It is believed that this gas cooled and broke up into the planets as a cloud of steam condenses into separate drops of water; and that these planets continued to travel round the central mass, the Sun, from which they were created.

The enormous jet of white hot matter pulled out of the Sun by the passage of this star would be similar in shape to a cigar; that is, thin at the ends and thick in the middle. The greater part of the mass would be in the thicker portion, and it is natural to believe that the planets formed in this section would be larger than those formed either nearer the Sun or farther away from it. This supposition is borne out by the fact that Jupiter and Saturn, the largest of the planets, occupy positions that are approximately central in the Solar System. Further, the fact that Mercury, the smallest planet, is the one nearest the Sun, also fits in with this theory, for Mercury appears to have been created from matter near the inner end of the filament.

If the Solar System were really created in this manner, at least one small planet should have been produced at the tip of the jet of glowing matter pulled out from the Sun. Until recently, however, the planet believed to be farthest from the Sun was Neptune, which is much larger than any of the four planets nearest the Sun. The discovery of Pluto seems to solve this difficulty, for it seems probable that in this tiny planet we have at last found a trace of the crest of the tidal wave in which the planets were created millions of years ago.

It is interesting to find that certain of the planets are themselves the centres of miniature reproductions of the solar system. For instance, Jupiter, the largest of the planets, has no fewer than nine moons or satellites, and the discovery of these gives an interesting example of the progress of exploration of the heavens.

Until early in the 17th century astronomers had no suspicion that there were tiny bodies rotating round Jupiter. The first glimpse of them was obtained in 1610 by Galileo, the great Italian astronomer. Galileo was a pioneer of the refracting telescope. He constructed his first instrument in 1609 and later developed the invention considerably. In January 1610 he completed his fifth telescope. This was much more powerful than any he had previously made, and when he looked at Jupiter through it he was astonished to find that the planet was accompanied by what looked like three stars. These changed their positions with startling rapidity, sometimes appearing on one side of Jupiter, and sometimes on the other. A few days later he discovered a fourth, and realised that all four travelled round the planet in exactly the same manner as the Moon encircles the Earth. The remaining five satellites are much smaller and fainter, and remained undiscovered until comparatively recent times, when telescopes far more powerful than those of Galileo had come into general use.

As the drawing at the head of this page shows, Jupiter's four principal satellites are in practically the same plane, and on occasions all of them are seen in almost a straight line. Each in turn passes across the face of Jupiter, travels to the farthest extremity of its orbit and returns, to be itself eclipsed as it swings round behind the planet.

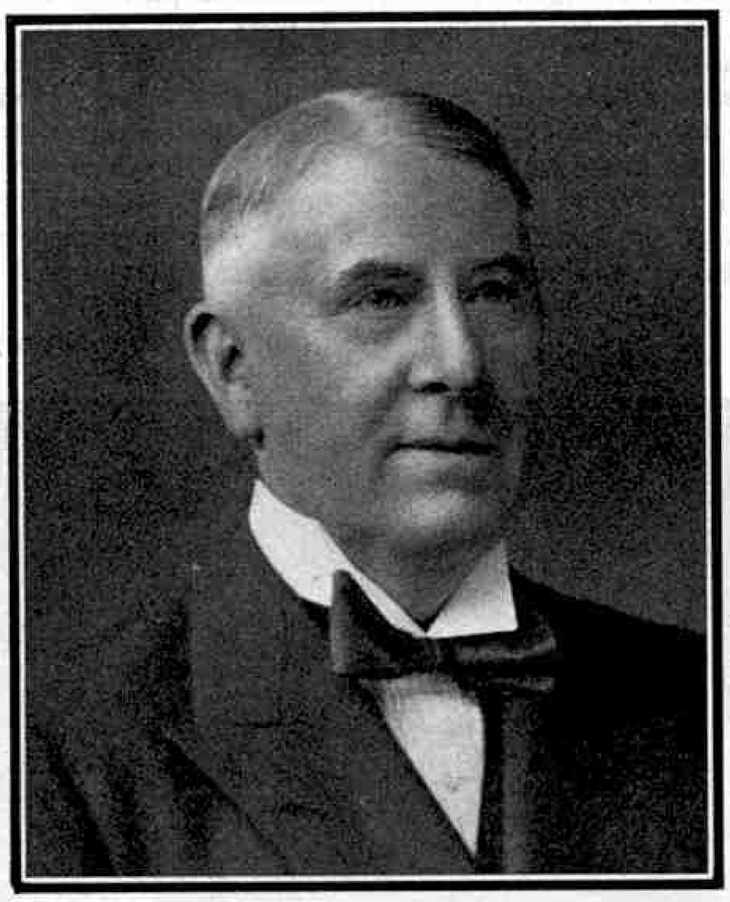
XVII.—THE MEDICAL PROFESSION

THIS month we are turning our attention to the medical profession, which is in many respects the premier profession, and is certainly one of the oldest in existence. There have been doctors of sorts ever since Man first began to show signs of civilisation. The earliest practitioners, of course, could only be described as "witch doctors," and it is a remarkable fact that in many parts of the world their successors still concoct weird and repulsive medicines in order to drive out the evil spirits that they believe to be the cause of illness. Even as recently as 250 years ago the ideas held concerning diseases and their remedies were crude, and even barbaric in character. Since that time the genius of a long line of famous doctors has completely transformed both medicine and surgery, and brought about a greater proportion of human progress than most of us realise.

Medical science has made marvellous advances during the past 130 years. Full advantage has been taken of every discovery that seemed likely to help in the fight against disease, and to-day medical methods are based on careful and exhaustive experiments. Health is no longer regarded as a matter concerning only the individual. It is now generally recognised that a strong and healthy population is one of the first requirements for any country, and every year increasing attention is being paid to the national aspect of health problems in relation to the prevention of disease as well as its cure.

As they grew in importance it became necessary to give the members of the medical profession an official status, and the General Medical Council was formed. It now regulates all conditions of training, maintains the standard of education, and registers properly qualified students. It may also be pointed out that a high standard of conduct in their relations with each other and with their patients is demanded from doctors. The effect of loyal observance of the code thus imposed upon the profession has been to raise its tone to a level that has won the admiration and respect of the civilised world.

A FAMOUS SURGEON



The Right Honourable Lord Moynihan, K.C.M.G., C.B., is President of the Royal College of Surgeons of England, and is the only surgeon who has been elevated to the peerage while still in active practice. Specialising in surgery, he quickly achieved eminence in his profession, and has been the recipient of numerous distinctions, including honorary degrees of many universities in the United Kingdom and abroad.

Lord Moynihan was several times mentioned in despatches for his services during the Great War and attained the rank of honorary Major-General. He was knighted in 1912 and became a peer in 1929.

The first requirement of a boy who intends to join the medical profession is a sound all-round education of the public or secondary school type. In planning the closing years of his school career he should remember that his future will be definitely scientific in character, and he should therefore take care to include physics and chemistry, for these form a necessary preliminary to his actual medical studies. If a medical degree at some university is to be taken—and this should be the aim wherever possible—the ground to be covered in these preliminary stages should also be so devised that the Matriculation examination of the selected institution may be passed with credit. In certain instances the preliminary chemistry and physics, together with biology, form part of the medical course; but in others some of these subjects may be taken while still attending school.

A boy who has reached school-leaving age, and has passed the necessary preliminary examinations, must now enter a medical school in order to study for his degree, or to qualify for the diplomas of the Royal Colleges of Physicians and Surgeons that will enable him to practice. To-day there are many suitable schools. Most of them form part of the organisation of a university, and practically every university in the United Kingdom now gives medical training of recognised value, and grants degrees in medicine and surgery that entitle their holders to be registered as medical practitioners. At each of them highly qualified professors, lecturers and demonstrators give the necessary instruction by means of lectures and laboratory work, and they are associated with hospitals, infirmaries and other centres in which clinical experience may be gained.

The large number of good medical schools seems to make the choice difficult, but it is usually easy for a student to select the one that suits his own circumstances best. The fees vary considerably, and full information in regard to them must be sought from the authorities of universities and medical schools that appear suitable. Additional expense is incurred if it is necessary that a student should travel far from home, and generally speaking the nearest university offers the best means of keeping expenses low.

Naturally Oxford and Cambridge Universities are the most expensive. They have great reputations, of course, and the value from both the medical and social point of view of a degree taken at one of them is sufficiently high to justify the expense incurred. It must be remembered also that students at these universities complete their courses in medical schools connected with the great London hospitals, where they have unrivalled opportunities of obtaining practical experience.

At most universities it is possible to defray at least part of the cost of training by means of scholarships. These are usually awarded to the students who secure the highest places in the preliminary examinations or in other examinations specially conducted for the purpose. The methods followed at different universities vary considerably, and full information should be obtained from the registrars or secretaries.

It is important to remember that those who take up medical studies must apply to the General Medical Council, 44, Hallam Street, London, W.1., for registration within 15 days after commencing their professional studies. In doing so they must produce evidence that they have reached the age of 17 years, and have passed the general examination that is accepted for Matriculation or entrance to the Faculties of Arts or Science of a university of

the United Kingdom. They are also required to show that they have passed in the special subjects of the pre-medical science examination.

At least five years must be devoted to professional studies. These years are divided between lectures and laboratory work in various branches of medicine and surgery, and in the latter part of the time clinical work in hospital wards, where every student must hold minor appointments in which he undertakes actual practice under the superintendence of his seniors. For instance, he will act for six months as a dresser in casualty wards, and he must spend a prescribed period in a hospital devoted to the treatment of fevers or to some other special purposes. Most of these special tasks are undertaken in the final years of his course, and on the completion of these he will have gained an all-round knowledge of the practical needs of the profession that will be sufficient to qualify him for registration.

The progress of a student is marked by examinations. These are taken at various stages during the five years, and conclude with the degree examination, or with the final examination required by the Conjoint Board. He then has conferred upon him the Degree or Conjoint Diplomas of the Royal Colleges of Physicians and Surgeons, and his name is included in the register of medical practitioners.

After qualification and registration comes the problem of the best means of making use of the knowledge gained during the years of training. Actually this problem is one that necessarily must be considered very early, and practically every student should have some aim in front of him in order that he may adapt the latter part of his course to it, so far as the regulations permit. The solution will depend on the inclinations and circumstances of the individual student. If he is able to spare the necessary time and money he may continue his studies and enter on research work with the intention of becoming a specialist in some branch of medicine or surgery. As an alternative he may study the problems of public health. The majority of qualified men enter upon general practice.

A specialist can only acquire the knowledge that makes his services of value by undergoing a long and concentrated course of training. Having chosen his field of work, he studies every aspect of it closely, serving on the staffs of hospitals and other institutions that give him the opportunities he needs for widening his experience. In time his command of a particular branch of the profession leads general practitioners to approach him in difficult cases, and they follow his advice in treatment, relying on his judgment, which in turn is based upon his intensive study of one aspect of their work. The fees of an established specialist are higher than those of an ordinary medical man, and it is to him that the greatest prizes in the medical profession usually go.

During recent years there has been a great increase in the number of official appointments open to registered medical practitioners. Some of them are very remunerative, but it must be remembered that to a certain extent the holders of these appointments may be regarded as specialists. For example, all those who intend to enter the Public Health Service, whether under a municipality or a county, or in connection with the Ministry of Health, must secure one of the Public Health Diplomas that are now granted by universities, in which special post graduate courses are usually arranged to enable students to qualify.

Many good appointments are open to medical men in the Navy, Army, and Air Force, and in Colonial and Indian services. Here again a certain amount of specialisation is necessary, and the holder of an appointment of this kind must take special care to keep himself in touch with the latest developments connected with his work. In many cases the appointments are made for a certain number of years, and at the expiry of the period of service general practice is usually taken up.

The pay received in official appointments shows a very wide range, but generally speaking from £300 a year may be received by whole-time assistants, and an appointment as a medical officer under a local authority may carry with it a salary ranging from £500 to £1,500, according to the size and importance of the district covered. In the Navy and Army the commencing pay is about £500 a year, and this rises to about £1,000 a year as Surgeon Commander, R.N., or Major, R.A.M.C. In the colonial medical service the initial pay is usually about £600, and senior posts carry with them salaries up to £1,000. In certain instances the pay may be augmented by means of private practice.

In regard to general practice it is not usual to begin by merely opening a surgery in a selected district, although this is occasionally done, particularly in newly-built suburbs or in rapidly growing quarters. A more usual method of entry into private practice is to purchase a partnership, often after a period spent as a paid assistant. It involves an initial outlay, but at the same time it avoids the risk that is inevitable when an attempt is made to establish an entirely new practice. In many instances a practice may be purchased outright. The buyer then secures the valuable social and professional contacts already made by his predecessor, and in ordinary circumstances he is assured of an immediate return on the money he expends. The purchase price of a practice does not usually exceed twice the yearly income obtained from it, and is often little more than half of this. Thus the cost of a practice bringing in £1,000 a year would be from £1,000 to £2,000.

The average income of the general practitioner in this country is from £600 to £800, but the range is wide, and the sum received will depend largely on the type of practice. Naturally a practice in a poor district is not so remunerative as one in a prosperous suburb, unless the greater population in the former case compensates for the higher fees and more certain returns in the latter. There are limits in this direction, of course, for no doctor can successfully attend more than a certain number of patients. The National Health Insurance Act has greatly changed the outlook of the practitioner. It ensures medical attention for many whose visits to surgeries and consulting rooms had previously been made only in extreme and urgent cases, and it has stabilised to a certain extent the income of those who form a panel of Insurance Act patients.

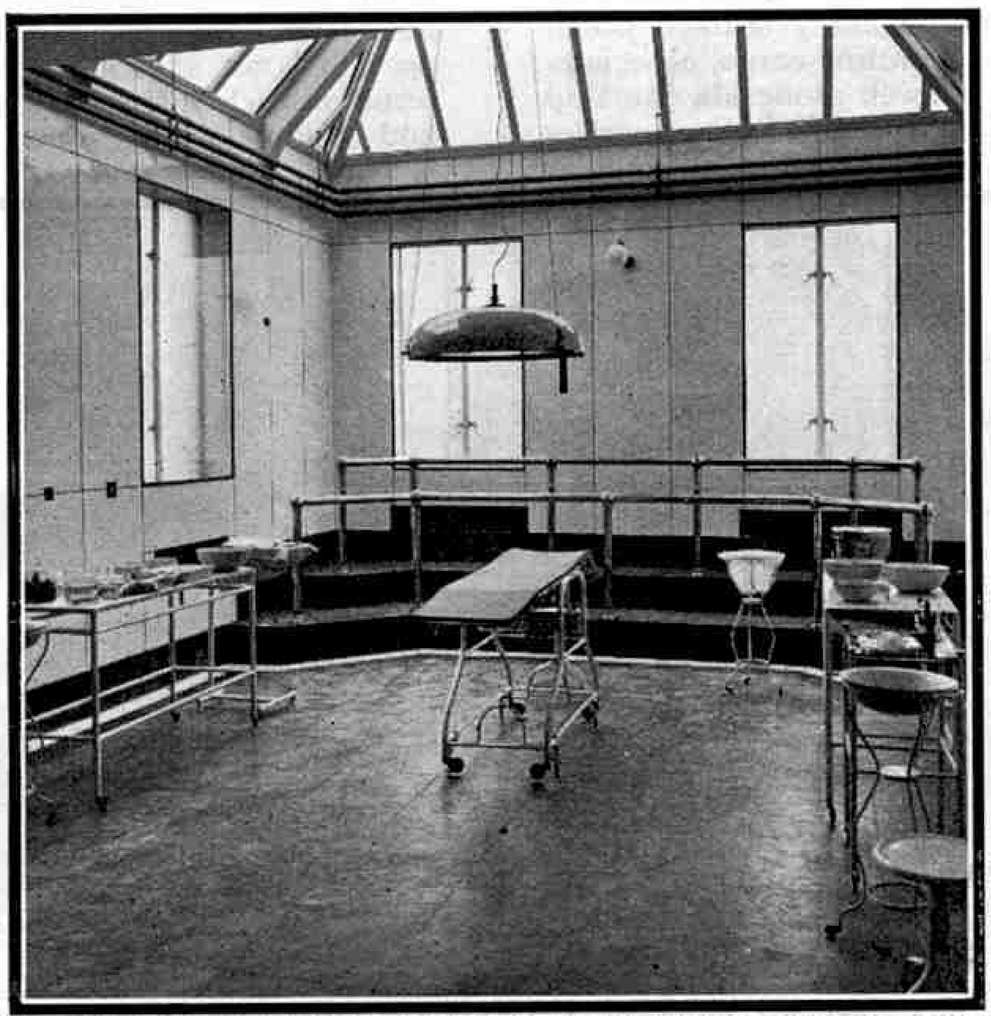
It is interesting to note that a qualified man may gain useful experience, and at the same time satisfy a desire to travel, by taking a position as a ship's doctor. He need not, of course, adopt this as a permanent career, for it is not usually too well paid.

One aspect of the medical profession that should not be overlooked is research work. The majority of doctors necessarily are engaged in the cure of diseases, but the profession in general cannot rest content with the mere treatment of human ailments, and attention is more and more being directed to the study of the causes of diseases in order that preventive measures may be undertaken. In many instances preventive measures are, in fact, of far greater importance than curative treatment.

The stamping out of malaria in many places is an excellent example of the prevention of disease that has followed research work. The difficulty encountered years ago in finding a cure for the disease pointed to the necessity for tackling it at its source. The romantic story of how this was done is now familiar. By careful and painstaking work Sir Ronald Ross, the famous British expert in tropical diseases, discovered the association between malaria and a particular species of mosquito, and the subsequent adoption of means of getting rid of the pest has diminished the effect of the disease to a wonderful extent. The work of the medical profession in fighting malaria ranks indeed as one of its greatest contributions to civilisation. The history of the Panama Canal alone is sufficient proof of this. Attempts to work in the malaria-ridden area through which the canal must pass were futile until a determined effort was made to exterminate the mosquito responsible for the disease.

Other diseases that afflict dwellers in tropical countries are now being studied in order that preventive measures may be planned. Work of this kind may be said to be only just beginning, and it offers good opportunities for qualified men whose tastes incline them to specialise in this direction. Schools of Tropical Medicine have been established in London and Liverpool in this country, and in Khartoum and other places abroad; and the necessary instruction in the peculiar means of studying yellow fever, sleeping sickness, and other tropical plagues may be obtained in them.

A Modern Operating Theatre



The well-equipped operating theatre of a modern hospital. Particular care is taken to ensure that the light is ample and uniform, and scrupulous cleanliness is observed.

Electro-Hydraulic Transmission

The "V.S.G." Gears and their Application

By D. Arnold-Forster, C.M.G., Rear Admiral (Ret.)

THE simple straightforward nature of hydraulic machinery has always appealed strongly to many engineering minds. Take, for instance, cargo-handling appliances in ships. Although modern electric winches have largely replaced steam winches for working cargo derricks, some important steamship lines have stuck all along to hydraulic cargo cranes. These handy cranes have fixed jibs, and pivot on the decks. A vertical hydraulic cylinder and ram works the wire hoisting whip, and two smaller rams slew the crane as required to plumb outboard, or over a hold. The cranes are manipulated very simply by two levers, one to hoist or lower, and the other for slewing. They are very quick and positive in action, and therefore many seamen prefer them to electrically-operated derricks for handling cargo, especially from lighters bobbing up and down in a swell alongside the ship at some exposed anchorage. A typical big "P. & O." liner carries as many as 16 of them.

Those who read the account of the search last summer for the sunken liner "*Egypt*" by the Italian salvage steamer "*Artiglio*" may have noticed an interesting little incident in connection with these cranes. After many failures to find anything at all, the first thing the suspended deep sea diver bumped against in the pitch darkness was a vertical ram with a large sheave in its head carrying steel wires. This information, telephoned up to the surface, at once removed all doubt of those in charge of the operations that the wreck they had located was the lost "P. & O" liner. The diver had swung against one of the forecastle hydraulic cargo cranes.

For many purposes, however, there may be little to choose between well-designed electric and hydraulic machinery. Each has its own special virtues and vices; and many attempts have been made to combine the virtues of both systems in mechanism for transmitting power. A successful and interesting example of this combination is found in the hydraulic variable speed gears and variable delivery pumps made at Elswick by The Variable Speed Gear Ltd., and known as the "V.S.G." The mechanism is the latest development of the original "Williams Janny" gear that was referred to in an article on the swashplate in the "*M.M.*" for October 1930. It is used for many purposes in ships at sea, and in factories and workshops on shore.

The "V.S.G." machines are applied in either of two different ways. Driven at constant speed by an electric motor, or any other source of rotary power, they are used to convert the steady rotary motion into accurately controlled rotary motion of varying speeds in either direction; or they may be used simply as variable delivery hydraulic pumps. They are completely boxed up inside a neat casing, and there is nothing showing to give one an inkling of how they work. Even when the casing of a machine is opened up to show the moving parts, most people on seeing the mechanism for the first time would be puzzled to explain it. Reference to the diagrammatic explanatory drawing in Fig. 5 will make the matter clear.

The swashplate, or "socket ring" as it is called in the "V.S.G." machines, is shown connected to the mainshaft by a universal joint. Let us suppose the shaft to be rotated by an electric motor coupled to its right-hand end; then the socket ring will rotate with it and, as shown in the diagram, it will be free to wobble about as it likes. But if the circular "tilting box," shown free of the shaft on the right, is pushed hard up against the back of the socket ring and held firmly at the angle of tilt shown, then the socket ring will be obliged to revolve in the same plane. When in place, the tilting box is carried on horizontal pivots fixed inside the casing of the gear, so that it does not revolve with the shaft. It is securely held from swinging on its horizontal pivots by mechanical connections (not shown). The triple lines in the diagram indicate series of Michell type bearings round the flat face of the tilting box and inside its rim, which form the bearing surface between the stationary tilting box and the revolving socket ring.

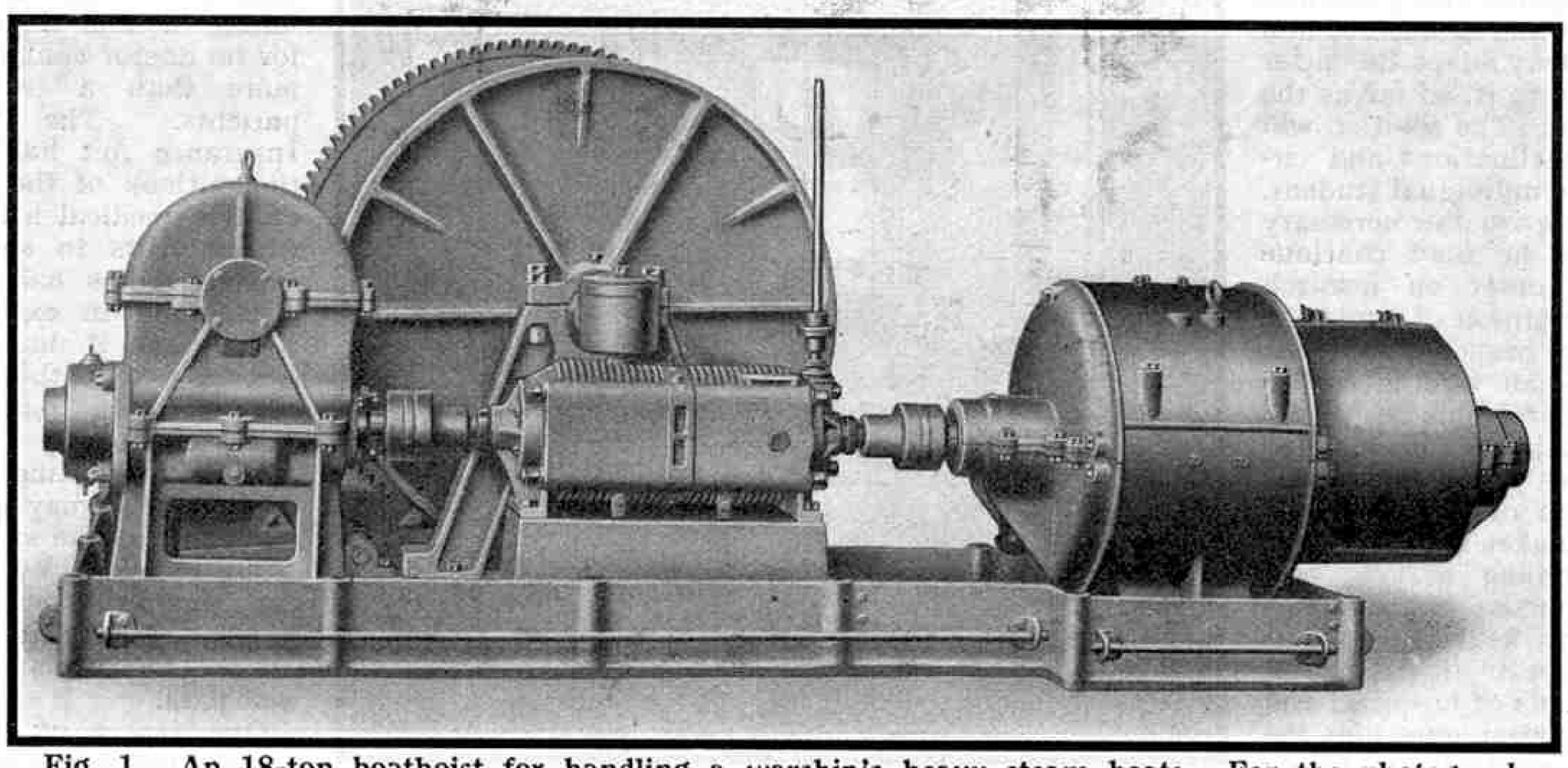


Fig. 1. An 18-ton boathoist for handling a warship's heavy steam boats. For the photographs illustrating this article we are indebted to The Variable Speed Gear Ltd.

On the left end of the shaft, and revolving with the socket ring, is the "cylinder barrel," which has a number of cylinders bored through it on a circle near its outer circumference and in line with the axis. In the actual gear there are as many as eleven of these cylinders equally spaced round the dotted circle; but for the sake of clearness two only are shown in the diagram, their connecting rods being indicated by dotted lines. The right-hand end of the casing is closed by a solid cover (not shown), but the left-hand end is closed by a flat plate called the "valve-plate," which when in place bears up against the end face of the cylinder barrel. This valve-plate has two long, curved ports cut through it, communicating with the end ports of the groups of cylinders on each side.

The lower part of the cylinder barrel is depicted in section, in order to show that, though the cylinder barrel is obliged to revolve with the shaft, it is not keyed rigidly to it, but is allowed a little play by using a sliding universal joint. This freedom of movement ensures that when in action the cylinder barrel will rotate in perfect contact with the valve-plate. A spring makes the initial contact between the cylinder barrel and the valve-plate, but when the machine is in action the state of hydraulic balance keeps them together.

As the socket ring and cylinder barrel revolve in the direction shown by the arrows, the piston of the upper cylinder, which is shown at the right extreme of its stroke, will gradually be forced to the left as it is carried down the near edge of the circle. At the bottom of its circuit this piston will be at the left extreme of its stroke. On its upward journey on the remote edge of the circle it will move again to the right. The piston of the other 10 cylinders will go through the same cycle, so that as the shaft revolves, every piston connected with the near edge of the socket ring is being forced *in*, while all those connected with the remote edge are being pulled *out*. Clearly, if the two ports in the valve-plate are connected to the pipes of some external closed system kept full of oil, then, as the shaft revolves at steady speed, oil will be forced continuously

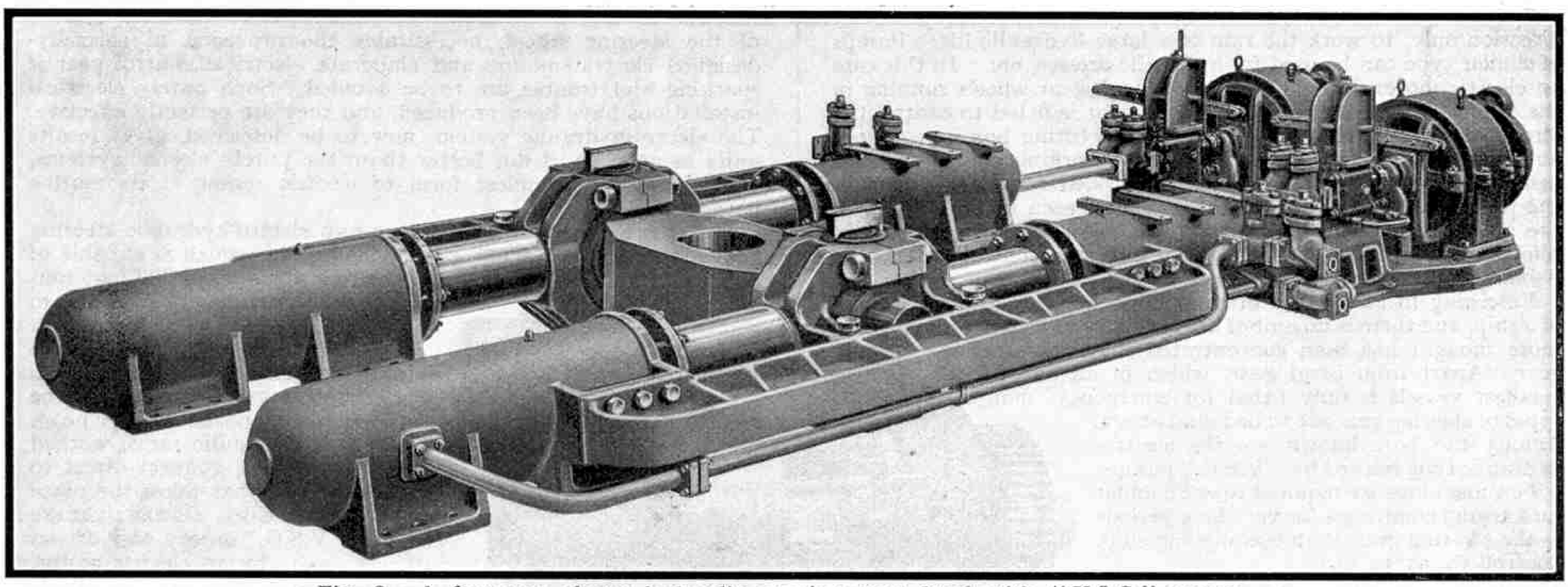


Fig. 2. A four-ram electro-hydraulic steering gear fitted with "V.S.G." pumps.

out from the near valve-plate port and through the external system, returning again to be drawn in through the remote valve-plate port.

The inclination of the tilting box on its horizontal pivots can be varied by mechanical connections, and these control arrangements are shown in some of the other illustrations. If the angle of tilt is reduced, the length of stroke of all the pistons will be reduced by a corresponding amount. If the tilting box is moved to the vertical, or "neutral position," there will be no stroke on the pumps; if it is inclined over to the left, instead of to the right as shown in the diagram, the motion of the pistons will be reversed. Thus, by varying the tilt, the volume of oil passing through the ports of the valve-plate may be regulated to a nicety; its flow may be reversed in direction, or stopped altogether, with no variation in the steady revolutions of the shaft. In this form the gear can be used to supply oil pressure to operate any hydraulic machine, and to control its motion entirely.

By connecting the two ports of a running "V.S.G." pump to the corresponding ports of another exactly similar machine, the second machine will be revolved as a motor. The reciprocal action in two such similar machines is, in fact, equal and opposite. Referring again to Fig. 5, suppose oil to be forced in through the near port of the valve-plate and allowed to flow freely out by the other port. All the near set of pistons are then forced out, and the pressure of their connecting rods on the socket plate will cause it to turn in the opposite direction to the arrow, the shaft of course turning with it.

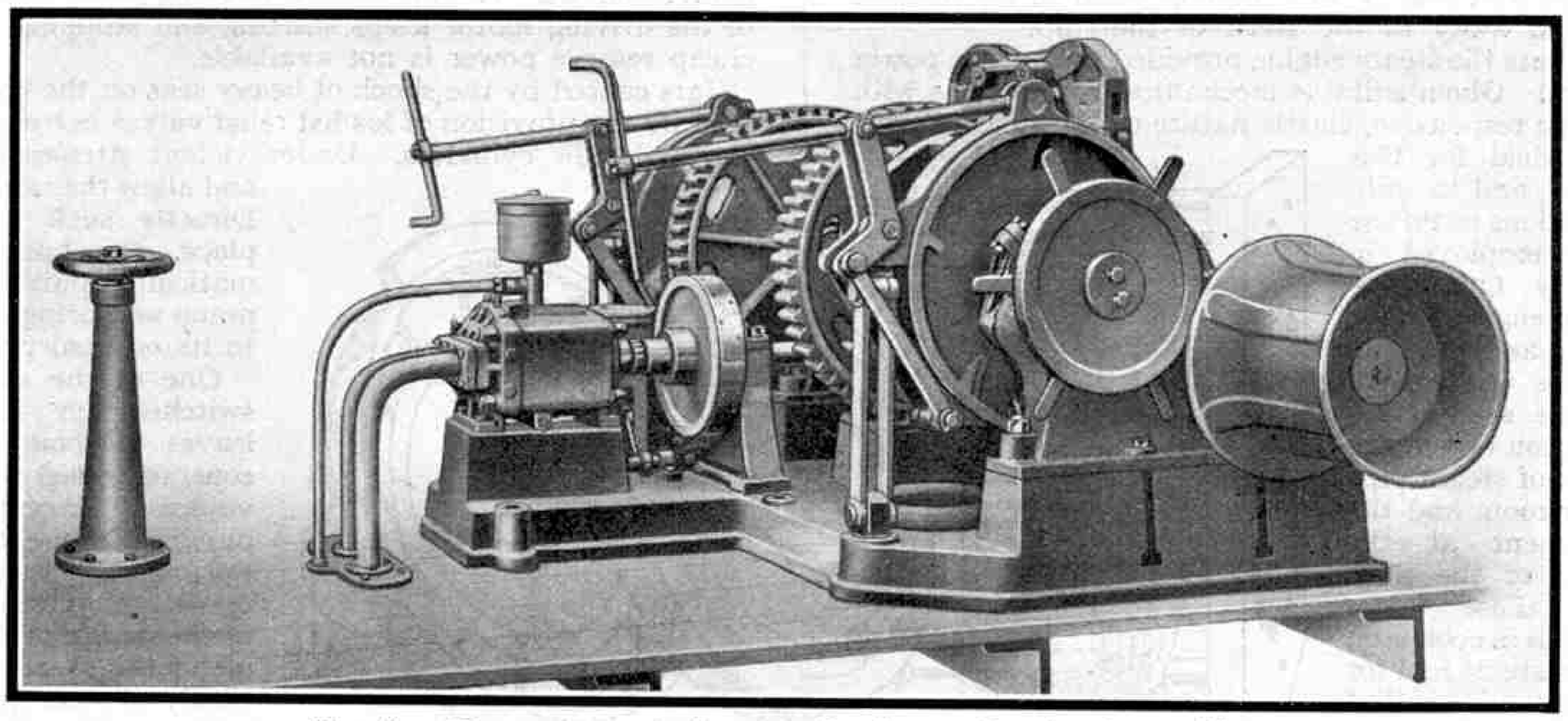


Fig. 3. The anchor windlass on the forecastle of a large ship.

When two gears are used in this way, the variable pump part is called the "A" end, and the hydraulic motor part the "B" end. The tilting box of the B end is permanently fixed at an angle of about 20°, giving it a constant length of stroke. The direction of rotation and speed of the B end is controlled entirely by varying the tilt at the A end. Sometimes space is saved by bolting an A and a B end together, with a common valve-plate between them; or if the electric motor and the A end are required to be some distance from the B end, their ports are connected by two hydraulic pipes to carry the oil.

The casing that encloses all working parts of these gears is kept full of oil, so that efficient lubrication of the Michell bearings and all working parts is ensured and friction is reduced to a minimum. This oil in the casing does not come under pressure. Any small oil leakage in the pressure system is made up automatically through non-return valves fitted to each of the two valve-plate ports, and connected by pipes to small oil replenishing reservoirs placed somewhere overhead. There are also spring-loaded relief valves in each port of the valve-plate, which allow oil to short-circuit across from one port to the other if the working pressure should become excessive. These relief valves guard the mechanism from risk of damage through overloads.

Control gear for varying the angle of the tilting box of a "V.S.G." pump may be some simple form of hand gear, or it may be automatic, or a combination of both. Automatic control is effected by means of a small pressure cylinder and ram opposed to an adjustable loaded spring and connected with the tilting box. As the oil pressure in the pump rises, the small control ram is forced out and reduces the angle of tilt. When it reaches a maximum predetermined pressure, the tilting box is pushed over to the neutral position, all stroke is taken off the pistons, and the pump "idles" until the pressure begins to drop. The normal working oil pressure is about 300 lb. to 500 lb. per sq. in., but it may rise to from 1,000 lb. to 1,500 lb. per sq. in. to overcome unusual resistance or to produce the effort required to start a heavy load. For special purposes there are machines to work up to still higher pressures.

In order to relieve the control mechanism holding the tilting box from all strain or vibration when the gear is worked at high speeds and pressures, four small balancing rams inside the casing are secured to the tilting box, two near the top and two near the bottom. The cylinders working these rams are mounted on the valve-plate and connected two to each port in such a way that they act as pressure-filled dash pots, and resist any tendency of the tilting box to vibrate. These control rams are shown in Fig. 5, disconnected from the tilting-box.

An important feature of these gears is that by shortening the stroke of the pump it can, if called upon, produce higher pressure in the smaller quantity of oil delivered. When connected to a B end, which has a fixed stroke, the shaft of the B end will revolve more slowly as the stroke at the A end is reduced; but the slower it revolves the higher will be the oil pressure available and the greater the torque it can produce. Thus the highest possible torque is available at starting up or at slow speeds.

Fig. 4 shows an actual "V.S.G." pump with the casing removed. This particular pump is intended to provide oil pressure in one

direction only, to work the ram of a large hydraulic lift. Pumps of similar type can be used for hydraulic presses, etc. In this case an electric motor drives the shaft through gear wheels running in the oil inside the casing. No external gear is fitted to control the stroke of this pump, but the angle of the tilting box is regulated automatically by pressure-worked rams working against springs inside the casing. These pressure-controlled rams are shown in the photograph. The four blank cylinders seen in the casting of the valve-plate are for the tilting box balancing rams previously referred to. As this pump has no external control fitted, the balancing rams are not required.

Efficiency in steering is of vital importance to the navigation of a ship, and there is no unit of her auxiliary machinery upon which more thought has been concentrated than the steering gear. Apart from hand gear, which in all but the smallest vessels is only fitted for emergency, many types of steering gear are to be found at sea. Among the best known are the electro-hydraulic type worked by "V.S.G." pumps.

Few machines are required to work under such trying conditions for very long periods as the steering gear of an ocean-going ship. Controlled, as it always is, by some form of "hunting gear" operated by the helmsman far away on the navigating bridge, the steering gear must respond instantly to every movement of the steering wheel. After lying inert for some time it may be called upon to turn the ponderous rudder head slowly but accurately through one or two degrees. Full helm either way may be required very quickly at any moment; and for long periods it may constantly have to start, stop and reverse at varying speeds. It must act with equal precision whether the torque necessary to turn the rudder head at the moment is heavy or light. It must be able to hold the rudder over at any angle of helm, whatever the resistance due to the speed of the ship; and it must be unaffected by the shock of heavy seas transmitted through the rudder head. Above all, it must be thoroughly reliable under all conditions, and able to take care of itself in its isolated compartment tucked away in the stern of the ship.

For very many years the steam engine provided the motive power in all steering gears. Given suitable mechanical connections with the rudder head, the responsive, elastic nature of the steam engine makes it almost ideal for this particular purpose; and in spite of the known objections to its use it is still largely employed in steering gears to-day. One objection is that a steam engine that is continually starting and stopping must necessarily be wasteful of steam. Then there are further losses by condensation or leakage in the long lengths of steam pipe between the boiler room and the steering compartment at the extreme after end of the ship. Taken together, these losses mean appreciable loss in economy, with consequent waste of fuel for the boilers. Another point is that the constant heat given off by these steam pipes in passing through cargo spaces and living quarters is sometimes troublesome.

The increasing application of electric power for auxiliary purposes in steamships naturally led electrical engineers to concentrate on the production of electric steering gears. The advent of the Diesel-engined ship in which, unless donkey boilers are provided, no steam is available for auxiliary purposes, hastened the development of these electric gears. By using electric power for steering gears the drawbacks of the steam gears referred to are avoided. Unfortunately, however, the electric motor is not by nature so elastic as the steam engine in transmitting power. In its simplest forms, therefore, an electric motor cannot effectively replace the steam engine in steering gears. To produce the starting torque on a heavy rudder head, and to follow exactly the erratic movements of the steering wheel, necessitates the provision of specially-designed electric motors and elaborate electrical control gear if sparking and trouble are to be avoided. Such purely electrical installations have been produced, and they are perfectly effective. The electro-hydraulic system, now to be described, gives results quite as good as, if not better than, the purely electric systems, while using the simplest form of electric motor as its motive power.

Fig. 2 is a photograph of a four ram electro-hydraulic steering gear fitted with "V.S.G." pumps. This set, which is capable of exerting a torque of 300 foot tons on the rudder head, is in use in ships of 27,000 tons displacement.

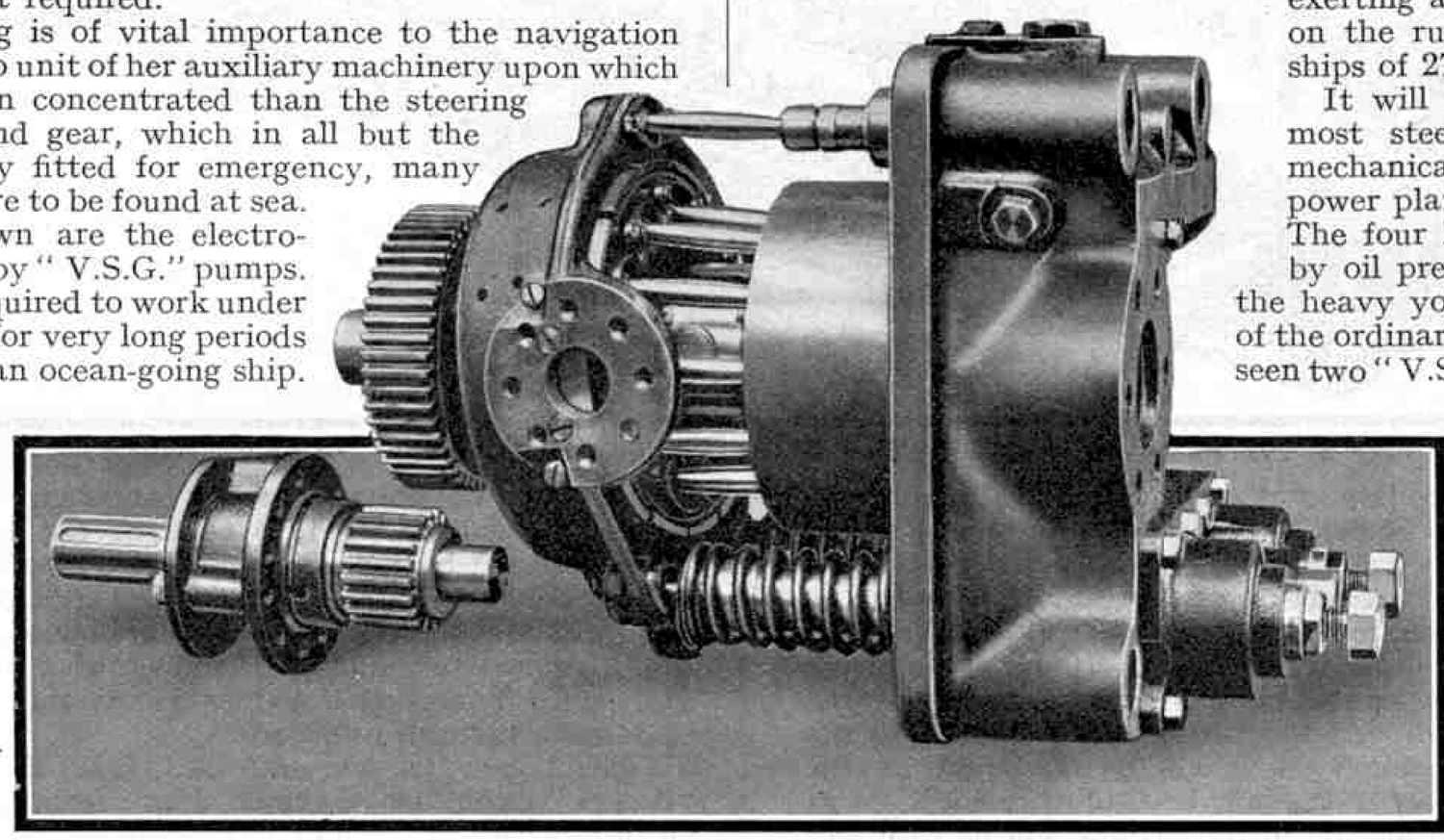


Fig. 4. View of a "V.S.G." pump with the casing removed.

It will be noticed that, unlike most steering gears, it has no mechanical gearing between the power plant and the rudder head. The four hydraulic rams, worked by oil pressure, connect direct to the heavy yoke that takes the place of the ordinary tiller. On the right are seen two "V.S.G." pumps, each driven by an electric motor. Only one of these pumps is used to work the gear, the other one, with its motor, being available as a standby. The inclination of the socket ring in the pump is controlled by a very simple form of hunting gear worked off the telemotor gear from the steering wheel and the rudder head. In its "neutral" position the pump idles, and the oil locked in the system holds the rudder firmly. When stroke is put on the pump, two diagonally opposed rams receive oil pressure, while the other two exhaust back to the pump. The direction and speed of the rams' movements are accurately controlled by the stroke put on the pump.

The simplest form of non-reversing shunt motors are used with this gear. An interesting point with regard to the running motor is that the inertia stored in its spinning armature provides a reserve supply of power to overcome the starting resistance whenever the helm is moved. In pure electric steering gears, where the armature of the driving motor keeps starting and stopping, this useful and cheap reserve power is not available.

Jars caused by the shock of heavy seas on the rudder are eliminated by the provision of loaded relief valves between the pump and the hydraulic cylinders. Under violent stresses they by-pass oil and allow the rams to give a little. Directly such movement takes place, the hunting gear automatically puts stroke on the pump and brings the rudder back to its original position.

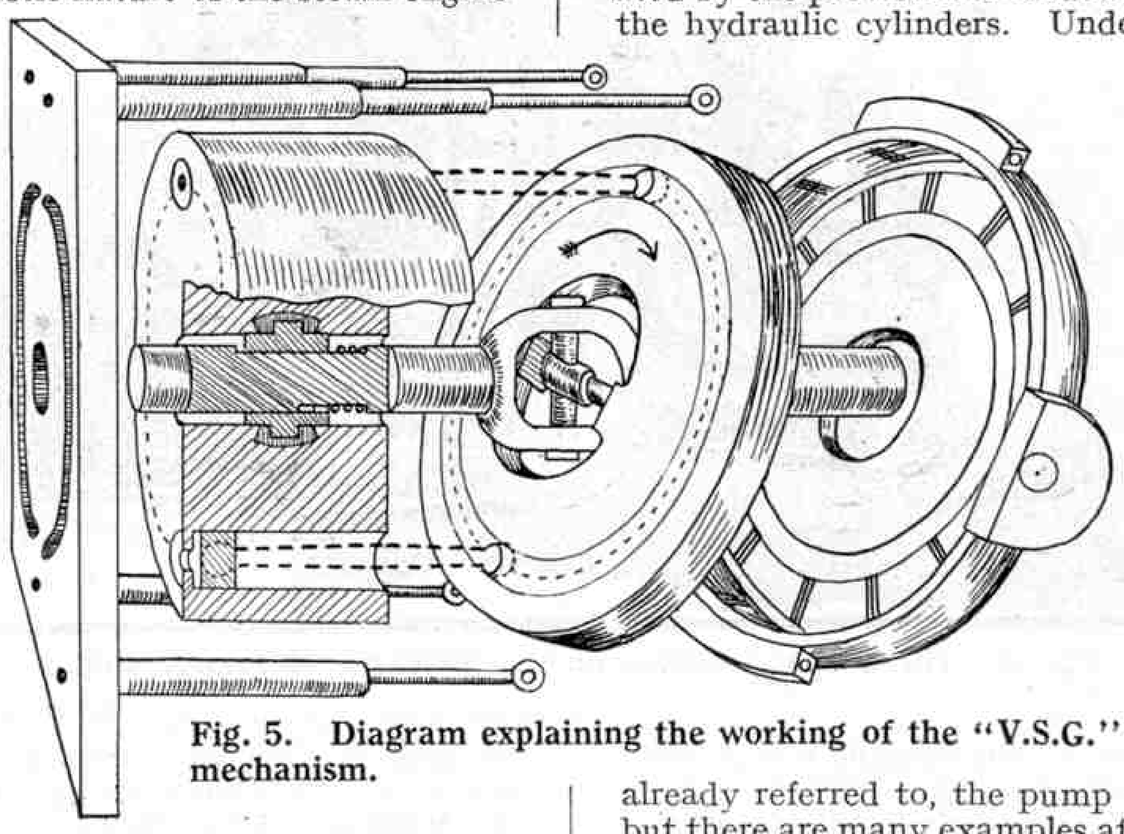


Fig. 5. Diagram explaining the working of the "V.S.G." mechanism.

One of the electric motors is switched on before the ship leaves harbour, and runs at constant speed till the end of the voyage. Except for the slight humming noise from this motor the steering gear is silent in operation. Owing to the nature of the design of this gear and the oil in the system, there is practically no wear and tear of moving parts, so that the gear is easy to maintain and requires very little attention.

In the applications of "V.S.G." already referred to, the pump part of the gear only is employed; but there are many examples at sea of the use of the pump together with its rotary hydraulic motor.

Fig. 3 shows the anchor windlass on the forecastle of a large ship. This windlass takes 2 in. studded link cables on its main drum, and has warping bollards for hawsers at each end. There are also more powerful types of "V.S.G." driven anchor windlasses and capstans for taking the largest ship's $3\frac{1}{2}$ in. studded cables. In the illustration, the B end only of the gear is seen. The A end, with the electric motor driving it, is down below decks out of the wet, and is controlled by the hand wheel abaft the windlass. The large hand brakes shown are used to hold the windlass when the ship is riding at her anchor. They are not (*Continued on page 199*)

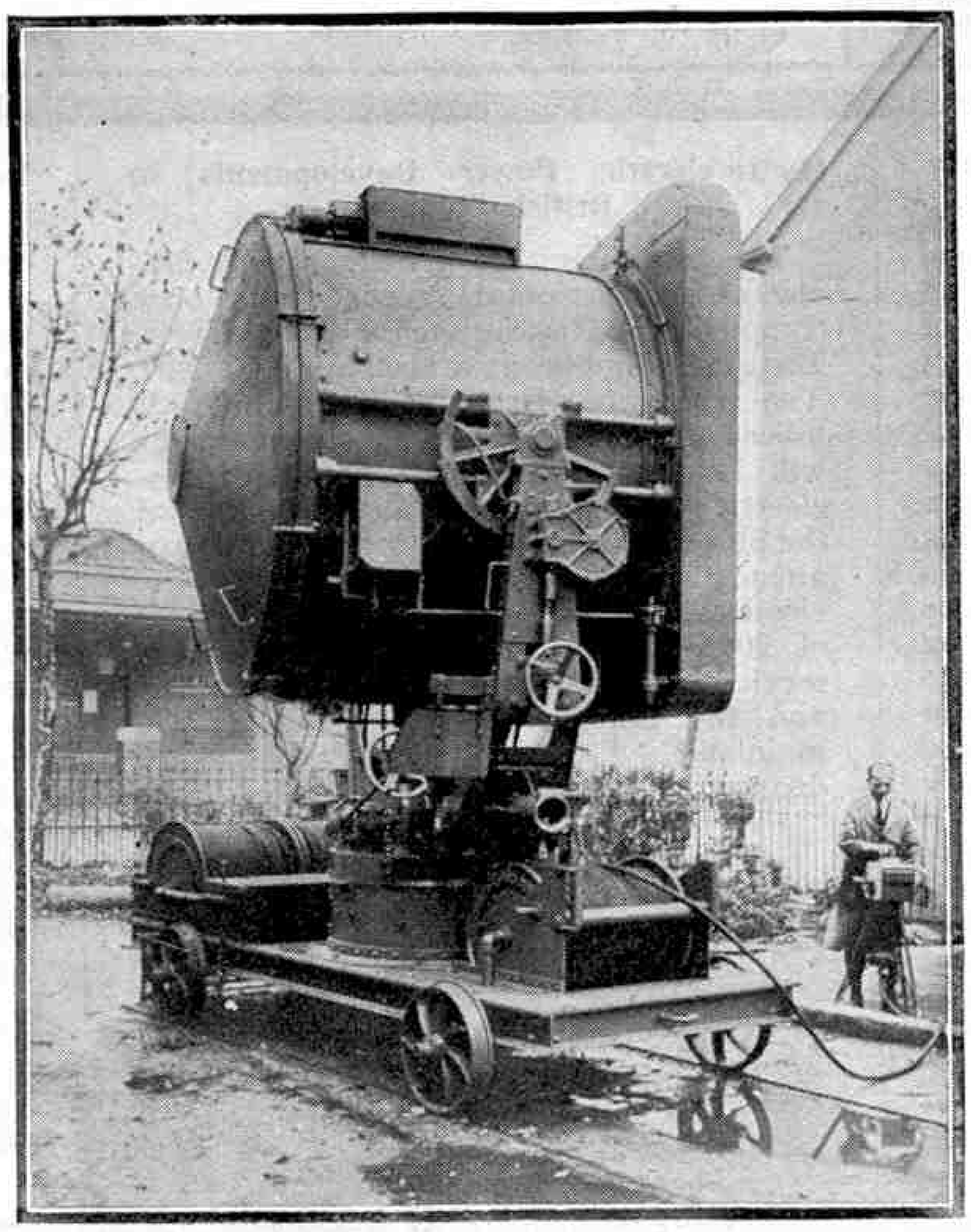
The World's Most Powerful Searchlight

A Beam of 3,500,000,000 Candle Power!

ONE of the most remarkable developments of recent years has been the enormous increase in the brilliance of artificial lighting for both public and private purposes. It seems almost incredible to us nowadays that domestic operations could have been carried on by the feeble light of the old "batswing" burner. It is true that the coal gas of those days was much better suited to a burner of this type than the gas of to-day, but even so the illumination of the average room was miserably poor compared with present day standards. The same state of affairs existed, of course, in regard to street lighting, the lamps giving only a feeble yellow light that was of little use except in the immediate vicinity of the lamp itself.

One factor that has played a very important part in the development of artificial lighting has been the speeding-up in the various means of locomotion. Before the motor-propelled vehicle arrived, for instance, the ordinary oil lamp seemed to be quite adequate for the needs of cyclists, but such lamps would be utterly useless for the motor car or motor cycle of to-day.

The speed of warships has played a considerable part in the development of the form of light with which we are now particularly concerned, namely, the searchlight. As long as warships were comparatively slow and had guns of short range there was no special need for a light of exceptional power. Nowadays, however, when warships attain speeds of as much as 40 miles an hour and have guns with an effective range of many miles, the case is very different, and the most powerful light that can possibly be obtained is none too efficient.



One of the two 3,500,000,000 c.p. Searchlights built for a European State by the London Electric Firm of South Croydon, Surrey. The huge size of the apparatus can be judged by comparison with the man on the right of the photograph.

A searchlight is an electric arc lamp provided with special arrangements for projecting the light in any required direction. The discovery of the electric arc is due to one of the greatest of English scientists, Sir Humphry Davy. In 1802, while carrying out a series of experiments at the Royal Institution, London, Davy found that if two rods of carbon, one connected to each terminal of his great battery of 2,000 cells, were first brought into contact and then gradually separated, a brilliant arch of light was formed between them.

The intense brilliance of this arch, or arc, as it was subsequently called, suggested the possibility of utilising it for illuminating purposes. The discovery was before its time, however. Although the arc could be produced by means of a large voltaic battery, the cost of maintaining this was far too high to be practicable; and it was not until the dynamo became a reliable source of current that the arc lamp became a commercial possibility.

In pre-war days we associated searchlights almost entirely with warships. For land use these lights may be said to have come into their own during the Great War, when they proved of very great value in dealing with attacks from the air. Those who remember the German aeroplane attacks upon London will recall the wonderful spectacle of searchlights sweeping the sky in every direction, seeking for hostile machines and endeavouring to hold them in their beam when found.

In the searchlight the light of the arc is concentrated by a reflector and sent out as a bundle of parallel rays of great intensity, the illuminating power varying with the size of the projector. Powerful as are the projectors used on warships, they are eclipsed by those for land use. It is not so very long since a searchlight of 30,000 or 40,000 candle power was regarded as quite extraordinary, but recently there have been constructed by the London Electric Firm, of South Croydon, Surrey, two searchlights producing no less than 3,500,000,000 candle power! If the difficulty of the Earth's curvature could be overcome, the light from these searchlights would be visible for hundreds of miles. These remarkable searchlights, which we believe are the largest in the world, were constructed to the order of a European State, for use in connection with coast defence work.

As might be expected, these searchlights are of massive proportions, the apparatus being about 14 ft. in height. The projector is approximately 7 ft. in diameter and is mounted on a trolley provided with cast steel flanged wheels to permit of the apparatus running on a narrow gauge track. It contains a parabolic mirror of silver glass, a high-intensity arc lamp, a plain front-closing glass and a louvre shutter. This shutter enables the light to be cut off instantly when required, without the necessity of extinguishing the arc.

In order to increase the utility of the projector to the utmost, special arrangements are provided for effecting control of its movements either locally or from a distance. The distant control is electrically operated, and if necessary the operator may be miles away. The light has an elevation angle of 90 degrees.

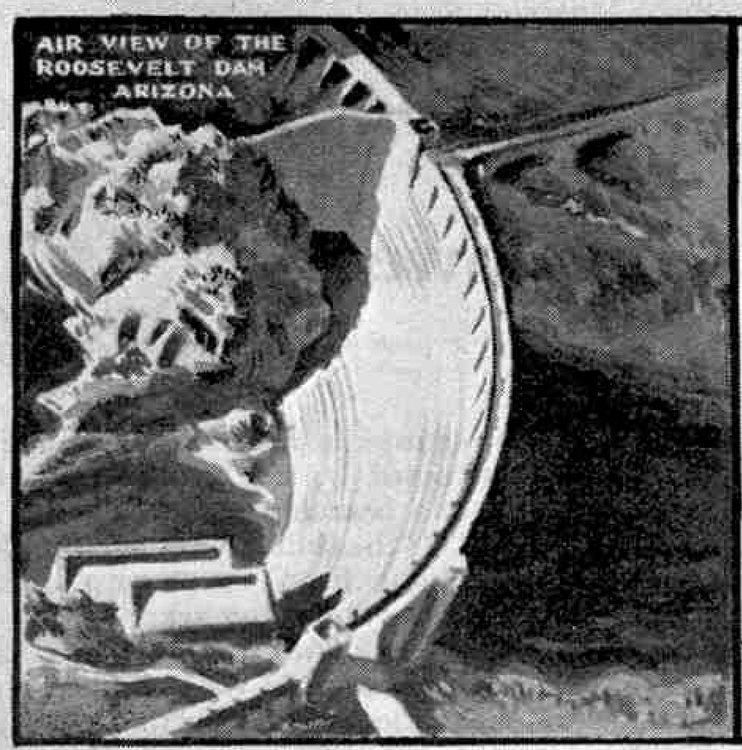
When the searchlight is being used to locate an object, either quick or slow motion of the beam may be given, slow motion generally sufficing when once the object has been sighted. An optical device known as a "Focuscope," which forms an image of the arc on a small ground-glass screen, greatly simplifies the operation of focussing. In addition there are the usual sighting tube and the coloured glass window through which the arc can be observed.

The cylindrical lantern barrel is built of sheet steel and is provided near the rear end with a light-tight internal-sliding door, so that a man can enter for the purpose of cleaning the mirror and effecting any necessary adjustments. Inside the barrel is a horizontal footplate to enable the cleaner to carry out his work in comfort.

The front-closing glass fitted to the front end of the lantern barrel consists of a number of segmental panes of plate glass. These panes are slid in position by two rings, of which the inner one is so designed that any segments of glass can be removed without disturbing the others.

The arc lamp of this searchlight is of the high intensity type and will burn for about two hours between trimming operations. The inclined negative carbon is 14 m.m. in diameter and the horizontal positive carbon is 16 m.m., the latter being rotated practically continuously by means of ratchet gear, to assist in producing a uniform crater. This crater is so small as to be little more than a point and as a result the parallel beam of light emitted is of high penetrating power. The generation of an arc light of 3,500,000,000 candle power is not carried out without the production of great heat and volumes of fumes, and in this huge searchlight the hot air and gases from the lamp are drawn off by an electrically-driven fan mounted on the top of the barrel. The fan motor is switched on simultaneously with the current supplied to the lamp.

Searchlights for warships have been brought to a very high pitch of perfection. It is evident that in the (*Continued on page 251*)



Engineering News of the month.

Construction of Giant Cunarder Begun

Work on the new Cunard liner, to which several references have already been made in these pages, has now begun in the yards of John Brown & Co. Ltd., of Clydebank. Details of the new vessel which were recently made public show that it will be 1,018 ft. in length and will have a gross tonnage of 75,000. No definite announcement has yet been made in regard to the type of propelling machinery that will be employed, but it is thought that quadruple-screw Parsons turbines with single reduction gearing will be used. If machinery of this type is installed, it is probable that high pressure oil-fired boilers of the Yarrow water-tube type will be used to generate the necessary steam.

It is interesting to note that the liner will be of such a size that it will be necessary to widen and deepen the River Clyde in order that it may be launched in safety. Opposite the slipway from which the vessel will be launched, a large section of the bank is to be cut away, and the river channel at Rashielee also will require widening. The cost of the necessary work is estimated at £79,000.

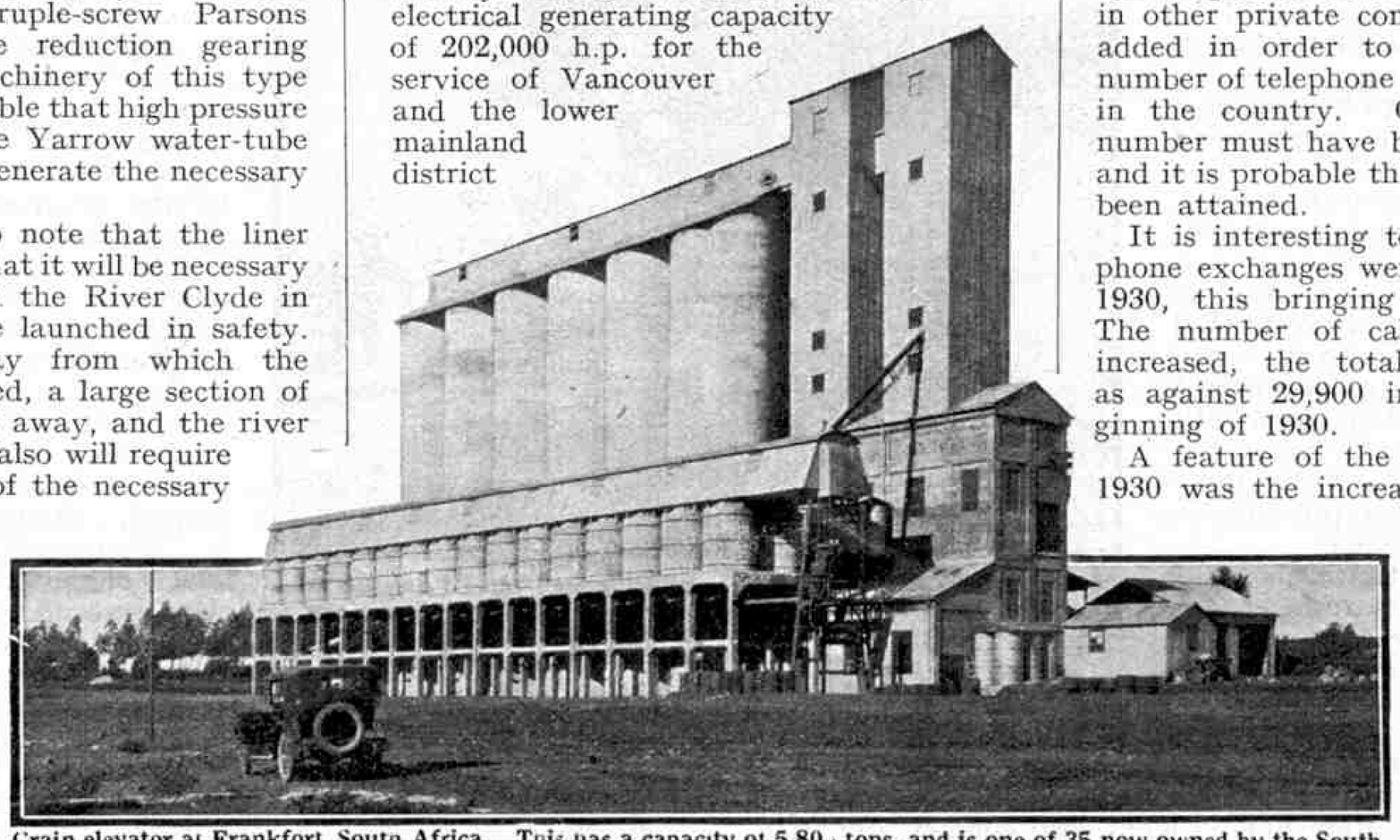
The new liner should be ready for launching in May, 1932, and if no setbacks are experienced and this operation is carried out according to schedule, she will be ready to undergo sea trials in September, 1933.

In order to accommodate the new liner a new graving dock is to be built at Southampton. This will be the largest in the world. It will be 1,200 ft. in length, 45 ft. in depth, and will have a width at the entrance of 135 ft. A definite decision has not yet been made in regard to the site of the dock, but if this is to be ready for service in 1933, the work must be commenced at an early date, and carried on without interruption.

It is interesting to note that the construction of the dock has been decided upon as being more economical than enlarging the famous Southampton floating dock, below which constant dredging is necessary. Before this dock could be moored in position, it was necessary to dredge the bed of the river to a depth of 65 ft. and altogether to remove about 940,000 c. yds. of soil.

Hydro-electric Power Developments in British Columbia

The initial unit of a huge new hydro-electric power plant recently has been completed at Ruskin, on the Stave River, British Columbia, at a cost of £1,500,000. The new generating station is about 35 miles east of Vancouver and when complete will be the third largest of the hydro-electric power plants utilising the waters of the Stave watershed. The three plants have already made available a total electrical generating capacity of 202,000 h.p. for the service of Vancouver and the lower mainland district of British Columbia.



Grain elevator at Frankfort, South Africa. This has a capacity of 5,800 tons, and is one of 35 now owned by the South African Railways and Harbours, in addition to port elevators at Cape Town and Durban. Our photograph is reproduced by permission from the "South African Railways and Harbours Magazine."

The initial unit now installed in the Ruskin plant develops 47,000 h.p., but eventually the station will be fitted with four units of equal size, and will develop a total of 188,000 h.p. The generating unit already in service is the largest in Canada, the rotor being 28 ft. in diameter. The weight of the revolving parts of the generator and turbine is 650,000 lb., and when the hydraulic thrust is added, the weight borne by one bearing reaches 1,000,000 lb.

The concrete dam erected across the Stave river at Ruskin is 195 ft. in height and 420 ft. in length on the crest. From it, water will be conveyed to the power house through a number of penstocks, 19 ft. in width, of which only one is at present in use. This carries 3,500 c. ft. of water per second, the equivalent of 45,000,000 gallons per day.

Two Million Telephones in Great Britain

According to statistics recently issued there were 1,958,000 Post Office telephones in use at the beginning of this year, a figure that exceeds the number in service at the beginning of 1930 by 110,000. This figure does not include the number of instruments in service on the Hull, Guernsey, and Jersey systems, the addition of which would bring the number up to about 1,997,000. To these the telephones in use on the railways and in other private companies also must be added in order to arrive at the total number of telephone instruments in service in the country. On 1st January the number must have been nearly 2,000,000, and it is probable that this figure has now been attained.

It is interesting to note that 230 telephone exchanges were constructed during 1930, this bringing the total to 4,836. The number of call stations also was increased, the total now being 33,800, as against 29,900 in service at the beginning of 1930.

A feature of the telephone service of 1930 was the increase in the number of automatic exchanges, 31 of these, which between them serve 22,270 subscribers, having been opened. Seven of the new exchanges were installed in London. That city now possesses 30 automatic exchanges, which deal with calls from about 96,000 subscribers, the exchanges opened last year adding 10,300 to the number of subscribers using the automatic call system.

World's Record for Captain Campbell

Captain Malcolm Campbell was successful in his attempt to create a new land speed record, to which reference was made on page 126 of the "*M.M.*" for February. In the "*Blue Bird*" he covered the measured mile on Daytona Beach in two directions at an average speed of 245.736 m.p.h., thus exceeding the record made by the late Sir Henry Segrave by more than 14 m.p.h. The greatest speed was attained on the southward run, the car travelling at 246.575 m.p.h. although the conditions were not very favourable. During preliminary trials Capt. Campbell achieved the wonderful speed of 265 m.p.h.

Automatic Lifts in Skyscrapers

The automatic lifts in operation in the huge office buildings of America are of considerable interest to those who have not had the opportunity to study them at first hand. They provide the only means of quick access to the higher floors and it is their efficiency that has made the skyscraper a solution of the problem of finding accommodation in the limited business areas of New York and other American cities.

A good example of an American lift system is that in the New York News Building. This includes 16 cars, 13 of which are used for the transport of passengers, two for goods and the third for service purposes. Stopping at each of the 36 floors of the News Building in turn would take quite a considerable time, and therefore only five lifts travel to the highest floor. These ascend and descend at a speed of 700 ft. per min., and after starting from the ground floor do not stop until the 23rd floor is reached. Five other lifts travelling at the same speed operate between the first and the 23rd floors, stopping only at those above the ninth. The remaining three cars are only used for "local" calls between the first and ninth floors. They have a speed of 600 ft. per minute.

The lifts are fitted with a special control system similar to the one in use in the "*A Noite*" building, at Rio de Janeiro, and described on page 856 of our issue for November, 1930. On this system passengers call the number of the floor at which they wish to alight as they enter the car. The operator then presses a button on which is a number corresponding to the one called. Electric relays brought into action during the journey then cause the car to stop automatically at each floor where a call has to be made.

Passengers wishing to board a lift press a button beside the gates and this also stops the car at the required point. When a lift is full, or if so many stops are being made that time is being lost by any one car, an operator in a central office moves over a switch and the car is allowed to proceed without being stopped by external signals. Electric signs tell this operator where every lift is at any moment, and also show him where requests have been made for it to stop.

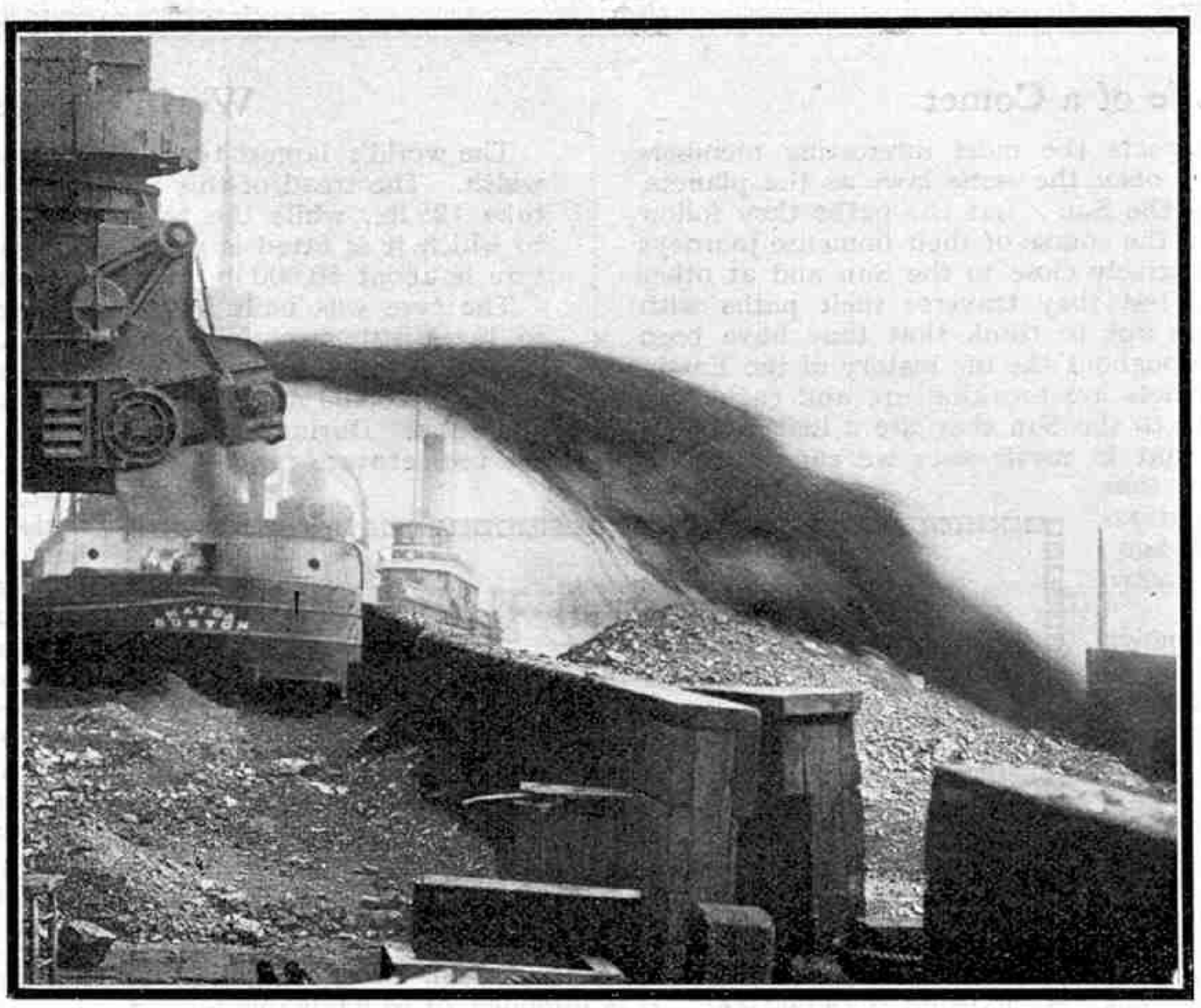
British Level Luffing Cranes for Gibraltar

A British firm has recently secured the order for the construction of four 5-ton level luffing cranes, complete with transporter bridges for coal-handling operations on the Mole at Gibraltar. The transporter bridges will each be 118 ft. in length and 100 ft. in height. The cost of the four cranes is estimated at about £30,000.

Progress at Scapa Flow

The latest vessel to be raised at Scapa Flow is the 20,000-ton battle cruiser "*Von der Tann.*" This vessel was sunk in 13 fathoms of water on 21st June, 1919, and has since remained keel uppermost. After the vessel had been brought to the surface, it was towed a short distance into slightly shallower water, preparatory to starting on its journey to Lyness Pier, where the depôt of Cox & Danks Ltd., the salvage engineers in charge of operations, is situated.

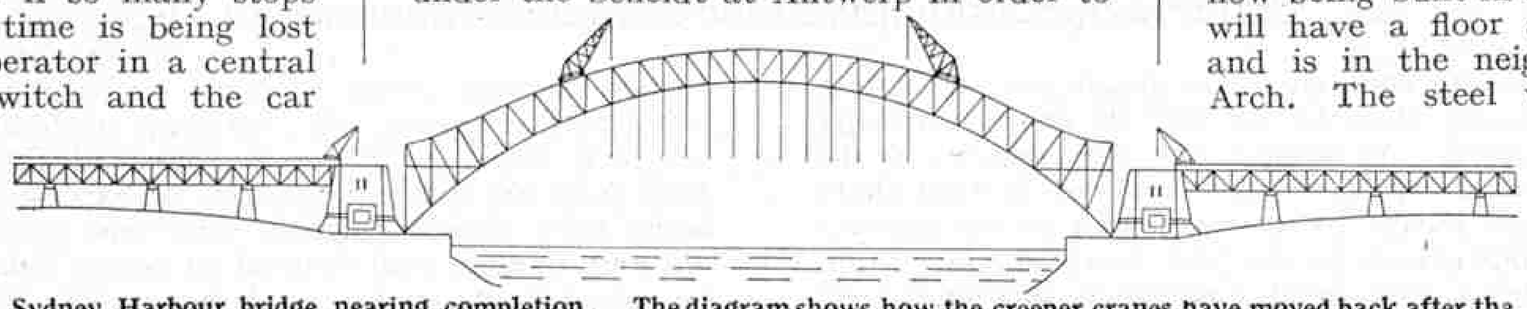
During the seven years they have been working at Scapa Flow, vessels with a total tonnage of 150,000 have been raised by Cox & Danks Ltd. These have included 25 destroyers, four battle cruisers, one battleship and one light cruiser. Attention is now being turned to the "*Prinz Regent Luitpold,*" and it is expected that this vessel will shortly be ready for bringing to the surface.



High speed coal dumper at work at the Curtis Bay, Baltimore, pier of the Baltimore and Ohio Railroad. The plant is one of the largest of its type in the world, and has a capacity of 4,000 tons per working hour, or 10,000,000 tons per year under normal conditions. It was described in the "M.M." for March 1929.

Tunnelling Under the Scheldt at Antwerp

Two tunnels are to be constructed under the Scheldt at Antwerp in order to relieve traffic congestion in the city. One of them will be for the use of vehicular traffic and the other for pedestrians only. Including the necessary approaches the length of the first of these will be 7,500 ft., but that of the second will be only about 1,500 ft. The contract for the work has been awarded to a Liège firm, who state that the vehicular tunnel should be completed in 1,000 working days, while the smaller one will only occupy 650 working days.



Sydney Harbour bridge nearing completion. The diagram shows how the creeper cranes have moved back after the sections of the arch have been joined in order that the hangers and cross girders may be erected.

Reconstruction of the Kingsway Tunnel

On page 845 of our issue for November, 1929, we gave details of the proposed reconstruction of the Kingsway Tramway Tunnel, London, in order to enable double-decked tramcars to pass through it. The subway extends from the Westminster Embankment to the junction of Southampton Row and Theobalds Road, a distance of about ⅝th of a mile, and when the work was commenced it was expected that it would be completed by the beginning of this month. Actually it was finished well in advance of the scheduled time, and after being closed since 3rd February, 1930, it was re-opened on 14th January of this year.

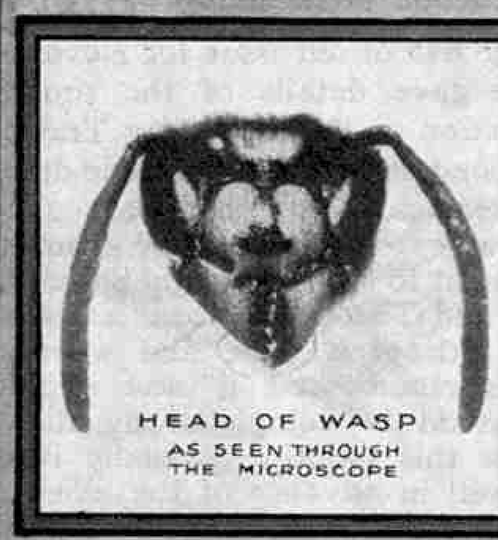
The engineering work involved in the reconstruction was of an interesting character. In order to increase the height of the subway sufficiently, the track had to be lowered by about 5 ft., except at the Southampton Row end. There the contractors decided that it would be easier to raise the roof, which is now very little below the level of the roadway. At this end the subway formerly consisted of two cast iron tubes and brick arches. It is now a single tunnel, covered by a steel roof supported on steel stanchions, which in turn are encased in concrete.

Special care was necessary in dealing with the portion of the subway immediately beneath the Strand, because of the heavy overhead loads it carried. At that point also it consisted of two tunnels. The bottom halves of the two cast iron tubes were removed, and concrete walls were then built to support the upper sections of the tubes, which meanwhile were held in position by means of timber struts. During the reconstruction the Aldwych and Holborn stations were considerably enlarged and improved.

Huge Hotel Building for London

A hotel building, the steel frame for which will weigh over 10,000 tons, is now being built in London. The building will have a floor area of 56,000 sq. ft. and is in the neighbourhood of Marble Arch. The steel work is being manufactured and erected by Dorman, Long & Co. Ltd., the well-known firm of structural engineers.

Some idea of the work entailed in the erection of the gigantic building may be gathered from the fact that 3,000 tons of steel will be required for the foundation and basements alone! The hotel will have eight floors, in addition to a basement and sub-basement, and will contain 900 bedrooms. It will be fitted with a flat roof, and a novel feature will be that it will be served by a separate tube railway station. The booking hall will be below Oxford Street and will be reached through the main entrance to the hotel.



Of General Interest

The Life of a Comet

Comets are in many respects the most interesting members of the Solar System. They obey the same laws as the planets, and like them travel round the Sun; but the paths they follow are of a different shape. In the course of their immense journeys they are sometimes comparatively close to the Sun and at other times far away in space; but they traverse their paths with such regularity that we are apt to think that they have been behaving in this manner throughout the life history of the Earth. In reality, however, the comets are breaking up, and each time we see them on their return to the Sun they are a little smaller. They break up so slowly that in most cases we cannot detect any change even when we take into consideration observations made hundreds of years ago; but in time all the comets known to us will disappear.

The total life of the well-known Halley's Comet probably will not extend over more than 250,000 years; and other comets appear to be breaking up even more rapidly. For instance, Encke's Comet, a small one that returns to the Sun after a journey through space of only 3⅓ years, is not likely to have a life of more than 10,000 years. Large comets live longer than small ones, but it is believed that very few will have an existence of more than 10,000,000 years. Compared with the Earth, comets may be said to have a short life and a merry one. They career about the Solar System for a few million years, while the Earth has steadily pursued its regular course round the Sun for well over a thousand million years, and appears likely to continue to do so for at least as long a period.

It appears therefore that comets are comparatively recent additions to the Solar System, and this raises the interesting question of their origin. It is thought that they are fragments of matter that have come sufficiently close to the Sun to be captured by its gravitational attraction. At present the Sun appears to be in a very thinly populated region of the Universe, so that there is more likelihood of the escape of a comet than of the capture of a new one. At various periods in the past, however, the system of which the Earth forms part must have been surrounded by many more stars and other heavenly bodies than at present; and the interesting suggestion has been made that most of the comets that we now see, and many that have long since been broken up or have escaped into outer space, were captured about six or eight million years ago. At that time the Solar System passed through the constellation of Orion, and perhaps through one of the great nebulæ associated with it. Some of the fragments of matter in this region may then have been captured and carried along by the Sun.

Comets clearly visible to the naked eye are rare to-day; but if this theory of their origin is true they must have been very common objects at the time of Man's first appearance on the Earth, perhaps 7,000,000 or 9,000,000 years ago.

Over a Hundred Years Ago!

Across the Atlantic

"Steam Boats. A company is forming in London to establish a steam-boat communication between Great Britain and the United States. Our countryman, Perkins, is of opinion that the project is practicable, and that the passage can be made within twelve days."—"LIVERPOOL COURIER," 12th September, 1824.

A Ship Canal Never Built

"London and Portsmouth Ship Canal. This grand national undertaking is now decided on. The estimated expense is £4,000,000; it is intended to be navigable for line-of-battle ships; and the largest Indiamen, by the aid of steam vessels, will be able to perform the passage from London to Spithead in about twelve hours."—"LIVERPOOL COURIER," 7th September, 1825.

Magnetic Clothes!

"Captain Franklin states that on the spot where he fixed his winter quarters on his last expedition, he observed that the magnetic needle oscillated whenever he approached it in a dress of waterproof cloth, though it remained stationary when any of the party approached it in their ordinary clothes. He does not, however, offer a satisfactory explanation of this phenomenon."—"THE TIMES," 16th June, 1828.

World's Largest Tyre

The world's largest tyre is 12 feet in diameter and four feet in width. The tread of this mammoth weighs 600 lb. and the inner tube 125 lb., while the total weight of the tyre and the wheel to which it is fitted is about one ton. The load capacity of the tyre is about 50,000 lb., and its value is placed at about £1,000.

The tyre was built by the Goodyear Tyre Company in order to investigate certain problems in connection with the manufacture of those of ordinary size, and it has recently completed a tour of 26,000 miles through the United States, Canada, Mexico and Cuba. During that time all kinds of weather were experienced, the temperature ranging from 20°F. below zero to 110°F. in the shade and, of course, in Mexico and Cuba the rubber became even hotter when the rays of the semi-tropical sun fell directly upon it. In spite of this, and of its contact with mud, sand, snow, ice, and sage brushwood, the tyre returned to Akron in good condition.

Building the tyre occupied three months and it requires so much air that it takes just 45 minutes to inflate it to a pressure of 3 lb. per sq. in. For its long journey it was fitted on a hub fixed between the ends of two shafts that extended in the rear of a specially constructed motor car. An electrically operated brake was fitted to the hub, but this was only used for emergency stops, the brakes on the vehicle itself fulfilling all ordinary purposes.

New Chemical for Use in Refrigerators

The interesting discovery has been made by Mr. J. Midgely, an American chemist, that a substance distinguished by the name of dichlorodifluoromethane is very suitable for use in refrigerating plants. In those at present on the market ammonia, carbon dioxide, ethyl chloride, or sulphur dioxide are used as refrigerating agents, the lowering of temperature being caused by their rapid evaporation. Most of these have the drawback that they are either poisonous or explosive, and thus accidental leaks may cause disaster. The new chemical may be inhaled without danger, and instead of being inflammable may actually be used to put out flames, being similar in this respect to carbon tetrachloride, the liquid that is used in many forms of fire extinguisher. At ordinary temperatures the new substance is a gas. Its boiling point is 30°C. below the freezing point of water, and it becomes a solid when cooled to a much lower temperature.

The new refrigerant is not Mr. Midgely's first important discovery, for he was chiefly responsible for the introduction of ethyl petrol. This consists of ordinary petrol to which a small proportion of a chemical called lead tetraethyl has been added. When used in internal combustion engines the mixture may be subjected to a much higher compression than ordinary petrol without giving rise to pre-ignition, or "knock," and therefore may be used when greater power and sweeter running are desired.

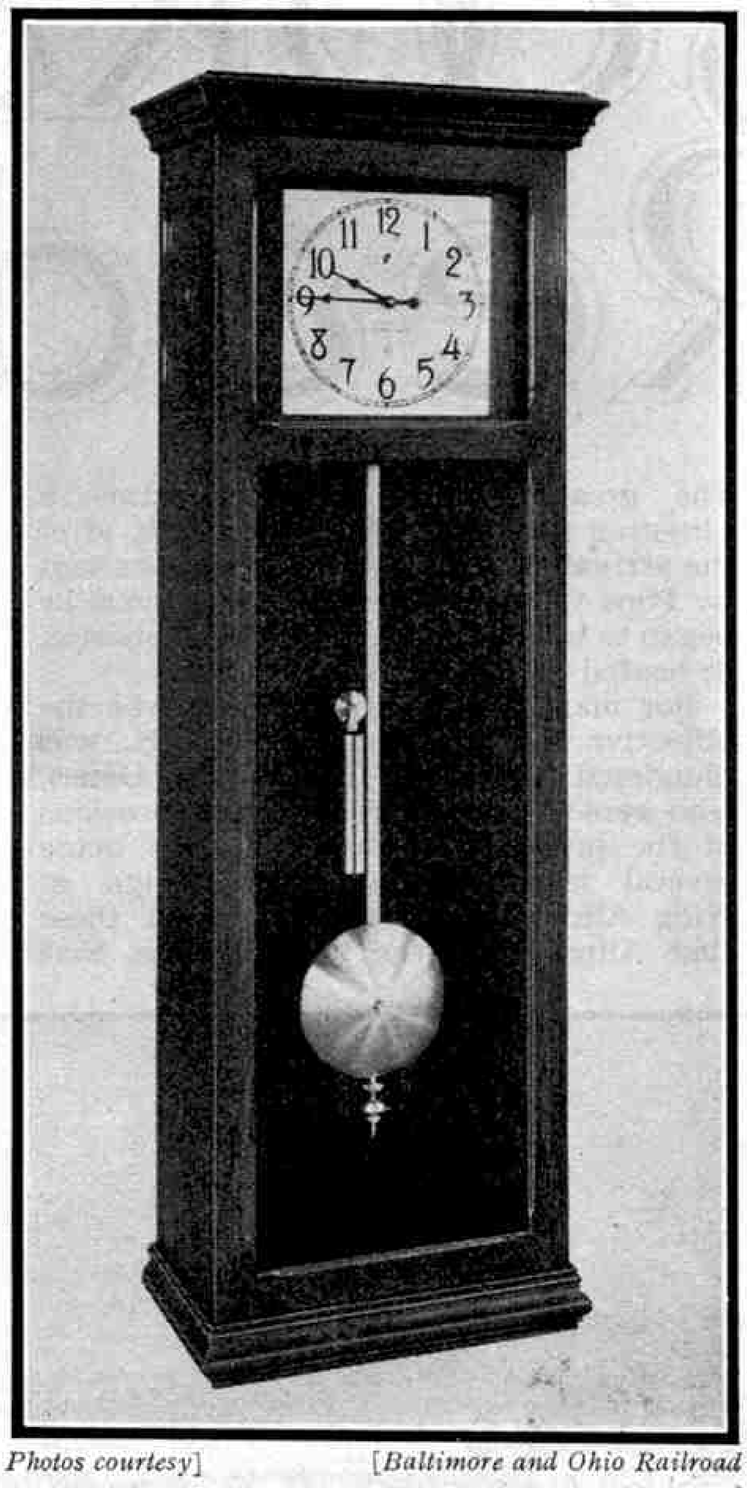
Radio Electric Clock that Corrects Itself

In the September 1930, "*M.M.*" we described the motor coach passenger station that has been opened by the Baltimore and Ohio Railroad in New York. This station forms the centre of the motor coach service provided by this company to connect their Jersey City terminal with the heart of New York. In our description we referred briefly to the radio clock installed in the station. This clock is the first of its kind to be installed in any railroad station in the world, and on account of its great interest we give further details of its operations.

The most remarkable feature of this clock is that it is entirely automatic and does not need any adjustment by hand. It is 6½ ft. in length and 18 in. in width, with a 14 in. dial and a pendulum slightly over 3 ft. in length. It is automatically wound by current from the commercial supply, and power is generated by gravity and transmitted to the pendulum rod. The pendulum swings quite freely and there is no train of gears or springs and no dead-beat escapement.

Connected with the clock is a radio receiving set designed by Professor L. A. Hazeltine, the inventor of the Neutrodyne. This set, which will operate on current either from the commercial supply or from storage batteries, has been built exclusively for the purpose of receiving the time signals from the United States Radio Station at Arlington, Virginia, and it will receive nothing but these signals. Each day at noon, and at 10 p.m., the signals are received and the clock then automatically corrects itself without any kind of supervision. Actually very little correction is necessary, for the clock is remarkably accurate. It has been estimated that it varies less than five beats in the course of 18,400 beats.

This clock acts as a master clock and controls two secondary clocks, one situated in the main lobby and the other in the waiting room. These clocks have marble dials 22 in. in diameter, encased in bronze bezels, with bronze Arabic figures, minute marks and hands. They are connected electrically with the master clock, from which they receive an impulse once in each minute.



Photos courtesy] [*Baltimore and Ohio Railroad*

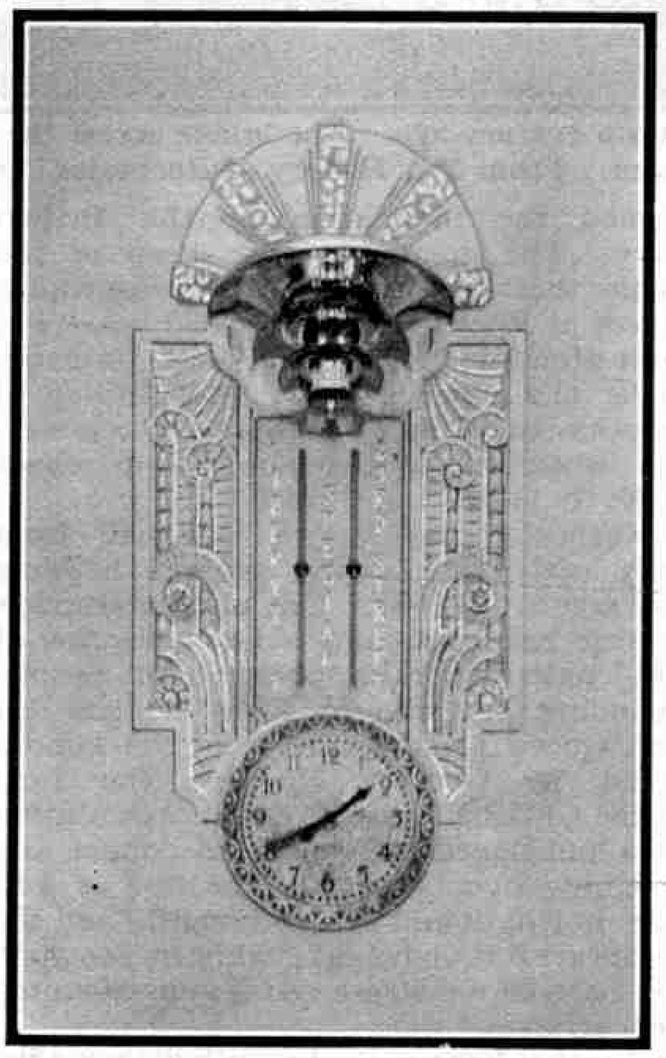
The radio-controlled electric master clock installed in the Motor Coach Passenger Station recently opened by the Baltimore and Ohio Railroad in New York.

Town Where Street Lamps Burn All Day

The most remarkable street-lighting system in the world probably is that of Medicine Hat, a well-known town in Southern Alberta, Canada. Visitors to this town usually are astonished to find that the street lamps are illuminated throughout the day, even when this is bright and sunny, and on enquiry they are still more astonished to be informed that it is far cheaper to leave them burning than to engage men to go round putting them out!

The solution of the puzzle is quite simple —the gas employed is natural and the waste is unavoidable. The gas rushes upward in enormous quantities through pipes leading from underground wells and the outflow shows little signs of diminishing. Far more is obtained than can be burned and the excess is simply discharged into the air.

Medicine Hat is not the only town in Alberta that is lit by natural gas. This province contains many natural gas springs and the city of Calgary, which has a population of about 45,000, is heated by means of it, and there is even a prospect that the gas may be transported through long pipe lines to large centres in Alberta and Saskatchewan, a process that would be much cheaper than that now employed of bringing coal by rail over long distances to be transformed into gas.



One of the secondary clocks controlled by the master clock shown above.

Origin of Elephant "Cemeteries"

There is a common belief that when elephants feel that they are about to die they make their way to places that have come to be regarded as elephant cemeteries. This belief is due to the fact that discoveries are often made of piles of ivory and bones that appear to be too large to have been gathered together accidentally.

The so-called elephant cemeteries usually are on the muddy banks of streams or lakes, and a more reasonable explanation is that the remains are those of old and weak animals that have been unable to extricate themselves from the mud when they have come down to the banks in order to drink, or have been too feeble to climb the bank again. These sink into the mud and are quickly lost to sight.

It is a very curious circumstance that in the wilds of Africa a dead elephant is very rarely seen. This lends support to the above explanation, for practically every aged animal would die in such a position that its skeleton could not be found except by digging. On a recent hunting expedition in East Africa a dead elephant actually was seen, and the event was regarded as so remarkable that special photographs were taken of the remains!

Dust in the Atmosphere

On the clearest day the air above a large city is laden with dust and even in places that are far removed from crowded cities, a surprisingly large proportion is always to be found in the atmosphere. For instance, in the Western Highlands of Scotland this may be as much as one-thirtieth of the amount in the air of London.

Interesting measurements recently have been made of the amount of dust in the air above New York, and it has been found that at least 2,100 tons of dirt, dust and cinders are suspended in it. If this were piled in a pyramid on a square base with a side 200 ft. in length, its height would be no less than 400 ft., or half that of the Woolworth Building.

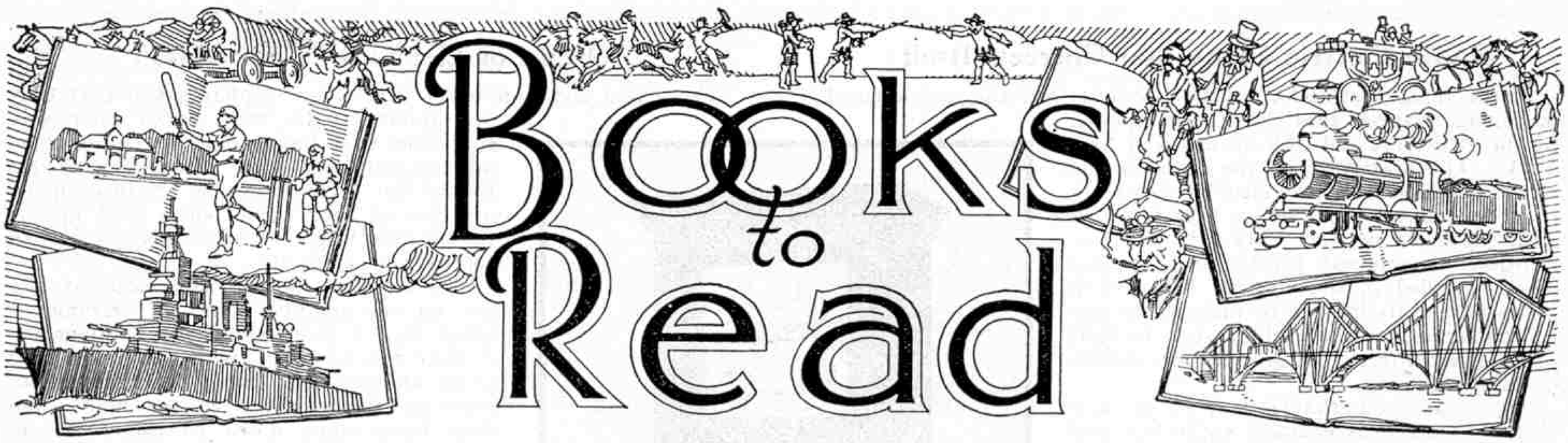
It is the dust in the atmosphere that is responsible for the splendid colours of the sky at sunrise and sunset, but it is also responsible for a large proportion of the pulmonary diseases that are such a terrible scourge of city life.

When Do You Wind Up Your Watch?

Many watch manufacturers recommend that watches should be wound up in the morning and not at night. The reason for this is that at night the temperature usually is less than during the day. The usual tendency is to wind a watch up tightly—the number of overwound watches repaired by watchmakers is a proof of this—and if a watch is left in a comparatively exposed position during the night, the contraction of the metal spring due to the fall in temperature may result in breakage. This will not readily occur if the watch is wound up in the morning, for it is usually placed in an inside pocket, where it receives bodily heat. The spring then expands and the risk of its breaking is lessened.

Shooting Microbes

Dr. Holweck, a French scientist, shot X-rays at microbes in the hope of finding how much weight must be dropped on their backs in order to kill them. He found that the impact of a speck of dust falling one-hundredth part of an inch would be a million times heavier than that required to kill one microbe. This is not an excessively severe blow, for it would take a blow many million times heavier to kill a man!



On these pages we review books that are both of interest and of use to readers of the "M.M." We have made arrangements to supply copies of any of these books where readers find difficulty in obtaining them through the usual channels.

Orders should be addressed to the Book Dept., Meccano Limited, Old Swan, Liverpool, and 1/- should be added to the published price of the book to cover the cost of postage. The balance remaining will be refunded when the book is sent, as postages on different books vary according to the weight and destination.

"A History of Rochester"

By F. F. Smith
(The C. W. Daniel Company, London. 15/- net)

Rochester to-day is as peaceful a city as one could wish to find, but for more than a thousand years it played an important and often thrilling part in connection not only with the history of Kent, but also with that of England. In this volume Mr. F. F. Smith, who is an alderman of the city, sets out to present to us this pageant of history, and to show the wealth of interesting material that lies hidden away in old records and other documents in possession of the city corporation.

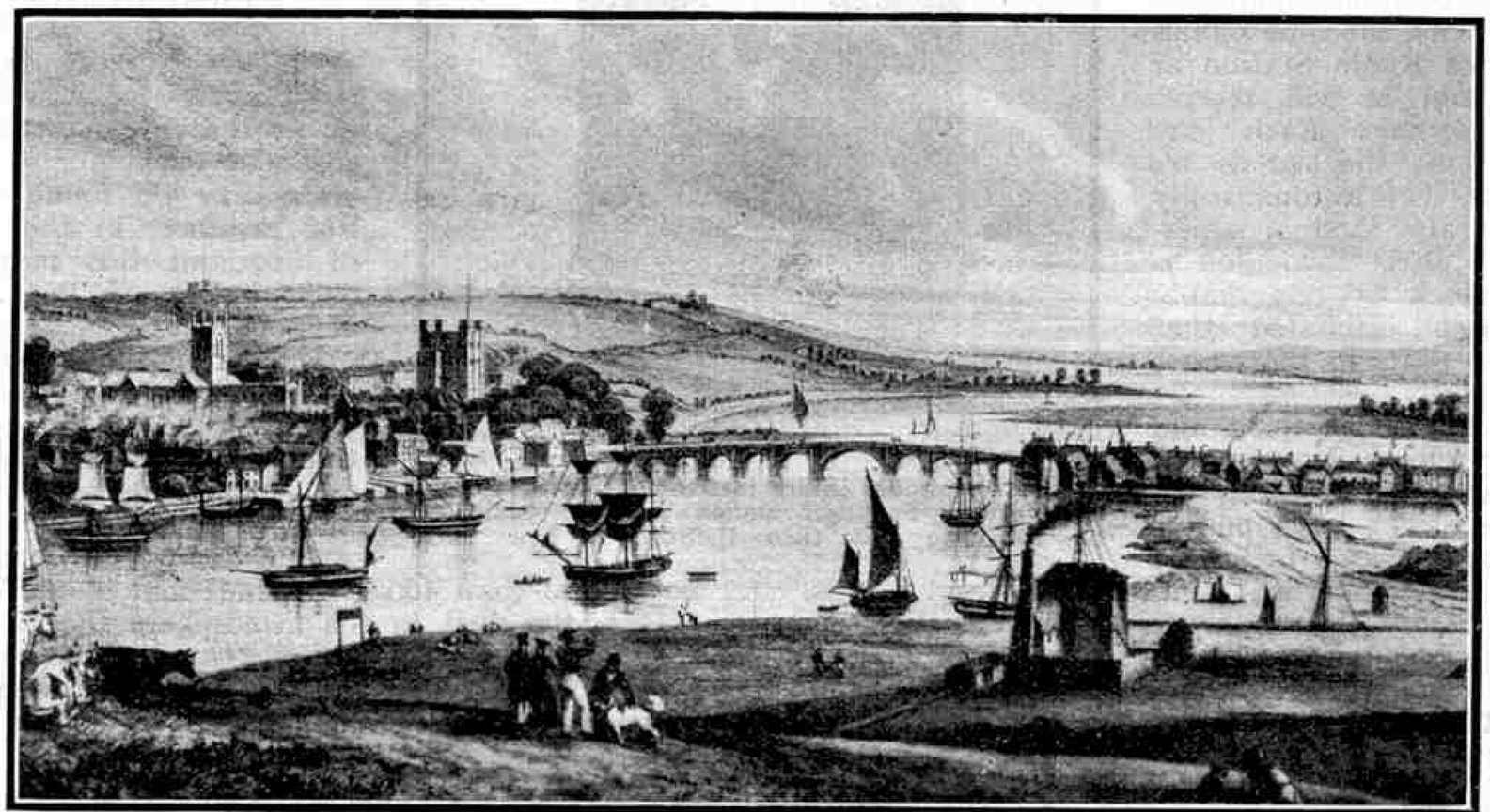
The author commences his story with the Roman invasion of Britain in 55 B.C. The Romans gave the name "Cantium" to the county of Kent, and Rochester was "Durobrevis" or "Durobrevoe." In the military tables it is written *Roibis*, from a contraction of which, with the addition of the word *ceaster*, derived from the Latin *castrum*, it was called *Rhoneceaster*; which by further contraction became "Rochester." The towns and military posts established by the Romans were of various degrees of importance. Among them were towns known as stipendiaries, compelled to pay tribute and governed by Roman officers; and Rochester was one of these. It became a Roman station of considerable importance, and was laid out on the lines of a *castrum tertiatum*, that is a camp one-third longer than it was broad. The great Roman road known as Watling Street, commencing at Dover, passed through Canterbury, Rochester and London, and proceeded north as far as Chester. After the Romans left, the Saxons were in occupation for some 600 years, and the codes of laws established by their kings became adopted by the British inhabitants. The great King Ethelbert became a Christian about the year 596, shortly after the arrival in Kent of the missionaries sent by Pope Gregory; and in the year 600 he began to build the first church in Rochester, dedicated to St. Andrew.

For many centuries Rochester was the objective of invading armies. It was plundered time after time by the Danes, who were the most persistent and ferocious of the invaders of Britain. They made several invasions during the reign of King Alfred, and it was to resist these that Alfred built the fleet of ships that formed the foundation of the British navy. The great tower or keep of the castle that has been such a conspicuous object at Rochester for over 800 years was built after the Norman conquest, probably under the supervision of Odo, Bishop of Bayeux, and Gundulf, Bishop of Rochester, the work on it extending from about 1080 to 1126.

Rochester has had a Guildhall from very early times. The present building was erected in 1687. One of its features is a large hall containing a fine collection of full-length portraits of eminent people, including portraits of King William III and Queen Anne, painted by the famous artist Sir Godfrey Kneller. The vane of the Guildhall consists of a representation of a full-rigged ship made of copper and weighing over $1\frac{3}{4}$ cwt. The hull is 4 ft. 6 in. in length and 1 ft. in breadth, and the masts are 5 ft. in height; while on the main deck are 26 miniature metal guns mounted on carriages.

Another famous Rochester building is the house for the Six Poor Travellers, which is known all over the world through the writings of Charles Dickens. This is a charity set up by the will of Richard Watts, member of Parliament for the city in 1563. By his will he directed that six poor travellers, not being "common rogues or proctors," should receive gratis for one night lodging and food, and the sum of 4d. each. From 1856 up to the time of his death in 1870 Dickens lived and worked at Gad's Hill Place, near Rochester, and many of the characters and scenes in his books are identified with people and places in the city.

The famous Samuel Pepys refers in his diary to his visits to Rochester. On one occasion he appears to have had rather a scare. His host, on conducting him to his room late at night, informed him that a man who had died in that room was in the habit of walking there. Pepys admits that this made him "somewhat afraid." He continues: "Lay and slept well till three in the morning, and then waking, and by the light of the moon I saw my pillow (which over night I had flung from me) stand upright; but not be thinking myself what it might be I was a little afraid, but sleep overcame all."



An old view showing Rochester a century ago. The bridge across the Medway and the castle and the church are clearly seen. From "A History of Rochester" reviewed on this page.

A Roman timber bridge with stone piers is supposed to have existed at Rochester at the point where Watling Street crossed the River Medway. About 1200 A.D. a timber bridge of ten spans 43 ft. centre to centre was built, its total length being 431 ft. and its width 10 ft. A wooden tower for the purpose of defence was erected at the east end of the structure. This bridge was burnt down by Simon de Montfort, Earl of Leicester, in 1264. It was restored, but was again damaged by floods and ice, and by 1293 was in such bad repair that people had to cross the river in boats. The present fine bridge was completed in 1914 at a cost of about £100,000.

The author succeeds in conveying an excellent idea of the outstanding scenes in the story of this interesting city, but some of the chapters will be of interest only to those with a personal knowledge of the city. The book is well illustrated by modern photographs and reproductions of old prints.

"A.B.C. of Television"

By R. F. Yates. (Chapman & Hall Ltd. 10/6 net)

Television has taken a strong hold upon the imagination of amateur wireless experimenters in all parts of the world, and there is a growing demand for accurate and detailed information regarding the construction and use of television equipment. The *"A.B.C. of Television"* has been written with the object of supplying this demand, its author being a well-known American authority on wireless.

Commencing with a simple account of the elements of television, the book deals with the various sections of the subject in detail. These sections include photo-electric cells and neon lamps, the scanning of objects to be televised, and the problem of synchronising or keeping in step the scanning discs of transmitter and receiver. Finally, practical instructions are given for the building up of a simple television receiver, in which the picture is "framed" or kept in position by means of a hand-operated resistance controller that is employed to vary the speed of the motor driving the scanning disc.

As this book originates in America, it is natural to find that the greater part of it deals with the work of American inventors. The ingenious scanning devices introduced by C. F. Jenkins are fully explained and illustrated, and successful experiments carried out by Dr. Alexanderson of the General Electric Company, New York, are also dealt with. Special attention is directed towards the television apparatus developed by the Bell Television Laboratories, and interesting information is given about the giant neon lamp employed in the receiver. This lamp consists of a glass tube of enormous length, bent backward and forward in order to form a square screen. It contains 2,500 tinfoil electrodes, and the picture received appears on this glass screen in the form of 2,500 spots of light of various intensities. Dr. Ives and his fellow workers in the Bell Laboratories have also experimented with a quartz crystal as an aid to synchronising; but no means of keeping the scanning discs in step that is as simple and certain in action as that now employed by Mr. J. L. Baird, the British inventor, appears to have been developed so far in America.

A chapter that to many experimenters will be of special interest gives instructions for building simple forms of transmitter and receiver for home use. With these the transmission of the outlines of simple objects from one room to the next is possible, synchronism being ensured by mounting both scanning discs on the same shaft.

The book contains many plates illustrating interesting events in the history of television and showing the apparatus employed by various experimenters. In addition there are in the text numerous drawings and diagrams that help to make the various processes clear.

"Intermediate Mechanics"

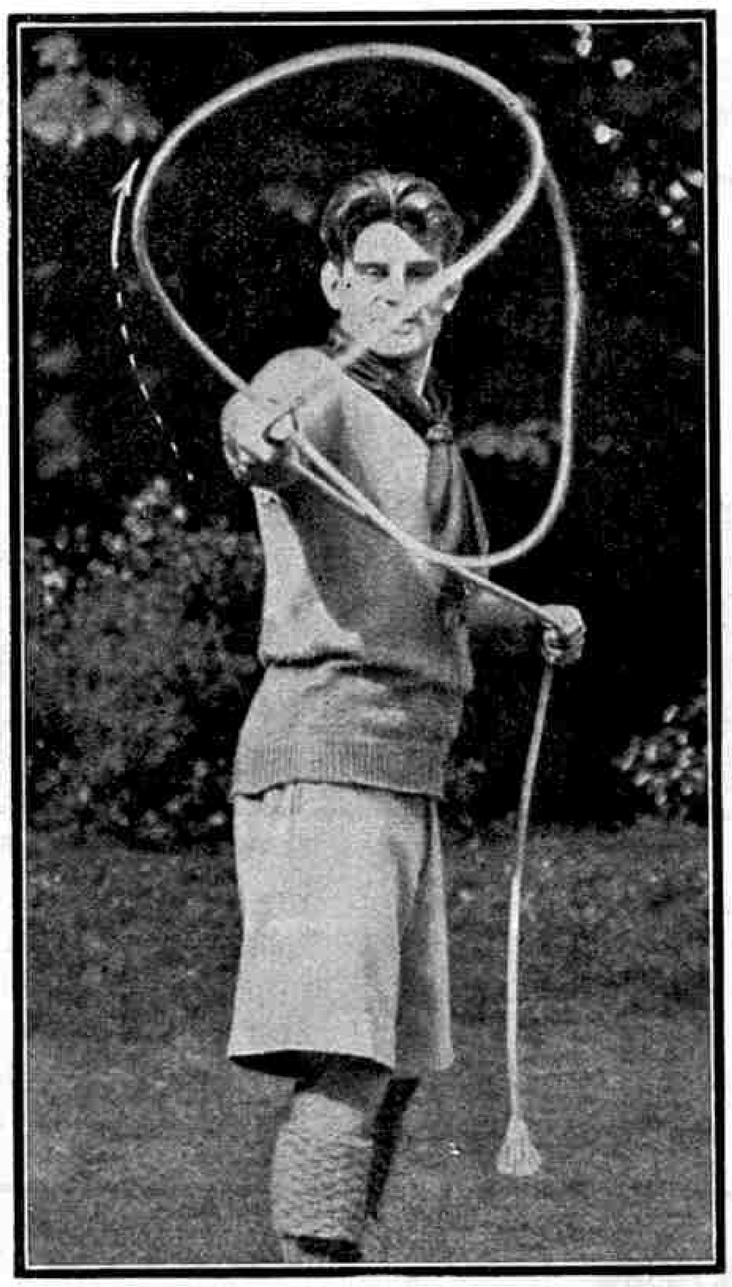
By D. Humphrey, B.A., B.Sc.
(Longmans, Green & Co. 10/6 net)

This book affords a striking example of the improvement in engineering text-books that has taken place during recent years. It is the first of two volumes in which mechanics as a whole will be dealt with, and it is devoted to dynamics. It is not intended for beginners, but will be found very useful by *"M.M."* readers who are studying mechanics as part of their training for an engineering career, or who are in the intermediate stages of their studies for a University degree.

"Bran the Bronze-Smith"

By J. Reason. (J. M. Dent & Sons Ltd. 5/- net)

This is an attractive story of life in Britain in the Bronze Age, centuries before Julius Cæsar landed on our shores. In those far-off times Britain, contrary to the popular opinion, was not a land of half-naked savages who painted themselves blue and amused themselves by continual fighting. The remains of hill forts and villages, and buried hoards of tools and weapons, prove that the people were comparatively civilised and were farmers, fishermen, and miners, who exchanged their products for goods brought by traders from the Continent.



A typical rope spinning movement. From the book "Rope Spinning" reviewed on this page.

The story concerns the adventurous life of Bran, a wandering smith, whose faithfulness to a friend led him through feud and battle to be the right hand of a chief. Bran, who came from Northern Gaul, had been captured at sea by traders and sold as a slave in Cornwall. He became a most successful worker in bronze, and was possessed of enormous physical strength. The story tells us how he fulfilled a prophecy of a British priest that he should forge a chain for his neck and ankles, and out of the chain should make a sword to conquer a city. The city was in Ireland. Bran was carried to that country by pirates, and after wonderful adventures, in which he showed great wisdom as well as bravery, he became the ruler of the kingdom of which the city was the centre.

The author has produced a thoroughly good story, which gives an interesting picture of the manner of life of our ancestors nearly 3,000 years ago. Its attraction is increased by the illustrations. There is a large number of these, some of them being in colour, and they have been drawn by the author himself.

"Rope Spinning"

By D. W. Pinkney. (Herbert Jenkins Ltd. 2/6 net)

Rope spinning as an ornamental form of exercise has spread slowly but surely in this country during the past few years, and, almost before we are aware of the fact, it has become popular. It is a unique combination of an exercise and an accomplishment, and it demands the perfect co-ordination of eye and hand that are characteristic of all the highest types of games. It certainly possesses an extraordinary fascination, and almost everybody who has learned one or two simple spins falls under its spell.

Mr. Pinkney set out to produce a book that would serve as a practical guide to the beginner in rope spinning, and in this he has succeeded. His instructions have been drawn up with great exactitude and, in conjunction with the excellent drawings and photographs, make the methods employed in the different spins perfectly clear. Persistent practice is of course of the first importance. Some people seem to pick up the art of spinning quickly, while others have to exercise the utmost patience and perseverance before they achieve success. To all beginners there come times when the rope behaves like an irritated snake, eluding one's grasp, coiling itself round one's limbs and, as the author says, doing everything but bite!

The book concludes with an interesting chapter on the use of the lariat, that is to say lassoing, by Don Potter, Assistant Camp Chief, Gilwell Park. During the past year or so many thousands of Boy Scouts have learned the simpler spins, and the pastime is rapidly becoming popular among Girl Guides.

"The Book of Howlers"

By H. Cecil Hunt. (John Lane Ltd. 1/6 net)

The supply of "howlers" seems to be inexhaustible. This is Mr. Hunt's third collection, but it shows no signs of falling off in quality, and to dip into it is a sure remedy for depression! Naturally some "howlers" are funnier than others, but it is impossible to glance down a page of this book without coming across one or two that compel a smile, if not a full-size laugh! Some of the items are rather obviously "manufactured," but they are none the less funny; and there is an ample supply of delightful ones that bear the stamp of genuineness.

If Mr. Hunt publishes still another collection of "howlers," as he threatens to do, we suggest he might include the one about the enthusiastic member of the Meccano Guild who wrote that: "There would be no more war according to the Treaty of Meccano"! The confusion between "Meccano" and "Locarno" is perhaps excusable in a member of the Meccano Guild, for he knows that this organisation has been described as a "Junior League of Nations."

Interesting New Books

The undermentioned books, recently published, will be reviewed in a future issue.

"Book of the Morgan" (Pitman. 2/6)
"Aviation of To-day, its History and Development" *by* J. L. Nayler & E. Ower (Warne. 15/-)
"Light Aero Engines" *by* C. F. Caunter (Pitman. 12/6)
"Navy League Sea and Air Map of the World" (Philip. 5/6)
"Prison Breakers" *by* Alban M. Phillip (Philip Allan. 5/-)
"Strange Adventures of Seas" *by* L. G. Lockhart. (Philip Allan. 5/-)
"Rattlin the Reefer" *by* E. Howard (Dent. 2/-)

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 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.

An Aerial Ropeway in the Pyrenees

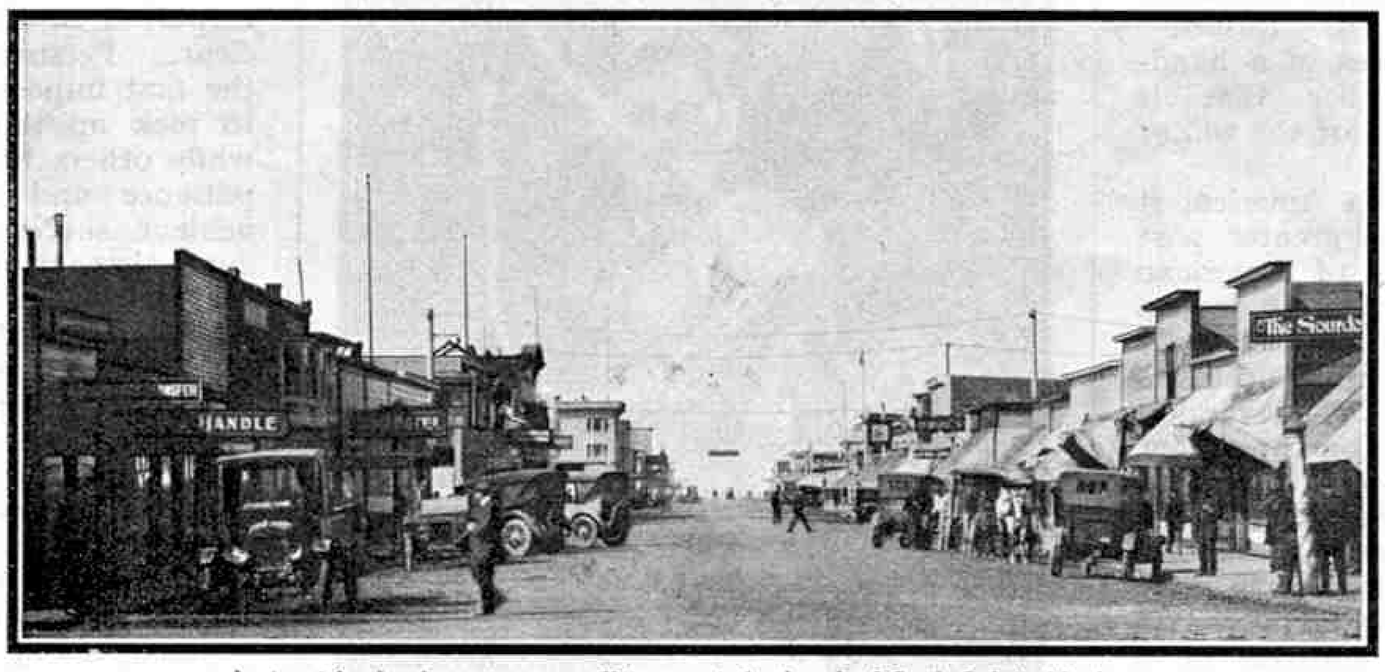
An overhead cable is used for the transport of iron ore from the mine at Escoums, in the Eastern Pyrenees, to Joncet, the nearest point on the railway, and during a recent visit I was greatly interested in the manner in which this is operated.

At the upper end of the cable is a wooden hut that at first glance appears to be filled with wheels and wire. From this, two fixed guide wires supported on standards run down the mountain side in addition to a moving endless wire that passes round large wheels at the ends of the aerial railway. The buckets in which the iron ore is carried are supported on pulleys running on the fixed wires and are drawn along by the moving endless wire.

There are 44 buckets. Each holds about half a ton of ore and they travel at intervals of about 220 yds. As they arrive at the upper end of the cable they are automatically released and run to the filling point on a semi-circular overhead rail. There ore is allowed to fall into them and they are then pushed along the rails back to the endless cable. An automatic device clamps each in turn to the moving wire and the long journey down to Joncet, six miles away, then commences.

During the journey each bucket is lowered about 1,200 ft. Thus the gradient is severe and heavy braking is necessary in order to prevent the loaded containers from travelling too quickly. In some respects, the brakes employed are perhaps the most interesting feature of the cableway. They consist of two large paddle wheels and it is the resistance of the air to the movements of the blades of these that serves to hold the swinging buckets in check as they run down the ropeway with their heavy loads of ore.

G. Ruoff (Portsmouth).



A street in Anchorage, a small town at the head of Cook Inlet, Alaska.

The head of the aerial ropeway down which iron ore is carried from the mines at Escoums, in the Pyrenees.

The Beet Harvest of the Fens

Littleport, the village in Cambridgeshire in which I live has a population of 4,900. It is the centre of a great agricultural district in which sugar beet is largely grown, and the busiest time of the year comes when this is ready for transport to the factory in which the sugar is extracted from it.

The beet from Littleport is taken to Ely, about five miles away, and it is very interesting to visit the factory when the season's crop is being brought in. Some of it arrives by rail, the factory having a siding into which wagons are shunted to be unloaded, but a large proportion is brought in motor lorries and steam wagons. From morning until night throughout the season an astonishing number of these may be seen converging on the factory from all directions. Little time is lost in emptying them. Each in turn is brought to a standstill beneath a large pipe and a powerful jet of water from this immediately washes the beet into a trench, along which the stream carries it into the factory.

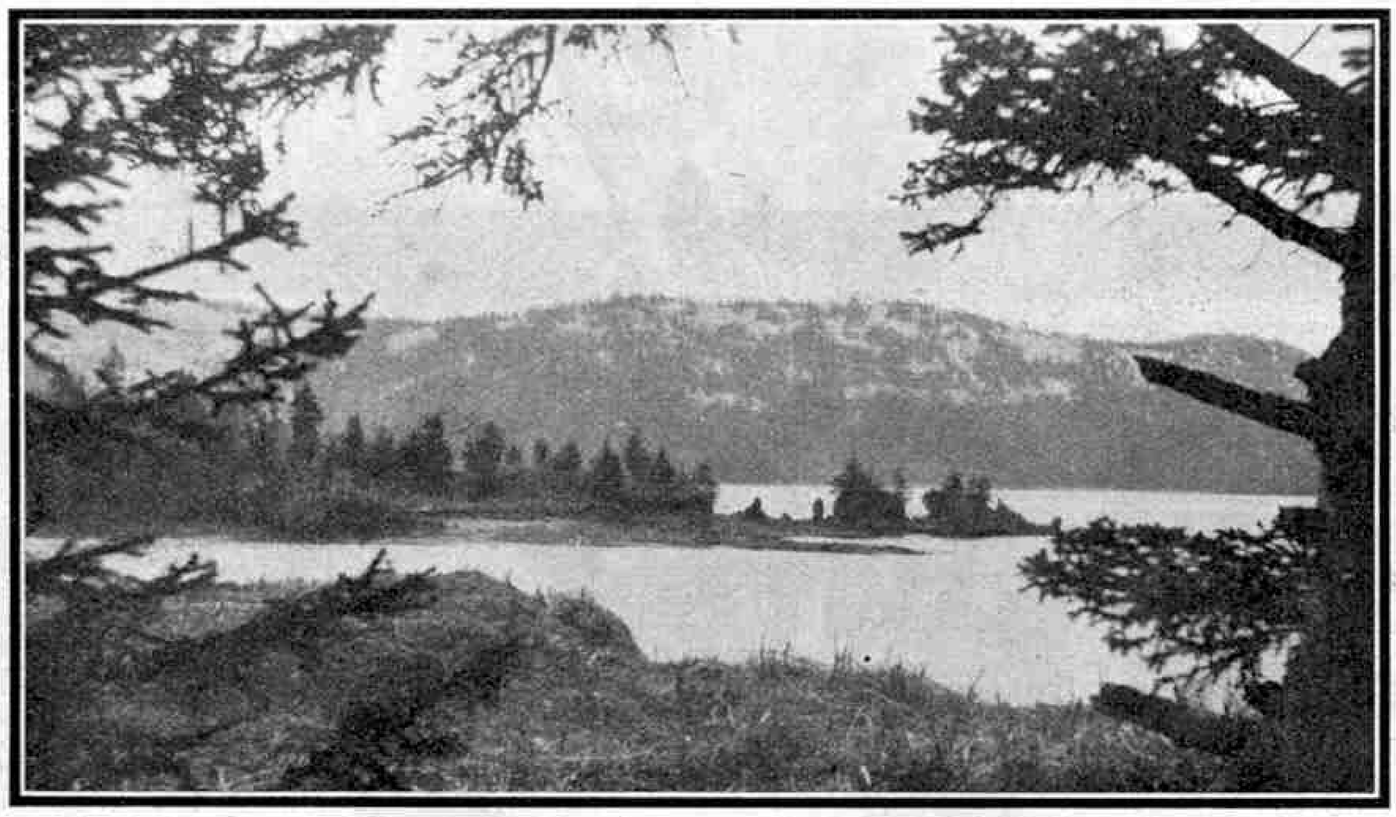
The Ely sugar factory has a fleet of tugs and barges that make extensive use of the waterways of the Fens. When a loaded barge comes alongside the wharf a grab is lowered into it and the roots are quickly lifted out to be piled in an enormous heap while waiting their turn to be treated.

The building of a beet factory at Ely is a great boon to the neighbourhood, for it provides an outlet for a valuable crop. But it has brought with it one great disadvantage. The river alongside which the factory stands is so polluted by waste products that fish cannot live in its waters. Formerly it was greatly frequented by anglers, who almost invariably enjoyed very good sport, but to-day very little fishing can be done in it.

R. Laws (Littleport).

My Impressions of Alaska

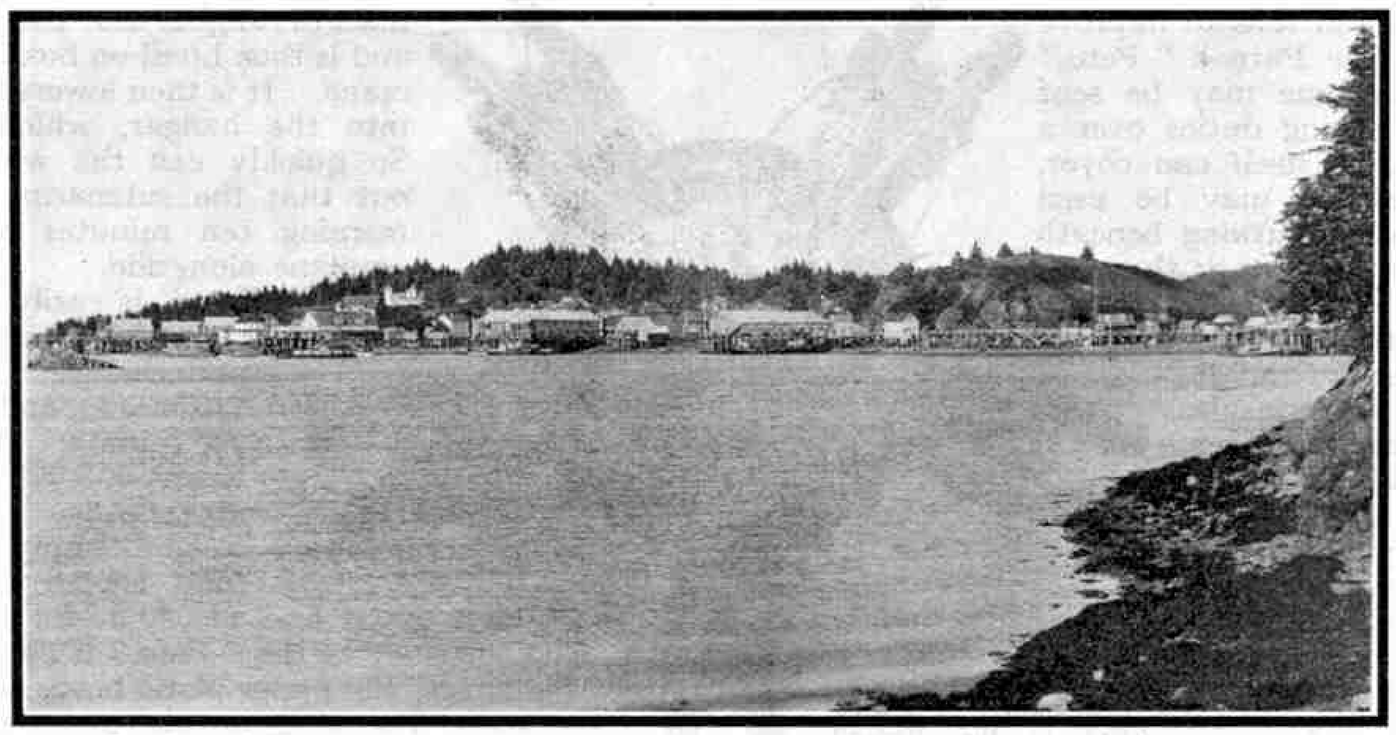
A popular idea of Alaska is that the territory is an ice box; that polar bears and other fierce animals abound in it; that there it is dark night and day throughout the winter; and that the natives inhabit igloos, or snow huts, and live on walrus oil, blubber and sealskin. This is scarcely true, even of the strip of country that borders the Arctic Ocean, where the temperature frequently falls to 70°F. below zero. The Eskimos 100 miles south of the Arctic Circle know nothing of igloos, and at such places as Seldovia, on Lower Cook inlet, temperatures of more than 100°F. have been recorded, while 90°F. has been registered at Fairbanks, in the centre of the country.



A typical scene in Seldovia Bay, on the southern coast of Alaska.

I lived in Seldovia for two years and thoroughly enjoyed my stay there. The town has only 450 inhabitants, but in it there are four grocery stores, two salmon canneries, a school with 65 pupils and even a newspaper. The newspaper is an eight-page production called "*The Seldovia Herald.*" As it was published by my father, I usually had the pleasure of "printing" it on a mimeograph, but a big printing press is to be installed in order to produce it under conditions similar to those in modern newspaper offices.

Like many other Alaskan towns, Seldovia covers an amazing area. It is built along the water front and large parts of it are almost entirely over the water itself. Narrow board walks zigzag through the town, around rocks and out over the water to astonishing distances. These are greatly distrusted by tourists who visit the place and often they cannot be induced to set foot on them.



The water front at Seldovia, Alaska. The long low building in the centre is a salmon cannery.

It was only in summer that we saw any visitors, for then a small steamer called three times a month. This vessel was the only means of mail and passenger transport available, and it only put in an appearance once a month throughout the entire winter.

The school was an interesting place. For over a year I was almost the only white pupil, the remainder being chiefly natives or half-breeds. There were three teachers and the instruction was good.

The prosperity of the town depends almost entirely upon that of the fishing industry. The surrounding hills abound with game, moose, bear and porcupine predominating. The porcupine is one of the two principal foods of the natives during the winter—salt fish is the other—and the animal abounds to such an extent that it is scarcely possible to step out of the town without seeing signs of its presence. Although it is said to taste like chicken, I have never had any desire to eat it, but the natives are very fond of it, and often may be seen following the trail of one of the animals.

J. Busey (Alaska).

Blasting in a Slate Quarry

During my holidays I had the privilege of visiting a great slate quarry at Penrhyn, near Bethesda, in North Wales. This presents an extraordinary appearance, for its sides are cut into gigantic terraces. It is of enormous extent, and the 2,000 men at work in it at the time of my visit looked incredibly small as they moved about at the bottom of the great pit.

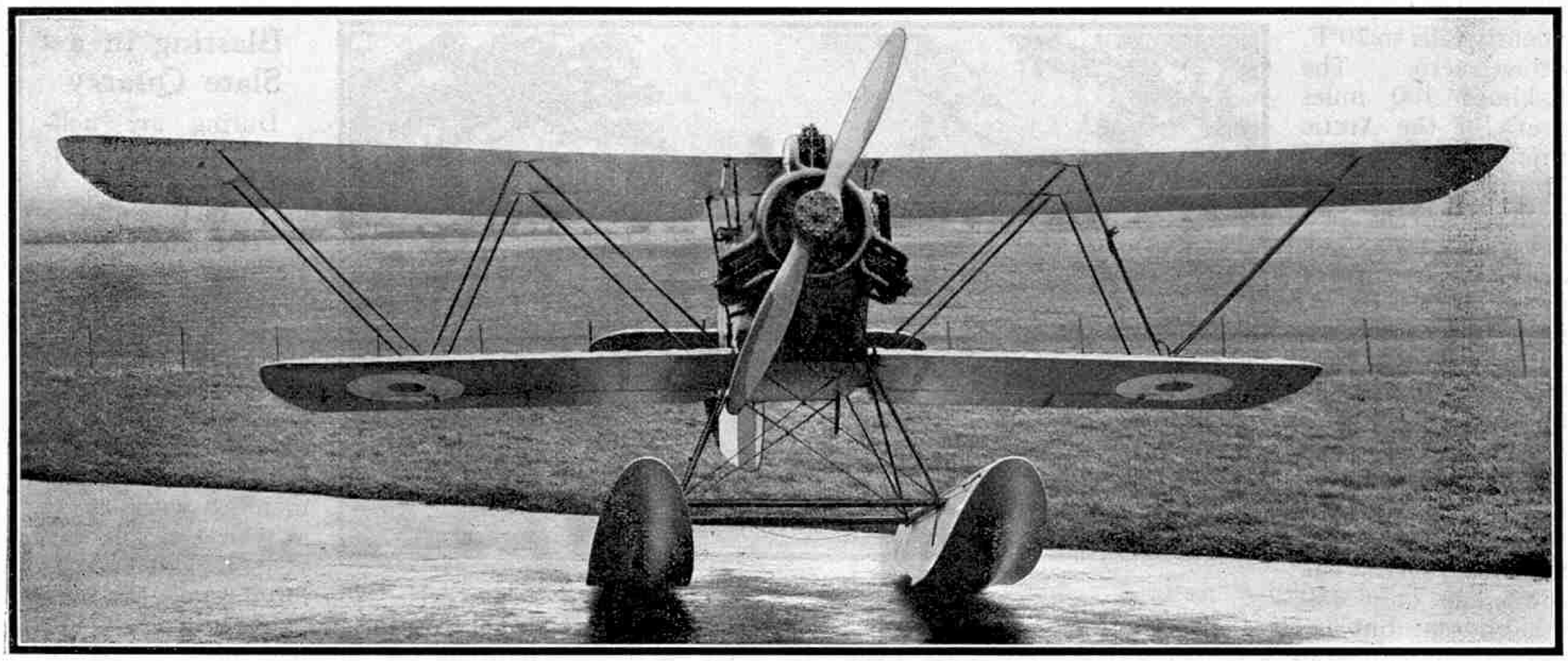
We were fortunate in the moment of our arrival, for the men were completing the insertion of dynamite into holes drilled in the face of the slate hillside. When all was ready for blasting, a bugle was blown and immediately the men in the quarry ran to little slate huts that had been erected in various positions. A second bugle note sounded a further warning, and after complete silence for a few moments the entire hillside appeared to be thrown into a state of complete upheaval, to the accompaniment of a thunderous roar. For five minutes afterwards nobody moved, this time being allowed for the explosion of any laggard charges. Then one by one the men left the shelters and resumed their work, quite unmoved by the terrific explosions that had just occurred.

It was very interesting to watch the workmen dealing with the masses of slate. This has a well-defined grain, and the huge chunks from the quarry are split into slabs two inches in thickness and sawn into pieces about three feet in length and two feet in width. These are easily split into thin slabs by highly skilled workmen, who use hammers and chisels. The grain is so even that the pieces of slate are seldom broken or split badly. Finally the sheets are cut to the required size by a machine furnished with a huge blade resembling a scythe.

A. Brook (Batley).

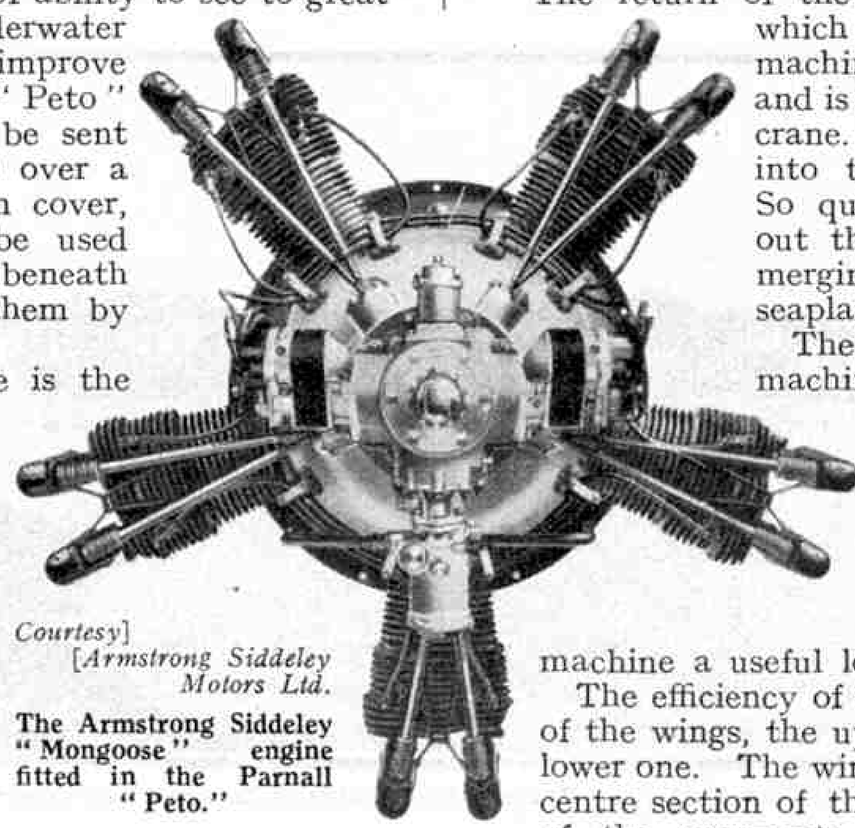
The Parnall "Peto" Seaplane

An Aircraft Carried in a Submarine



THE Parnall "Peto" seaplane is specially intended for service with submarines. At first sight the association of aircraft with vessels designed to travel under water may seem strange, but a little consideration shows that a submarine carrying an aeroplane may be far more useful than one not so equipped. When a submarine is submerged, it is, of course, impossible for its commander to see what is happening above; and when the top of the periscope is above water, or even when the vessel is running on the surface, the range of vision is comparatively small on account of the low viewpoint. This lack of ability to see to great distances naturally limits the value of underwater craft for patrolling purposes, and it is to improve matters in this respect that the Parnall "Peto" has been designed. This machine may be sent up in order to carry out scouting duties over a wider area than the submarine itself can cover, and in certain circumstances it may be used also to detect enemy submarines lurking beneath the surface, and to attempt to destroy them by means of depth charges.

Of all sea-going vessels the submarine is the most crowded with machinery; and it would be impossible to find room inside one to stow away an aeroplane however small. Before it was possible to equip underwater craft with aeroplanes, therefore, it was necessary to design a machine of the smallest size possible, consistent with efficiency from a military point of view, and also some method of securing this machine to the exterior of the submarine. After a long series of experiments directed to this end, there was produced the Parnall "Peto," a small two-seater seaplane of the biplane type. When the wings are opened out the machine has a span of 28 ft. 5 in.; but when the wings are folded its width is reduced to only 8 ft. It is 22 ft. 6½ in. in length and 8 ft. 11 in. in height, and is thus sufficiently small to fit into a hangar that may be built on a modern submarine. As the machine is intended for continual use at sea, the metal used in its construction is stainless steel, which resists corrosion by salt water. This makes its cost greater than otherwise would be the case, but it has been found that compensation is obtained in the shape of reduced maintenance charges.



Courtesy]
[*Armstrong Siddeley Motors Ltd.*

The Armstrong Siddeley "Mongoose" engine fitted in the Parnall "Peto."

The hangar in which this interesting little aeroplane is housed is built on the deck of the submarine, and of course, it is watertight. The machine rests on a trolley that runs on rails leading to the open deck. When required for action it is brought out, its wings are opened, and the engine set in motion by turning the handle of the self-starter. Two or three minutes' running is sufficient to warm the engine, and the machine may then be launched into the air by means of a catapult similar in action to that used for despatching aircraft carried on surface vessels. A description of one of these catapults was given in the article on "*Speeding up the Mails*" that appeared on page 200 of the "*M.M.*" for March, 1930.

The return of the Parnall "Peto" to the submarine from which it operates is easily carried out. The machine alights near the vessel and taxis alongside, and is then lifted on board by means of a swivelling crane. It is then lowered on to the trolley and run into the hangar, which is immediately closed. So quickly can the whole operation be carried out that the submarine may be ready for submerging ten minutes after the arrival of the seaplane alongside.

The "Peto" is easily handled, and for a small machine it has a high load capacity and an excellent performance. At sea level its speed is 113 m.p.h., and its rate of climb is 600 ft. per minute. It is capable of reaching a height of 5,000 ft. in 11 min., and at that altitude has a speed of 107 m.p.h. Its weight empty is 1,300 lb., and when fully loaded 1,950 lb. This gives the machine a useful load of 650 lb. for the crew and ammunition.

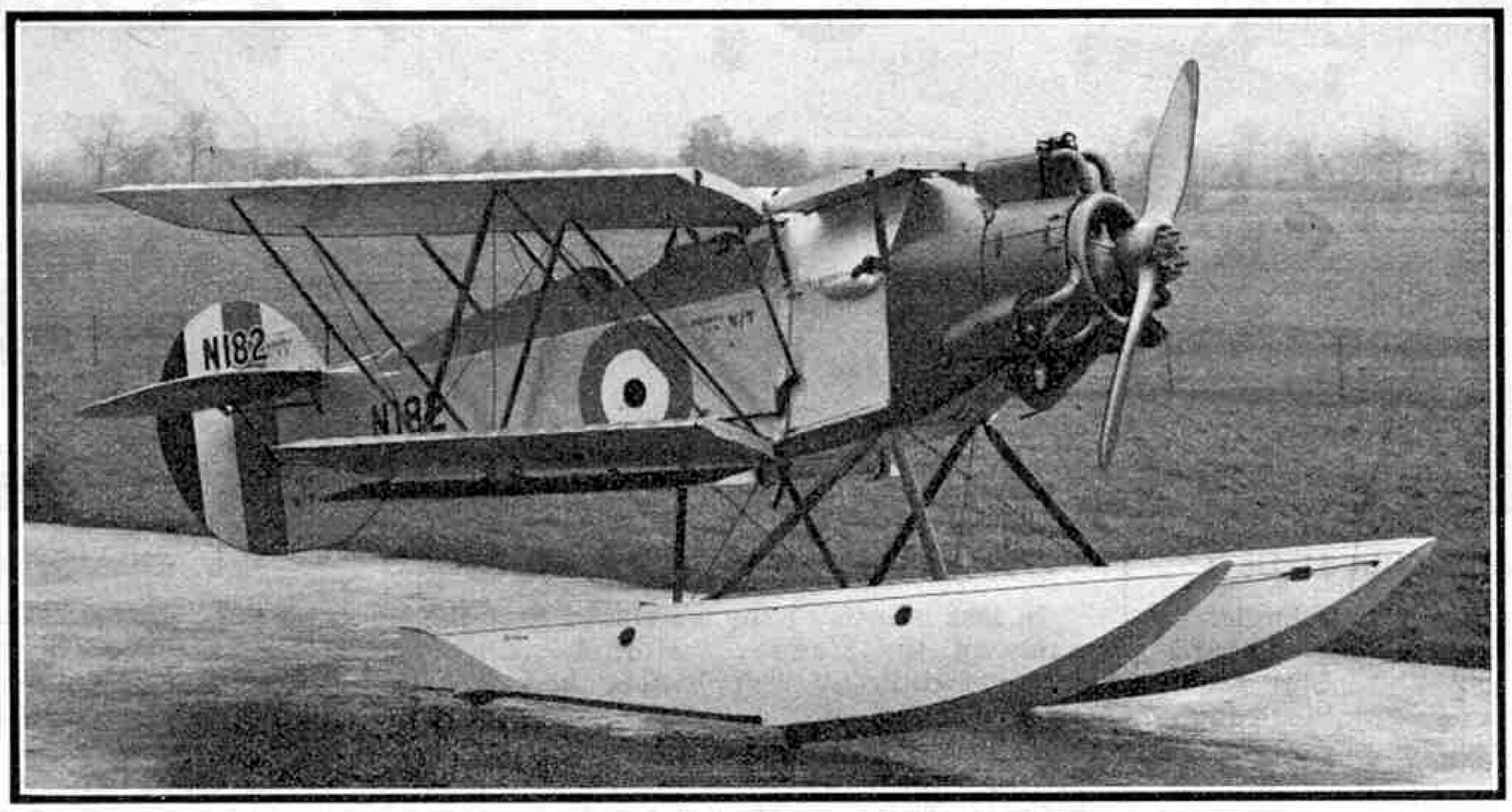
The efficiency of the "Peto" is due partly to the staggering of the wings, the upper plane being set slightly in front of the lower one. The wings are also swept slightly backward, and the centre section of the upper plane is on a level with the eyes of the occupants of the machine, giving an exceptionally wide field of view to the pilot and his passenger. The lower wings are a little smaller than the upper ones, their span being only 20 ft. 5 in.; and the upper wings are set at a slight upward angle to each other in order to increase the stability of the machine, a practice that is followed in most types of aircraft.

The fuselage is built up from spruce longerons, braced with struts made of spruce and stainless steel. The top deck is dome-shaped, and joins up to the inside of the centre section. The part of the fuselage that is in front of the forward cockpit is fitted with detachable aluminium panels, and the rear portion is covered with fabric.

The spars, ribs and drag struts are constructed of spruce, braced

internally with tie rods and externally with streamlined steel struts built in the form of a Warren girder. The ailerons extend the full length of the upper wings and are controlled by an arrangement of tubes and levers. The centre section is supported and braced to the fuselage by steel tubes. The tail unit is of composite construction, the fin and rudder being made entirely of stainless steel. The tail plane, which is carried on the top side of the fuselage, is adjustable in the air, and the fin is underslung.

The undercarriage consists of streamlined steel struts that are cross-braced with cables in the front and rear panels. The two duralumin floats are of the single step pattern and are fitted with water rudders. They are carried cantilever fashion on the front and rear booms, and can be removed readily without interfering with the bracing.



The Parnall "Peto" with wings folded. The thin wing-section of the machine is particularly noticeable. For this illustration, and for the front view of this aeroplane reproduced on the previous page, we are indebted to George Parnall & Co. Ltd., Yate and Bristol.

The engine fitted in the "Peto" is the well-known Armstrong Siddeley "Mongoose." This is a five-cylinder air-cooled radial engine. The cylinders have a bore and stroke of 5 in. and 5.5 in. respectively, and thus the total swept volume is 540 c. in. The compression ratio is 5 to 1. The latest model of the "Mongoose" has a rated output of 150 b.h.p. at 1,850 r.p.m., and the maximum power developed is 165 b.h.p. at 2,035 r.p.m. Lubrication is on the dry sump system, and is controlled by two pumps. The oil pressure is from 60 lb. to 100 lb. per sq. in., and the relief valve blows off at 85 lb. per sq. in. It is interesting to note that the "Mongoose" engine has been specially designed for use on training aircraft for land or sea work, and has been officially adopted by the R.A.F. and by the Royal Canadian Air Force.

The engine is supported in the "Peto" by a simple girder-type plate attached to the fuselage by steel tubes, and is covered by an easily detachable cowling. Fuel is fed to it entirely by gravity, the supply coming from a 14½-gallon petrol tank fitted inside the fuselage under the centre section. The oil tank, which has a capacity of 1½ gallons, is situated immediately below the petrol tank. The quantity of fuel and oil carried is sufficient to enable the machine to remain in the air for two hours. This gives a possible cruising range of more than 200 miles, a distance that would take a submerged submarine about 15 hours to cover.

An Original Low Wing Monoplane

One of the most interesting aeroplanes of recent years is the Saro "Meteor." The first machine of this type was constructed by the well-known firm of Saunders-Roe Limited, of Cowes, and was designed by Mr. H. E. Broadsmith in conjunction with the late Sir Henry Segrave, to whose order it was built. It shows great originality in design, special care having been taken to give it an outline favourable to the attainment of high speed, and it is not difficult to find in it evidence of the unique knowledge of streamlining gained by Sir Henry Segrave during his numerous successful attacks on speed records on land and water.

Sir Henry Segrave had the distinction of being as much at home in an aeroplane as he was in a motor car or a motor boat. He served in the R.A.F. during the War, when he was well-known as a daring pilot of single-seater fighters. It was his intention to make use of the "Meteor" for business journeys in Great Britain and on the Continent, and only his untimely death in the disaster to "*Miss England II*" on Lake Windermere in June, 1930, prevented him from developing still further the ideas that he had embodied in the machine.

The above photograph of the Saro "Meteor" is reproduced by permission of Saunders-Roe Ltd.

The first aeroplane of this interesting type to be produced was flown in the "King's Cup" race of 1930 by Flt. Lt. R. L. R. Atcherley, who took part in the Schneider Trophy Contest of 1929 as a member of the British High Speed Flight. Unfortunately the machine had very little opportunity of showing its capabilities in the race, for a fault that developed in one of the engines compelled its retirement during the first stage.

The machine is a four-seater low wing cantilever monoplane, and has been designed for the private owner who wishes to possess a fast touring aeroplane that has a reasonable landing speed and is safe in operation. The cabin is roomy and comfortable, and the fact that the machine is a low wing monoplane ensures the occupants an excellent and unimpeded outlook in all directions. His experience with single-seater fighters during the War convinced Sir Henry Segrave of the great importance of providing the pilot of any speedy machine or vehicle with a good view, and this was confirmed during his subsequent career as a racing motorist.

The first machine was constructed of wood, but it may be noted that after this had been subjected to exhaustive trials under all conditions, Sir Henry had intended to produce a second model in which a metal fuselage would be employed. The fuselage is of plywood and its shape has been carefully designed to give perfect streamlining. The wing is constructed of similar material.

The "Meteor" is fitted with two de Havilland "Gipsy III" engines. These are of the four-cylinder, inverted, air-cooled type, and each has a capacity of 5,716 c.c. The "Gipsy" engine has a normal output of 108-110 b.h.p. when run at 2,000 r.p.m., but the rated output is 105 b.h.p. The maximum power developed by the engine is 120 b.h.p., this output being attained at 2,200 r.p.m. The engine consumes 6.5 gallons of petrol per hour when running at normal speed, but when being employed at full throttle the consumption is increased to 9 gallons per hour.

The engines are built into the wing to lessen wind resistance and are provided with carefully thought-out cowling arrangements in order that exhaust pipes and other excrescences may offer as little opposition to the airstream as possible. Similar care has been taken with the undercarriage, fairings being fitted where possible to reduce its effect on the speed of the aeroplane.

The Saro "Meteor" Mark I has a wing span of 39.5 ft., and a chord of 8.5 ft. Its length is 28 ft., and it is 7.5 ft. in height. The machine has been designed to have a top speed of 140 miles per hour and a cruising speed of 125 miles per hour. Its stalling speed is about 50 miles per hour. The service ceiling is about 13,000 ft., and the absolute ceiling is 17,000 ft. The initial rate of climb with both engines in operation exceeds 1,000 ft. per minute, while even with one engine out of action the machine will climb at the rate of 350 ft. per minute.

Air News of the Month

From New York to India in 11 Days

Arrangements have just been completed between Imperial Airways, the Cunard Steamship Co., and the White Star Line, for the institution of a new combined high speed air and ocean freight service which is at first to extend from New York to India via London. It is also hoped in the near future to arrange connections with the Trans-American Air Mail Service, giving a 12,000-mile air-ocean-air service from San Francisco to India.

On the institution of the new through service, a parcel to be transported from the west coast of America to India will be flown 3,000 miles across the United States to New York. There connections will be established twice weekly with the White Star and Cunard eastbound liners. On these the parcel will be carried a further 3,000 miles across the ocean. It will then be taken to Croydon, where it will be transferred to an Imperial Airways liner for the first stage of the flight to India. A parcel should only take 14 days between San Francisco and India, while the transit from New York to India will occupy only 11 days instead of the 28 days that would be necessary by ordinary means of transport.

A valuable extension of this new service will become available when the new England—South Africa air route is opened. It will then be possible for communications from New York to reach Nairobi in 10 days, and Cape Town in 18 days. This will be a great advantage, for at present the time normally taken to reach these places from New York is from 32 to 40 days, and from 28 to 32 days, respectively.

It is interesting to note that if bonds are sent by the new service the special express charges will be more than covered by the saving of interest that will result from the shortening of the time required for these to reach their destination.

Trophy for Air Speed of 625 m.p.h.

M. Blériot, the pioneer French aviator who was the first to fly across the English Channel, has offered a challenge cup for award to the first airman to attain a speed of 1,000 kilometres, or 625 miles, per hour. M. Blériot believes that his trophy will be awarded within three years.

New Names for Military Aircraft

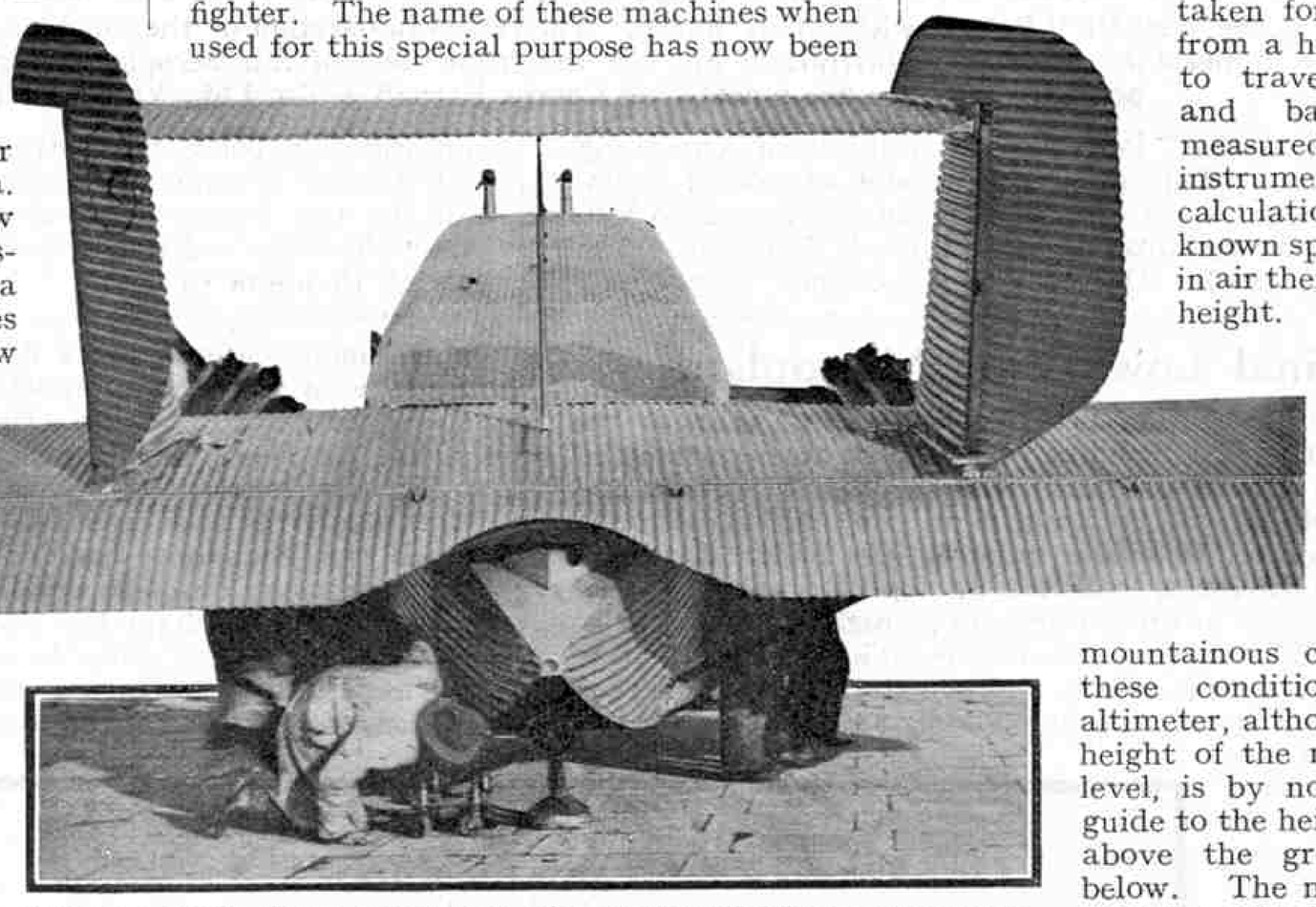
In last month's issue we stated that the name of the Hawker "Hornet" single-seater fighter of the R.A.F. had been altered to "Fury," and that the machine was also known as the "Norn" when intended for service as a single-seater fleet fighter. The name of these machines when used for this special purpose has now been further altered to the Hawker "Nimrod."

Other machines that have had their names altered to conform to the system of naming mentioned last month are the Hawker "Fury," the two-seater fleet fighter reconnaissance version of which is known as the "Osprey," and the Short military "Calcutta" open-sea reconnaissance flying boat, which has been re-named the "Rangoon." The Fairey IIIF two-seater general purpose machine is now known as the "Gordon."

Machines of the Fairey "Gordon" and Hawker "Nimrod" type will be included in the equipment of the aircraft carrier H.M.S. "Eagle" on her cruise to South America.

Proposed British Air Services

The possibilities of air services from Manchester to the Isle of Man, Blackpool, North Wales, and the Lake District, are now being considered by Northern Air Transport Ltd. It is probable that a service to Ireland also will be established.



Rear view of one of the Junkers low wing monoplanes used by Luft Hansa on their Croydon-Berlin air route. The photograph shows clearly the corrugated metal construction that is popular with German aeroplane builders.

New Altimeter for Use in Fog

A pilot may now determine his altitude accurately when flying in fog by means of a useful instrument that has recently been produced in America. The instrument is known as a sonic altimeter. It works on a simple principle, the time taken for the sound waves from a high-pitched whistle to travel to the ground and back again being measured by a sensitive instrument. A simple calculation involving the known speed of sound waves in air then gives the required height. It will be seen that it resembles the sonic depth finder used at sea.

In addition to being of value for fog flying, the device may be used when flying over mountainous country. Under these conditions, an ordinary altimeter, although registering the height of the machine above sea level, is by no means a reliable guide to the height of the machine above the ground immediately below. The new sonic altimeter would instantly inform a pilot of this height.

The device has been subjected to exhaustive tests and it is stated that on one occasion Colonel Lindbergh landed a machine solely by its aid. At present efforts are being made to reduce its weight sufficiently to make it of practical value for service in an ordinary light aeroplane.

Australia—New Zealand Flight

A remarkable flight between Sydney and New Zealand has been made by Mr. G. Menzies in the Avro "Avian" machine, "*Southern Cross Junior*," in which Wing Commander Kingsford Smith made his famous record flight from England to Australia. The machine was fitted with a De Havilland "Gipsy II" engine, and covered the 1,300-mile flight across the Tasman Sea in 12 hours 30 minutes, an extremely creditable performance.

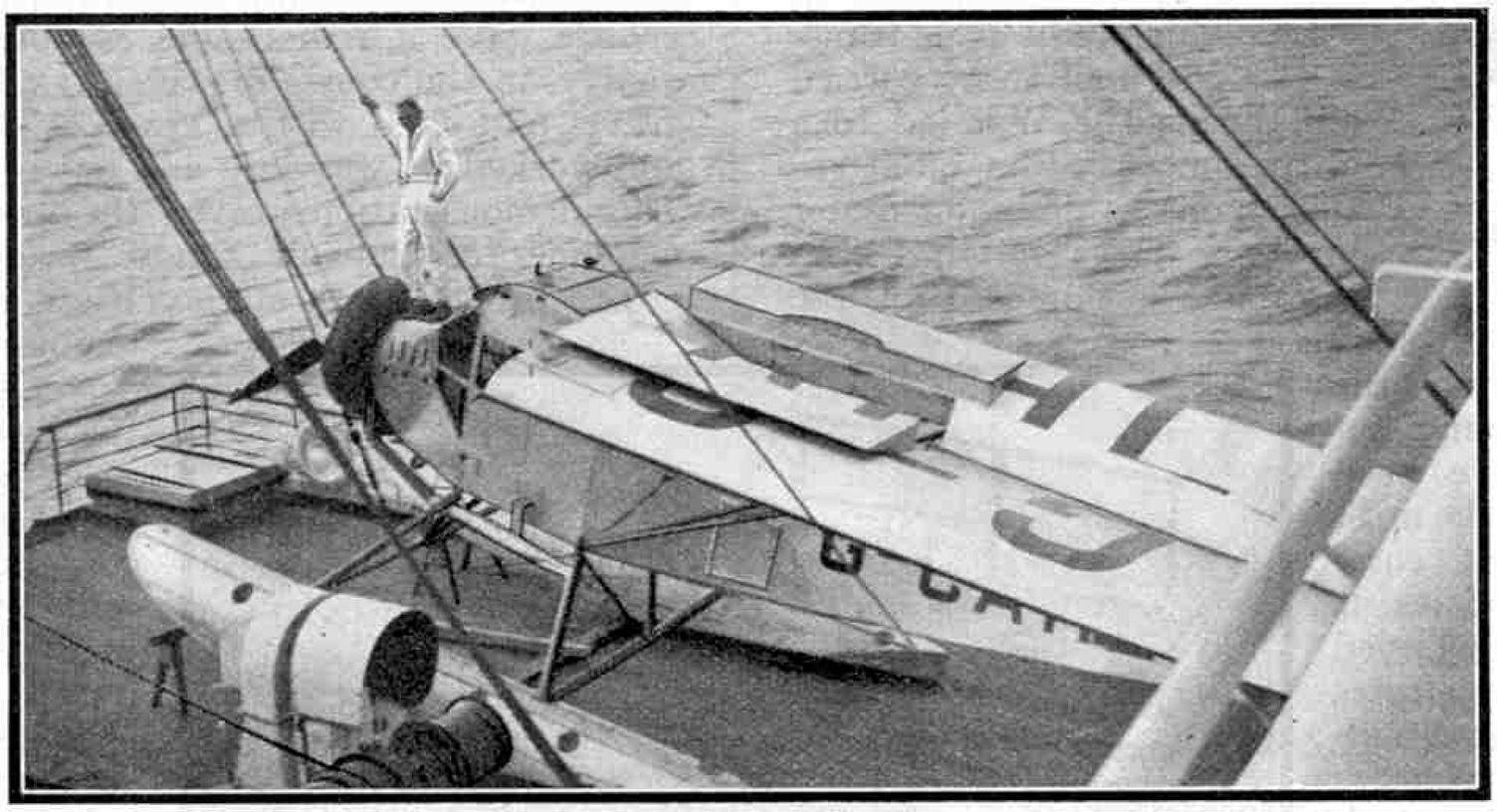
* * * *

Another Fairey long range monoplane is now being built for the Air Ministry. In certain quarters this step is believed to foreshadow another British attempt to secure the endurance record.

Montreal to Jamaica by Air in 33 Hours

A new air mail service between the West Indies and Canada is shortly to be established, and a British pilot, Captain A. R. C. Holland, has already signed a contract with the Jamaican Government for the transport of mails between Jamaica and Cuba as part of a regular air mail service between the former island and Montreal. Captain Holland intends to use British-built machines for this service. On his journey to Jamaica he took with him a Canadian-built seaplane that he intends to use as a "general purpose" machine, however. On arrival at the Bahamas this was unloaded from the Canadian National steamer, *"Lady Somers,"* in which the voyage from Canada was made, and Captain Holland flew the remainder of the distance to his base at Jamaica. A photograph of the seaplane on board the *"Lady Somers"* appears on this page.

The distance in a straight line between Montreal and Jamaica is approximately 2,200 miles and will be covered in 33 hours.



A seaplane on the deck of the Canadian National steamer, "Lady Somers," in which vessel it was taken to the West Indies to be used by Captain A. R. C. Holland on the air mail service between Jamaica and Cuba referred to on this page. This photograph is by courtesy of Canadian National Railways.

R.A.F. Aircraft Apprentices

The Air Ministry announce that 500 aircraft apprentices between the ages of 15 and 17, are required by the R.A.F. for entry into the service schools of technical training. They will be enlisted as a result of an open and limited competition to be held in the near future, but boys in possession of an approved first school certificate may be admitted without any other educational examination.

Successful candidates will be required to complete a period of twelve years' regular Air Force service from the age of 18, in addition to the training period. At the age of 30 they may return to civil life, or may be permitted to re-engage and to complete time for pension.

The scheme offers a good opportunity to well educated boys of obtaining a three-years' apprenticeship course of high standard, and of following an interesting technical career. During the training period the rate of pay is 1/- a day for the first two years, and 1/6 a day thereafter until the apprentice has both attained the age of 18 and been posted to a unit on completing his training. When he is appointed to a unit for duties as an aircraftman the commencing rate of pay varies from 3/3 to 5/6 a day in addition to free board and lodgings and a uniform allowance.

A few apprentices who show special promise are admitted to the Royal Air Force College, Cranwell, for further training with a view to their becoming commissioned officers.

Full information regarding the dates of the respective examinations, the methods of entry and the aircraft apprenticeship scheme generally may be obtained on application to the Secretary, Air Ministry (Aircraft Apprentices Department), Gwydyr House, Whitehall, London, S.W.1.

New Giant German Flying Boat

An interesting all-metal flying boat of gigantic size has been designed by Dr. Rumpler, a well-known German aeronautical engineer. Actual construction of the machine has not yet been started, but a scale model shows it to be a twin-hull monoplane flying boat of well-streamlined design.

The cantilever wing of the machine, which is to have a span of 289 ft., will be mounted above the two hulls on short turrets similar to the engine supports employed on the Dornier "Do.X." It will have a chord of 41 ft., and will be of sufficient thickness to carry a total of 135 passengers and a crew of 35, in addition to providing ample accommodation for personal luggage, cargo and mails. Ten four-bladed pusher airscrews driven by engines with a total of 10,000 h.p. will propel the giant flying boat. It is expected that eventually Diesel engines will be used, and it is interesting to note that these will be fitted inside the wing in order to facilitate examination and repairs. The airscrews will be driven by means of propeller shafts.

The hulls will only be used to carry the fuel and oil supplies of the flying boat and therefore will be made very narrow and well streamlined. They will be 160 ft. in length and 59 ft. apart. At the rear they will be joined by a large stabilising span, which will carry the rudders and elevator surfaces.

It is expected that the Rumpler flying boat will weigh 250,000 lb. or nearly 112 tons, when fully loaded, and that in addition to 170 persons it will be able to carry 13,000 lb. of cargo. The disposable load will be 143,000 lb. and the paying load 44,000 lb. The estimated take-off of the machine is 60 miles per hour, while the stalling speed will be about 55 m.p.h., and the cruising speed 185 m.p.h. The service ceiling is estimated at between 8,000 and 13,000 ft. The cruising range will be about 3,700 miles.

THIS MONTH'S AIR STORY

Pilot: "This machine is equipped with two Wright 'Whirlwind' engines."

Passenger: "That's funny, isn't it? Surely they should have made one of them a left?"

American Naval Airship nearly Completed

The giant American naval airship "Z.R.S.—4" that is being constructed in the Goodyear factory at Akron, Ohio, as explained on page 600 of our issue for August, 1930, is now rapidly approaching completion. The tenth of the twelve main frames, and the cone-shaped nose, 76 ft. in length, have been raised into position, and the portion of the framework that is finished measures 685 ft. in length. The parts to be fitted will add another 100 ft. to the length of the vessel.

Progress on the airship is now so far advanced that the front sections are already being covered with fabric. One of the giant gas bags to be fitted, each of which has a capacity of 1,000,000 c. ft., has already been completed and tested, and three more are being made. In addition one of the power transmission units to be used in the giant airship, which has been renamed *"Akron,"* has undergone a test that calls for continual non-stop running for 500 hours. The test was primarily intended to make certain that the transmission gearing would stand up to the strain of continual running.

It is hoped that the vessel will be completed soon enough to enable the initial flight to be made in the early summer of this year.

First Passenger Air Line in New Zealand

New Zealand's first passenger air service has now been in operation for some time, and the results have proved so satisfactory that it will probably be extended. The service is maintained by Taranaki Airways between Wellington and New Plymouth, North Island, and at present it is being operated by two Desoutter Mark II monoplanes equipped with D.H. "Gipsy III" engines. These are similar to the machine described and illustrated in the article on page 128 of our February issue. Although three stops are made between Wellington and New Plymouth, the journey is completed in two hours.

Another interesting air mail service recently has been started in the Fiji Islands. The service connects the many islands in the group and is being run by Captain Fenton, M.C., who is being supported by the Fijiian Government. At present only one machine is in use. This is a Dornier "Libelle" light flying boat equipped with a British "Cirrus" engine. It has been named the *"Princess of the Skies."*

U.S. Naval Air Service Flights in 1930

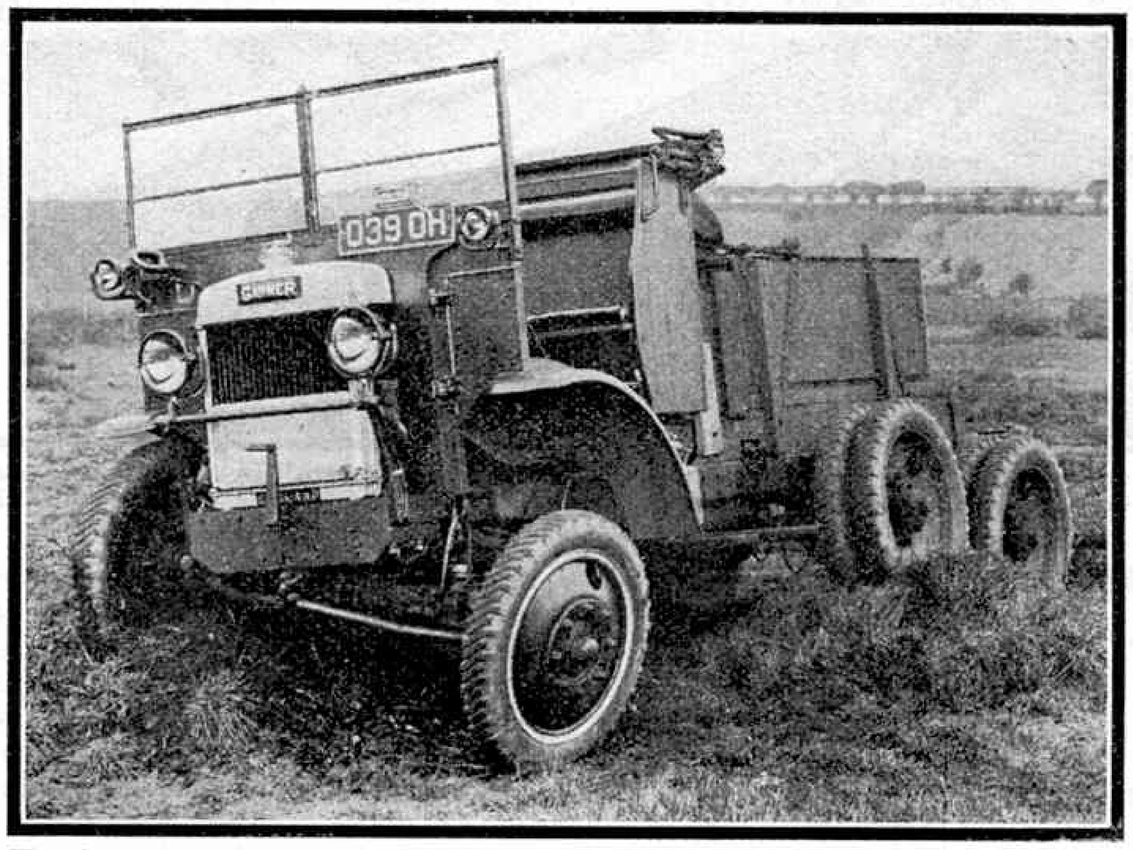
During 1930, 253,095 flights were made in U.S. Naval Air Service machines. These flights occupied a total of 266,984 flying hours and only 14 of them ended in fatal crashes. This means that 19,070 hours were flown for every fatal accident. In comparison with the preceding year this shows an improvement, for then 11,289 hours were flown for each fatal accident.

Remarkable Six-Wheeled Chassis

A Splendid Opportunity for Model-Builders

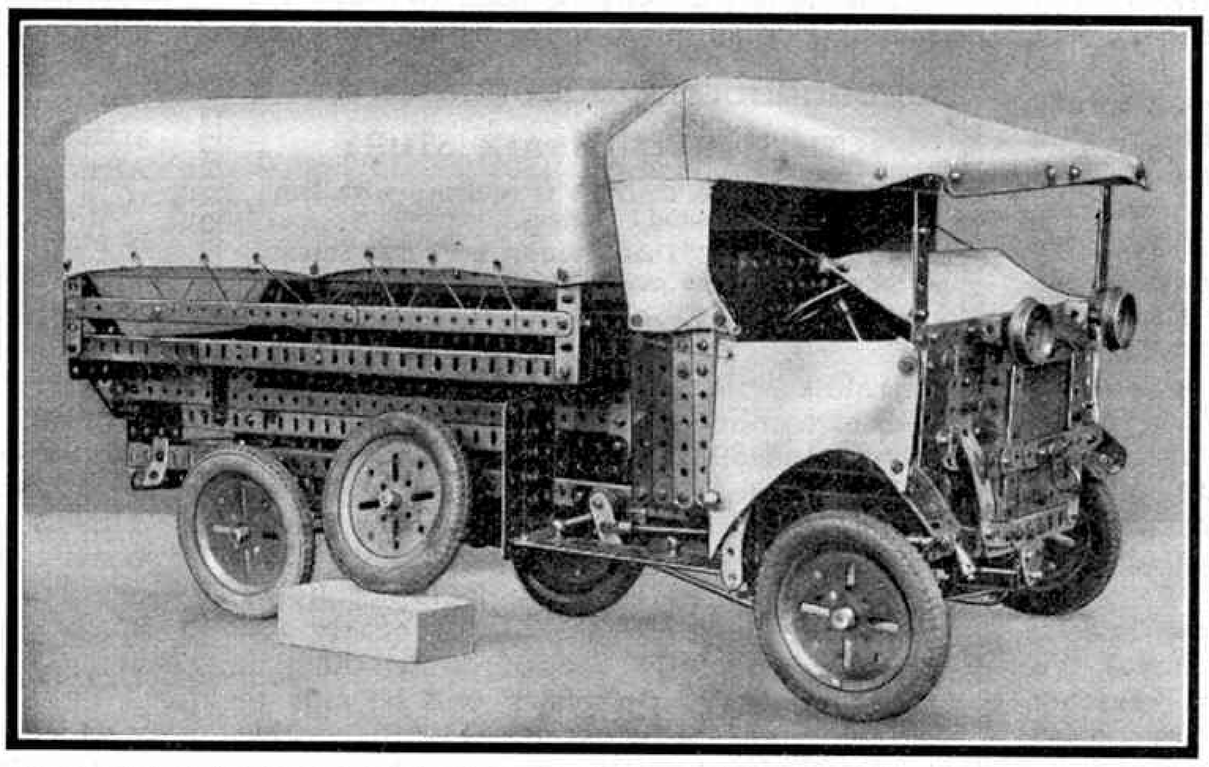
Kenneth Garner who built this fine Meccano Model.

THE severe conditions in which large-scale transport had to be carried out during the War led to a great concentration of attention upon the design of motor lorries. The result has been a rapid development in the general efficiency of such vehicles, and during the past few years many interesting types have been produced. Among the most successful of recent commercial motor vehicles is the Garner rigid six-wheeled lorry. This incorporates the many excellent qualities of the Garner vehicles of standard pattern, together with certain special features that render it useful for transport purposes over ordinary roads and the roughest ground alike.



The Garner six-wheeled motor lorry. The photograph shows how the articulation of the axles enables the lorry to negotiate rough country.

A test of this Garner six-wheeler was carried out a short time ago over some of the roughest ground to be found in the British Isles, corrugated in places by ruts ranging from a foot to two feet in depth. This test showed that the chassis was capable of traversing the most uneven surface without difficulty; while in hill-climbing ability and speed on the level it surpassed many four-wheelers intended only for service on hard roads. In order to illustrate the adaptability of its wheels and axles to such unpromising conditions, the chassis was driven on low gear, in zigzag fashion, up a gradient of one in six, so that its three axles continually assumed different angles. A load of 30 cwt. was carried, and this was increased at certain points by half-a-dozen passengers. Yet in spite of this load the machine always appeared to have power in hand, and it completed the ascent with ease.



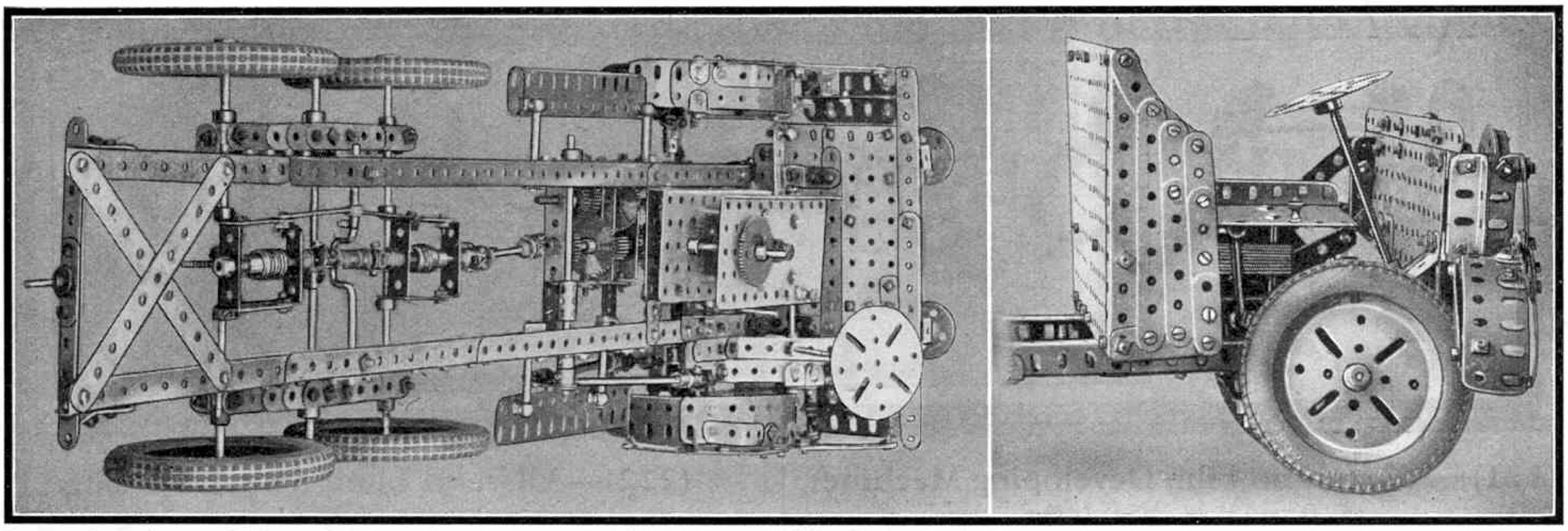
The model of the lorry built by Kenneth Garner. This splendid model incorporates all the main features of the actual vehicle, and is described in the accompanying article.

In addition to descending a hill with a gradient of one in $4\frac{1}{4}$, and demonstrating the efficiency of its brakes while travelling at high speed on the level, the vehicle gave a remarkable demonstration in a gravel quarry, in the course of which it climbed heaps of loose gravel and sand with a gradient of fully 50 per cent., and worked its way into and out of holes 4 ft. in depth. This demonstration proved the special suitability of the machine for difficult sandy surfaces.

The frame length of the chassis is 15 ft. $6\frac{1}{2}$ in.; the loading space behind the driver's cab is 11 ft.; and the distance between bogie axles is 3 ft. 4 in. The gear-box and clutch is incorporated with the engine unit, the whole being three-point supported in the frame. The main gear-box provides four forward speeds and reverse, but behind it is carried, on a pair of tubular cross-members, an auxiliary two-speed reducing gear-box, so that actually eight forward and two reverse speeds are available. The main shafts of the two gear-boxes are connected by a flexible disc joint to allow for any misalignment due to frame distortion.

Considerable attention has been given to the matter of effective braking. Drums are provided for all four rear wheels, and in these work shoes 17 in. in diameter with a face width of $2\frac{1}{2}$ in., one set being operated by a pedal through a Dewandre servo, and the other controlled by a hand lever. The arrangement of the various controls is as follows. The main change-speed and brake levers are on the right; the auxiliary change-speed control is at the left; and, apart from the clutch and brake pedals, there is a slipper-type accelerator pedal. The ignition and throttle controls are mounted on the steering column below the wheel.

The front wheel wings are carried on a pair of vertical hinges, so that they can be swung forward to give accessibility to the engine. The hinges are designed also to permit of tilting in order to clear the wheels.



Further views of the model lorry. It is interesting to compare the photograph on the left with the chassis of the actual lorry shown below. The Garner patent front wing arrangement is well seen in the photograph on the right.

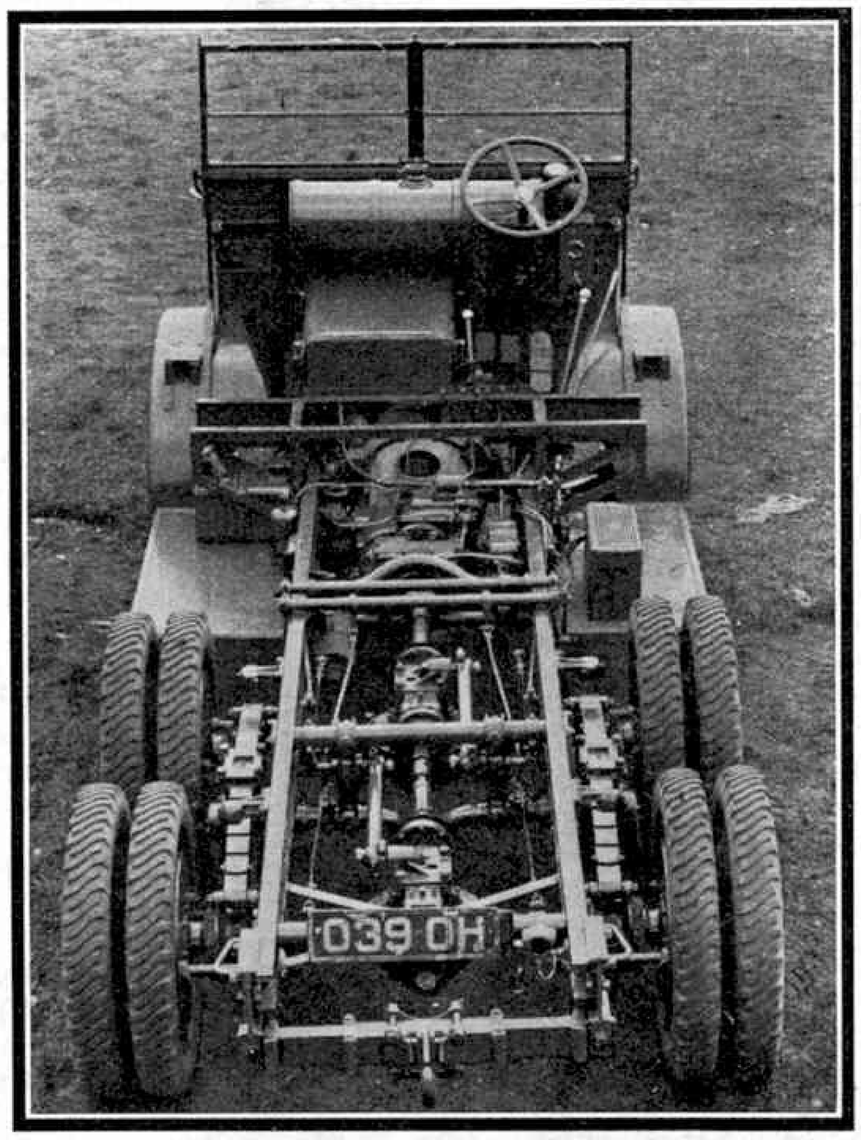
The arrangement of the back axles and suspension is on more or less orthodox lines. Between the axles the frame is joined by a pair of tubular cross-members, one above the other; and on the ends of the lower member are centrally pivoted double-inverted semi-elliptic springs on each side, their outer ends being pivoted to brackets on the axles. The two cross-tubes are joined by a pair of vertical members that form the anchorages of a pair of torque members attached to lugs cast on covers fitted to the housings of the driving shaft worms.

The bogie has two inverted semi-elliptic springs at each side, and a ball-jointed radius and torque rod stretches from the top cover of each of the driving worm casings to stout brackets connecting a tubular cross-member with the fulcrum member for the rear springs. The torque member attachments take the form of balls and sockets to afford the necessary flexibility. Excessive vertical and tilting movements of the axles are prevented by steel wire cable slings and rubber buffers held in brackets secured to the frame side members.

One of the most interesting features of the chassis is the arrangement of the front axle and springing to permit perfectly free axle movements without imposing twisting stresses on the frame. The axle is located by two long radius rods at the back, universally anchored to brackets fitted under the side frames, and joined by a tubular cross-member. These take the thrusts when the wheels meet obstacles while travelling forward. In addition, forward thrust on the axle is resisted by a third radius rod of wide V shape, secured at the centre by a ball and socket to the front end of the frame, and having its outer ends attached to the axle close to the steering pivots.

The front suspension comprises two quarter-elliptic springs, their inner ends held in a pivoted bracket, and their outer ends passing between rollers carried in brackets secured to the axle. These springs are not parallel with the axle, but are inclined forward, thus increasing their length and flexibility. It will be seen that by this arrangement both the axle and the front radius rod articulate together with the springs to the limits imposed by the slings and rubber buffers already mentioned.

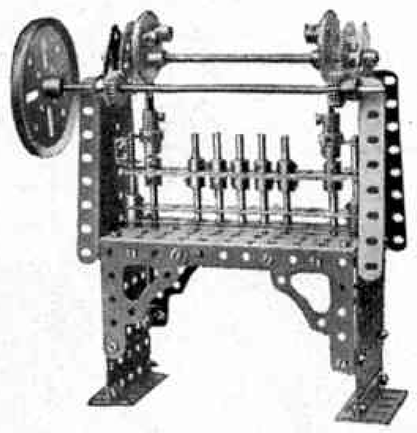
The steering box, which is of the cam and lever pattern, is mounted at the extreme front of the off-side frame member. In order to obviate road shocks as much as possible, the drop arm to the steering wheel is connected by a drag link about 4 ft. in length, carried back to an idle lever pivoted to the frame, from which a second rod is taken forward to the steering arm. The vehicle will turn in a circle 47 ft. 6 in. in diameter.



The Garner lorry chassis with the body removed, showing how the transmission to the second and third axles is carried by overhead Worm drive.

The Garner chassis affords a splendid subject for reproduction in Meccano. This will be apparent from the accompanying photographs of the fine scale model constructed by Kenneth Garner, son of Mr. Garner, of Garner Motors Ltd. Construction of this model was begun during the summer of 1928, at which time the technical staff of Garner Motors Ltd. were busily engaged in drawing up plans for their new production. The greater portion of the model, namely, the frame, bogie, and articulating front axle, was developed from the original drawings of the actual chassis. The model proved very helpful to the designers in assisting them to work out the general details, as it showed quite clearly a number of movements that it was not possible to convey clearly by drawings alone. The cab and bodywork are built to scale, the measurements being based on the dimensions of actual vehicles in the Garner Works.

The model is driven by a six-volt Meccano Electric Motor, which is incorporated in the frame as a substitute for the orthodox engine. The gear-box gives two speeds forward, and reverse travelling is obtained by reversing the motor. The final drive to the second and third axles is transmitted by Worm gears. (*Continued on page 251*)



Suggestions Section

Edited by "Spanner"

(221)—A Meccano Film Developing Machine

(S. Desai, Mota Falia, India)

Nowadays the vast majority of films are developed in specially-designed tanks. Many Meccano boys, however, will be familiar with the method of developing a spool of film by holding one end in each hand, and running the film backward and forward through the developer in a dish. The apparatus shown in Fig. 221 is intended to carry out development on similar lines, but by the turning of a handle instead of the wearisome alternate raising and lowering of the hands. It may be adapted to take films of different sizes, and it is capable of turning out quite good results. In using the apparatus it is, of course, necessary to carry out all the operations by ruby light.

The model consists of a base built up from 5½″ × 2½″ Flanged Plates and 7½″ Angle Girders, to which are secured the bottom ends of two vertical 24½″ Angle Girders. The rollers that carry the film are Wood Rollers (part No. 106) covered with paper, or preferably with short lengths of radiator hose pipe, which may be obtained in different sizes from most motor dealers. The rubber covering is better than the alternative method, as it enables the rollers to be easily kept clean and free from chemicals.

The lower roller is rotated through the medium of a belt by a crank handle, while the upper one is mounted in a frame slidable on the upright girders in order that the device may use different sized films.

Each side of the sliding frame consists of a 2½″ Angle Girder, which is held in contact with the flange of the 24½″ Girder by means of two ½″ Reversed Angle Brackets.

The film is first run through a dish of plain water until it is thoroughly wet and limp, and is then placed on the rollers, sensitive (dull) side out, its ends being overlapped about half-an-inch, and fastened together with paper fasteners of the split type. The tension on the film belt thus produced is adjusted so that on turning the handle the film moves also.

Under the lower roller is placed a dish of such a size that when it is filled with the prepared quantity of developing solution, this reaches the axis of the roller. Before the developer is poured into the dish the joint in the film should be arranged at the lowest point, so that the developer does not begin to act on an exposed portion of the film while pouring is in progress, and before turning is commenced.

The time during which development should be continued is best ascertained by what is known as the "time and temperature" method. In this method the temperature of the developer is first taken, and the correct time of development is then found by consulting the tables given in the *"Wellcome Photographic Handbook and Diary,"* and in many other photographic publications.

When development is complete, fixing may be carried out in a similar manner by substituting for the developing dish another dish filled with hypo. Washing in running water or several changes then follows in the usual way.

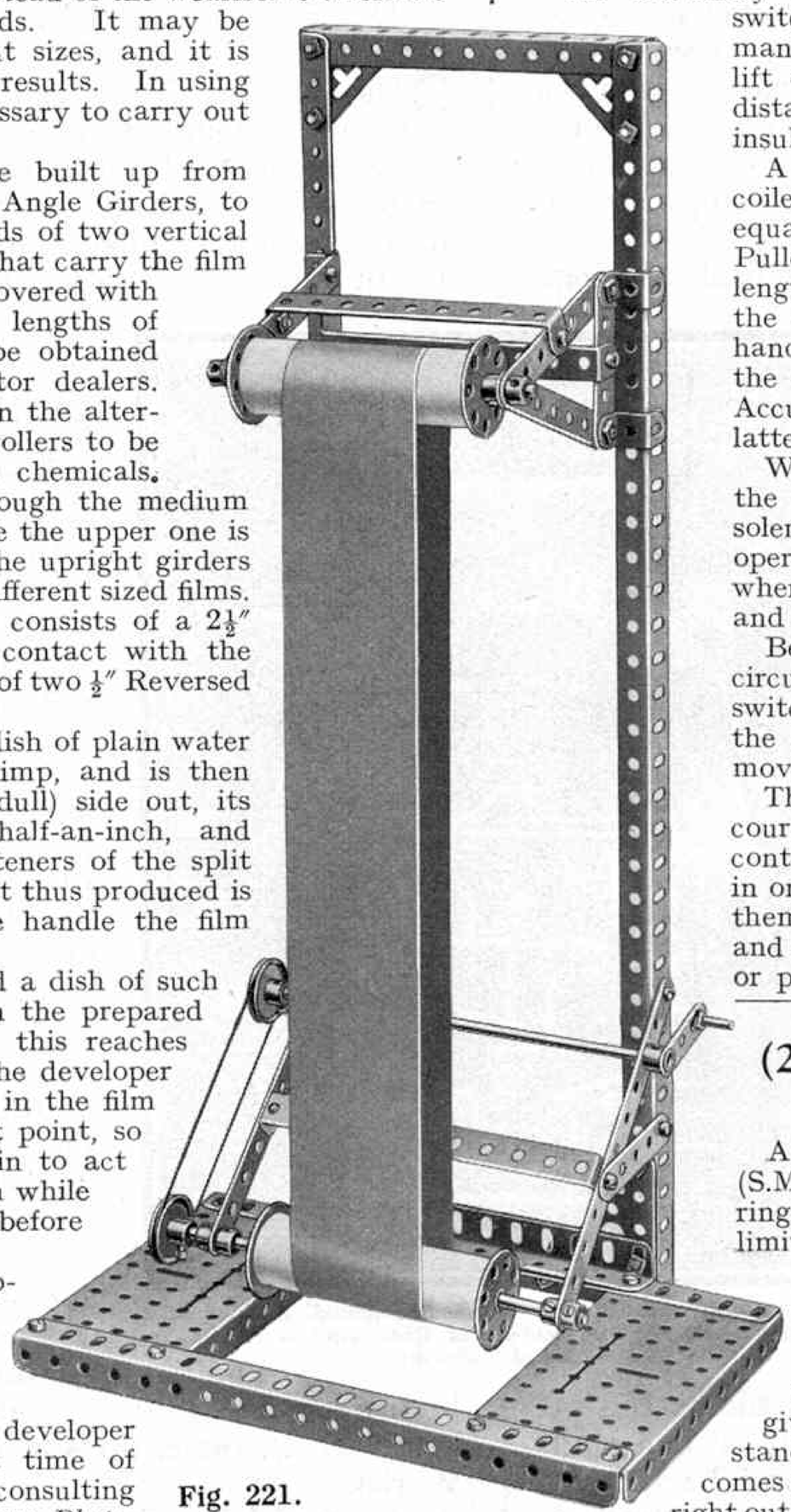


Fig. 221.

(222)—A Useful Limit Switch for Lifts

(J. Rawlings, Lee, S.E.12)

Among the most important safety devices that are to be found in all modern lift installations are limit switches. Limit switches perform the important function of cutting off the power at either end of the lift's travel, thus preventing the lift from being dashed against the top or bottom of the shaft. Automatic brakes aid in bringing the cage to rest when the power is cut off.

An extremely simple yet ingenious method of fitting limit switches to a Meccano lift is made in the following manner. The hoisting cord that is attached to the lift cage passes over two Pulleys spaced a short distance apart. One of the Pulleys must be insulated from the rest of the model.

A piece of fine copper wire (about 35 gauge) is coiled closely round the hoisting cord for a distance equalling that between the centres of the two Pulleys. The insulated Pulley is connected by a length of wire to one end of the winding of a solenoid, the other end of which is attached to a simple hand-operated on-off switch. The other contact of the switch is connected to one terminal of an Accumulator, while the remaining terminal of the latter is taken to the frame of the model.

When the copper wire on the hoisting cord bridges the two Pulleys, the circuit is complete and the solenoid is energised. The solenoid is arranged to operate a "cut-out" in the motor circuit, so that when it is energised, the cut-out breaks the circuit and stops the Motor.

Before the Motor can be re-started the solenoid circuit must be broken by means of the on-off switch, which should be closed again as soon as the wire-wound portion of the hoisting cord has moved off the Pulleys.

The terminals of the hoisting Motor are, of course, connected directly to the accumulator, the contacts of the cut-out being arranged in series in one of the leads, so that the current passes across them on its way to or from the Motor. The Motor and solenoid circuits are hence arranged in "shunt" or parallel with each other.

(223)—Warning Device for Crane

(E. Vickery, Manchester)

A novel modification of the Jib Radius Indicator (S.M. 282) has been suggested, whereby the Indicator rings an electric bell when the jib is luffed out to the limits of safety. As most of our readers are aware, the Radius Indicator itself consists of a rod that is mounted pivotally and weighted at one end so that it remains always vertical. The device is attached to the side of the jib and the upper end of the rod reads against a scale giving the jib radii. The principal addition to the standard Indicator is an insulated 6B.A. Bolt. This comes into contact with the rod when the jib is luffed right out, so that the circuit is completed and the bell rings. One terminal of the bell is "earthed" to the model and the other is connected to the Accumulator or battery. The remaining terminal of the latter is attached to the insulated Bolt.

Another direction in which this idea could be developed would be on the lines of a limit switch, which would stop the Motor at each end of the luffing range of the jib.

(224)—Automatic Motor Brake

(D. Garnett, Southbourne, Bournemouth)

Readers of the "Suggestions Section" will remember perhaps, that we published a suggestion for an automatic brake for the 6-volt Motor in the August, 1929, "*M.M.*", the object of which was to apply a retarding force to the armature spindle of the Motor immediately the power is cut off. A brake of this nature is very useful in hoisting machinery of all kinds.

Fig. 224 illustrates an improved form of this type of brake. The rotating member of the brake is a 1″ fast Pulley shod with a 1″ Dunlop Tyre and secured to the armature spindle. The fixed portion of the brake consists of a Bush Wheel on a Rod 1 that is free to slide in a Collar, which is fixed rigidly between the ends of a pair of Simple Bell Cranks. The latter are bolted to vertical Strips 2, which are secured to the arms of a Single Bent Strip on the Motor Plate.

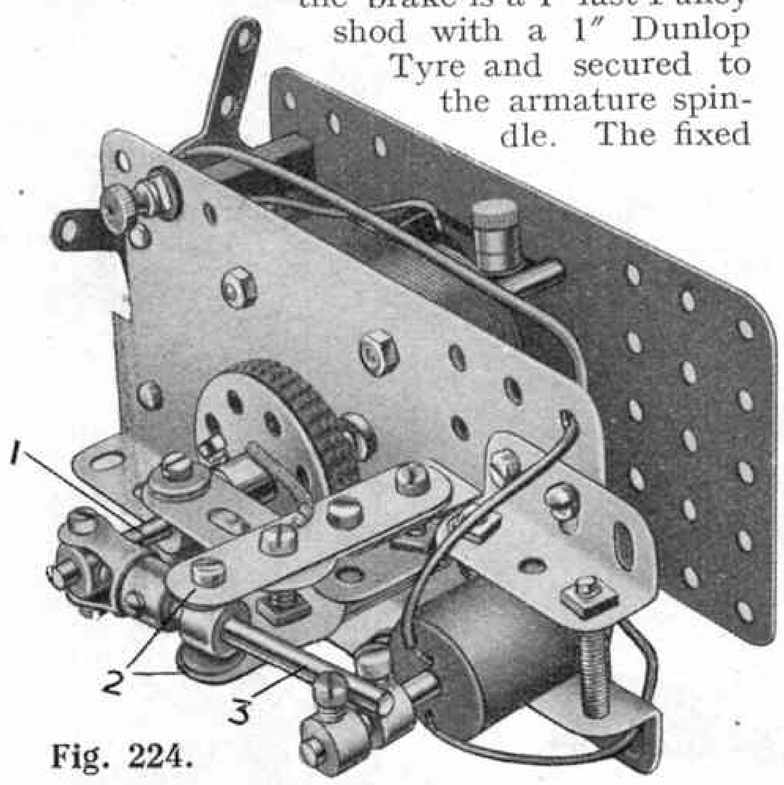


Fig. 224.

A Rod 3 is mounted in a Collar that is free to turn about the Bolts retaining it in place between the Strips 2. One end of this Rod is attached pivotally by a Swivel Bearing to the Rod 1, whilst its other end is connected as indicated to the end of the solenoid plunger. The Bush Wheel is normally kept in contact with the tyre-shod Pulley by means of a small piece of Spring Cord, which is bolted to the Strip 2 and presses on to the Bush Wheel. A similar piece of Spring Cord should be attached to the other side (the underneath) of the model.

The solenoid is composed of a Bobbin wound with four layers of No. 23 SCC wire. One of the wires is attached to a terminal, which is insulated from the Motor Side Plate by an Insulating Bush and a Washer, and the other wire is bolted in metallic contact with the plate. One of the Motor terminals is treated in a similar manner. Connection is made to the Accumulator from the terminal on the Motor side plate and the remaining Motor terminal.

When the Motor is running, current is flowing through the turns of the solenoid, which keeps the plunger down, and consequently the brake is held off. When the current is cut off, the solenoid is de-energised and frees the plunger, thus allowing the face of the Bush Wheel to come into contact with the Tyre on the 1″ fast Pulley.

In order that the device may function efficiently all moving parts should be carefully adjusted so that freedom of movement is assured.

(225)—Automatic Steering Gear for Model Yachts

(B. Redhead, Lincoln)

Those who are the fortunate owners of model racing yachts will be keenly interested in the working model of Braine's automatic steering gear shown in Fig. 225. The object of the device is to keep the model boat on a straight, predetermined course. In the case of a boat fitted with an ordinary tiller, a straight course is exceedingly difficult to maintain, for a sudden gust of wind may strike the boat and cause her to "pay off." She may, of course, return to her original course, but the chances are that she will proceed in an entirely different direction. Careful trimming of the sails and adjustment of the helm is of little avail, since although these may be correct for a given strength and direction of wind, a wayward gust may upset all the model yachtman's careful calculations. The Braine automatic steering gear surmounts these obstacles in a way that will be clear from a little study of the Meccano model. For practical application of the gear, the model would, of course, be modified considerably. For instance, there would be no necessity for the metal base plates, and the main boom and mast of the yacht would take the place of the Meccano Rods that represent these parts in the illustration.

The tiller 1 is secured to the upper end of the rudder stock and in shape resembles the letter T. Each end of the top of the T is connected by crossed cords to the main boom at the point 3. The other end of the tiller moves under a yoke and its extremity has fixed to it a short length of Spring Cord 2. The other end of the spring may be anchored in various positions in the base plate to alter its tension.

When the boat is running "close hauled," that is, sailing close in to the wind, the main boom is pulled inboard as far as possible by sliding the Collar 3 towards the end of the boom. Under these conditions if the boat's head tends to "pay off," the boom swings outward, thus angling the rudder through the medium of the cords attached to the tiller, and returning the boat to her original course.

The setting of the mainsail is accomplished by sliding the Collar 3 on the boom, moving it towards the mast when the boat is sailing before the wind with the boom swung outboard, and sliding it in the reverse direction when it is desired to set her on a close hauled course.

The most critical adjustment of the device lies in the correct tensioning of the Spring 2 for various courses and wind strengths. A little practice, however, will soon enable the model yachtsman to adjust matters so that, unless something abnormal occurs, his craft will keep on a straight course. In some cases the gear may prove more sensitive and reliable if a length of thin elastic be substituted for the Spring Cord 2.

Miscellaneous Suggestions

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

(M.108). A Neat Wheel for Double Tyres.—Eric Skinner (Anerley) points out that a novel motor lorry wheel may be built up from a typewriter ribbon spool. Two 2″ Dunlop Tyres may be mounted side by side on the periphery of the spool, and it will be found that the central hole through the spool is a running fit on the standard size of Meccano Rod. We have built up a wheel in the manner suggested, and we can vouch for its realistic appearance, and the way in which it enhances the appearance of a model lorry.

(M.109). An Automatic Switch.—Many Meccano boys must have had the annoying experience of groping around in a semi-dark cupboard trying to find a solitary nut or grub-screw! In order to make such a search easier, S. Wild (Ashton-under-Lyme) suggests the fitting of a device that switches on a light when the door is opened. The switch is arranged in the following manner. A $3\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip is secured by a wood screw near the top of the door, on the inside and close to the hinge. The Double Angle Strip is bent upward slightly until it comes into contact (when the door is opened) with an Angle Bracket or similar part, fixed to the top frame of the door so that it coincides with the lower edge of the frame. One wire from the battery is taken to one contact of the switch, while from the other contact a wire is attached to one side of the lamp. It only remains to connect the lamp with the battery.

(M.110). Safety Device for Trailers.—For trailers that are hauled by a clockwork tractor, O. Beatton (Port Glasgow) suggests a way in which the tractor may be pulled up in the event of the trailer breaking away. The device is very simple, for it consists in connecting the trailer by a length of cord to the brake lever of the Motor, so that when the trailer breaks away, the lever is pulled down and the tractor is brought to rest.

(M.111). "Making Old Bolts New."—That the heads of old-style bolts may be rounded like the latest type in a Meccano lathe is the suggestion of J. Wahl (Johannesburg, S. Africa). The lathe is quite a simple affair, for it consists essentially of a Coupling secured on the end of a rotating Rod. The shank of the bolt is held in the Coupling and the head can be shaped with the aid of a file as the bolt is turning. Unfortunately, this process removes the lacquer, a fact that soon causes the heads of the bolts to become tarnished.

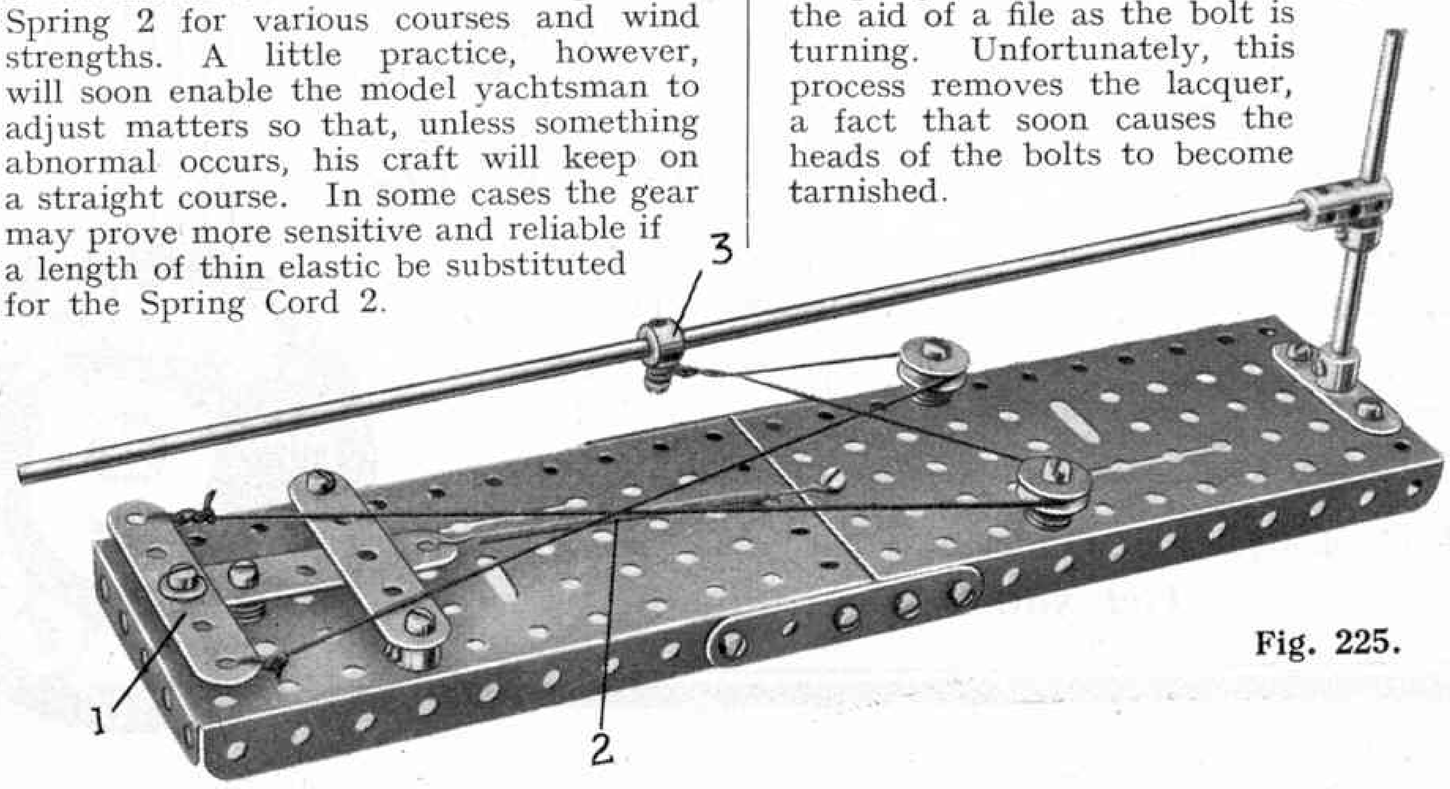


Fig. 225.

Boys, Here is Good News!

The 1931 edition of the Meccano Book of New Models—a bigger, better and more thrilling book than ever—is now ready. It consists of no less than 40 pages of new models, new mechanisms and new ideas, as compared with only 24 pages in all previous editions. Every Meccano boy should obtain a copy as early as possible.

The principal object of this book is to keep Meccano model-builders in touch with the latest improvements and developments connected with their hobby. The book contains illustrations and details of the best of the new models and new movements submitted in recent competitions, together with many others that have been designed by our own experts. The models shown in this book are of outstanding interest and variety. They range from simple models that can be built with small Outfits to elaborate types that will appeal to older boys.

How to obtain the book

The 1931 Book of New Models may be obtained from any Meccano dealer, price 9d., or direct from Meccano Ltd., Old Swan, Liverpool, price 10½d. post free.

There are special editions for Australia, New Zealand, South Africa and Canada and details of the prices of the book in these countries are as follows:—

Australia: Price 1/9 from dealers or 1/11 from E. G. Page & Co., 52, Clarence Street, Sydney. (P.O. Box 1832K).
New Zealand: Price 1/- from dealers or 1/2 from Models Ltd., P.O. Box 129, Auckland (Kingston Street).
South Africa: Price 1/- from dealers or 1/2 from Arthur E. Harris, 142, Market Street, Johannesburg. (P.O. Box 1199).
Canada: Price 25 cents from dealers or 30 cents from Meccano Ltd., 34, St. Patrick Street, Toronto.

Readers living in countries other than those mentioned above should order from Meccano Ltd., Old Swan, Liverpool, England, sending a remittance of 1/2 with their orders.

Get your copy to-day!

A Chance for Owners of No. 0 and No. 5 Outfits

How to Qualify for Splendid Cash Prizes

THIS month we announce the third of the 1931 series of Meccano "Outfits" Model-building Contests. In this contest prizes are offered for the "Best Models Made Entirely from Either a No. 0 Outfit or a No. 5 Outfit." Readers who possess larger Outfits may of course enter, provided that they use only parts that are contained in either the No. 0 or the No. 5 Outfits. For the benefit of those who are not familiar with the Contents of these Outfits we give lists of the parts in each. It is of course not necessary to use all the parts contained in the Outfit.

Competitors may build any type of model they like, and the more original the subject the better will be its chance of winning a prize.

Entries will be divided into four Sections, as follows:—Section A, for models built entirely from the parts contained in No. 0 Outfits, by competitors living in the British Isles. Section B, for models built entirely from No. 5 Outfits, by competitors living in the British Isles. Section C, for models built from No. 0 Outfits, by competitors living overseas. Section D, for models built from No. 5 Outfits, by competitors living overseas. Each Section is open to readers of all ages. Competitors may submit both a No. 0 Outfit model and a No. 5 Outfit model if they wish, but no competitor can win more than one prize in this contest.

The following Prizes will be awarded in each of the Sections B and D: First Prize; cheque for £3-3s. Second Prize; cheque for £2-2s. Third Prize; cheque for £1-1s. Six Prizes of Meccano goods, value 10/6. Six Prizes of Meccano goods, value 5/–. Twelve Prizes of a Meccano Engineer's Pocket Book.

The following Prizes will be awarded in each of the Sections A and C. First Prize; Meccano goods, value £2-2s. Second Prize; Meccano goods, value £1-1s. Third Prize; Meccano goods, value 10/6. Six Prizes, each consisting of a No. 0a Accessory Outfit. Six Prizes, each consisting of a Meccano Engineer's Pocket Book.

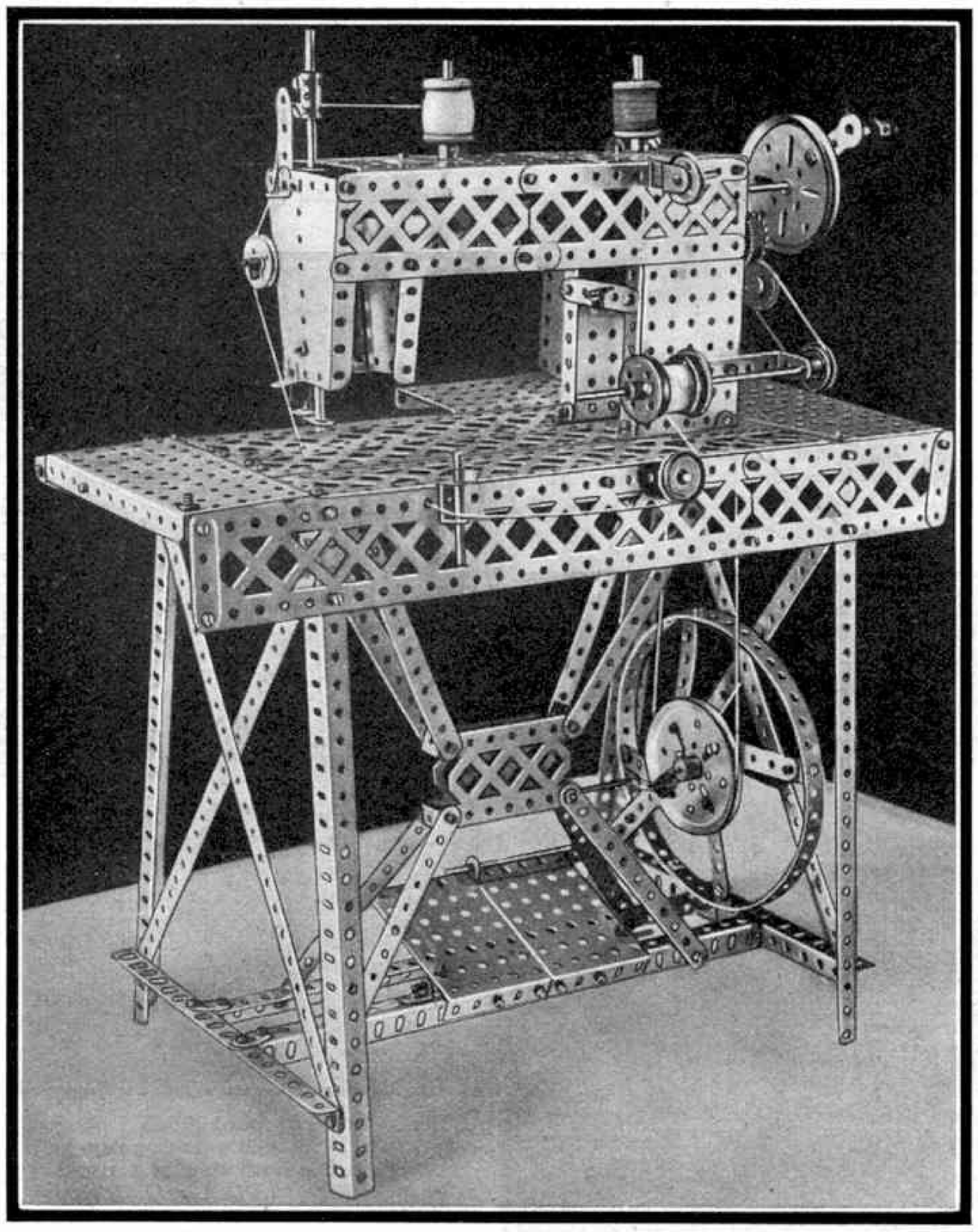
A number of Meccano Certificates of Merit will also be awarded in each Section.

Competitors need only send in clear photographs or good drawings of their models, together with any written explanations that may be necessary. Full lists of prize-winners will be published in the "*M.M.*" as soon as possible after the closing dates.

Each photograph or drawing submitted must bear the competitor's age, name and address on the back, together with the letter A, B, C, or D, indicating the Section for which the entry is eligible. Competitors must enclose with their entries complete lists of the parts required to build the models submitted.

Envelopes containing entries should be addressed: March "Outfits" Contest, Meccano Ltd., Old Swan, Liverpool, and the appropriate letter indicating the Section should be marked in the bottom left-hand corner.

The closing dates for this competition are as follows:—Home Sections, A and B, 30th April, 1931. Overseas Sections, C and D, 31st July, 1931. Entries received after these dates will be disqualified.



An interesting model sewing machine, built by R. S. Giovanni, Naples, which secured a prize in a recent competition. This machine works in a most realistic manner. The cotton is arranged to wind off as it would do if the machine were actually sewing, and simultaneously a spare bobbin is filled ready for use.

Photographs or drawings of unsuccessful models will be returned to the senders provided that a stamped addressed envelope of the necessary size is sent with the entry. It should be noted, however, that prize-winning entries become the property of Meccano Ltd.

The following is a complete list of the parts contained in the No. 0 Outfit:—

4 of No. 2; 9 of No. 5; 4 of No. 10; 2 of No. 11; 8 of No. 12; 2 of No. 16; 2 of No. 17; 1 of No. 19s; 4 of No. 22; 1 of No. 23; 1 of No. 24; 1 of No. 34; 6 of No. 35; 1 of No. 36; 16 of No. 37; 6 of No. 37a; 1 of No. 40; 1 of No. 44; 2 of No. 48a; 1 of No. 52; 1 of No. 56b; 1 of No. 57; 4 of No. 90a; 2 of No. 125; 2 of No. 126; 2 of No. 126a.

The parts contained in the No. 5 Outfit are as follows:—

16 of No. 1; 2 of No. 1b; 26 of No. 2; 4 of No. 2a; 12 of No. 3; 8 of No. 4; 36 of No. 5; 4 of No. 6; 6 of No. 6a; 14 of No. 8; 4 of No. 8a; 2 of No. 8b; 4 of No. 9; 1 of No. 9d; 12 of No. 10; 8 of No. 11; 36 of No. 12; 6 of No. 12a; 2 of No. 13; 1 of No. 13a; 3 of No. 14; 4 of No. 15; 5 of No. 15a; 5 of No. 16; 3 of No. 16a; 5 of No. 17; 4 of No. 18a; 1 of No. 19; 1 of No. 19s; 4 of No. 19a; 4 of No. 19b; 4 of No. 20; 4 of No. 20a; 4 of No. 20b; 2 of No. 21; 4 of No. 22; 3 of No. 22a; 3 of No. 23; 1 of No. 23a; 2 of No. 24; 3 of No. 26; 2 of No. 27a; 1 of No. 28; 2 of No. 29; 2 of No. 32; 2 of No. 34; 19 of No. 35; 1 of No. 36; 1 of No. 36b; 169 of No. 37; 6 of No. 37a; 24 of No. 38; 6 of No. 40; 2 of No. 41; 1 of No. 43; 1 of No. 44; 3 of No. 45; 4 of No. 46; 1 of No. 47; 2 of No. 47a; 2 of No. 48; 10 of No. 48a; 6 of No. 48b; 4 of No. 48d; 1 of No. 50a; 4 of No. 52; 4 of No. 52a; 5 of No. 53; 2 of No. 53a; 2 of No. 54; 1 of No. 56; 1 of No. 56a; 1 of No. 56c; 2 of No. 57; 19 of No. 59; 2 of No. 62; 2 of No. 62b; 6 of No. 63; 1 of No. 65; 1 of No. 70; 2 of No. 77; 1 of No. 80a; 6 of No. 90; 4 of No. 90a; 40″ of No. 94; 2 of No. 95; 2 of No. 96; 1 of No. 96a; 1 of No. 98; 4 of No. 99; 7 of No. 100; 1 of No. 102; 4 of No. 103f; 2 of No. 108; 2 of No. 109; 3 of No. 111; 6 of No. 111c; 2 of No. 115; 1 of No. 116; 1 of No. 116a; 4 of No. 125; 4 of No. 126; 5 of No. 126a; 1 of No. 128; 2 of No. 130; 4 of No. 142a; 1 of No. 147a; 1 of No. 147b; 1 of No. 148; 1 of No. 159; 1 of No. 160; 1 of No. 162; 2 of No. 163; 1 of No. 164; 2 of No. 165; 1 of No. 166.

Model-builders residing outside the British Isles should make a special effort to enter this Contest. The Overseas closing date is specially extended for their benefit and they have ample time in which to build their models and submit them.

We would like to mention here that written descriptions accompanying entries should be as short as possible. Some competitors are so enthusiastic in their explanations that they forward long descriptions. It is impossible, of course, for the judges to read through them, as in all Meccano competitions they have to examine many hundreds of entries.

Competitors should try to think out a model that is really new and original, and it is always well to remember that many of the highest awards in recent contests have been gained by competitors who have taken the simplest subjects for their models.

"Collis Truck" Model-building Contest

MODEL-BUILDERS should remember that all Sections of the Meccano "Collis Truck" Competition are still open. The Home Sections close on 30th April, and the Overseas Section on 31st July, so there is still plenty of time to send in entries. This great opportunity to win a handsome cash prize should not be missed. Full details of the Contest were published in the February issue of the "*M.M.*"

Results of Meccano Model-Building Contests

By Frank Hornby

"Aircraft" Contest (Home Sections)

THIS Contest was organised with a view to testing the cleverness of Meccano boys in devising realistic models of various forms of aircraft. The construction of a model of this kind in Meccano is by no means an easy task, and that perhaps is why this branch of model-building has received comparatively little attention in the past. Nevertheless the "Aircraft" Contest has proved that it is possible to reproduce the real thing in a most convincing manner, providing that sufficient care and thought are given to the constructional details.

A good number of entries was received and I give below full lists of the prize-winners in the Home Sections A and B.

Section A (for competitors over 14 years of age).

FIRST PRIZE, cheque for £3-3s.: Malcolm McDonald, Ranelagh, Dublin. SECOND PRIZE, cheque for £2-2s.: G. R. Home, Eastville, Bristol. THIRD PRIZE, cheque for £1-1s.: George Moore, Mile End, London, E.3.

SIX PRIZES of Meccano products, value 10/6: Victor C. Kaile, Mayford, nr. Woking; Kenneth C. Ackroyd, Woodhall Spa, Lincolnshire; Ray C. Grant, Aberdeen; Bertram Unné, Harrogate; Edgar Whatley, New Moston, Manchester; B. L. Simpson, London, S.W.5.

TWELVE PRIZES of Meccano products value 5/-: R. Foster, Dorchester, Dorset; F. Edmonds, Hereford; A. L. Hampson, Widnes; J. C. Salter, Bristol; Edward Greenwood, Holloway, N.7; M. Collinge, Dublin; Eric Heard, Wood Green, London, N.22; Cyril E. Wrayford, Willingstone Cottages, near Moretonhampstead; Duncan Young, West Croydon; Louis W. Grey, Jnr., East Ham, London, E.6; Aubrey Shattock, Northampton; A. A. Wiseman, Haverhill, Suffolk.

SPECIALLY COMMENDED, Certificate of Merit: Robert McKeand, Portpatrick; Henry D. Burrough, Sherborne; Eric Whittaker, Bitterne, Southampton; M. A. Mason, Litherland, Liverpool; W. Raybould, Walsall; R. E. Bradfield, Didcot, Berks.; Ronald G. W. Croney, Balham, London; Philip A. Rodgers, Sheffield; Alfred P. Heyhurst, Failsworth, near Manchester; G. F. Lunnis, Manningtree, Essex; Frank Mee, Thornton, Leicester; George Wilkinson, Snelstone, near Ashbourne; Charles N. Marston, Halifax.

Section B (for competitors under 14 years of age).

FIRST PRIZE, Meccano products value £2-2s.: P. Davies, Grangetown, Yorks. SECOND PRIZE, Meccano products value £1-1s.: Frank Stringer, Sidcup, Kent. THIRD PRIZE, Meccano products value 10/6: T. Davies, Town Hill, Swansea.

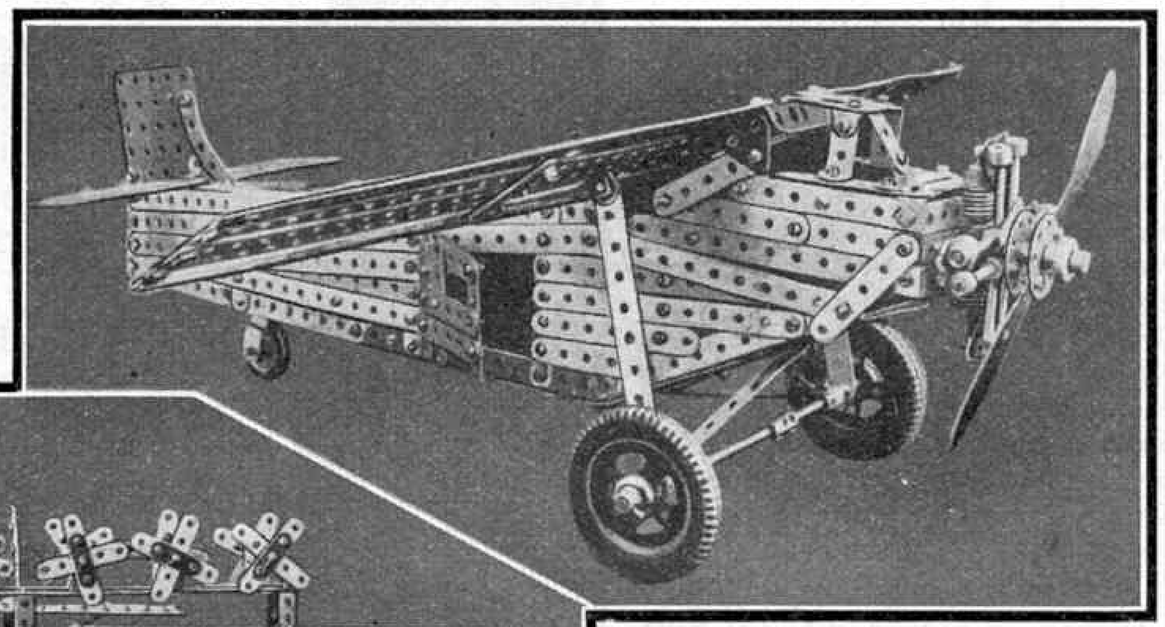
SIX PRIZES of Meccano products value 5/-: Robert B. Liddle, Leith, Edinburgh; P. W. Boughton, Hove, Sussex; John Coe, Ipswich, Suffolk; W. J. R. Peacock, Cheltenham; George R. Lambert, Nottingham; Dennis Hunt, Stratton, near Cirencester.

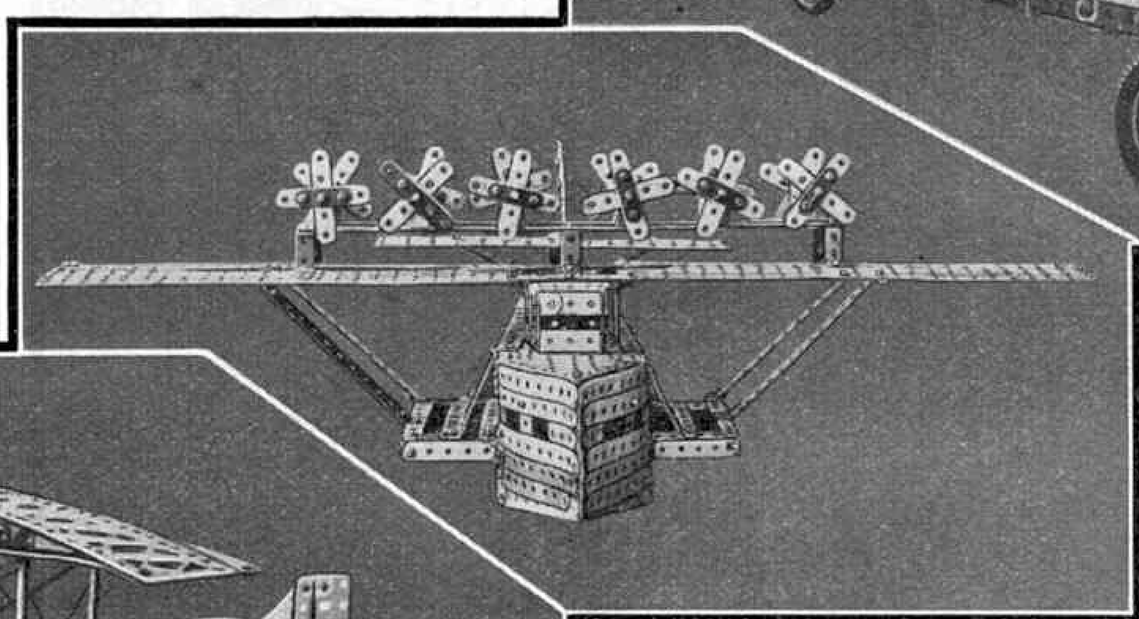
SPECIALLY COMMENDED, Certificates of Merit: A. V. F. A. Young, Braintree; George Smythe, Drumoak, Aberdeenshire; Ernest Scott, Wakefield; Donald V. Rolfe, Kenton, Middlesex; J. F. Taylor, London, W.1.

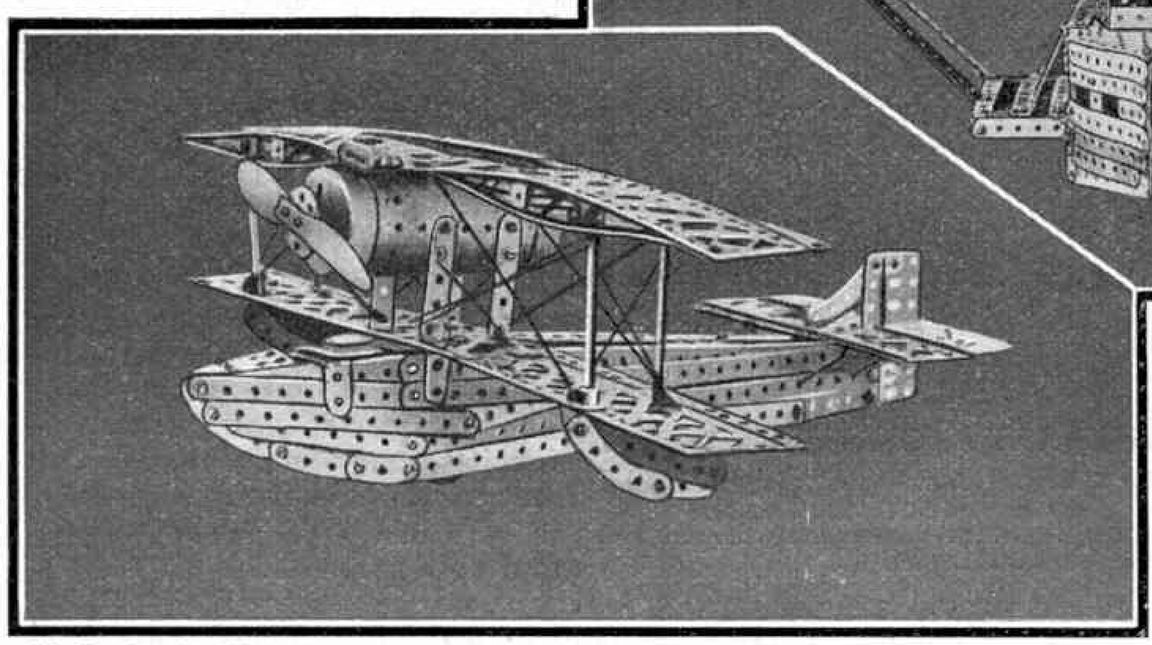
I must admit that the task of judging the models was not easy and it was necessary to examine each model with the utmost care and to compare its good points with those of its rivals before a final decision could be reached.

I think all readers will agree, however, that Malcolm McDonald's fine monoplane, illustrated here, is worthy of its distinction as the First Prize-winner in Section A. It is an excellent sample of Meccano construction, and besides being realistic in appearance it includes most of the mechanical details of an actual machine.

I congratulate G. R. Home on gaining the Second Prize in his Section. His model is a replica of the famous German flying boat DO.X, which was illustrated and described in the "*M.M.*" recently. The model is fitted with 12 propellers, which unfortunately do not work. Each "engine" is represented by three 2½" Double Angle Strips bolted together, as shown in the accompanying illustration, and an Axle Rod journalled in holes in their upturned ends carries a propeller on each end.







The upper photograph shows Malcolm McDonald's fine monoplane. (Centre) A full front view of a model of the great German DO.X by G. R. Home. (Bottom) George Moore's prize-winning flying boat.

The "floats," which are constructed from Strips, are 3½" long and 2½" in width, and they are connected to the fuselage by means of 2½" Strips, and to the underside of the wing by 5½" Strips.

In shape and proportion the fuselage is excellent, and starting at a point at the "bow" end it gradually widens to a maximum width of 3½", and then tapers away at the tail end to a width of 1½". The wing span is 25", the wings being built up from Plates and Strips.

Another interesting model of a flying boat secured the Third Prize for George Moore.

The great German DO.X seems to have created a deep impression on Meccano boys, for the great majority of models entered in this Contest feature this famous flying boat, and it was a model of this kind that won the First Prize in Section B for P. Davies. It follows in almost every detail the model submitted by G. R. Home in Section A. Davies' model is perhaps more sturdily built, but apart from this there is little to choose between them. Frank Stringer also won his prize with a model of the DO.X.

A fighting monoplane, equipped with three machine guns and a searchlight, formed the successful entry from Tally Davies. The guns are placed one on each side of the fuselage and one on the top. The searchlight is mounted on the top of the plane and is represented by a Chimney Adaptor secured to the front edge of the wing by means of an Angle Bracket. Each half of the single wing is formed from two Braced Girders held together edge to edge by means of Strips. Sector Plates are used in forming the sides and the nose of the machine, the space between them on the top being filled in with 3½" Strips. There are two propellers, each of which is made up from 5½" Strips, fitted with a 1" Pulley for a boss. Tally Davies is only 10 years old, and his success in this Contest is therefore very creditable.

"Autumn" Contest (Overseas Section)

I am now able to announce the successful competitors in the Overseas Section of the 1930 "Autumn" Competition. A few of the prize-winning models are illustrated here, and I am glad to be able to say that the standard of the entries sent in continues to be good.

The full list of prize-winners is as follows:—

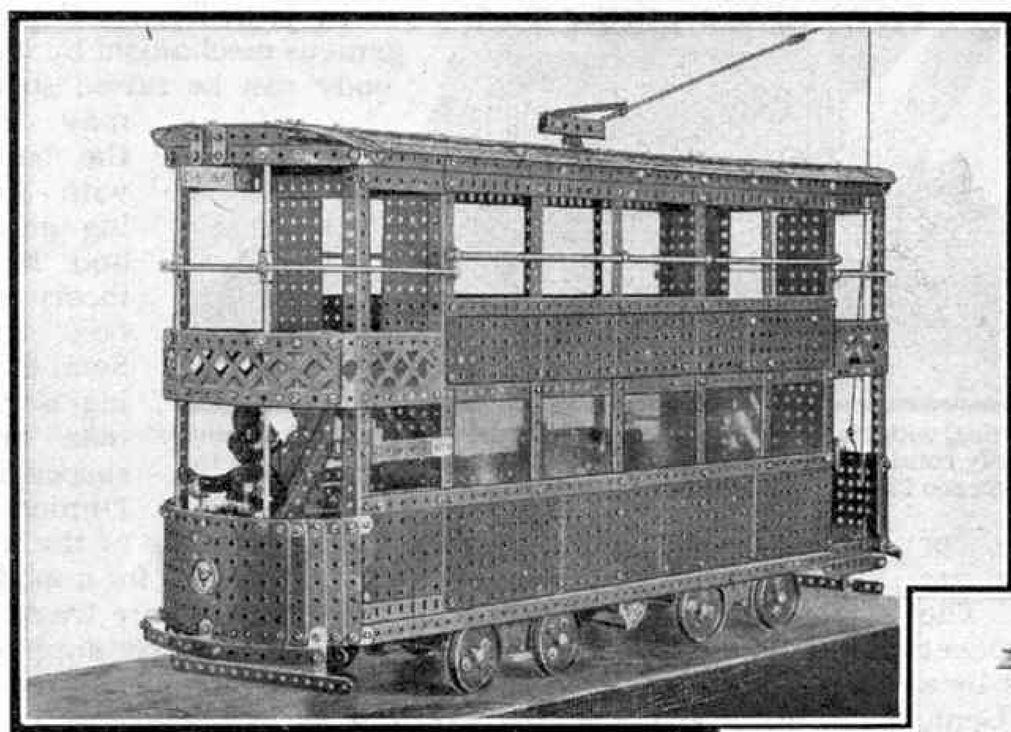
FIRST PRIZE, cheque for £3-3s.: J. J. Pienaar, Johannesburg, S. Africa. SECOND PRIZE, cheque for £2-2s.: Vincent Keitzman, Johannesburg, S. Africa. THIRD PRIZE, cheque for £1-1s.: J. A. Bakker, Hilversum, Holland.

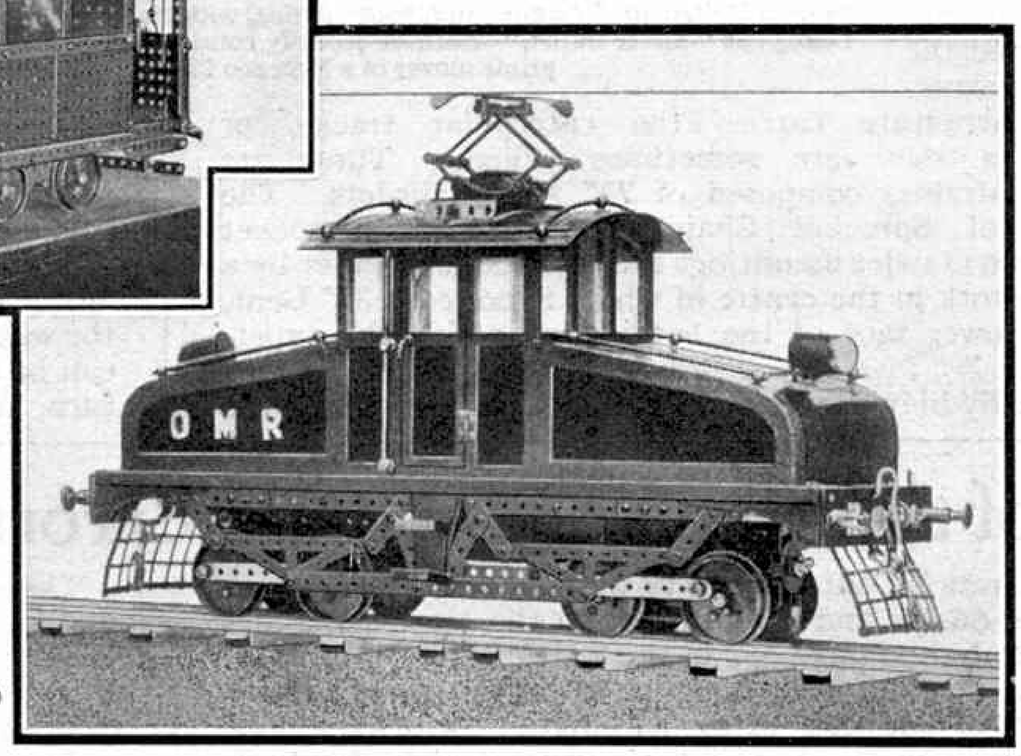
TWELVE PRIZES of Meccano products value 10/6: Walter Fagg, Otago, New Zealand F. M. Bennet, Ocean Falls, B.C., Canada; Aubrey Shepherd, Bloemfontein, S. Africa; Ernest J. S. Tait, Durban, Natal, S. Africa; Pete Anagnostopoulos, Athens, Greece; J. Ringnalda, Leeuwarden, Holland; D. P. Bharucha, Bombay, India; Mario Conti, Milan, Italy; L. de Campoamor, Madrid, Spain; William Govan, Toronto, Ontario, Canada; Paz Argentino Abecassis, Buenos Aires, Argentine; J. J. van der Ploeg, Hengelo, Holland.

TWELVE PRIZES of Meccano products value 5/-: Antonio Choy, Barcelona, Spain; James McClymont, Toronto, Ontario, Canada; P. L. Bargellini, Florence, Italy; R. Brenni, Mendrisio, Switzerland; J. Gordon Horn, Winnipeg, Canada; Ron Turner, Subiaco, Western Australia; G. Brown, Kangaroo Pt., Brisbane, Australia; Francis Paterson, Melville Forest, via Coleraine, Victoria, Australia; Robert Stokes, N.Z.A.F. Base, Private Bag, Auckland, New Zealand; Harold L. Potter, Mosman, Sydney, Australia; Allan Lancefield, Saskatoon, Canada; E. Larsen, Aparicio, Buenos Aires, Argentine.

TWELVE PRIZES of a Meccano Engineer's Pocket Book: D. R. White, Bangalore Cantt., S. India; Georges C. Vichos, Athens, Greece; L. Osborne, Oakleigh, Victoria, Australia; L. H. Massey, Posuan, Poland; Charles Carter, Delhi, Ontario, Canada; J. Taylor, Brooklyn, Wellington, New Zealand; J. G. Ross, Brakpan, Transvaal, S. Africa; G. G. McLean, East Brunswick, N.11, Victoria, Australia; Muir Pattison, Durban, Natal, S. Africa; C. L. Begemann, Merbaboeweg, Java, D.E.I.; M.D'Lima, Bombay, India; A. Robert, Turffontein, Johannesburg, S. Africa.

Although very many girls are included in the ranks of Meccano model-builders Overseas, their entries in Meccano competitions are not so numerous as I could wish. This is a great pity, because their constructional skill has been demonstrated on many occasions, and I hope that those among them who read this article will set to work to compete in future contests.





J. J. Pienaar, Johannesburg, is the builder of this realistic model tramcar, which forms an excellent illustration of the remarkable results obtainable from the judicious use of appropriate Meccano parts. The model electric locomotive shown on the right although not constructed entirely from Meccano parts, is a very praiseworthy effort. It was built by D. P. Bharucha, Bombay, India.

Among the prize-winning entries in this Contest I wish to mention first of all a model tram car built by J. J. Pienaar. I do not think I have seen before a model so closely resembling the real thing, but readers will be able to judge for themselves by glancing at the illustration. This model won the First Prize, and judging from its realistic appearance its construction must have entailed very careful work.

Motor cars of all types are usually popular as subjects for Meccano models, and for this reason perhaps, a great many of them are lacking in outstanding interest. This cannot be said of the fine racing car illustrated on page 232, however, which won the Second Prize for V. Keitzman. It will be seen that the model represents Mr. Kaye Don's famous racing car "Silver Bullet," and it is probably the best Meccano reproduction of this wonderful speed-machine that it has been my pleasure to see.

The Third Prize went to a Dutch competitor, J. A. Bakker, who submitted an interesting model of a motor lorry and trailer. The model's chief claim to a prize lies in the fact that it is constructed throughout with care and attention to the all-important question of proportion. It incorporates all the usual mechanical movements, including clutch, gearbox and differential. The trailer, which is pivotally attached to the Motor unit, runs on two road wheels shod with Meccano Dunlop Tyres, each wheel being fitted with brake gear. The model presents a distinguished appearance, due to the generous lines on which it is built and the correct proportioning of the various parts.

A most unusual type of model came from Pete Anagnostopoulos. It represents a hat factory, and consists of a long two-storey building, into one end of which rabbit hair enters, to emerge eventually from the other end in the form of a finished hat! Of course the hair is not actually made into a hat. What really happens is that, as the hair enters on an endless belt at one end of the factory, one or two miniature hats, previously placed in position on a second endless belt, emerge at the other end of the building. When the model is in operation the effect is quite good, and it is most amusing to watch the "factory" under production at high pressure.

One of the accompanying illustrations shows a model electric locomotive, built by D. P. Bharucha, Bombay. This competitor submitted also a model of an electric tramcar of a type used in the streets of Bombay. Both models work on the overhead conductor system, and by means of a cunningly concealed device, situated under the running rails, they run to and fro and automatically reverse at each end of the track. The locomotive is, I think, the better model of the two. It is 2 ft. long, 6 in. in width and 15 in. high. The electric current is picked up by means of a pantagraph collector built on the roof of the engine and conveyed by insulated wires to an Electric Motor concealed in the chassis.

The chassis and bogies, together with all the mechanism, are constructed from standard Meccano parts. The bodywork is executed partly in plywood, and partly in galvanised sheet metal. I do not recommend the practice of using any materials other than Meccano parts in building competition models, but in this instance the work put into the construction of the chassis alone fully merits the success which has crowned Bharucha's efforts. It should always be a competitor's aim, however, to use Meccano parts throughout when building a competition model.

Other interesting entries from the Overseas Section of this contest include a flying boat by Senor Paz Argentino Abecassis, Buenos Aires; a huge model of a mechanical excavator by F. M. Bennet, Ocean Falls, British Columbia; and a windmill pump by William Govan, Toronto.

William Govan's model represents a type of pump found in use on most Canadian farms for pumping water. The model is built entirely from Meccano parts, with the exception of the windmill blades, which are formed from a circular piece of tin fastened to a Face Plate, and strengthened with a second piece of tin for a vane. The model works quiet briskly in a steady breeze, and is equipped with gear that allows the blades to adjust themselves to the direction of the wind. Through a gear train, a balanced crankshaft and a system of levers, the rotary motion of the blades is converted into a reciprocating motion to operate the pump-rod. This latter is a long Rod, which extends to the base of the model where it connects with the ram-rod of the pump.

Models that can be put to some useful purpose in the home are always interesting, and one or two such models are usually to be found among the entries in Meccano Competitions. The "Overseas" Section of the "Autumn" Contest had an entry of this type from Leandro de Campoamor. It is intended for use in conjunction with a Pathé Baby Home Cinematograph.

Boys who are so fortunate as to possess one of these machines may have experienced a little difficulty in adjusting the elevation of the projected picture, so that it centres correctly on the screen. L. de Campoamor has successfully overcome this difficulty by constructing an adjustable stand for the machine. The projector rests on a framework consisting of two 7½" Angle Girders connected together at their ends by 4½" × ½" Double Angle Strips. One of these Strips is hinged to the base of the device so that the angle between the frame and the base may be varied. This is accomplished by operating a handwheel at the base. A Worm on the Rod of the handwheel engages a 57-teeth Gear on a Rod journalled

transversely in the base of the model and carrying two ½″ Pinions. Two Rack Strips, pivotally attached by bolts and lock-nuts to the side girders of the adjustable frame, are held in engagement with the Pinions by lengths of Spring Cord.

When the handwheel is rotated the Pinions are caused to raise the Rack Strips, which in turn impart motion to one end of the frame supporting the projector. The angle of elevation thus may be varied to suit all conditions.

I wish to mention now one or two of the entries among the smaller prize-winners. An outstanding model is a locomotive of 1830 constructed by James McClymont, Toronto, Canada. It is built from a very few parts, and might well have been entered in a "Simplicity" Competition, when it would probably have achieved even greater success than it has in the "Autumn" Contest. The model resembles very closely Stephenson's "*Rocket*." The body of the locomotive is formed from a Meccano Boiler, to one side of which a Sleeve Piece representing the cylinder is attached pivotally. The tall chimney is built up from three Sleeve Pieces placed end to end, and a "stay" formed from two 3″ Strips is fixed behind the chimney in order to hold it securely in place. One end of each Strip is attached to the chimney near the upper end, and the other end of each Strip is securely bolted to one of the upturned ends of a Double Bracket that is bolted to the top surface of the Boiler.

The Boiler is mounted on a chassis running on four 2″ Pulley Wheels. The tender is constructed on equally simple lines, but the various parts are so well proportioned as to give the finished model a very neat and dignified appearance.

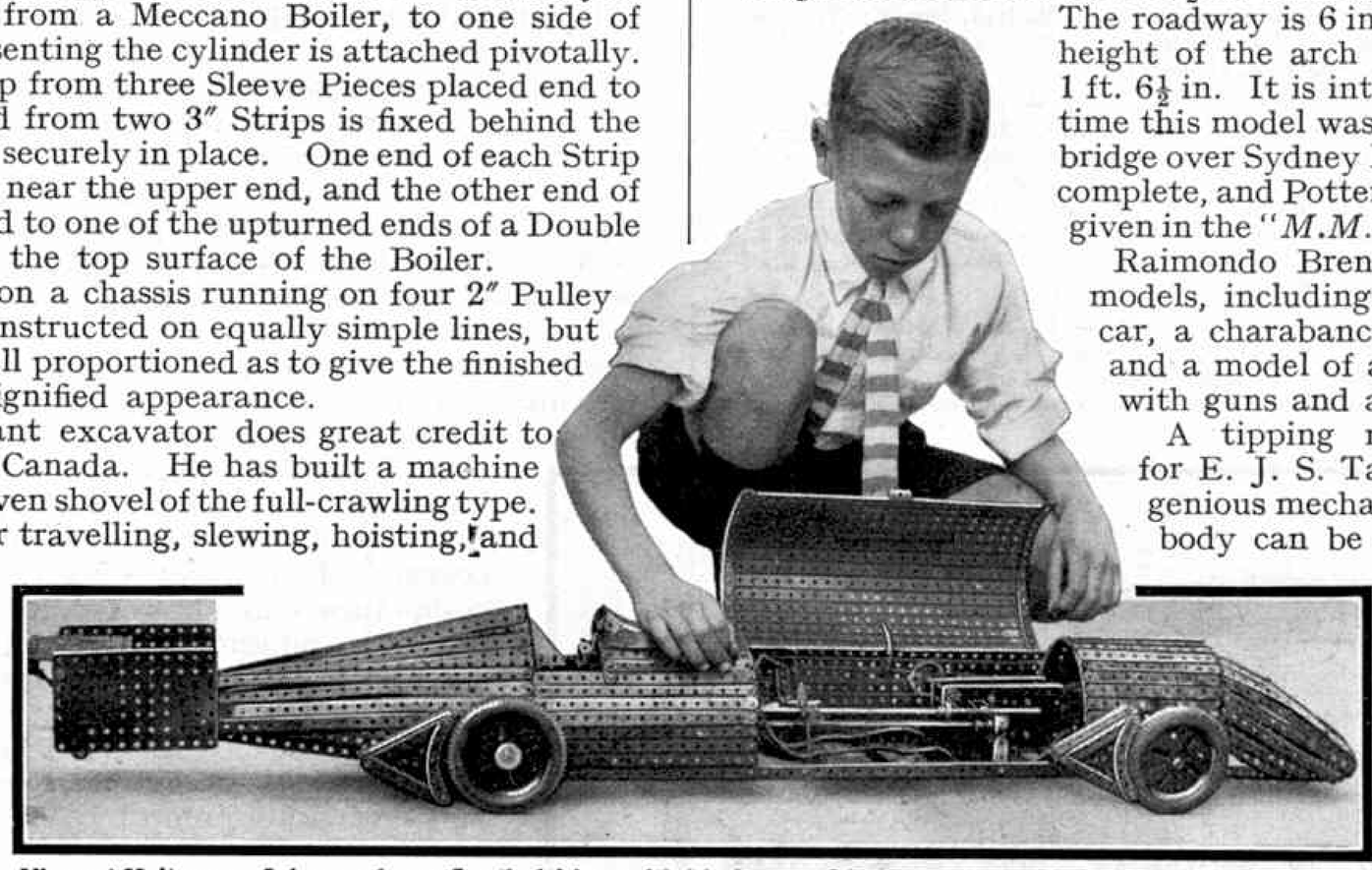
A good model of a giant excavator does great credit to Gordon Horn, Winnipeg, Canada. He has built a machine based on an electrically-driven shovel of the full-crawling type. It possesses movements for travelling, slewing, hoisting, and lowering of the boom, and for digging. The digging gear is hand operated and is controlled by a handwheel, which takes the place of an auxiliary motor in the actual machine.

Mention must be made also of the sub-structure on which is mounted the swivelling superstructure. The sub-structure carries the caterpillar tracks, or "full-crawlers" as they are sometimes called. These are mounted between frames composed of 7½″ Angle Girders. The crawlers consist of Sprocket Chains borne on 1″ Sprocket Wheels, and the two crawler mountings are connected together by a girder-built framework in the centre of which is bolted a 3½″ Gear, which forms the lower race of the bearing on which the superstructure rotates.

A model of the Sydney Harbour Bridge is included among the entries in this Contest. It was built by Harold L. Potter, and is made entirely from standard Meccano parts. The arch is composed of Strips and Angle Brackets, while the roadway or decking is made up from Strips, Angle Girders, and Flat Plates. Each of the shore pylons is sturdily constructed from a number of Angle Girders, Strips, and Plates. The decking is suspended by interlaced cord from the arch. The bearings by means of which the arch is pivotally attached to each of the pylons are arranged as follows. A Double Bracket is bolted to each end of the arch, with its turned-up ends pointing upward. Further Double Brackets are bolted to the face of the pylons, in a position opposite to those bolted to the arch. The Double Brackets are then pivotally connected together by inserting a 1″ Axle Rod through each pair, thus allowing the arch to move under varying temperatures, as in actual practice. The overall length of the model is 5 ft. 6½ in. while the length of span is 4 ft. 7 in. The roadway is 6 in. in width and the extreme height of the arch from the base of pylons is 1 ft. 6½ in. It is interesting to note that at the time this model was built the arch of the actual bridge over Sydney Harbour was only about half complete, and Potter had only the measurements given in the "*M.M.*" on which to base his model.

Raimondo Brenni submitted a number of models, including a four-seater coupè motor car, a charabanc complete with passengers, and a model of a battleship, fully equipped with guns and a wireless installation.

A tipping motor lorry won a prize for E. J. S. Tait. It incorporates an ingenious mechanism by means of which the body can be raised so that its contents may be tipped from the back. It is fitted with Ackermann steering gear, foot operated and hand brakes, and incorporates also a gear box and differential. Semi-elliptical springing is employed for the rear and front wheel suspension, and Meccano Dunlop Tyres fitted to each road wheel enhance the appearance of the model.



Vincent Keitzman, Johannesburg, South Africa, with his fine working Meccano model of Kaye Don's famous racing car "Silver Bullet," which he recently constructed. Keitzman is only 13 years of age, yet he is the prime mover in a Meccano Club among the boys in his district.

A prize was awarded to Robert Stokes for a model of a travelling jib crane. The operations of the model are travelling, slewing and jibbing, and all three are worked by power supplied by a Meccano Clockwork Motor situated in the cab. The driving spindle of the Motor is connected via 3 : 1 ratio gearing to a 6½″ Rod running the whole length of the cab. This rod carries two ½″ Pinions which can be brought into or out of mesh with Contrate Wheels, which in turn, are connected by further gearing to the main driving wheels.

Results of the First and Second "Errors" Contests (Home Sections)

In the first "Errors" Contest readers were asked to make lists of all the errors in design and construction in the Meccano model motor-cycle, illustrated on page 887 in the "*M.M.*" for November, 1930. Success in the Contest demanded a knowledge of motor-cycle construction in addition to model-building principles, and the number of entries received, and their general high standard, prove that Meccano enthusiasts are quite familiar with even the minutest details of the modern motor-cycle.

The biggest prize was awarded to the competitor whose list contained the largest number of errors actually appearing in the model; the second prize to the next highest, and so on. The following is a complete list of the prize-winners:—

First Prize, Meccano products value £2-2s.: E. Whalley, Blackburn. Second Prize, Meccano products value £1-1s.: G. A. Maggs, Clutton, near Bristol. Third Prize, Meccano products value 10/6: A. Prince, Truro.

Six Prizes of Meccano products value 5/-: W. E. Rudd, Dublin; W. Raybould, Walsall; R. K. Jones, Penylan, Cardiff; Douglas Kent, Blackpool, S.S.; H. H. Duckett, Wedmore; S. Horne, Sheffield.

Six Prizes of a copy of "*Famous Trains*" by C. J. Allen: James Dale, Mitcham, Surrey; Jack Wilkins, Bason Bridge, near Highbridge; D. Massey, Bexhill-on-Sea; S. W. McIan Wright, London, E.10; A. C. Marsh, Silverton, Near Exeter; H. Crook, Ashton-in-Makerfield.

Specially Commended, Certificates of Merit: F. Rochester, Pelton Fell, Co. Durham; J. Stevens, Pinner, Middlesex; L. Pratt, Stanmore, Middlesex; T. Tattersall, Walton, Liverpool; J. R. Grimsdell, Finchley, London, N.3; Robert Hamilton, Wilson Street, Girvan; Jack Walker, Thornaby-on-Tees; Donald Chapple, Wakefield; R. Daniel, Stokesley, Yorks.; L. Fletcher, Derby; B. Bates, Bradford; D. Vick, Nailsworth, Glos.; W. F. Hewett, Henleaze, Bristol.

Competitors were so thorough in compiling their entries that some of them included errors that did not actually exist! These were chiefly modifications in the design of the motor-cycle, and the large variety of different machines at present available is no doubt responsible for the different view points of individual competitors.

The subject of the Second "Errors" Competition was the locomotive illustrated in the December, 1930, "*M.M.*" The general opinion of competitors in this Contest suggests that it would have been a more difficult task to compile a list of good points instead of errors!

The prize-winners in the Home Sections of the Second Contest are as follows:—

Section A (for competitors over 14 years of age).

First Prize, Meccano products value £2-2s.: Herbert E. Caddy, Watton, Thetford, Norfolk. Second Prize, Meccano products value £1-1s.: Henry L. McMillan, Shrewsbury. Third Prize, Meccano products value 10/6: Philip A. Rodgers, Crookesmoor, Sheffield.

Twelve Prizes of Meccano products value 5/-: E. B. Jones, Walsall; N. W. Wilman, Cheltenham; W. Raybould, Walsall; Victor Kaile, Mayford, Nr. Woking; E. Plowman, Dalston, London, E.8; R. Bellamy, Reading; C. H. Williamson, Gateshead; William Crichton, Riddrie, Glasgow, E.1; E. Dunabin, Penketh, Warrington; S. E. Toulmin, London, N.W.3; J. Bell, Ascot, Berks.; John S. Peters, Gillingham, Kent.

Section B (for competitors under 14 years of age).

First Prize, Meccano products value £2-2s.: Jack Hayne, Tintinhull, near Yeovil. Second Prize, Meccano products value £1-1s.: Paul Westby, Sanderstead, Surrey. Third Prize, Meccano products value 10/6: Leonard Rawlings, Cambridge.

Twelve Prizes of Meccano products value 5/-: Charles Hayne, Tintinhull, near Yeovil; D. P. Elias, Weaste, Manchester; R. L. W. Catt, Carshalton, Surrey; Alan G. Nicholls, West Ealing, W.13; A. S. Denby, Harrogate; Arthur Gray, Newark; B. Gardner, Preston; Alan Jenkins, Keswick, Cumberland; R. H. Kniveton, Derby; Victor Jackson, Ormskirk; Joseph White, Leigh-on-Sea; Billy A. Shiells, Alston, Cumberland.

Few competitors noticed that the position of the cylinders is too high in relation to the driving wheels, and only a small number pointed out that no two pairs of wheels are suitable for the same gauge track. Probably the most prominent error is the use of a Ship's Funnel for the locomotive chimney!

In this page we reply to suggestions for new and improved Meccano parts that are submitted by readers. We receive many hundreds of these suggestions, and in order to provide additional interest for contributors we are offering a prize of 10/- for the best idea sent in during each month. Any number of ideas may be submitted by each reader, but each suggestion must be written on a separate sheet of paper, and the name and address of the sender must appear on each sheet used. Envelopes should be addressed to "Suggestions," Meccano Ltd., Binns Road, Old Swan, Liverpool.

MAGNETISED SCREWDRIVER.—A nut or bolt falling into a complicated gear box is often the source of much annoyance and waste of time to model-builders. Your suggestion that the Meccano Screwdrivers should be supplied with the tip of the shaft magnetised so that nuts, bolts and other small steel parts could be picked up, would help to overcome this trouble, and you will be interested to hear that you can magnetise your own screwdrivers quite easily. To do this you should wind about 50 turns of 24 or 26 gauge insulated wire around the shaft of the screwdriver and connect the ends of the wire to an accumulator for a minute or two. If the coil of wire is then removed from the driver, the latter will be found to be magnetised quite strongly. It will be necessary to repeat this process at intervals, as the tool is liable to lose its magnetism as the result of the rough handling that a screwdriver generally receives. (*Reply to A. J. Roberts, Leytonstone, E.11*).

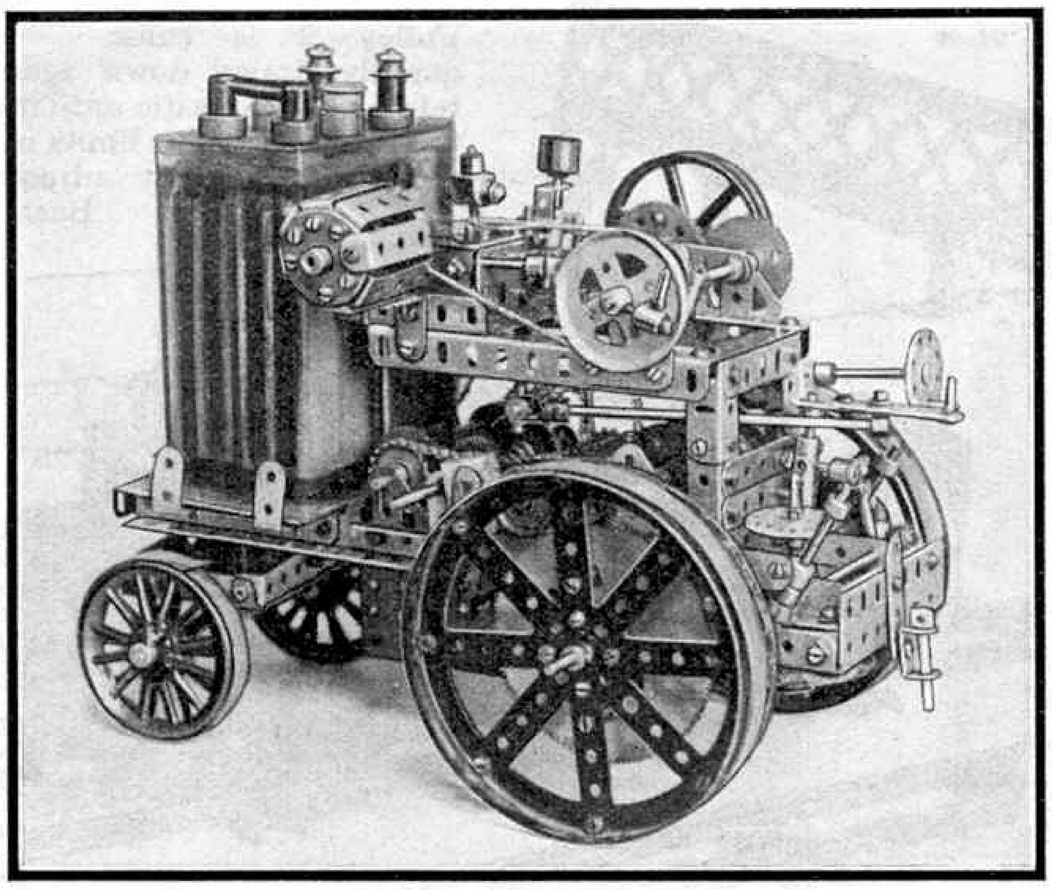
DUPLEX DRIVE MOTOR.—We have noted your idea that the Meccano Clockwork Motor should be provided with two driving shafts, one to run at high speed with a small torque, and the other to provide a slow-speed high-power drive. The additional shaft would be quite useful in certain types of models, but it is already possible to obtain a slow-high power drive by meshing a 1" Gear Wheel with the No. 1 Gear of the Clockwork Motor itself. Alternatively, where the slow drive is required for a crank action, etc., a number of Strips can be bolted to the winding spindle of the Motor, and will provide the required effect. We are nevertheless keeping your idea in mind. (*Reply to E. C. Fisher, Camelford*).

ALTERED GEAR WHEEL.—Your proposal that the Meccano 1" Gear Wheel should be manufactured with a tooth face, double its present width, is interesting, and will receive consideration. The "double-width" gear could be employed in a similar manner to the double- and triple-width Pinions, that is, to enable two Wheels to remain in mesh, while one is moved a considerable distance longitudinally. Instances where it is required to employ the 1" Gear Wheels in this manner are not very numerous, however. Your suggestion that the double-width gear could be employed as a small flywheel is novel, but the part would hardly fulfil this function efficiently. (*Reply to P. M. Woodward, Truro*).

NEW TYPE FUNNEL.—Your suggestion that we should produce a ship's funnel of the type fitted to the motor liner "*Britannic*," is interesting. The existing Meccano Raked Ship's Funnel (parts Nos. 138a/z) is of an up-to-date pattern and is quite suitable for inclusion in models of steamships of most kinds, but there are one or two instances where a squat oval funnel would be more appropriate. We would remind you that the existing Meccano Raked Ship's Funnel can be obtained in the correct designs and colours of 26 leading shipp ng companies. A complete range of these funnels is displayed at many Meccano dealers. (*Reply to Bruce Montgomary, Chesham Bois*).

UNIT STEAM PLANT.—A Meccano Steam Engine on the "unit" principle possesses possibilities. The idea would be to produce the boiler, cylinder assembly, and reversing block in separate units, which could be secured in any position in a model independently of each other. These units would then be connected together by means of metal tubing and special unions. The suggestion is interesting, and incidentally has received our consideration in the past; but it suffers from several drawbacks, among them being the difficulty of providing efficient steam-tight joints for the piping connecting the units, and the trouble of bending the tubing to fit various layouts. A steam plant built on these lines would not be as efficient and economical in running as the existing pattern, owing to the condensation of the steam in the relatively long supply pipes that would have to be used, although these might be asbestos insulated. (*Reply to G. R. Moule, Rhiwbina, Near Cardiff*).

CURVED GIRDER.—A curved braced girder might be of some use in ornamental construction work, but unless produced in a large range of sizes and radii, a part of this type would be very unadaptable. For this reason we do not consider it advisable to introduce it. Where curved brace work is required, as in the support for a bridge span, etc., you will find it quite a simple matter to build this up from Curved Strips of the required size and use lattice bracing composed of short Strips. (*Reply to H. Palmer, Portsmouth*).



Concentrated mechanism! The above illustration shows a remarkable model tractor built by Robert Sargent of Rushden. The model is noteworthy for the fact that, although of quite small overall dimensions, it incorporates a large size accumulator for supplying current to the Meccano Electric Motor, and the model thus forms an entirely self-contained power unit. An interesting feature is the non-skid treads that have been fitted to the road wheels; these treads consist of rubber bands stretched around the rims of the wheels. This unconventional tractor forms a really splendid model-building effort.

IMPROVEMENT TO SCREWDRIVER.—The standard Meccano Screwdriver is already a handy tool, and any suggestion for further increasing its utility is worth consideration. Your idea is to reduce the thickness of one side of the blade so that it can be inserted in the slot in the head of a standard bolt and used very much after the fashion of a turn key or "tommy bar." It is quite possible that this alteration would increase the adaptability of the tool, and readers who care to test it for themselves can quite easily form the blade to the required shape by means of a file. (*Reply to T. Jennings, Leytonstone, E.11*).

The best suggestion for a new or improved Meccano part sent in during the month of January was submitted by J. E. Broadhurst, of Westcross, Glam., and the monthly prize of 10/- has therefore been awarded to him. The winning idea was for an ingenious tubular element.

SPECIAL ACCESSORY SETS.—The arrangement of the parts in the present Meccano Outfits and Accessory Outfits is based on the models shown in the Instruction Manuals, each Outfit containing sufficient parts to enable a certain number of models shown in the Manuals to be built, while the Accessory Outfits contain parts to convert the Outfits into larger and more comprehensive sets. We are interested in your suggestion that special accessory sets containing selections of important mechanical parts should be introduced. We are making a note of your idea for reference. (*Reply to G. Silverlock, Great Crosby*).

EXTENSION FOR WINDING SPINDLE.—A special extension piece for fitting over the winding spindle of a Clockwork Motor might be of use in certain cases. The part would consist of a metal rod having a hole cut in one end, while a length of square section rod would be introduced into the other end. The slotted portion of the unit would be passed over the winding spindle of the Motor, while the standard Motor Key would be pushed on to the other end of the extension. In this manner it would be possible for a Motor fitted inside a complicated piece of mechanism to be wound easily, as the extension piece would bring the winding point well outside the model. This idea may be considered later. (*Reply to T. Thomson, Leith*).

NEW FLAT PLATE.—We doubt whether sufficient uses could be found for a $3\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plate that are not already covered by the existing $2\frac{1}{2}'' \times 2\frac{1}{2}''$ and $4\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates. Further a $2\frac{1}{2}'' \times 2\frac{1}{2}''$ Plate can always be converted into the suggested part by bolting a $2\frac{1}{2}''$ Flat Girder to one end. (*Reply to E. G. Akerman, Newcastle, N.S.W.*).

A SPECIAL ROLLER.—A special roller for use in models of steam rollers and similar machines is unnecessary. A Boiler, complete with Ends, makes an excellent roller for this purpose, especially if it is filled with scraps of lead, or a quantity of Meccano parts to provide the necessary weight. (*Reply to L. A. Bird, Nisson, Near Doncaster*).

IMPROVING THE APPEARANCE OF MODELS.—Your suggestion for improving the finished appearance of Meccano models is ingenious, but we are afraid hardly practicable. Apparently your idea is to fill up the unused holes in a model with special bolts, having heads coloured red or green, and fitted with short shanks that could just be gripped by a nut when attached to a Plate, Strip, etc. This scheme might perhaps give certain models a slightly more solid appearance, but in many models the extra bolt heads would be a distinct drawback. In any case, the process would be both tedious and costly to carry out. As a matter of fact the perforations in the Meccano parts, so far from being unsightly, often add considerably to the artistic appearance of a model. (*Reply to H. Evans, Bristol*).

MULTIPLE THROW CRANK-SHAFT.—We were interested in your suggestion that two- and four-throw crankshafts should be introduced, but we consider these to be hardly necessary, as a multiple-throw crankshaft can be built up from standard Meccano parts quite easily. An effective two-throw crankshaft can be assembled by using three short rods and four webs each composed of two Meccano Single Arm Cranks. Further small Rods should be pushed into the bosses of the Cranks at the extremities of the webs to complete the shaft assembly. A three- or four-throw crankshaft can of course be built up in a similar manner, and other parts such as Double Arm Cranks or Triangular Plates can be used for the webs. If Triangular Plates are used, effective "balance weights" are formed by the overhanging portions of the Plates (see S.M. 274 in the Meccano Standard Mechanisms Manual). (*Reply to H. Saunders, Calgary, Canada*).

USING SPRING CORD.—The Meccano Spring Cord may be employed for a variety of purposes. It may be used as a driving belt in conjunction with the Meccano Pulleys; as a light tension spring for holding a Pawl in engagement with a Ratchet; or as a kind of Bowden wire sheath in a remote control device, Meccano Bare Iron Wire being used as the actual cable. In order to join two lengths of the Cord together, a Spring Cord Coupling Screw (part No. 58a) should be used. This is merely screwed into the ends of the lengths of Cord to be connected, and results in a very strong joint. When it is required to attach a length of the Cord to a Pawl or other part, a lighted match should be placed under the end of the Cord so as to anneal the Spring, and the wire can then be drawn out and attached at the required point. (*Reply to R. J. Fowler, Oxford*).

New Meccano Models

Governor—Electric Locomotive—Crane—Sifter—Tower—Truck Hoist

THE principle of centrifugal force has a wide application in engineering. It is utilised, for instance, in the well-known "ball" type governor that is fitted to most stationary steam engines to regulate the admission of steam to the cylinders. Centrifugal force is also made use of in more delicate machinery, the speedometers fitted to motor cars and other high speed machinery operating on this principle; while every Meccano boy who has examined the mechanism of a gramophone motor will know that a centrifugal governor is incorporated for controlling the speed of the record turntable.

The simple model centrifugal governor shown in Fig. 1 will be found a very handy little unit and it may be incorporated in many types of power-driven models where it is required to regulate the speed.

The base of the governor consists of a 3″ diam. Pulley Wheel, and a 3½″ Axle Rod 1 rotates in the boss of the Pulley. A 2½″ Strip is secured to the Pulley by means of two bolts, washers being placed on the shanks of the bolts to provide the correct spacing. A ½″ Reversed Angle Bracket is secured to the end of the 2½″ Strip and a 3½″ Axle Rod is mounted in a vertical position in the Bracket and Strip and held in place by means of two Spring Clips. This Rod carries a Bush Wheel at its upper end to which is secured a Flat Bracket and a Reversed Angle Bracket 4 which forms the adjustable 'stop.'

The central 3½″ Axle Rod carries two 1″ Pulley Wheels 2 having their setscrews removed, these Pulleys being connected together by the governor arms. Each governor arm consists of two Flat Brackets 3 pivoted by their round holes on a ⅜″ Bolt, the shank of which is nipped by the set-screw of the 1″ fast Pulley Wheel 5. The outer ends of the Flat Brackets are secured pivotally by a bolt and two nuts to ½″ × ½″ Angle Brackets which in turn are secured rigidly to further ½″ × ½″ Angle Brackets. These latter Brackets are held securely to the bosses of the Pulleys 2 by means of bolts. Nuts should be screwed on the bolts of the top Pulley to prevent fouling of the vertical Axle 1. A thin elastic band should be passed round the groove in the top Pulley Wheel 2 and over a Spring Clip fastened to the top of the Rod 1. When the governor is driven at high speed by means of a cord passed round the groove in the lower Pulley 2, the Pulleys 5 tend to fly outward due to centrifugal force. The top Pulley 2 is consequently drawn down against the tension of the elastic until it touches the 'stop' 4 which limits its downward travel. By adjusting the Bush Wheel to which the Bracket 4 is secured, the speed of the model can be altered.

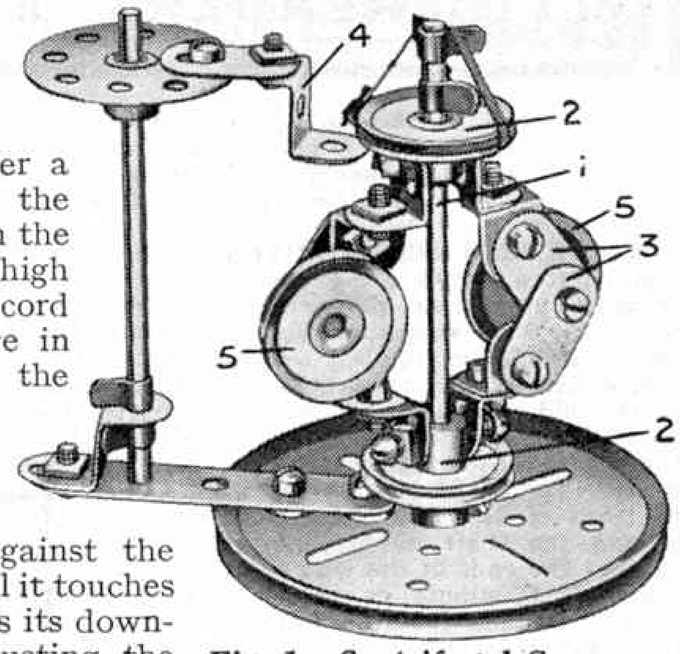


Fig. 1. Centrifugal Governor.

In order to construct the model centrifugal governor the following parts will be required:—1 of No. 5; 5 of No. 10; 8 of No. 12; 2 of No. 16; 1 of No. 19b; 4 of No. 22; 1 of No. 24; 4 of No. 35; 17 of No. 37; 4 of No. 37a; 2 of No. 38; 2 of No. 125; small elastic band.

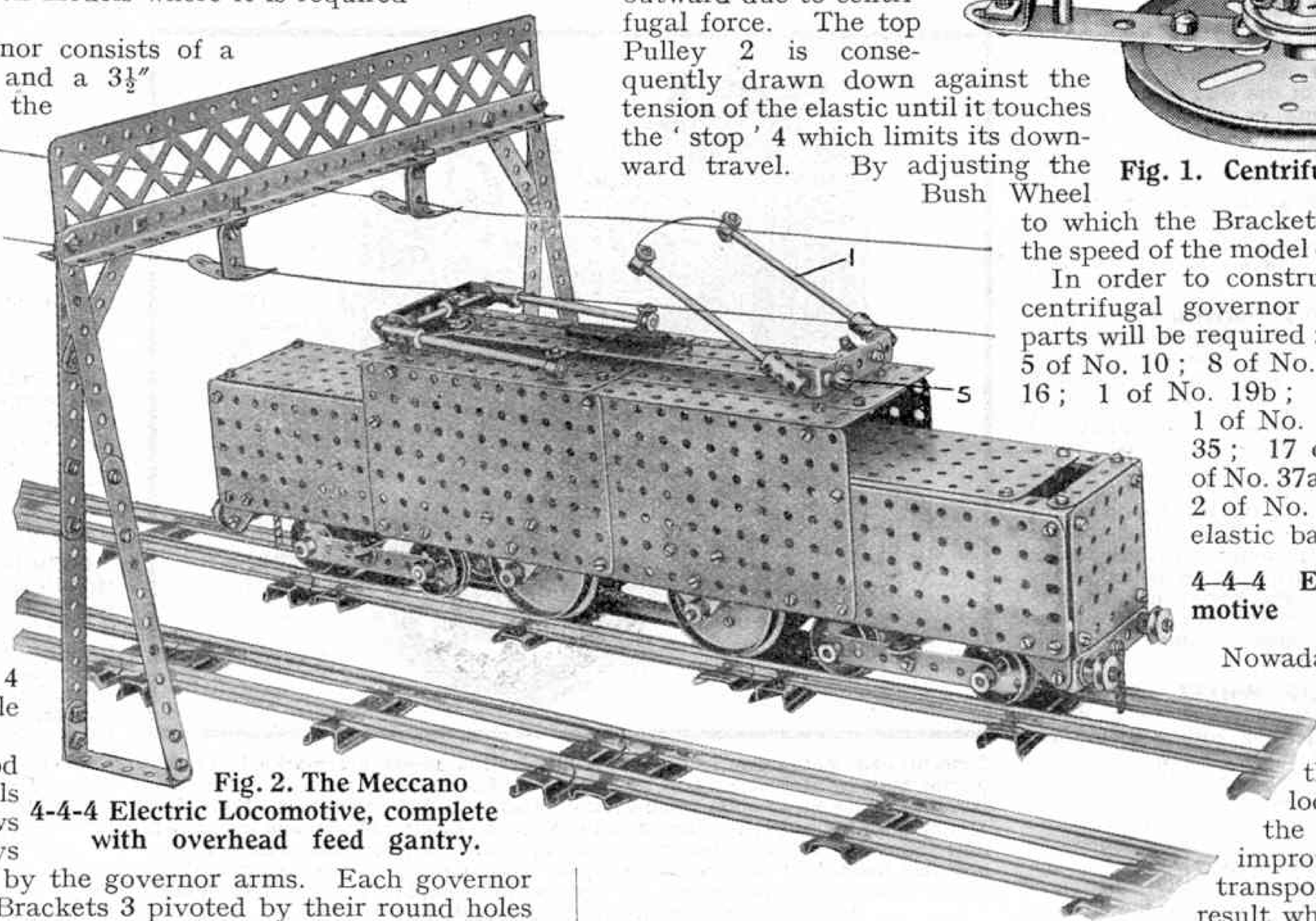


Fig. 2. The Meccano 4-4-4 Electric Locomotive, complete with overhead feed gantry.

4–4–4 Electric Locomotive

Nowadays we hear a great deal about the advantages of the electric locomotive and the wonderful improvement in transport that will result when high speed electric traction becomes universal. The Meccano model shown in Fig. 2 is a particularly realistic example of a modern type of 4–4–4 electric locomotive using the overhead system of current collection. The model incorporates a Meccano 6-volt Electric Motor and when run on standard Hornby track will be found to possess considerable hauling capacity.

The housing of the locomotive, as can be seen in Fig. 3, is built up from a number of 4½″ × 2½″ and 5½″ × 3½″ Flat Plates reinforced with 5½″ and 2½″ Angle Girders.

The Electric Motor is secured by its flange to the 5½″ Girder secured to one of the sides, and the drive from the armature shaft to the driving wheels is transmitted as follows: A ½″ Pinion is first secured on the armature shaft and this is meshed with a 57-teeth Gear Wheel on a secondary shaft. A ¾″ Pinion is secured on the other end of the secondary shaft and gears with a 50-teeth Gear mounted on a further shaft journalled in the Motor side plates. A ¾″ Sprocket Wheel is secured to the centre of this shaft and is coupled to a 1½″ diam. Sprocket mounted on the rear driving axle by means of an endless length of Sprocket Chain. The forward driving axle is in turn connected to this shaft by a further length of Chain passed round two 1″ diam. Sprockets. The driving axles are journalled in Flat Trunnions bolted to the sides of the housing and the driving wheels themselves are built up

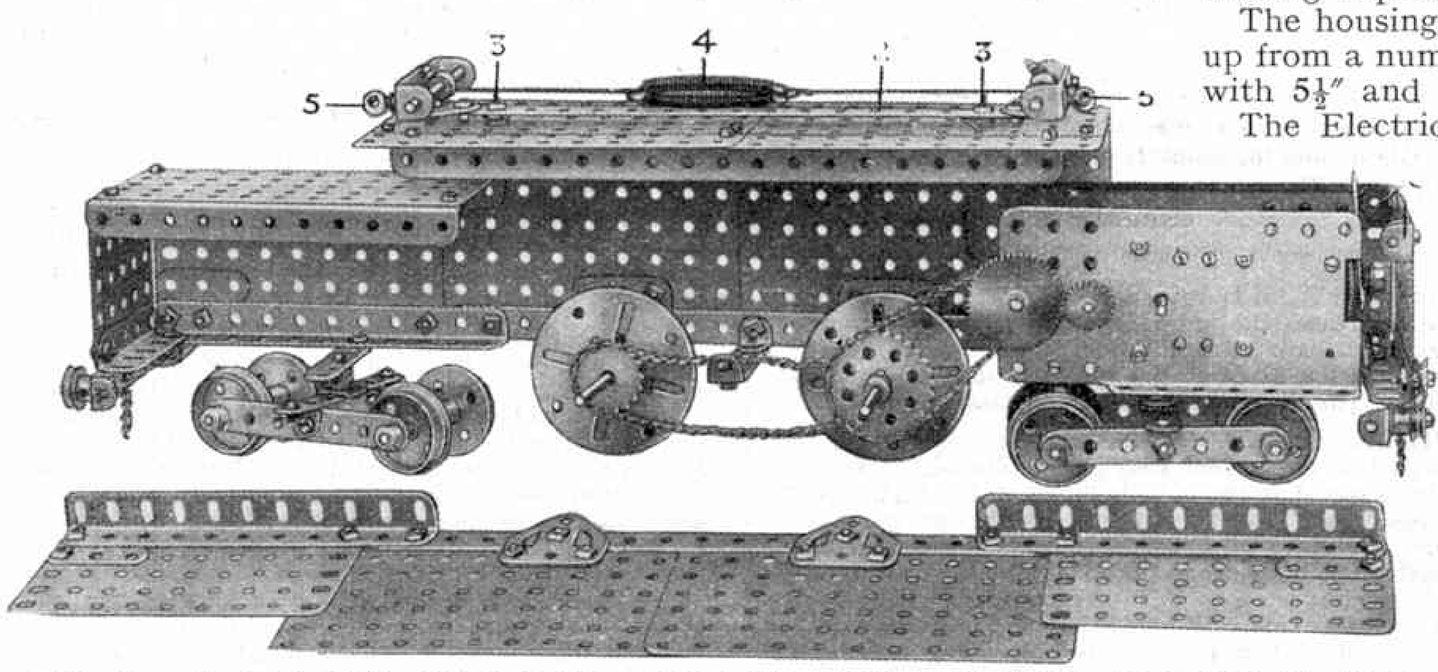


Fig. 3. The Electric Locomotive partly dismantled to show assembly of drive transmission.

from Wheel Flanges and Face Plates.

Each bogie frame consists of two $3\frac{1}{2}''$ Strips held apart by means of $3''$ Strips secured to the former by Angle Brackets. An Eye Piece is slipped on to each $3''$ Strip, the boss being secured pivotally to the frame of the engine by means of a $\frac{3}{4}''$ Bolt passed through the centre hole of a $2\frac{1}{2}''$ Strip secured to the frame and nipped by the set-screw in the boss of the Eye Piece.

Each current collector is composed of two $3\frac{1}{2}''$ Rods 1 secured by Couplings to a $3''$ Rod that is journalled in a $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip. The Double Angle Strips, in turn, are secured to a Trunnion at either end of a $9\frac{1}{2}''$ Strip 2 (see Fig. 3), and the latter is attached to the roof of the locomotive by means of two 6 B.A. Bolts 3, which are insulated from the roof by Insulating Bushes and Washers. A standard metal Washer is placed over each Insulating Washer in order to prevent the bolts on the Strip 2 touching the roof.

A Collar is secured by means of a set-screw on each of the $3''$ Rods journalled in the Double Angle Strips, and a short length of cord is tied to the set-screw and passed round the Rod before being fastened to two Springs 4. This results in both collectors tending to rise. Either of the collectors may be locked horizontally, however, by a Handrail Support 5, which is passed through a hole of the Double Angle Strip and inserted in the grub-screw hole of a Collar, so that by turning the Handrail Support, the Rod is gripped and prevented from rotating.

Those parts of the collectors that are in contact with the overhead wire, consist of short lengths of thick copper wire (24 or 22 gauge for instance) secured by set-screws to Collars on the ends of the $3\frac{1}{2}''$ Rods. A length of insulated wire is fastened to the $9\frac{1}{2}''$ Strip 2 and is taken to one of the Motor terminals, whilst the remaining Motor terminal is connected to the frame of the model.

Each of the $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Brackets 6 is duplicated in order that a nut may be held between their lugs. Hence it is only necessary to insert the bolt in the hole and screw it home. This method of construction is necessary because the interior of the model is inaccessible when the sides are in place.

The construction of the gantry for supporting the overhead feed wires will be clear from Fig. 2. The gantry shown in the illustration has been designed for use with a double track system, but it can quite easily be modified if it is intended to use only one set of rails.

When connecting up the system, the 22 gauge bare copper wire that forms the overhead current line should be anchored at each end to a screw eye attached to any convenient object. One terminal of the accumulator should be joined to the framework of the gantry, while the other pole of the accumulator should be connected to the rails on which the model runs. Care should be taken to see that the framework of the gantry does not come into contact with the rails as this would result in a short circuit of the battery.

In order to build the Electric Locomotive the following parts will be needed :—3 of No. 1a ; 4 of No. 3 ; 2 of No. 4 ; 6 of No. 5 ; 4 of No. 6a ; 2 of No. 8a ; 8 of No. 9 ; 2 of No. 9d ; 4 of No. 10 ; 18 of No. 12 ; 6 of No. 16 ; 5 of No. 16a ; 2 of No. 16b ; 1 of No. 17 ; 8 of No. 20 ; 4 of No. 23 ; 1 of No. 25 ; 1 of No. 27 ; 1 of No. 27a ; 116 of No. 37 ; 4 of No. 37a ; 16 of No. 38 ; 2 of No. 43 ; 2 of No. 48a ; 2 of No. 50a ; 4 of No. 52a ; 4 of No. 53a ; 25 of No. 59 ; 4 of No. 63 ; 6 of No. 70 ; 2 of No. 72 ; 20″ of No. 94 ; 1 of No. 95a ; 2 of No. 96 ; 1 of No. 96a ; 4 of No. 109 ; 4 of No. 111 ; 2 of No. 111c ; 2 of No. 126 ; 4 of No. 126a ; 2 of No. 136 ; 4 of No. 137 ; 2 of No. 302 ; 2 of No. 303 ; 2 of No. 304 ; 2 of No. 305 ; 1 Electric Motor.

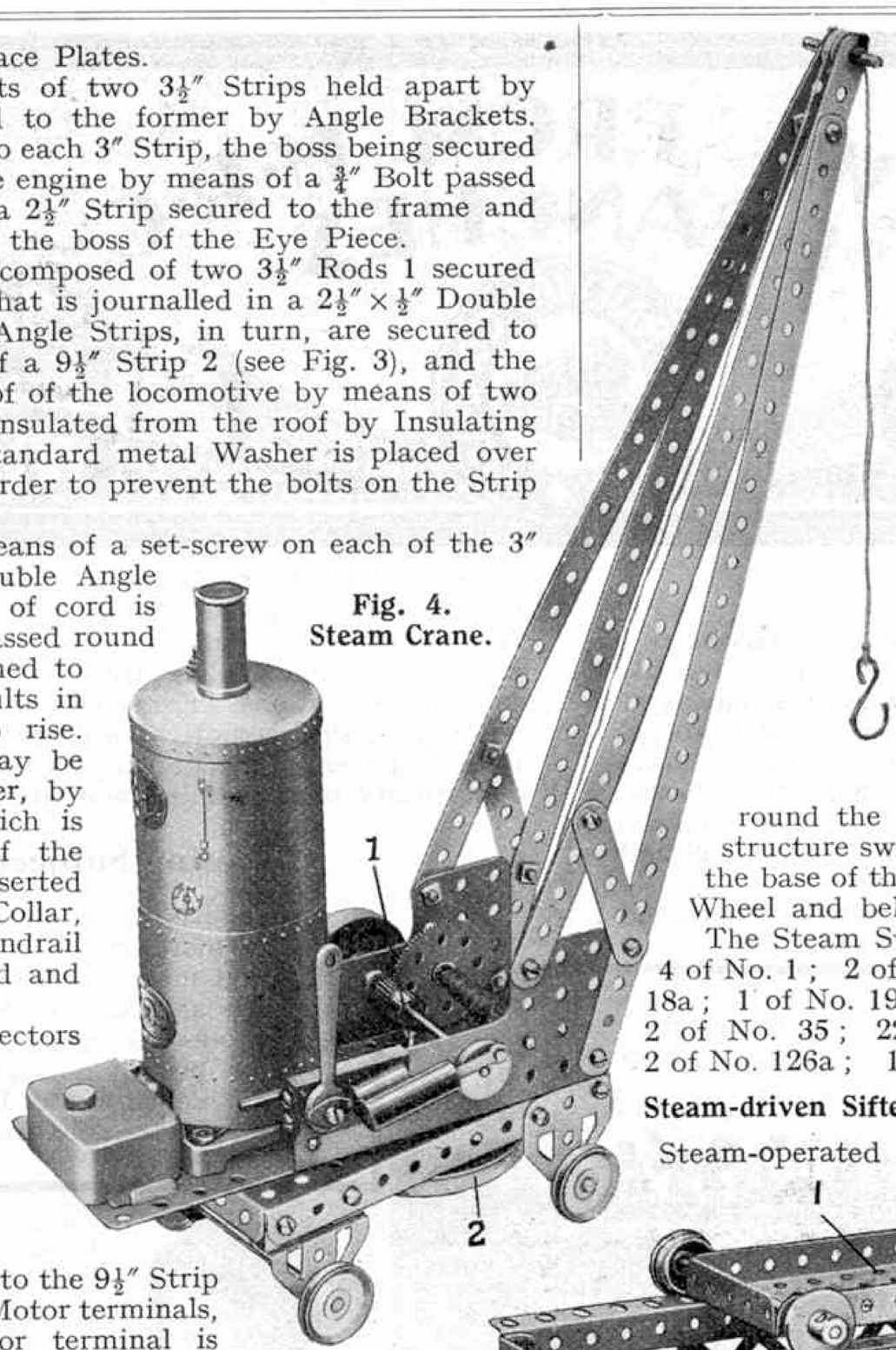


Fig. 4. Steam Crane.

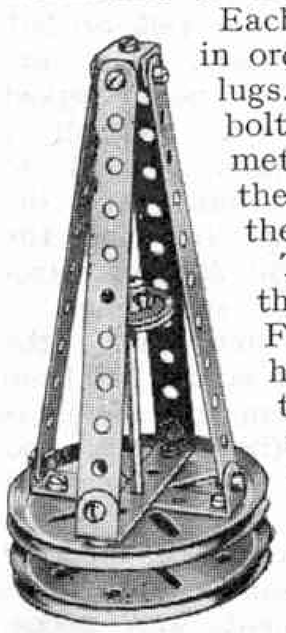


Fig. 6. A modest attempt at an Eiffel Tower !

Steam Travelling Crane

In Fig. 4 is shown a simple model crane operated by the Meccano Steam Engine. This model clearly illustrates the advantages of the special reversing block incorporated as an integral part of the Steam Engine, for by means of it it is possible to carry out both hoisting and lowering of the load attached to the crane hook ; when using an ordinary type of engine these two movements could only be arranged by incorporating a separate reversing gear which would complicate matters considerably.

The travelling base of the crane consists of a $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate to which two Flat Trunnions and two Trunnions are secured, the latter Trunnions being first attached to Angle Brackets which, in turn, are secured to the Plate. The Steam Engine base plate serves as the swivelling superstructure and to it are attached four $12\frac{1}{2}''$ Strips to form the jib of the crane. A $\frac{1}{2}''$ loose Pulley mounted on a $1\frac{1}{2}''$ Rod journalled at the top of the jib carries the hoist cord which is then wound round the secondary shaft of the Engine. The superstructure swivels about the Rod 1, which is passed through the base of the engine frame and is secured above by a Bush Wheel and below by the $3''$ Pulley 2.

The Steam Swivelling Crane contains the following parts :— 4 of No. 1 ; 2 of No. 10 ; 4 of No. 12 ; 2 of No. 16 ; 2 of No. 18a ; 1 of No. 19b ; 4 of No. 22 ; 1 of No. 23 ; 1 of No. 24 ; 2 of No. 35 ; 22 of No. 37 ; 1 of No. 52 ; 2 of No. 126 ; 2 of No. 126a ; 1 Steam Engine.

Steam-driven Sifter

Steam-operated models have a particular fascination, and another interesting example incorporating the Meccano Steam Engine is shown in Fig. 5. This represents a type of mechanical sifter often employed for grading and refining chemicals in large factories.

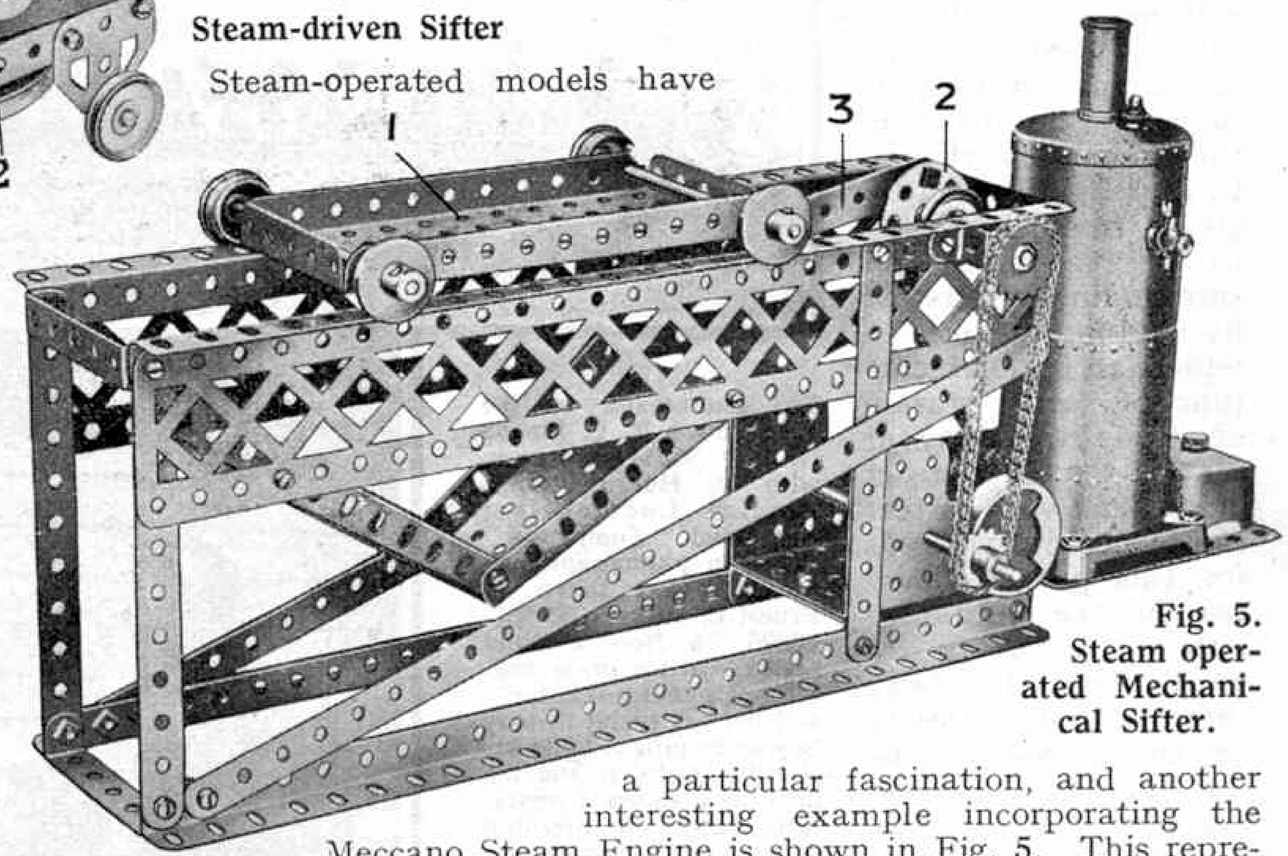


Fig. 5. Steam operated Mechanical Sifter.

The framework of the model is built up from $12\frac{1}{2}''$ Angle and Braced Girders spaced apart by means of $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips, and the Steam Engine base plate is bolted to one end of the framework as can be seen in Fig. 5. The actual sifter consists of a $5\frac{1}{2}'' \times 2\frac{1}{2}''$ "Perforated" Flanged Plate 1 mounted on $\frac{3}{4}''$ Flanged Wheels, which run on the top pair of $12\frac{1}{2}''$ Angle Girders of the framework of the model. A Trunnion is secured to one end of the Flanged Plate and one end of a $5\frac{1}{2}''$ Strip 3 is pivotally secured to the Trunnion by means of a lock-nutted bolt. The other end of the Strip 3 is pivotally attached to a Bush Wheel 2 mounted on a $4\frac{1}{2}''$ Axle Rod journalled in the frame.

A $1''$ Sprocket Wheel is mounted on the $4\frac{1}{2}''$ Axle and connected to a $\frac{3}{4}''$ Sprocket Wheel mounted on the secondary shaft of the Steam Engine by means of an endless length of Sprocket Chain.

When the Engine is set in motion, the tray 1 is oscillated backward and forward thus producing the required sifting action.

In the construction of the Mechanical (*Continued on page 258*)

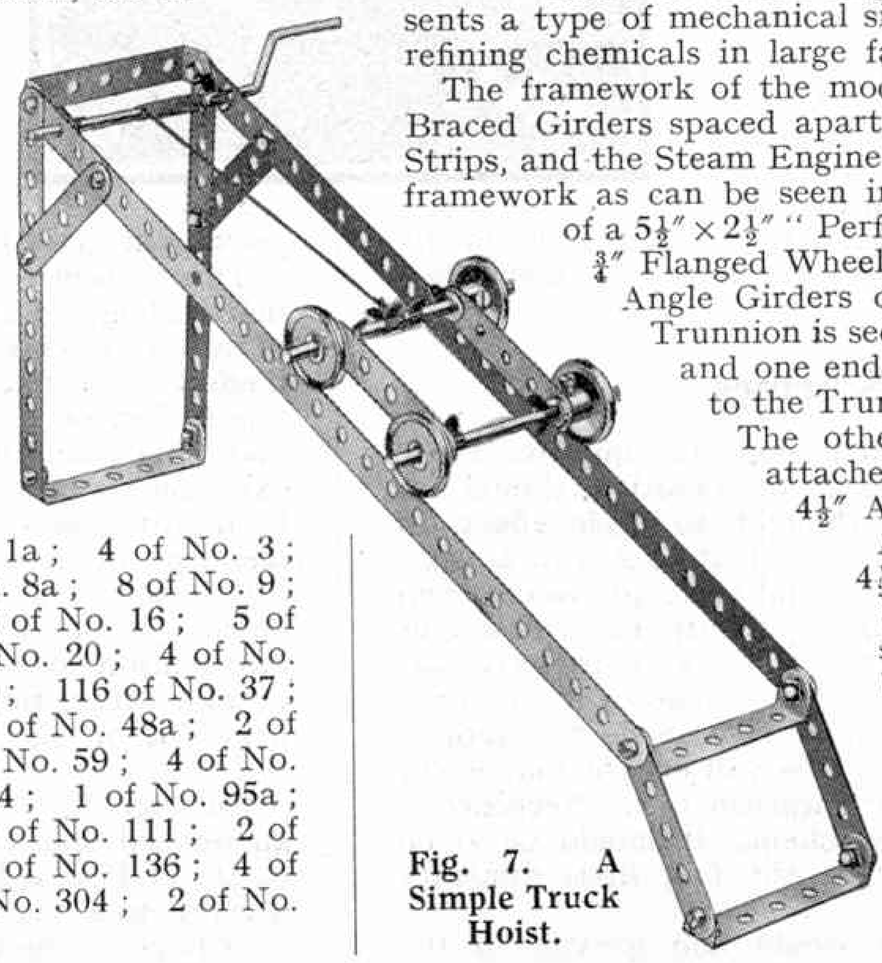
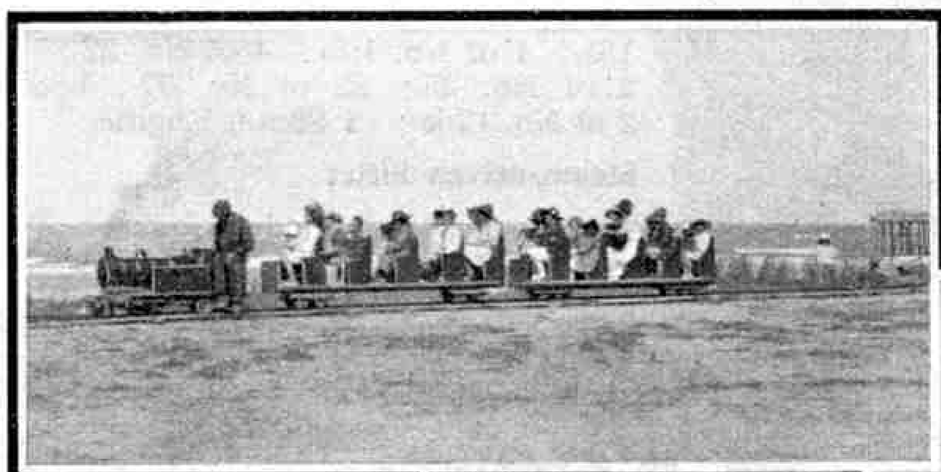


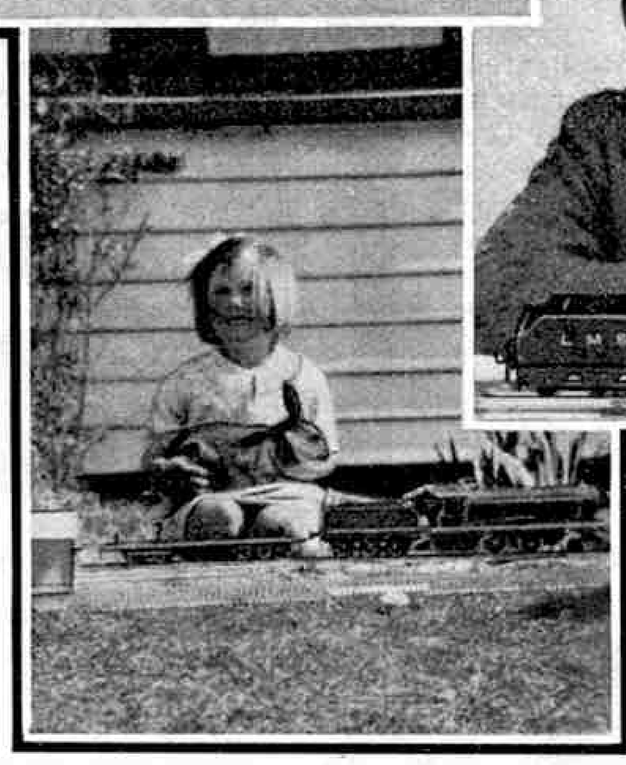
Fig. 7. A Simple Truck Hoist.

Reviewing Progress

Now that the second of the two winter sessions is drawing to a close, Chairmen and secretaries of Branches should take an early opportunity of reviewing progress, and of planning means of keeping up the interest of members. The majority of Branches have now been in existence a sufficient length of time to have attained a high standard of efficiency in ordinary track work. But there is always room for improvement and every official and member should be on the alert for new ideas that will add to the interest of proceedings at Branch meetings.

Changes in the ordinary routine of a Branch may be concerned with the Branch layout itself and with operations carried out on it, or with the general section of the programme. In each case there is plenty of scope for careful and thoughtful work. For instance, the Branch layout may be greatly improved by giving closer attention to the realism of the surrounding scenery, or by devising schemes to replace an unconvincing junction, or a station or goods yard layout by one that is more in accordance with correct railway practice. Ideas for this purpose may readily be obtained either by visits to local points of railway interest, or by a study of the pages of the "*M.M.*" that are devoted to model railway topics. For instance, on page 240 of this issue appears an article on the introduction of scenery into a miniature railway. A close examination of the layout of a Branch in the light of the interesting information contained in this article probably will indicate how improvements may be effected, and these in turn will undoubtedly help to show members how they may get more fun from their Hornby Trains.





The photograph on the right shows P. C. Moxon (H.R.C. 5525), Fareham, with his Hornby No. 2 Special Locomotive, "Midland Compound." The two photographs on the left were taken by Ernest C. Stonyer (H.R.C. 10306), a New Zealand reader. In the lower one, Stonyer's youngest sister—and her pet rabbit !—may be seen helping to build his Hornby Railway, and the upper one shows a miniature railway on Brighton Beach, South Canterbury, N.Z.

Trying New Schemes

Track work offers almost unlimited scope for improvements. Additions to the system, or new methods of operation, should not be introduced without giving due thought to their effect, of course. The best means of ventilating a bright idea is to arrange for a discussion of its merits by members, and I strongly recommend that a short period be set apart once a month for the serious consideration of suggestions. Any that are likely to have far-reaching effects, or to bring about a great change in the manner in which track work is carried on, should be made the subject of set debates among the members. This will ensure that every aspect of the proposal is thoroughly thrashed out. Needless to say, if it is decided to try any new scheme, it should be given a good chance, and not abandoned at the first little difficulty that may arise.

Among possible refinements that would add greatly to the interest of track operations may be mentioned the introduction of colour light signals, to which I made reference last month; the use of bell signalling codes; and the adoption of definite principles in marshalling goods trains, and in despatching them to their destinations. Every talk on railways, or visit to a station, goods yard or locomotive shed may suggest improvements, and those responsible for Branch programmes should seize every such opportunity of developing new ideas.

Choosing Subjects for Talks

When reading reports from Branches I often think that a little more care in arranging the general programme would make it of greater service in actual work. Talks and lectures form part of the normal proceedings of most Branches. Almost invariably these are of a very interesting character, but their value would be greatly increased if they were deliberately arranged to be of such a nature that the methods described and explained in them could be immediately translated into practice. An example of this comes from a Branch in which the Chairman gave a very instructive talk on bell signals and their use. In the next report from this Branch I was very pleased to read that, at the meeting following the talk, the task of introducing signalling of this kind into the Branch layout had been commenced. Members were already familiar with the system, and therefore had little difficulty in working out a satisfactory plan.

The result was that at the close of the meeting a practical trial of the system installed was made. A few minor adjustments were necessary in order to overcome slight difficulties that arose. These were quickly made and since that time bell signals have occupied a prominent place in operations on the Branch track.

This system could also be followed in dealing with goods train marshalling and hump shunting. A talk on this interesting branch of railway work would arouse the interest of members, particularly if efforts were made to indicate how the practices explained could be reproduced on a miniature scale. They would find that shunting and marshalling methods offer a promising field for model railway experiments of a type that can best be carried out by a group of keen enthusiasts, and I hope shortly to hear that the enterprising members of more than one Branch of the H.R.C. have devised satisfactory schemes for using retarders in shunting work. For devices of this kind Meccano parts are ideal, of course, and full information in regard to those in use on real railways may be obtained from the article on the Whitemoor Marshalling Yard on page 851 of the "*M.M.*" for November last.

* * * * * *

On page 57 of the January, 1931, issue of the "*M.M.*" it was announced that a Branch of the H.R.C. was in course of formation by Mr. R. Post at Highbury, London, N. The inclusion of this notice was due to a misunderstanding, and details of the Branch that Mr. Post hopes to found will be given at a later date.

Branch Notes

WESTON-SUPER-MARE.—In a debate on suggested improvements in the Hornby Series, the proposed additions receiving most votes were yellow distant signals; horseboxes; lamp brackets on composite coaches and brake vans; fog signals; and winding shafts on both sides of locomotives. A thorough overhaul of Branch stock has taken place and the Branch track has been re-laid. The addition of new signals has so improved the working of the layout that more signals are being purchased. Secretary: C. E. Hyssett, "Bayonne," 6, Elmhyrst Road, Weston-super-Mare.

FIRST KINGSTON-ON-THAMES.—Operations are carried out on a combined clockwork and electric track. A 1931 Hornby Locomotive No. 3C "Royal Scot" was tested and found to haul exceptional loads. Great interest was taken in comparative tests of this locomotive and a 1930 Hornby Locomotive No. 3C "Flying Scotsman," in which the older engine showed up very well. Visits have been made to locomotive sheds, the various London termini, and also to the Schoolboys' Exhibition. Secretary: C. L. Lex, 19, Richmond Park Road, Kingston-on-Thames.

FIRST RHYL.—A new goods yard has been included in the Branch layout. Two dramatic sections have been formed in the Branch and at a very pleasant social evening, 12 small sketches were given. A number of gramophone records also were played and the evening ended with refreshments. Secretary: G. B. Williams, "Gorsefield," Grange Road, Rhyl.

WHITGIFT GRAMMAR SCHOOL.—A lantern lecture entitled *"Britain's Greatest Railway"* and a talk on *"How to Calculate the Tractive Effort of a Locomotive"* have been given at indoor meetings. Outdoor events have included visits to Croydon Borough Electricity Works and the Science Museum, South Kensington. At the Electricity Works, an electric shunting locomotive attracted interested attention. Secretary J. D. Mellor, 71, Birdhurst Rise, S. Croydon.

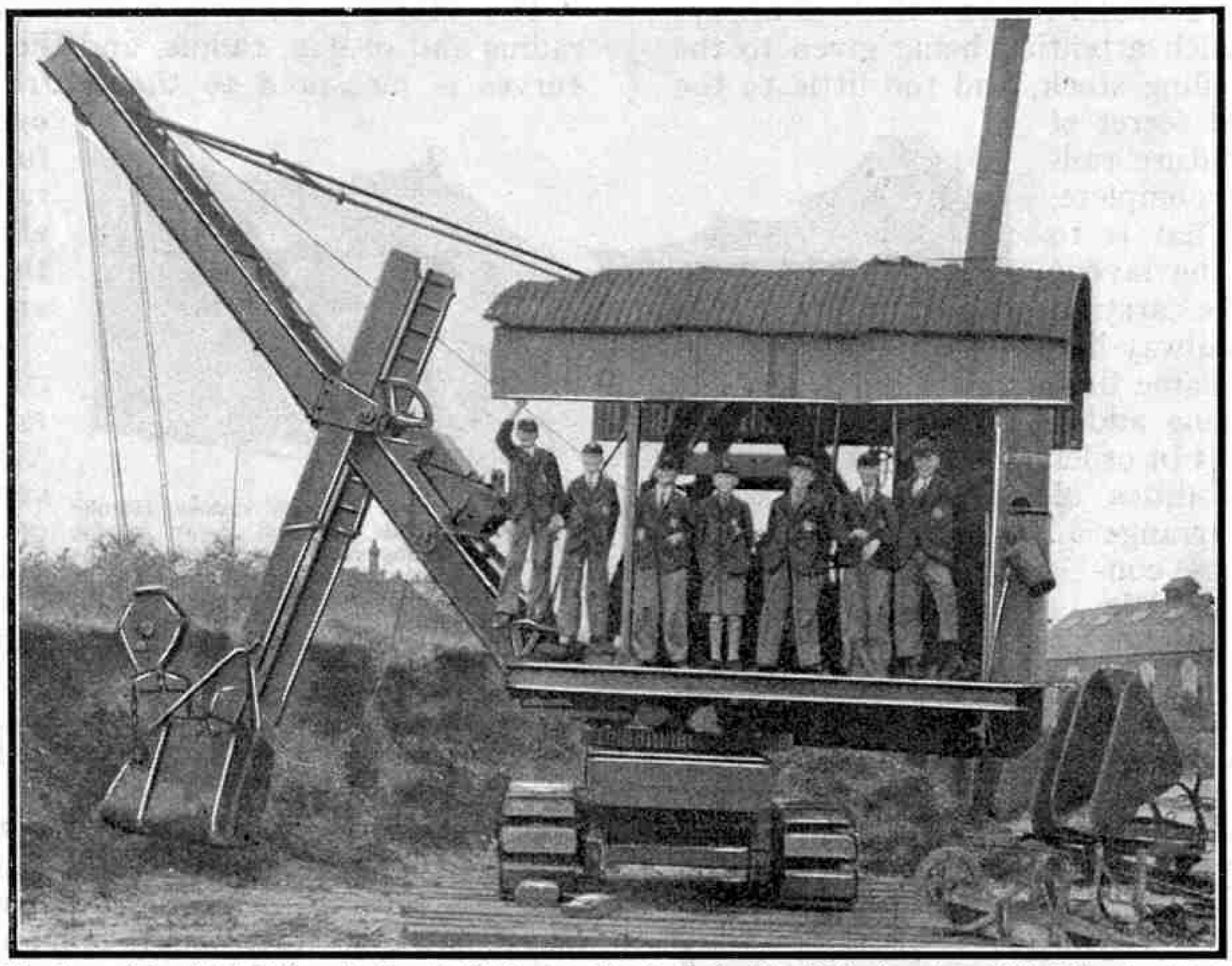
IPSWICH.—Lectures on *"The Work of an Engine Driver"* and *"American Goods Trains"* have been given during the month. In the sectional contests the "Air Brakes" beat the "Vacuum Brakes" by 109½ marks, and as a reward were excused subscriptions for two weeks. A tunnel constructed by two of the members is covered with papier maché and has a very realistic appearance. An island platform has been added to the layout and the colour light system is to be refitted. Secretary: P. E. Buck, 10, Dial Lane, Ipswich.

FARNHAM GRAMMAR SCHOOL.—An interesting lecture was given on *"Railway Signalling"* by the Branch secretary. A lantern lecture obtained from the L.N.E.R. was also given by the Chairman on the occasion of a visit by pupils of Odiham Grammar School. Secretary: H. S. North, "Karind," Boundstone, Nr. Farnham.

SOLIHULL.—At a recent meeting a very interesting lecture on *"Radium"* was given by a gentleman who had lived in Papua and has served with an expedition sent out to search for this rare substance. A lecture on *"Stamps and Stamp Collecting"* also has been given. This was followed by a competition, in which the prize was a set of the latest Maltese issue. Many excellent track meetings were held during the Christmas holidays and visits were paid to Tyseley Engine Sheds and to Messrs. Cadbury's Works at Bourneville. Secretary: Hugh S. Aitken, "Cardross," Broad Oaks Road, Solihull, Warwickshire.

THE PIRN HOUSE (INNERLEITHEN).—A large terminus complete with sidings and a well-fitted goods yard is being constructed. Other extensions are being made to the Branch track in order that a system of fast and slow trains may be run strictly to timetable. Secretary: Mr. Jack Prior, The Pirn House, Innerleithen, Peeblesshire.

PERTH ACADEMY.—The sidings have been reconstructed in order to allow more extensive shunting operations. The members have organised an interesting system of working in shifts. This has proved very successful, and a more intensive train service is now maintained. Secretary: Stewart McLaren, 57, King Street, Perth, N.B.



Members of the Solihull Branch No. 45 (Chairman, Mrs. L. E. Caulkin, M.A., Secretary, H. S. Aitken) making a close investigation of the working of the steam shovel engaged in preparations for the rebuilding of Solihull Station, on the G.W.R.

OVERSEAS

ASHFIELD (SYDNEY).—Construction of a permanent layout is now proceeding. This is laid on shelves supported by trestles. Electric light has been installed in the Branch room, and a transformer is now used to supply current. Permission has been granted to the Branch to visit any Government Railway Workshop in the Sydney area. On the first visit members inspected the Eveleigh (Sydney) Workshops. They were accompanied by members of the Kogarah Branch. Secretary: H. N. Johns, 11, Seale Street, Leichhardt, Sydney, N.S.W., Australia.

Further Branches in Course of Formation

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

BISHOPS STORTFORD—J. F. T. Lane, Holy Trinity Vicarage, Bishops Stortford.

BOLSOVER—John L. Lee, Mooracre Lane, Bolsover, Nr. Chesterfield.

CHANDLERSFORD — W. Hooper, St. Cuthberts, Hursley Road, Chandlersford, Nr. Southampton.

CONISBOROUGH—C. L. Ward, 4, Holywell Lane, Conisborough.

EAST WORTHING—R. Jupp, 1, Brougham Terrace, Brougham Road, E. Worthing.

FOLKESTONE—V. Vockins, 5, Alexandra Gardens, Folkestone.

GLASGOW—Peter McMahon, 7, Viewmount Drive, Maryhill, Glasgow, N.W.

HEYWOOD—T. Dyson, 80, Church Street, Heywood.

HIGH BARNET—G. L. Wright, 27, Normandy Avenue, High Barnet.

ILFORD—R. S. Riddle, 5, Northbrook Road, Ilford, Nr. London.

LEIGH-ON-SEA — M. McAteer, "Buona Vista," Marine Parade, Leigh-on-Sea.

LONDON, N.W.10—L. Sharpe, 43, Station Road, Harlesden, London, N.W.10.

LONDON, N.13—R. J. Cotton, 236, Princes Avenue, Palmers Green, London, N.13.

LONDON, N.8—E. Cock, 102, South View Rd., Hornsey, London, N.8.

LONDON, W.10—Mr. S. K. Hathaway, 349, Ladbroke Lane, London, W.10.

LOUGHBOROUGH—A. Fletch, "Westbury," Forest Road, Loughborough.

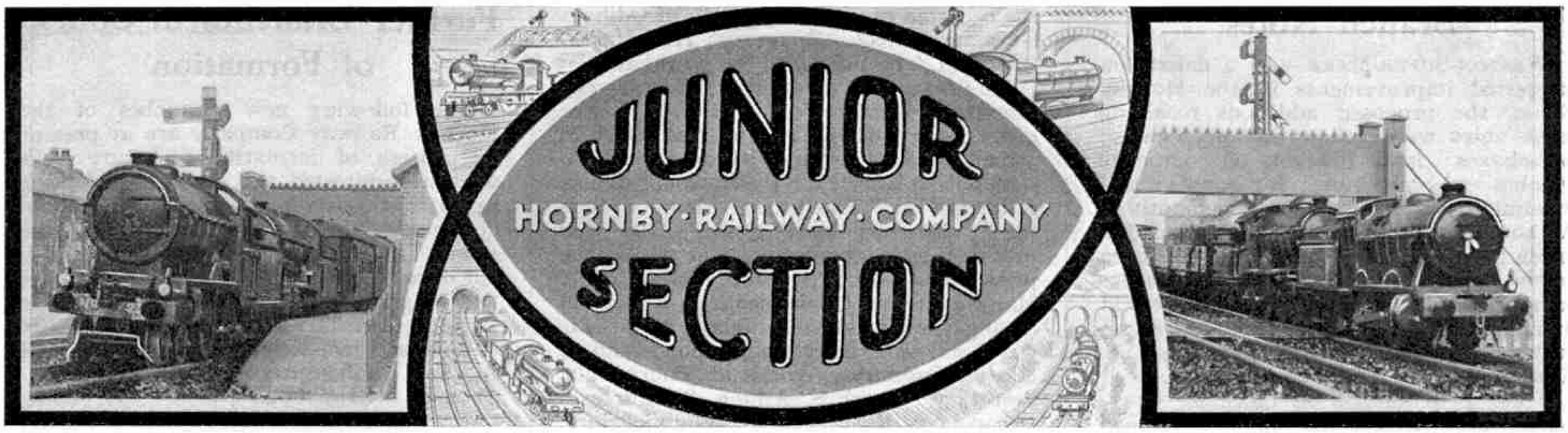
MANCHESTER—A. Chantler, 28, Victoria Avenue, Didsbury, Manchester.

Further H.R.C. Incorporated Branches

156. SYDENHAM & FOREST HILL—R. A. Davies, 92, Dacres Road, Forest Hill, London, S.E.23.
157. "THE ROBERT HILL" (KIDDERMINSTER)—Wilfred Barker, 44, Clarence Street, Kidderminster.
158. "THE BELFORT" (CATFORD)—J. H. Forth, 31, Ardoch Road, Catford, London, S.E.6.

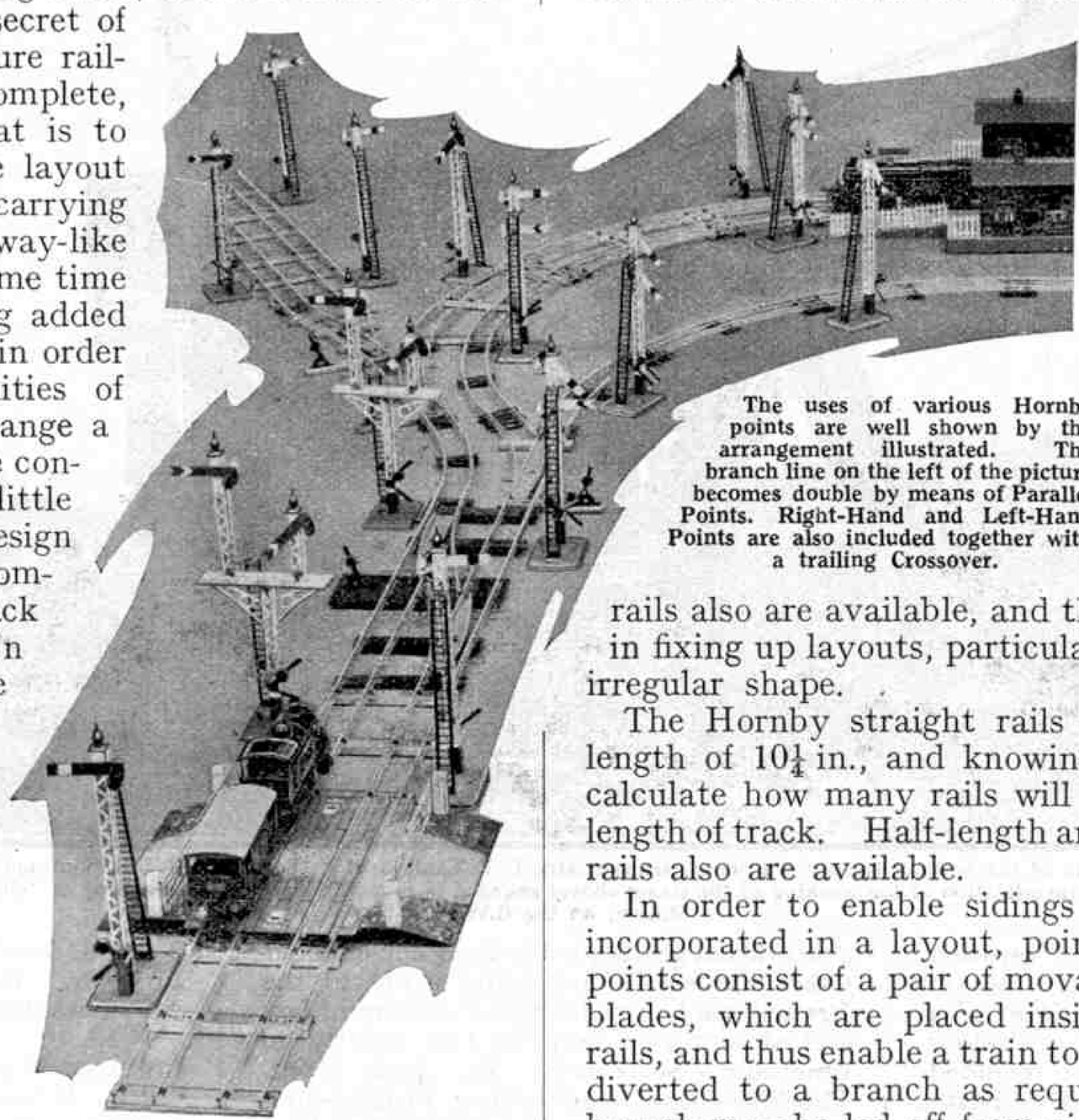
OVERSEAS

155. MADRAS—Mr. S. P. Shottam, 18a, Harris Road, Mount Road P.O., Madras, S. India.



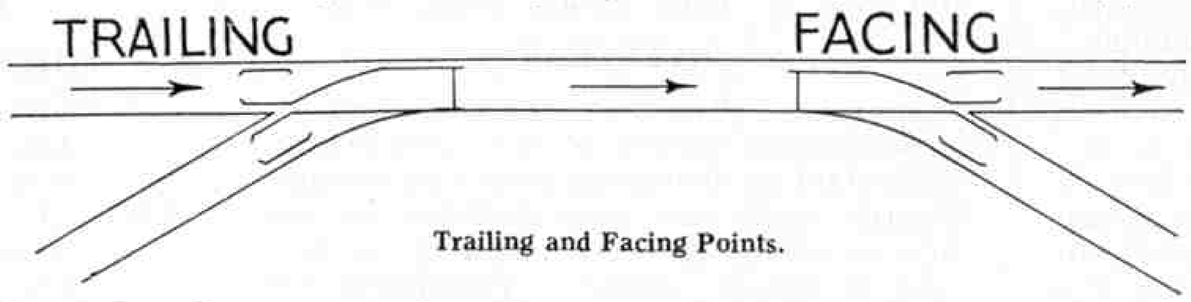
XXVII.—SOME NOTES ON HORNBY TRACK

IN the building up of a model railway there is always a danger of too much attention being given to the locomotives and rolling stock, and too little to the track itself. The great secret of success with any miniature railway is to have it always complete, yet never finished. That is to say, at any moment the layout must be suitable for the carrying out of a variety of railway-like operations, and at the same time must be capable of being added to in different directions in order to increase the possibilities of fun. It is easy to arrange a layout so as to fulfil these conditions, provided that a little attention is given to the design and use of the various component parts of the track of the Hornby System. In this article, therefore, we propose to survey briefly the various Hornby track units, and to explain the purpose for which each is intended.



The uses of various Hornby points are well shown by the arrangement illustrated. The branch line on the left of the picture becomes double by means of Parallel Points. Right-Hand and Left-Hand Points are also included together with a trailing Crossover.

Before doing so, however, it will be well to refer to a matter on which there still appears to exist misapprehension; namely, the amount of space occupied by layouts made up of curves of different radius. The standard radius of Hornby Railway curves is 2 ft., which means, of course, that a circle of these rails has a diameter of 4 ft. It does not mean, however, that a circle of these rails could be laid down in a space exactly 4 ft. in width. With these standard curves the radius is measured from the centre of the circle to the inner rail. Therefore, in order to find the overall space taken up by a circle of these rails, it is necessary to add to the 4 ft. diameter twice the width of the track (one width at each end of the diameter); the amount to which the sleepers project beyond the outer rail at each end of the diameter; and a small amount for overhang of certain vehicles. It is thus found that a circle of the standard 2 ft. radius rails requires an overall space of 4 ft. 6 in.



Trailing and Facing Points.

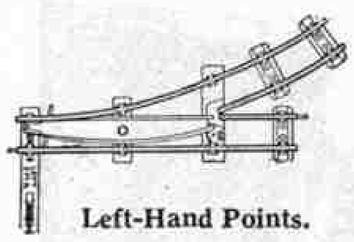
The Hornby System includes also curves of 1 ft. radius and of 9 in. radius, and the radius of both these curves is measured to the centre of the track. The overall space required for a circle of the 1 ft. radius curves, making allowance for everything, is 2 ft. 5 in.; and the corresponding space required for a circle of rails of 9 in. radius is 1 ft. 11 in.

In order to form a complete circle, 12 rails of 2 ft. radius are required, and six rails of 1 ft. radius or of 9 in. radius. Half-length and quarter-length curved rails also are available, and these are extremely useful in fixing up layouts, particularly if these are of rather irregular shape.

The Hornby straight rails are made to a standard length of $10\frac{1}{4}$ in., and knowing this it is quite easy to calculate how many rails will be required for a certain length of track. Half-length and quarter-length straight rails also are available.

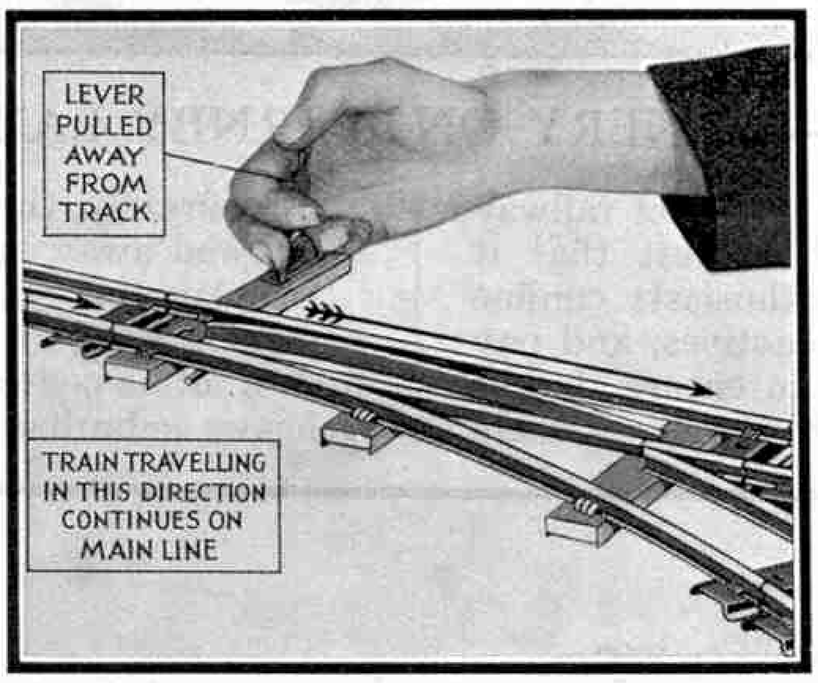
In order to enable sidings and branch lines to be incorporated in a layout, points are necessary. These points consist of a pair of movable rails known as switch blades, which are placed inside the ordinary running rails, and thus enable a train to travel straight on or to be diverted to a branch as required. In order that the branch may be led off from either side of the line, both right-hand points and left-hand points are required. Our correspondence shows that many beginners are a little uncertain as to whether points in their possession are right-hand or left-hand. This difficulty is easily cleared up. Let us suppose we have points in position to enable a curved branch to leave the main line; and that we are looking along the track from the facing or switch end of the points. Then, if the branch diverges to the left, the points are left-hand points; if it diverges to the right, they are right-hand points.

In addition to the ordinary Right-Hand and Left-Hand Points there are the useful Parallel Points, which enable a single line to be split up into two branches running parallel to one another; and the Double Symmetrical Points, which enable a single line to be


Left-Hand Points.

transformed into two branches curving away from one another. Some Hornby Railway owners find it difficult also to determine whether these are considered right-hand or left-hand, for in each case the branches are identical. If we examine points of either of these types we find that the lever and the projecting sleeper upon which it is mounted are situated at one side of the points. If, as we look along the points from the facing or switch end, the lever is at the right-hand side, the points are known as left-hand; if the lever is at the left-hand side, they are right-hand points. In laying down a track in which Parallel or Double Symmetrical Points are used, it is often found that whereas, say, right-hand points get in the way of an adjacent track or accessory, left-hand points can be used to produce the same effect without this interference.

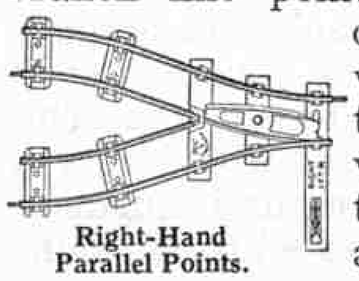
All points are interchangeable with the ordinary standard rails. Thus the straight portion of ordinary Right-Hand or Left-Hand Points is the same in length as a straight rail, and the curved branch corresponds to a full curved rail of the same radius. This applies also to the curved branches of Double Symmetrical Points. The total length of Parallel Points is equal to one full-length straight rail and a quarter-rail. Therefore, if two Parallel Points are added to an oval layout to form a loop line at one side, the opposite side of the layout must be increased in length by two straight rails, and one half or two quarter-rails. It is very useful to remember this when additions to a layout are being made.

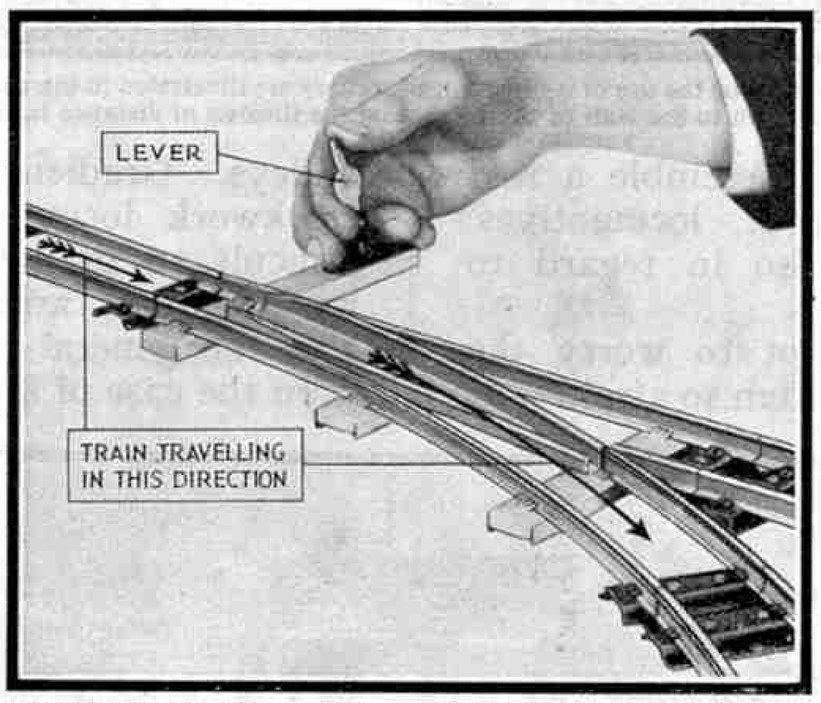


Right-Hand Points set to allow a train to continue on the main line.

Points are known as "facing" or "trailing" points according to whether they face the direction of an oncoming train or not, as shown in the diagram on the previous page. As a rule trailing points are used wherever possible in making crossings over main lines, on account of their safety in the event of incorrect settings.

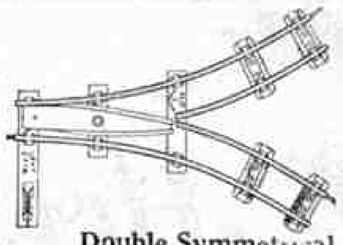
The uses of several of the component parts of the Hornby Track to which we have referred are illustrated by the photograph on the previous page. This represents a section of a large layout completely signalled and using several types of Hornby points and rails, in which the main line, after passing the Level Crossing, turns slightly to the left and then swings round to the station. A siding line is thrown off at the Left-Hand Points and this runs at the back of the station. There is also a branch line that becomes double track by means of Parallel Points. As the branch line points are single track, trains have to cross from one track to the other when joining the main line. For this purpose the Crossover is provided, this being a left-hand or trailing crossover when the trains are travelling in their normal direction.


Right-Hand Parallel Points.



Right-Hand Points set to divert a train to the curved branch line.

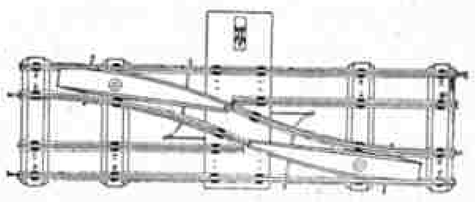
In using points it is of course essential to see that they are correctly set for the route the train is intended to follow. The tip or "toe" of one of the switch rails must be hard up against the stock rail, so that the flanges of the wheels cannot "split the switch" and pass between them. Derailment would of course be the result of this, possibly with serious consequences to the stock involved. Points should therefore be carefully examined before use to make sure that they are working correctly, and they should be closely watched while the trains are running.


Double Symmetrical Left-Hand Points.

In actual railway practice derailment would probably not follow an incorrect setting of trailing points, as the wheels of the engine would force the switch rails out of the way, and thus make it possible for the wheels of the rest of the train to pass safely. This is not the case with Hornby points, as their construction is somewhat different from that used in real points. With Hornby points the entrance to the curved branch line is entirely closed by the switch rails when they are set for the straight main line. For this reason derailment will be certain to follow incorrect setting.

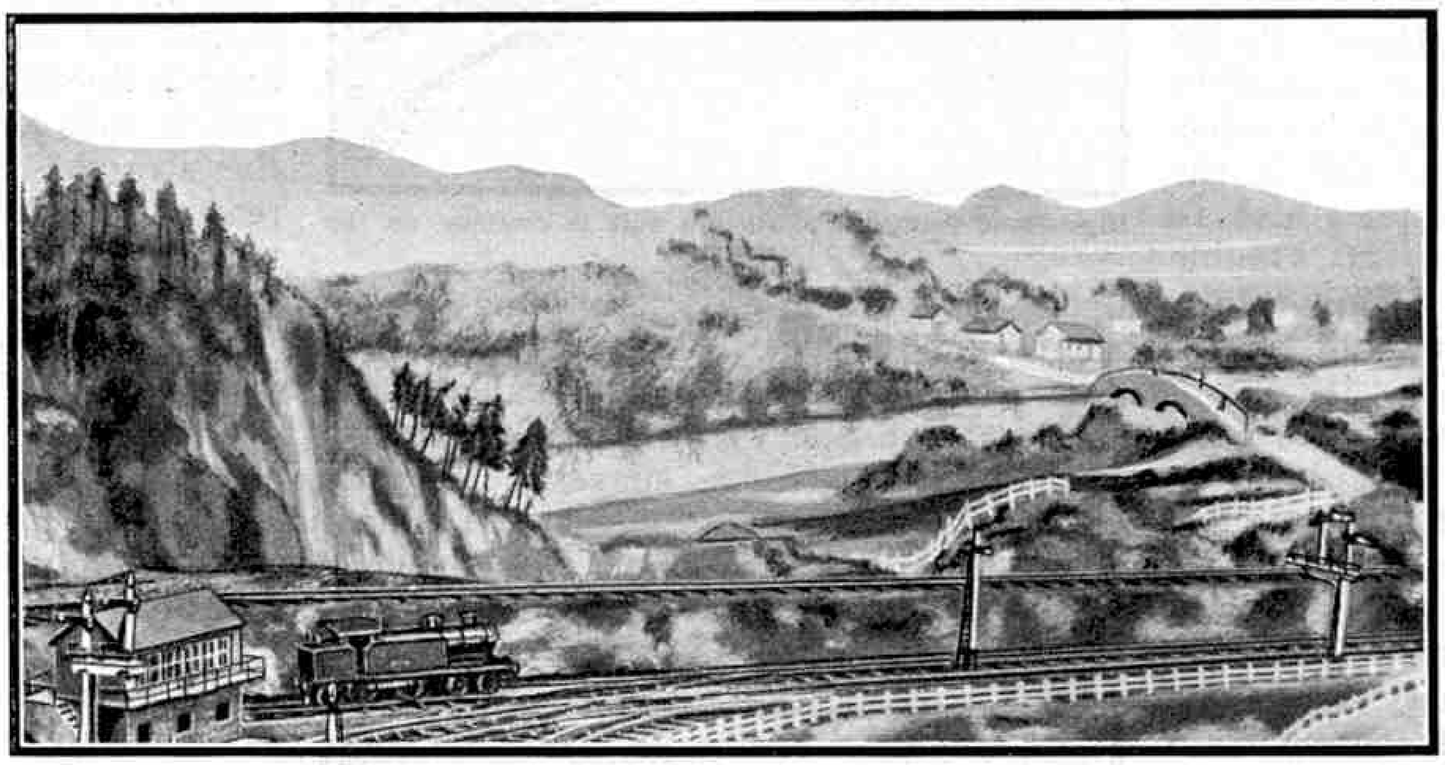
Crossings are also included in the Hornby Series. They are of two patterns, the Acute-Angle, or, as it is sometimes called, the Diamond Crossing; and the Right-Angle Crossing. The purpose of these, as their name suggests, is to allow one line to cross completely over another. They have no moving parts, and are therefore always in the correct working position. Each pattern is made in two types, suitable for 1 ft. and 2 ft. radius curves respectively.

Considerable doubt seems to exist as to which of the locomotives and rolling stock in the Hornby Series are suited to the rails of the various radii. Frequently enthusiasts are disappointed owing to the fact that they purchase a locomotive that is not suitable for running over the particular curves or points that they already possess. The 9 in. radius rails and points are specially intended for the M0 Train Sets, and cannot be used for any others. The M1 and M2 Train Sets, also the Hornby No. 0 Sets, both passenger and goods, are provided with 1 ft. radius rails and will perform in a perfectly satisfactory manner upon them. For all the other train sets in the Series the use of 2 ft. radius curves and points is essential, and of course trains which normally run on curves of sharper radius will give better results on these large radius rails. The Special Series of locomotives are intended for use on 2 ft. radius rails only, and this also applies to the No. 3 locomotives, Metropolitan locomotives, and the engine of the Riviera Blue Train Set. None of the eight-wheeled vehicles is suitable for use on any smaller radius rails than 2 ft.

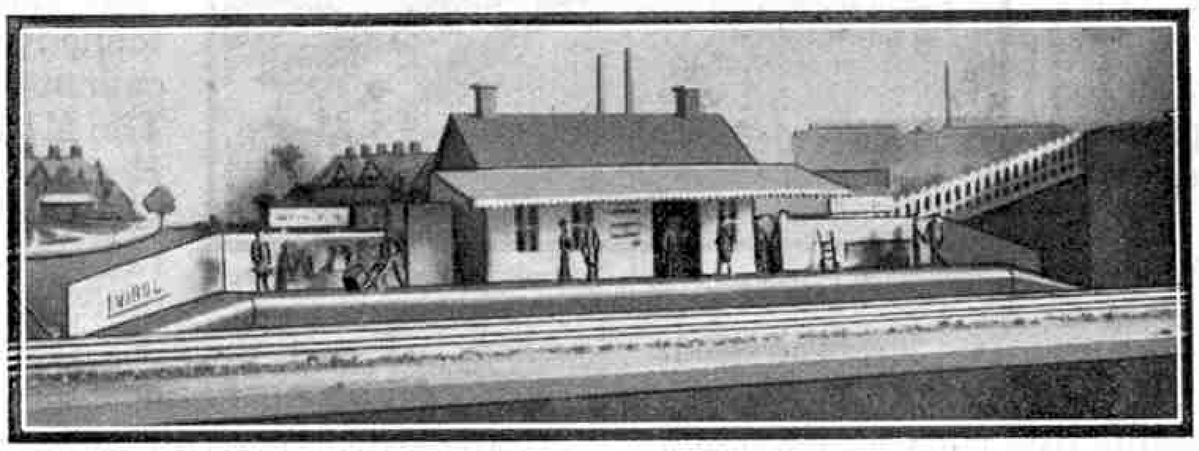

Right-Hand Crossover.

XXIX.—SCENERY ON HORNBY LAYOUTS

ONE of the great fascinations of the model railway hobby is the great variety of interest that it affords. For instance, some enthusiasts confine their attention almost entirely to locomotives, and pay little attention to the layout, except to ensure that it provides them with a sufficient length of run. Others find their greatest pleasure in making up trains of as varied a character as possible, and in providing their goods trains with actual loads to be carried from one place to another. Timetable working has many thousands of keen supporters; while others make a special hobby of track planning and correct signalling. There is one point on which all agree, however; and that is that the ideal miniature line must resemble a real railway not only as regards its layout, locomotives, rolling stock and accessories, but also in regard to its setting and surroundings.


The fine effects to be obtained by the use of well-arranged scenery are illustrated in this picture. The landscape is painted directly on to the wall of the room, and the illusion of distance is most striking.

The problem of surroundings is apt to worry the model railway engineer; in fact he is often so afraid of it that he leaves it severely alone! As a matter of fact the difficulties of providing a suitable scenic background for the average model railway are more apparent than real. In common with many other so-called difficulties, they begin to disappear as soon as they are tackled in earnest! It is true that there are limits to what can be done with a railway that always has to be completely dismantled after use; but every model railway owner should endeavour to have a part, at least, of his line semi-permanent, that is arranged in sections that can be taken up as a whole. In previous articles we have described how a layout may be arranged in sections of suitable length, screwed down to a baseboard, so that while it can be assembled quickly and accurately, the sections of which it is composed can be stowed away in small space.


The appropriate background used here greatly increases the natural appearance of the station.

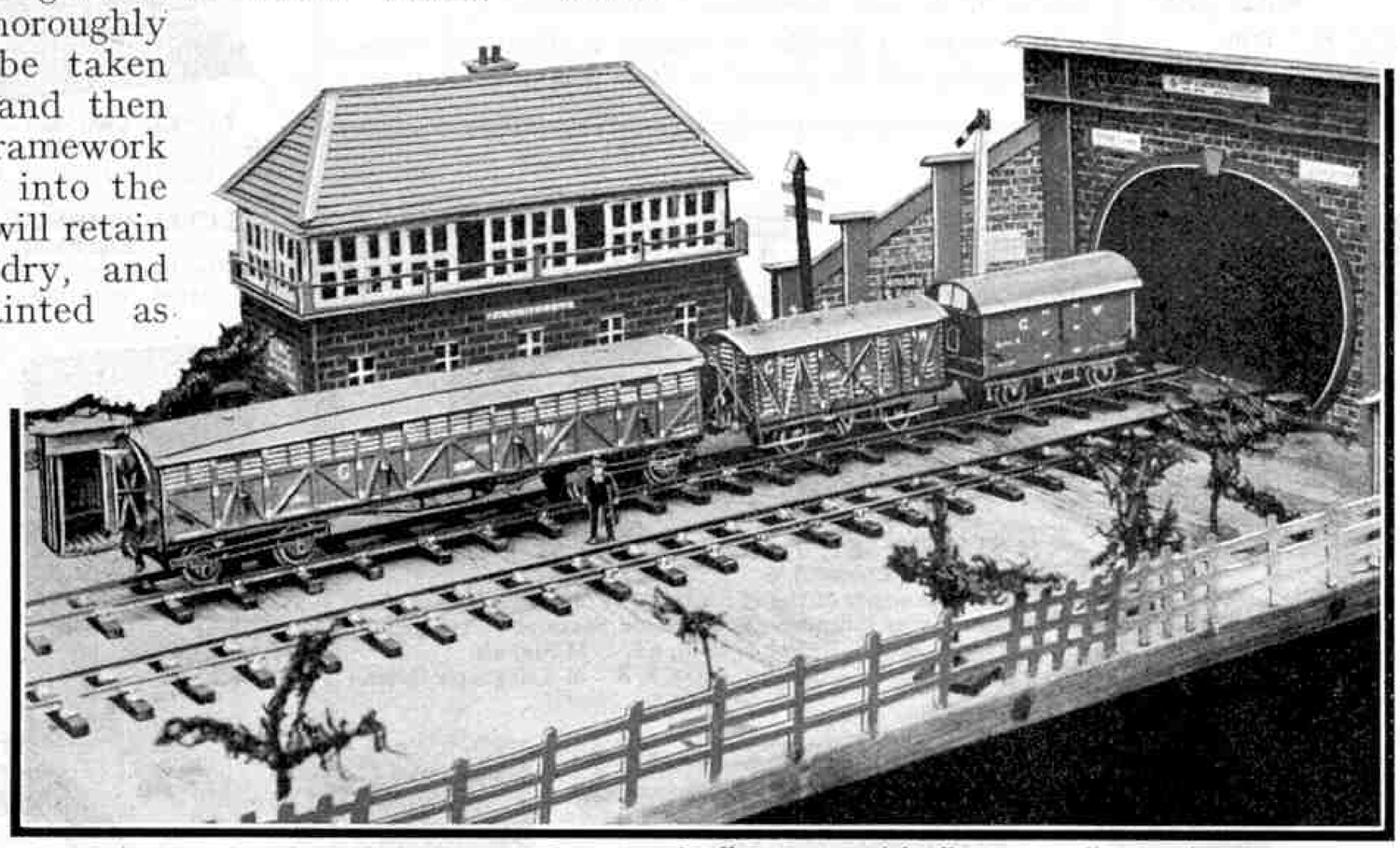
In planning scenery for any railway, the general plan of the layout and the purpose of the line should first of all be considered. For instance, a line on which a heavy suburban traffic is conducted should not be provided with a background that represents the Rocky Mountains, or the effect will be absurd! It is not always possible to provide a suitable background for every section of the line, but it is not difficult to obtain a generally suitable effect. A miniature railway that is apparently laid in flat country never looks as realistic as one that passes through hills and across valleys. Gradients are not desirable for lines on which clockwork locomotives are employed, but it is not difficult to produce the effect of undulating country by a careful arrangement of embankments, cuttings and the general background.

In the case of a permanent layout it is easy to make a most effective embankment. The baseboard should be narrowed so that it is little wider than the ballasted part of the track. Underneath this there should be arranged a false base, sloping as required until the opposite side of the valley that the line is supposed to be crossing is reached. The rails, of course, remain level as they were before, but the false base produces a complete illusion of a rising or falling gradient. In making the embankment a rough framework of strips of wood should be constructed to connect the upper and the lower baseboard. This framework should, if possible, be covered with pieces of old felt, or some similar material, the natural roughness of the surface of which should be increased by brushing

with a stiff brush. When this has been done, green paint should be laid on to represent grass, and occasional touches of brown and yellow give quite a pleasing representation of a typical grass embankment.

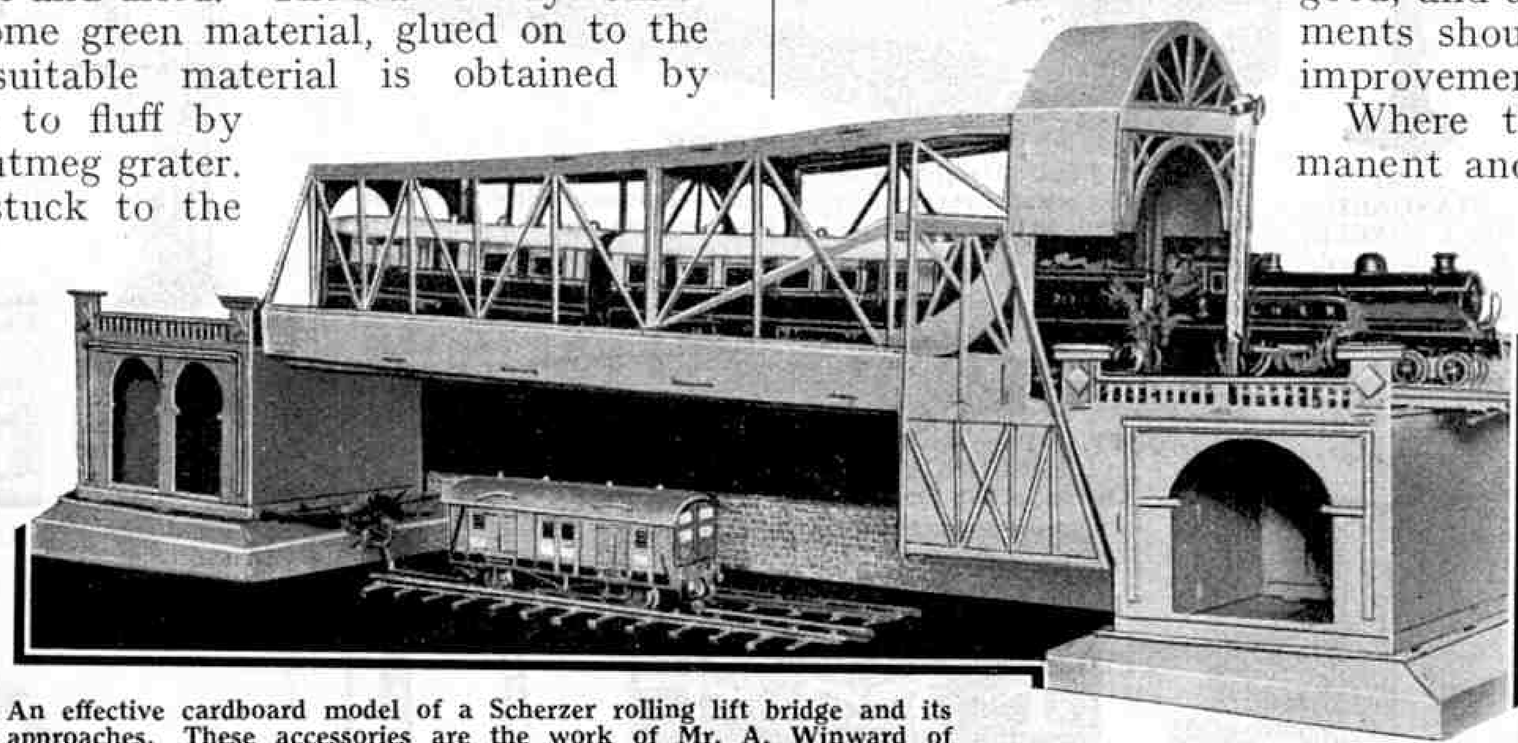
Another method of forming embankment sides consists of soaking fairly stout brown paper in a thin solution of glue and warm water. When the paper is thoroughly soaked it should be taken out and drained, and then attached to the framework and worked gently into the desired shape. It will retain this shape when dry, and then may be painted as desired. Alternatively, sand and very small stones might be sprinkled on it in patches before it is dry, so that the glue holds these in position.

When the layout cannot be even semi-permanent, the incorporation of such an embankment is scarcely possible. In such circumstances much may be done by the use of cuttings, made up into suitable lengths and used at the side of the track as desired. These cuttings may be made in a similar manner to the embankments, commencing with a suitable framework and covering this with any likely material that is at hand.



The possibilities of cardboard for the construction of scenic effects on a model railway are well shown in this photograph and the one below. It is interesting to note that not only the tunnel mouth and signal-box, but also the G.W.R. vehicles are made of cardboard.

Miniature trees placed in appropriate positions add greatly to the realism of a line. These trees may be made from suitable twigs, carefully prepared to the right size and shape and dried. The leaves may consist of small bits of some green material, glued on to the "branches." A suitable material is obtained by grating green felt to fluff by means of an old nutmeg grater. This fluff, when stuck to the twigs with Seccotine, looks surprisingly effective. The trees may be placed at many different points along the line on embankments or cuttings, or simply along the level stretches in front of an appropriate background.



An effective cardboard model of a Scherzer rolling lift bridge and its approaches. These accessories are the work of Mr. A. Winward of Manchester, to whom we are indebted for the photographs.

We come now to the actual background itself, which is of the greatest importance for producing the effect of distance and perspective. The mere mention of backgrounds seems to scare some railway enthusiasts, but we are convinced that this is merely because they have not experimented with them. To those who still maintain that backgrounds are ineffective, and more trouble than they are worth, we can only say—"Try them and see"!

Wallpaper frieze is usually recommended for railway backgrounds, and it certainly has many advantages, particularly in the saving of time and trouble. It is becoming more and more difficult to obtain really suitable friezes for this purpose, however, and in any case it is much greater fun to make up the backgrounds at home. It is not in the least necessary to be a clever artist in order to produce successful results in this direction. Generally speaking, detailed work is not only unnecessary, but also undesirable. All that is required is a suggestion of hilly country, pasture land, or wooded areas, with an occasional river, according to the nature of the imaginary country through which the railway passes. If desired, more detailed work may be added in the neighbourhood of important stations, but that is not really necessary.

Readers who are under the impression that they have not the ability to produce suitable backgrounds should make one or two experimental attempts with a length of, say, a yard of paper about 1 ft. in width, and place this strip in position behind their track, and look at it from the correct distance. In most cases it will be found that the effect is at least fairly good, and a few further experiments should produce a rapid improvement.

Where the railway is permanent and is arranged round the room, the walls should if possible be covered with light blue paper, and this used as the base upon which the scenery is drawn. For non-permanent layouts it is best to fix the background on light frames in sections of about three or four feet in length, which can be placed in position quickly, and packed away in small space after use.

Scenery made in this manner gives an extremely realistic character to the line. A miniature railway owner will find that he has great scope for the introduction of effective scenery. For instance, impressive rows of factory chimneys may be represented; where suitable, roads may be shown running from distant villages down to level crossings over the railway; and far-off hills and mountains lend charm to the scene.

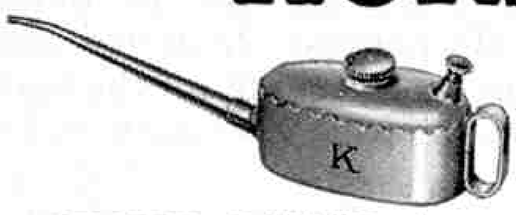
HORNBY SERIES

HORNBY ACCESSORIES

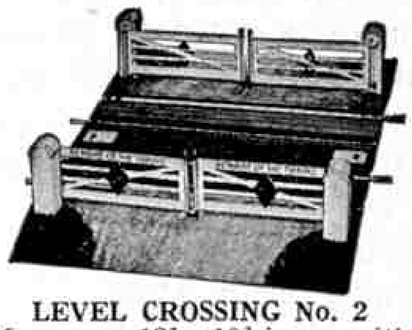
HORNBY SERIES

There is a splendid range of Railway Accessories in the Hornby Series, built in perfect proportion and beautifully finished. With these realistic Accessories the most elaborate model railway system may be constructed and operated in exactly the same manner as a real railway.

A selection of Hornby Accessories is illustrated below. Your dealer will be pleased to show you the full range.



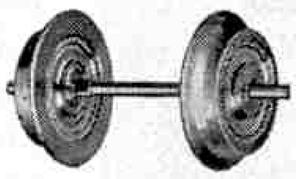
OIL CAN No. 2 ("K" Type)
This miniature Oil Can operates perfectly. The oil is ejected drop by drop by depressing the valve. Polished Copper. Price **3/6**



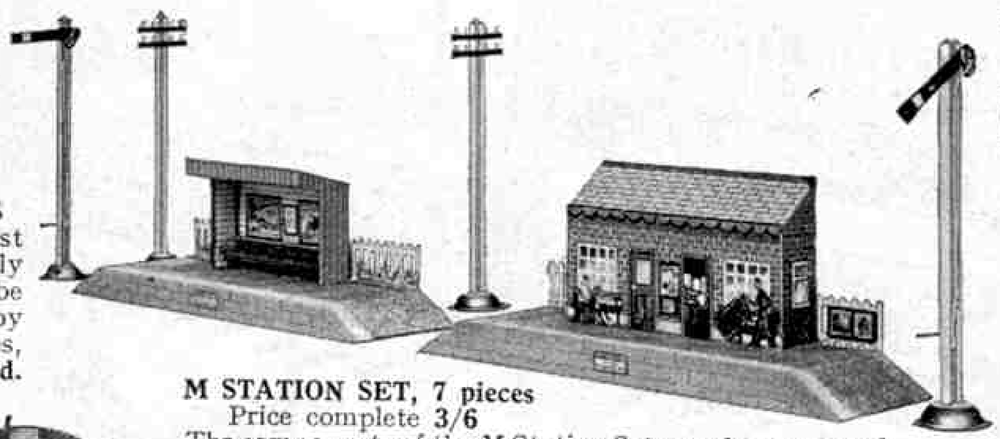
LEVEL CROSSING No. 2
Measures 13½ × 10¼ ins., with two tracks of gauge 0 rails in position .... Price **5/6**

LEVEL CROSSING No. 2 (Electrical)
Similar to Level Crossing No. 2, but fitted with two electrical tracks ... ... Price **8/-**

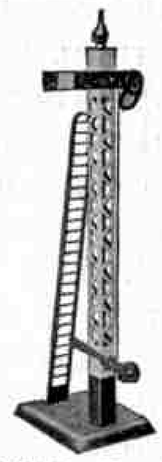
DOUBLE ARM SIGNALS No. 1
Price **4/3** per pair.
DOUBLE ARM SIGNAL No. 2
(As illustrated).
Price **3/-** each.



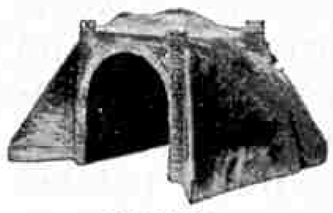
MANSELL WHEELS
These solid die-cast wheels are correctly designed and may be fitted to Hornby Wagons, Vans, Coaches, etc. Price, per pair, **4d.**



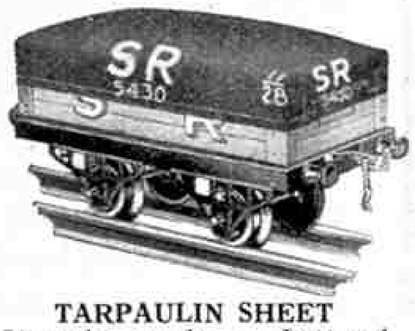
M STATION SET, 7 pieces
Price complete **3/6**
The components of the M Station Set may be purchased separately as follows:—M Wayside Station. Price, each, **1/-**
M Signal Box ... Price, each, **6d.** M Signals ... Price, each, **4d.**
M Station ... Price, each, **1/3** M Telegraph Poles. Price, each **4d.**



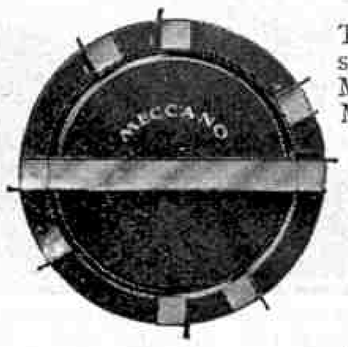
SIGNAL No. 2
Price **2/6** each.
"Home" or "Distant."



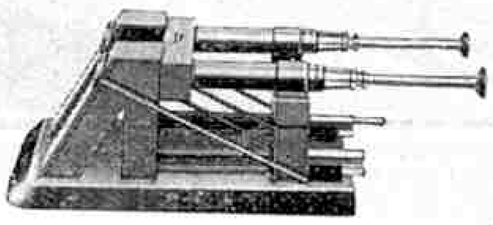
TUNNEL
Realistic and finished in colours ... Price **7/6**



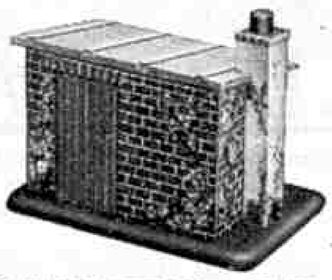
TARPAULIN SHEET
Strongly made. Lettered L.M.S., G.W., N.E. or S.R. The above illustration shows one of the Tarpaulin Sheets fitted to a Hornby Wagon. Price **3d.**



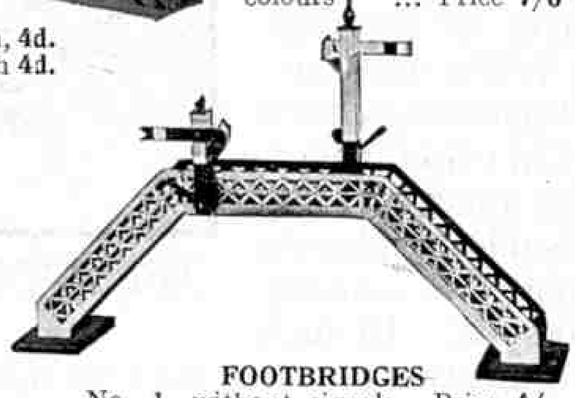
TURNTABLE No. 2
Price **4/6**
TURNTABLE No. 2 (Electrical)
Similar to Turntable No. 2, but fitted with electrical rails ... Price **8/6**



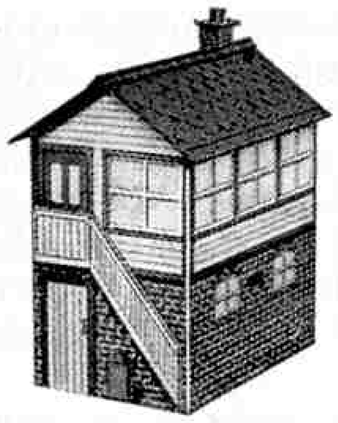
BUFFER STOPS No. 2 (HYDRAULIC)
Price **5/6**



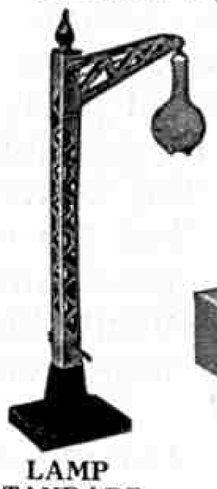
PLATELAYER'S HUT
Price ... **2/6**



FOOTBRIDGES
No. 1, without signals. Price **4/-**
No. 1a, with detachable tin-printed signal posts and arms ... Price **4/9**
No. 2, with detachable enamelled signal posts and arms (as illustrated). Price **7/6**
Signals only, for No. 2 footbridge. Price ... ... per pair **3/9**

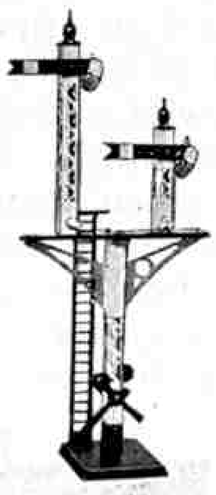


SIGNAL CABIN No. 1
Dimensions: Height 6 ins. Width 4½ ins. Length 6 ins. Finished in colours ... Price **2/9**

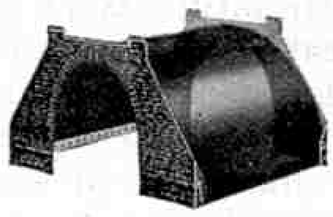


LAMP STANDARD No. 1 (SINGLE)
An electric flash-lamp bulb may be fitted into the globe. Price **3/6**

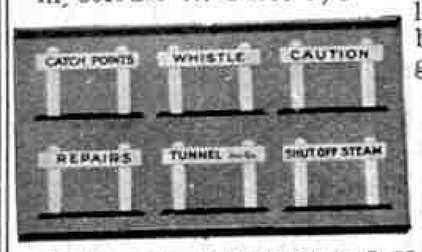
GOODS PLATFORM
Length 16¾ ins. Height 6¾ ins. Width 6 ins. The crane at the end of the platform revolves on its base. It is enamelled in colours and is fitted with a crank and ratchet mechanism for controlling the load ... ... Price **12/6**



JUNCTION SIGNAL
"Home" or "Distant." Signal arms operated by levers at base. Very realistic model, standing 14 ins. in height. Price **6/-**



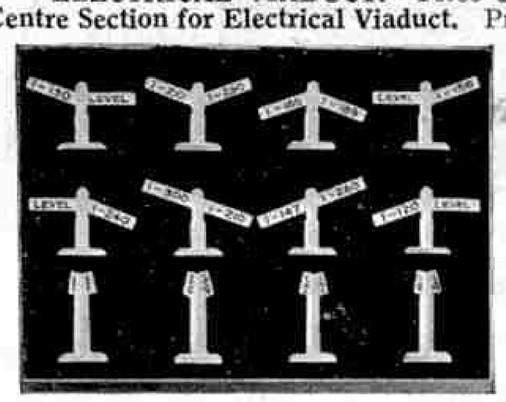
TUNNEL ENDS
These Tunnel Ends add realism to Tunnels made of cardboard, or other suitable material. They may be fitted into position quite easily. Price, per pair, **2/9**



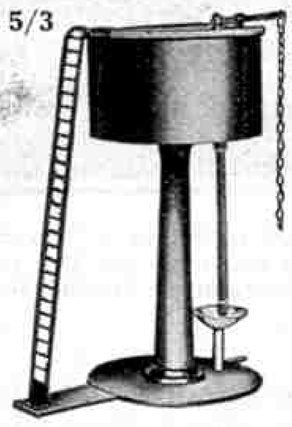
RAILWAY ACCESSORIES No. 8
Notice Boards.
Price, per set, **2/3**

RAILWAY ACCESSORIES No. 7
Watchman's Hut, Brazier, Shovel and Poker ... Price **1/6**

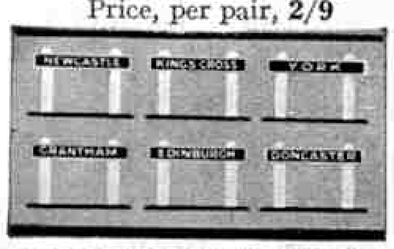
VIADUCT. Price **7/-**. **Centre Section only.** Price **4/9**
ELECTRICAL VIADUCT. Price **8/-**
Centre Section for Electrical Viaduct. Price **5/3**



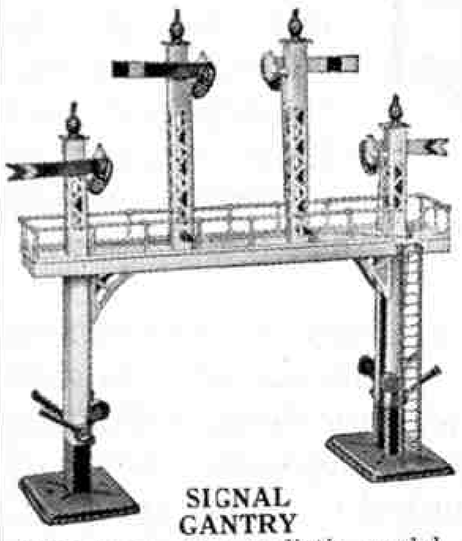
RAILWAY ACCESSORIES No. 5
Gradient Posts and Mile Posts. Price **2/-**



WATER TANK
Brightly coloured. Fitted with flexible tube and valve lever. Price **8/6**

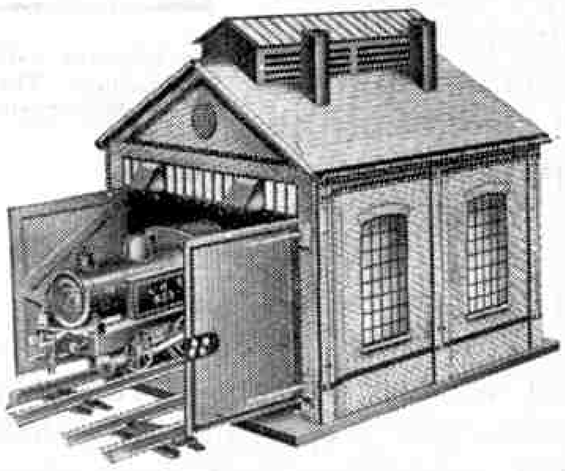


RAILWAY ACCESSORIES No. 9
Station Name Boards.
Price, per set, **2/6**



SIGNAL GANTRY
This is a very realistic model, the signal arms of which are operated by levers at the base of the standards. Attractively finished in colours. Price **10/-**

RAILWAY STATION No. 2. Excellent model, beautifully designed and finished. Constructed in three sections, which are detachable. Dimensions: Length 2 ft. 9 ins., breadth 6 ins., height 7 ins. ... ... Price **12/6**



ENGINE SHED No. 1
This Shed is beautifully finished in realistic colours. It will accommodate Locomotives and Tenders of the M series, and Locomotives of No. 0 and No. 1 types ... ... Price **15/-**

Suggested Hornby Train Improvements

INTERLOCKING SIGNAL LEVER FRAME.—We fear it would not be possible to introduce an interlocking lever frame in the Control System, for the method of locking the various point and signal levers would depend upon the particular type of layout. In addition such an accessory also would be costly to produce. No doubt many Hornby enthusiasts will be able to devise a system of interlocking levers for their own individual requirements. An interlocking frame made up of Meccano parts was described in the January 1929 "*M.M.*" (*Reply to R. Thornhill, Cheltenham*).

MINIATURE TINS FOR BISCUIT VANS.—This is a good suggestion, but owing to the fact that the tins would be rather difficult to handle realistically owing to their small size, we doubt if they would prove very popular. We suggest that you model these yourself from either metal or wood, suitably painted. (*Reply to G. Payne, Brighton*).

ROYAL TRAIN SET.—We agree that a train of this description would present a very pleasing appearance. The Royal Train is not familiar to the majority of railway enthusiasts, however, and as it could not be used very effectively for general purposes on a model railway, we doubt if such a set would prove popular. The No. 2 Special Pullmans would be quite appropriate for the purpose, as such vehicles are often used attached to ordinary express trains for the conveyance of royal personages. (*Reply to F. W. Coleman, Southport*).

SNIFTING VALVE ON "SHIRE" LOCOMOTIVES.—The addition of these valves behind the chimney would follow actual practice and give a very realistic appearance to the boiler. Your suggestion will be considered when a suitable opportunity occurs. (*Reply to R. Maclean, Glasgow*).

HORNBY CONTROL ON NON-PERMANENT LAY-OUTS.—The Hornby Control System is perfectly satisfactory when adapted to non-permanent model railways. Indeed one of its chief advantages is the ease with which it may be applied to any particular kind of lay-out. It is important that the rails should be fixed together with the special Hornby rail connecting plates, and that the signals, lever frames and other parts should be securely clamped in position by means of the locking clips provided. (*Reply to J. B. Fidler, Rugby*).

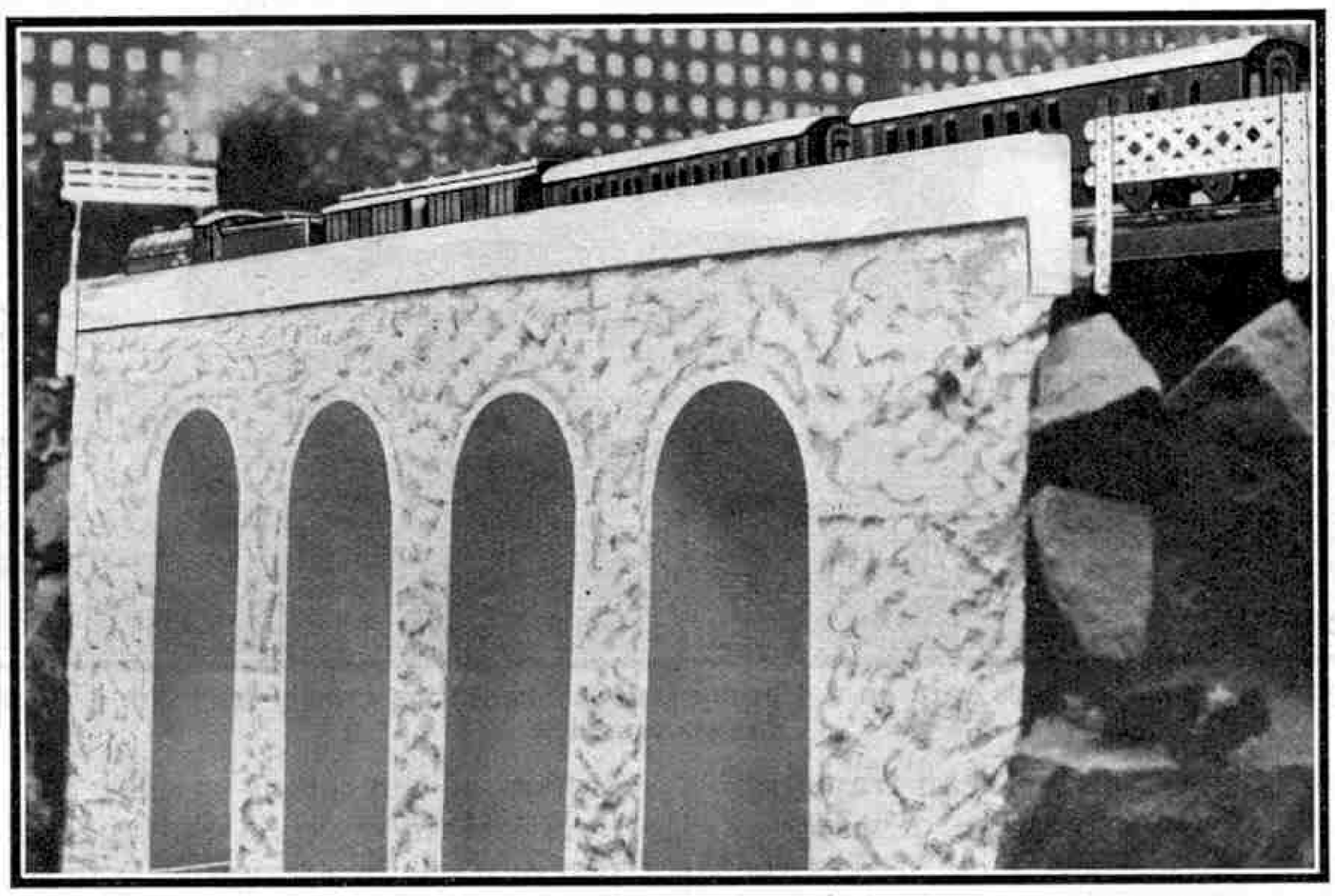
VACUUM BRAKE EJECTOR.—A vacuum brake ejector would no doubt improve the appearance of our models of L.M.S. locomotives, but there is a limit to the amount of detail of this kind that can be effectively applied to Gauge 0 locomotives. In addition small fittings of this kind are very fragile and are likely to get knocked off in service. (*Reply to R. Sackville, Burton*).

OPEN CARRIAGE TRUCK.—This type of wagon was formerly in common use on our railways for the conveyance of carriages and occasionally motor cars. Modern practice, however, favours the covered van for such duties. Complete protection from the weather is thus afforded, while the wagons themselves are not so limited in their sphere of action, as they may be used for the carriage of milk churns or theatrical scenery if necessary. As the introduction of a motor-car van of up-to-date design is at present receiving attention and will probably prove more popular on the whole, we are unlikely to consider the manufacture of an open vehicle of the type you propose. (*Reply to S. Hamson, Exeter*).

WOODEN COACHES.—We cannot consider the introduction of wooden coaches and wagons, as they would be quite out of keeping with the general plan of the system. A mixture of metal and wooden rolling stock looks very unrealistic and awkward. (*Reply to J. Wakefield, Hornsey*).

PLATELAYER'S TROLLEY.—We doubt if there would be a great demand for an accessory of this description, as it could scarcely be put to much use on a Hornby model railway. An excellent substitute is the discarded bogie of an old locomotive. (*Reply to H. S. Ellison, Boston*).

RUSTLESS RAILS.—We have stated many times that Hornby track is not intended for permanent out-door working. Rustless or brass rails such as you suggest would be much more costly than our present standard track, and there would be very little demand for them. (*Reply to K. Bretherton, Coalville*).



A remarkably picturesque viaduct on the outdoor model railway of Mr. G. Hemm of Liverpool. The various portions were cast in concrete faced with white cement and the parts were then joined together. Steel bars are incorporated to add strength to the structure which is thus a striking example of ferro-concrete work in miniature.

SADDLE-TANK LOCOMOTIVE.—Your suggestion for the introduction of saddle tanks representative of one of the types used by the late Lancashire and Yorkshire, or London and North Western railways is interesting, and will be considered. Modern practice in regard to shunting locomotives tends to do away with the saddle tanks, but such engines are still in common use. For the present we suggest that you make use of the Hornby No. 1 or the No. 1 Special Tank, either of which is very suitable for shunting duties. (*Reply to N. Henshall, Manchester*).

COWCATCHERS FOR HORNBY LOCOMOTIVES.—Cowcatchers would not be suitable for the existing Hornby locomotives, except possibly for the Blue Train locomotives. Such a fitting would have only a limited popularity. (*Reply to D. Taverner, Dover*).

TWELVE-TON END DOOR OPEN WAGONS.—These wagons are commonly used by the four group companies, and by many private owners, as they are specially adapted for discharging loads by tipping them endways. Such wagons probably would prove popular in the Hornby Series, and we shall bear the idea in mind when additions to our rolling stock are being considered. Particulars of any decision will appear in the "*M.M.*" (*Reply to F. Davies, Swansea*).

FOOTBOARDS FOR BRAKE VANS.—Footboards would certainly add to the realistic appearance of our Brake Vans, but we cannot consider the introduction of further details of this kind at present. Your suggestion will be noted for possible adoption later. (*Reply to R. Hawthorn, Coventry*).

MODEL REPAIR SHOPS.—Large accessories of this kind are not suitable for manufacture as components of a miniature railway system. They would be costly to produce with sufficient detail to make them really effective, and they would only be suitable for very large layouts. Why not try to build a workshop to your own ideas from Meccano parts? (*Reply to J. E. Brookes, Leeds*).

STEAM LOCOMOTIVES.—The clockwork and electric locomotives of the Hornby Series are so perfectly suited to the special requirements of Gauge 0 railways that we have had very few requests for steam locomotives. In such a small gauge it is difficult to produce a steam locomotive that is thoroughly efficient for all general purposes, and at the same time easy to manipulate. We have had the matter under consideration, however, and if there appears to be a real demand for steam locomotives we may introduce them later. (*Reply to J. Hawley, Gainsborough*).

LARGER CYLINDERS.—Your remarks concerning the size of the cylinders on our No. 2 Special L.N.E.R. locomotives are interesting, but as a matter of fact the cylinders fitted are quite in proportion to the rest of the engine. Any alteration in size, therefore, would tend to detract from, rather than add to, the realistic and true-to-type appearance of the locomotive. (*Reply to J. Askew, Maryport*).

AUTOMATIC TURNTABLE.—Your suggestion that the Hornby Turntable should be fitted for either electric or mechanical control is interesting, and will have consideration. (*Reply to J. Kyle, Plymouth*).

WATER TROUGHS.—As we have previously stated water troughs to be placed between the rails on a suitable stretch of straight track on a Hornby railway would serve no useful purpose, and would not be very realistic. If it is particularly desired to include water troughs on a layout they may be constructed of strips of cardboard or wood, with glass, preferably tinted blue, placed on the top to represent the water. (*Reply to K. Summers, Bushey*).

AMERICAN BOGIE PASSENGER CAR.—The American type rolling stock recently introduced in the Hornby Series has proved very popular, and further additions may be made later. (*Reply to E. Walsh, Melbourne*).

L.N.E.R. "SOMERSAULT" SIGNALS.—In view of recent developments in signalling, especially in the use of the colour-light system, it is probable that these "somersault" signals will ultimately be superseded. For this reason, therefore, we doubt if their popularity would be sufficient to justify their introduction. (*Reply to B. Matthews, Selby*).

S.R. "MOGUL" LOCOMOTIVE.—We agree that the "Ashford" 2-6-0 type locomotive would be a very fine prototype for a Hornby model. As you point out such locomotives have a wide range of usefulness for both passenger and goods work. Until six-coupled mechanisms are available in the Hornby Series, however, we cannot consider the claims of these engines; but no doubt they will be reviewed in due course. (*Reply to V. Wood, Bromley*).

Buffer Stops in the Hornby Series

By "Tommy Dodd"

IT is interesting to reflect that nearly all railway lines must end in buffer stops, although as one travels over any of the important main lines, such as from London to Scotland, or London to the West of England, the idea that the rails have a definite end to them seems almost impossible. At large terminal stations, however, the tracks necessarily come to an end, and the main feature about these rail ends is that there is always some kind of stopping apparatus fitted to them in the form of buffer stops of one type or another. The main lines also have other endings in goods yards, where the freight trains start and finish their journeys.

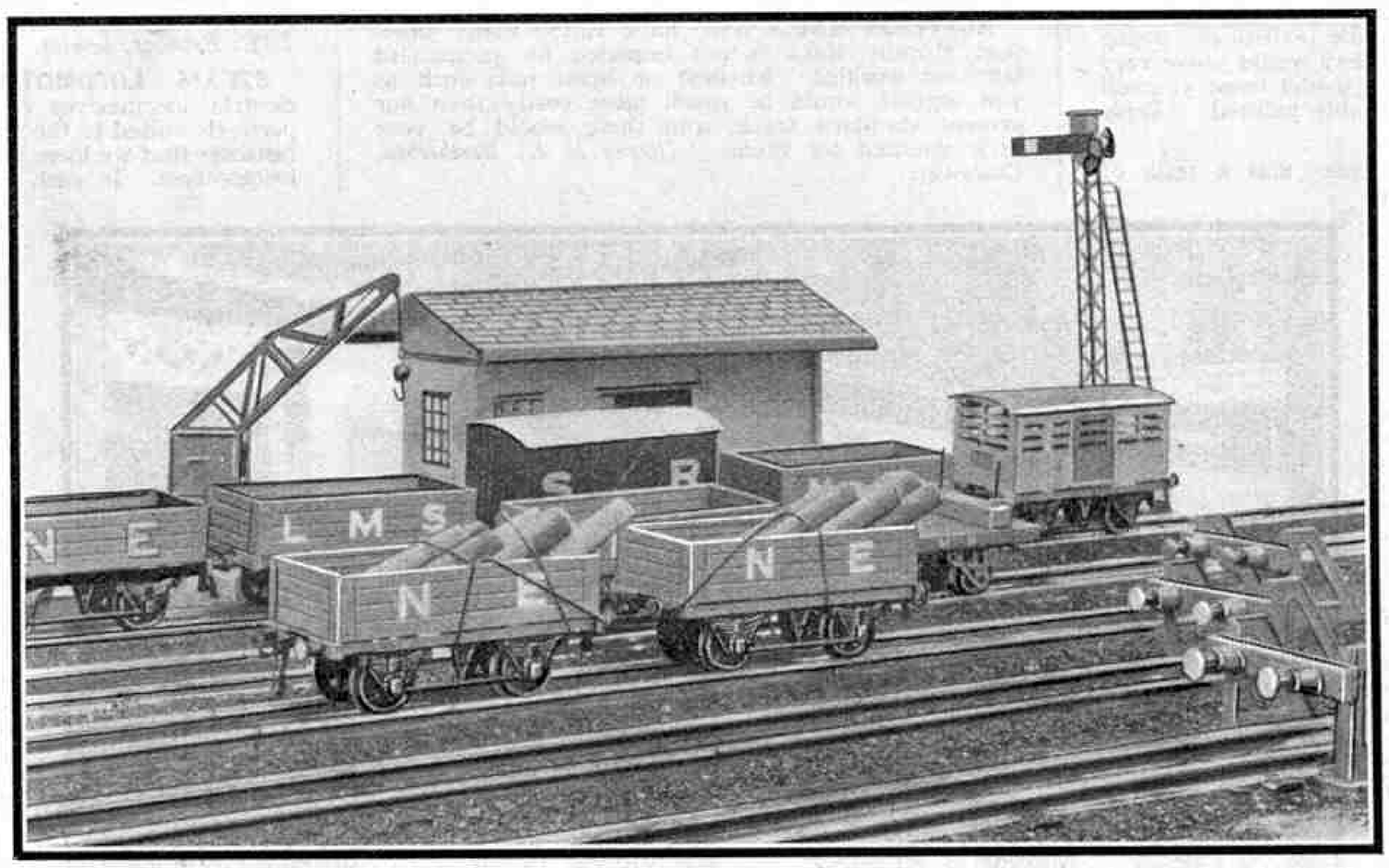
The most general types of stopping apparatus are the hydraulic stops, the plain spring pattern buffers, rail-built buffer stops, and what are known as "dead ends."

The action of the hydraulic buffer stops, as the name suggests, depends upon water pressure. They consist of a supporting framework, upon which are mounted two long cylinders. One end of these cylinders is closed, and from the other end there projects a long stout rod, at the end of which the actual buffer head is formed. The rod or shank has a piston fixed on its inner end, which can travel up and down the cylinder. A certain pressure of water is maintained in the cylinder. When a vehicle strikes the buffers the piston travels backward in the cylinder, and as it does so the water passes from back to front of the piston through an opening provided for the purpose. This opening decreases gradually in size, and consequently as the piston moves backward the resistance to its motion increases, producing a corresponding increase in the retarding effect on the train. In most up-to-date patterns of these buffers the cylinders are very long, and are capable of bringing to rest heavy trains moving at speeds of 10 miles an hour or so.

The hydraulic buffer stops of the Hornby Series are splendid representations of the real thing, and their action faithfully follows that of their prototype. It is impossible, of course, for them to operate on the hydraulic principle, and they depend on the use of springs of suitable strength to retard any train that gets out of hand. They may be readily connected up to standard Hornby rails, and to prevent them from becoming disconnected from the rest of the track if a train should strike them with unusual force, they are so arranged that Connecting Plates may be used to join them firmly to the next piece of rail.

It is an interesting practice on the L.N.E.R. to test regularly the hydraulic buffers at King's Cross Station, in order to make certain that they are in perfect working order. This test is usually carried out by one of the large express passenger locomotives, which slowly approaches and pushes the buffers in to the limit of their travel. As may be imagined, this is a very fascinating operation to watch, and invariably there are numbers of railway enthusiasts present when the test takes place.

Buffers of the plain spring pattern are frequently used in terminal stations for the lines devoted to parcels and milk traffic, and also on those lines where horse-box and carriage traffic is handled. Such buffers are used also to a great extent in carriage sidings, and they are sometimes to be seen on engine roads.



A photograph of a goods yard on a Hornby Railway indicating clearly how No. 1 Buffer Stops are used.

Rail-built buffer stops and "dead ends" are also familiar railway features. The latter consist merely of a stockade of disused sleepers, filled in with earth, and a plain wooden beam receives the impact of the buffers of the rolling stock.

The Hornby No. 1 Spring Buffer Stops may be used just as freely in a terminus as in sidings, though, of course, they are more suitable for the latter purpose. Their effective appearance, especially where several are employed side by side, may be gathered from the accompanying illustration. This shows a small goods yard with two through roads and three sidings, which are terminated by spring buffer stops. These stops are most effective in preventing wagons from running away and doing damage during shunting operations. The height of the buffer beams and buffers in both patterns is now made to agree with the reduced buffer height standard on all the latest Hornby rolling stock. Consequently the rolling stock buffers meet the stops squarely, and the wagons do not tend to be thrown up off the track or derailed, provided, of course, that the speed is not excessive.

On real railways there are also to be seen triangular iron stop blocks mounted on the rails, and sometimes it is found that the rails at the end of a siding have their ends turned up in a curve. Other and even more primitive methods of retarding vehicles are found in country districts.

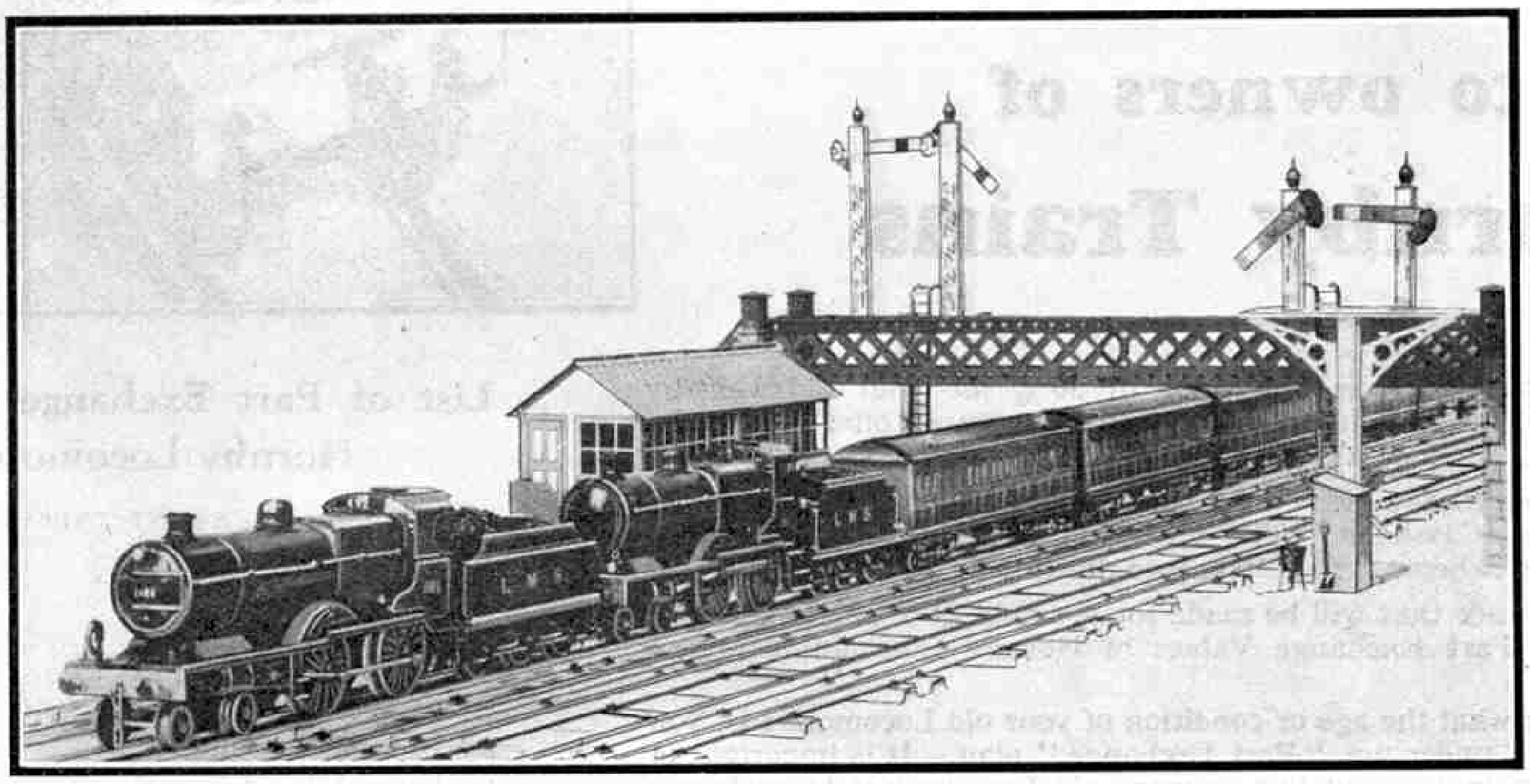
Why Trains are Double-Headed

Piloting in Miniature Practice

A PHASE of railway working that is of great interest to railway enthusiasts, and always arouses the curiosity of the casual onlooker, is piloting or "double-heading."

The general reason for the use of two locomotives at the head of a train is that neither of them alone is sufficiently powerful to haul a load at the speed required; but there are many cases where the necessity for double-heading is not immediately obvious. For instance, two locomotives of large and powerful design may be seen heading a light and possibly easily-timed train. In this case the double-heading may be due to the fact that an engine is required farther down the line for certain work. In such a case, in order to avoid running the engine light, thus occupying the track in possibly a busy district, the engine is attached as a pilot to a convenient train. If this train is heavy, and the line is sharply graded, the assistance thus afforded will be valuable, and may perhaps prevent a loss of time that otherwise might have occurred.

Alternatively it may be that a special train was worked by the engine, and that there is no train that it can conveniently take on the return journey. Therefore it goes back to its home shed as a pilot engine, even though the particular train may be well within the powers of the train engine provided.



A heavy express, hauled by two Hornby Midland Compounds, running on a busy stretch of four-road track. The position of the headlamp of the pilot engine indicates that this is assisting over a portion of the journey not exceeding twelve miles in length.

A rather surprising feature of piloting is that the performance put up by two engines on one train frequently excels what would have been done if the load had been divided into separate trains in proportion to the respective capacities of the engines. Owing to the general use nowadays of powerful locomotives, the need for piloting is not so great as when engines of more limited tractive power were widely employed on our railways.

Certain combinations of locomotives have acquired in the past a great reputation for speedy running with heavy trains. For instance, two L.N.W.R. locomotives were regularly used for many years between Crewe and Carlisle for the heavy Scottish expresses. These engines were both of the 2–4–0 type, one of the "Samson" class with 6 ft. driving wheels, and the other of the "Precedent" class with 6 ft. 6 in. driving wheels.

On the Midland Railway a 4–2–2 single wheeler and a 4–4–0 compound have been known to give splendid results. More systematic piloting was carried on on the Midland Railway than perhaps on any other line. This was no fault of the locomotives provided, for they were consistently good. The reason for the large amount of double-heading was that weight restrictions prevented the employment of large locomotives. This, combined with the speed of the Midland services and the severe grading of the main line, made it necessary to restrict the loads hauled by the various classes of engines, so as to prevent them from being unduly pushed to maintain time. The punctuality of the Midland train services was to a considerable extent due to this policy. The practice of limiting the loads to be hauled by the various locomotive classes is pursued on similar lines to-day by the L.M.S.R.

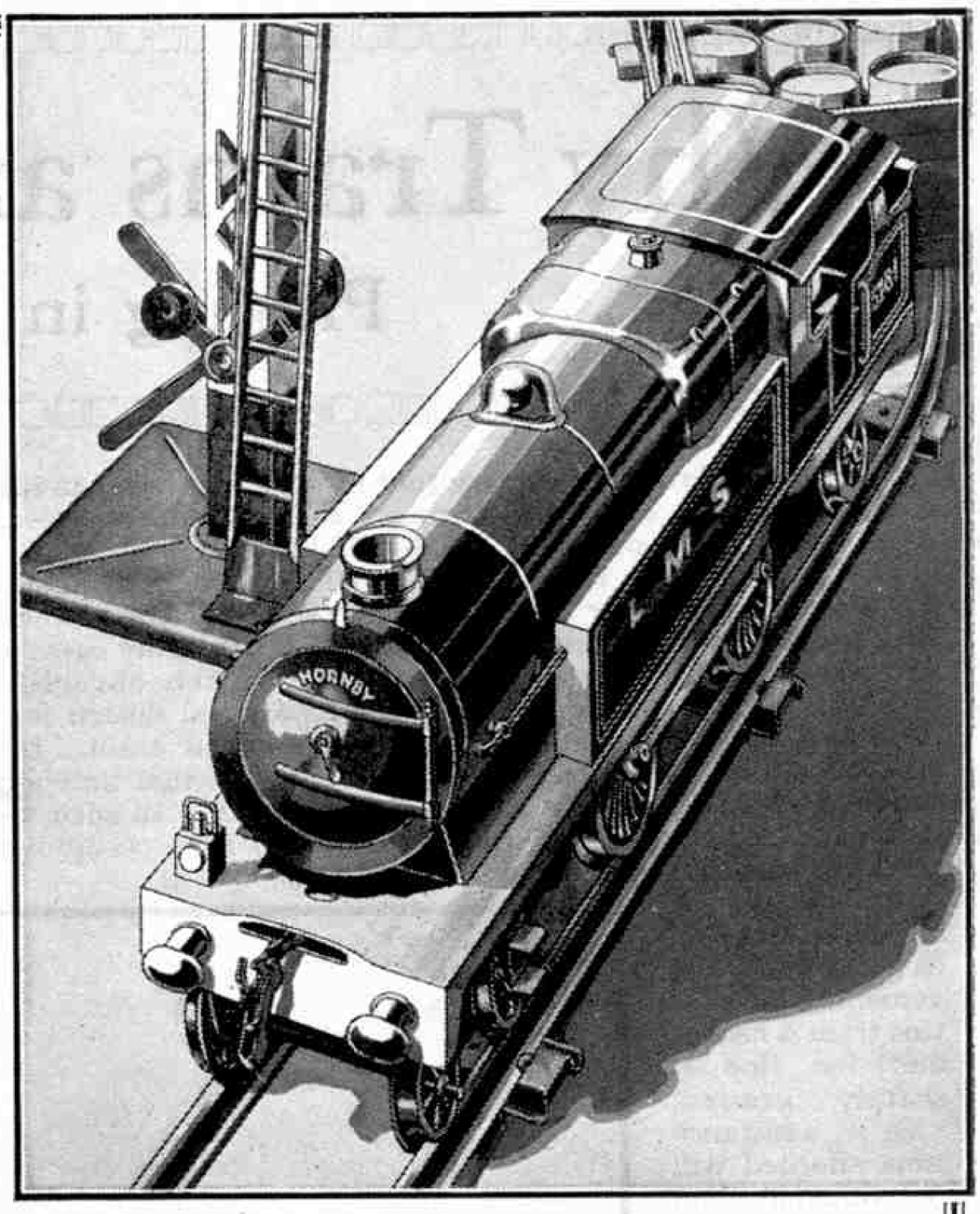
Much piloting has been done at various times on other systems, but there have been some locomotive superintendents whose invariable practice was "one train one engine." This was the case on the Great Northern Railway for a long time; but with the great increase in loads in more recent years arrangements were made for piloting certain trains before the famous Gresley "Pacifics" were introduced in 1922. Piloted trains were exceptionally rare on the London, Brighton and South Coast Railway, and the G.W.R. have always been noted for the capability of their locomotives, which made pilot engines unnecessary except over the very severe gradients in Devon and Cornwall.

A curious example of the use of two engines where one normally would have sufficed occurred more than 30 years ago on the North British Railway. The through expresses from King's Cross to the North were then, and had been for a number of years, hauled by North Eastern locomotives between Newcastle and Edinburgh. The course from Berwick onward was over the North British Company's line, and suddenly this company decided to work the trains on this section with their own engines, and the North Eastern were given notice accordingly. It was announced also that although the trains would stop at Berwick for the engines to be changed, the run would be made in the same time as before. In order to ensure that this should be accomplished, and to prevent the possibility of any failure on the road, two North British engines were used for a considerable time. Finally, however, an agreement was reached by which each company worked certain trains between Newcastle and Edinburgh, and the necessity for the use of two locomotives disappeared.

Owing to the varying conditions of railway operation, some curious locomotive combinations are to be observed at times. All railway enthusiasts are familiar with the famous L.M.S.R. single-driver locomotive "*Cornwall*," which has the largest driving wheels in the world, and has been used in recent times as an inspection engine. On one occasion this engine worked from Crewe to Euston with a directors' special, and in order to return her conveniently to her home shed she was actually attached as a pilot to the mid-day Scottish express from Euston, the train engine being the well-known "Claughton" class locomotive "*Patriot*." It is a great pity that no photograph was taken of the engines on this notable occasion.

War-time conditions accounted for many curious locomotive assortments, for with the curtailment of passenger train services a large number of express engines became available for goods work. Two passenger engines might be used together; a little goods engine of old design might be piloted by a relatively up-to-date express engine; or a heavy coal train might be seen with a single-driver or 2–4–0 as train engine, and perhaps a modern 0–6–0 as pilot. For a considerable period the large 4–6–4 "Baltic" tanks that had been designed for the former London, Tilbury and Southend Railway were employed in coal train operation between Wellingborough and London on the Midland. They were sometimes to be seen in company with regular goods engines, or sometimes with a large-wheeled express locomotive. Their appearance on this duty would hardly have occurred in normal times, as they were unsuited for the work, their bunker capacity being somewhat limited for heavy-duty trips of this length. (*Continued on page 272*)

New Hornby Locomotives for old!



Wonderful offer to owners of Hornby Trains

Just think of it—an allowance of 50% for your old Hornby Locomotive! This is the most generous part exchange offer ever made.

You have probably been using a Hornby Locomotive for some years and would like to own one of the fine new models that now figure in the Hornby Catalogue. The object of the Hornby Locomotive Part Exchange Scheme is to help you to do this.

The allowance that will be made for your old Locomotive is shown in the list of Part Exchange Values of Hornby Locomotives given on this page.

No matter what the age or condition of your old Locomotive is, you can exchange it under our "Part Exchange" plan. It is important to note that we cannot accept two or more old Locomotives in exchange for one new Locomotive.

What you have to do

Here is an example of how the plan works. Assuming you have a No. 1 Tank Locomotive that you wish to exchange, you see from the list that its exchange value is 6/3. You then look at the Hornby Train catalogue and choose one of the new Locomotives, the cost of which is not less than 12/6 (or, in other words, not less than double the Part Exchange value of your No. 1 Tank Locomotive).

Say that you decide to have a No. 2 Special Tank, the price of which is 25/–. Pack up your old No. 1 Tank and deduct 6/3 from 25/– (the price of the new No. 2 Special Tank) enclose a remittance for 18/9 plus 1/– carriage on the new Locomotive—19/9 in all. Send the Locomotive and the remittance to Meccano Limited, Liverpool.

Alternatively, you can take your old No. 1 Tank Locomotive to your dealer with a remittance for 18/9, and he will give you the new No. 2 Special Tank Locomotive that you require.

IMPORTANT.—The Hornby Locomotive Part Exchange Scheme is not applicable to any country outside Great Britain.

List of Part Exchange Values of Hornby Locomotives

CURRENT TYPES	
M2930 Locomotive	1/–
M1/2 Locomotive No. 3031	2/3
No. 0 Locomotive	5/3
No. 1 Tank Locomotive	6/3
No. 1 Locomotive	6/3
No. 1 Special Locomotive	8/3
No. 1 Special Tank Locomotive	8/3
No. 2 Special Locomotive	11/3
No. 2 Special Tank Locomotive	11/3
No. 1 Electric Tank Locomotive, Permanent Magnet	12/6
No. 2 Electric Tank Locomotive	18/9
No. 3E Locomotive	18/9
No. 3E Riviera "Blue" Locomotive	18/9
No. 3C Locomotive	13/9
No. 3C Riviera "Blue" Locomotive	13/9
Metropolitan C Locomotive	11/3
OBSOLETE TYPES	
George V Locomotive / No. 00 Locomotive (These models were identical)	3/3
M3 Locomotive	4/3
Zulu Locomotive	5/3
Zulu Tank Locomotive	6/3
No. 2 Locomotive	10/–
No. 2 Tank Locomotive	11/3
No. 1 Locomotive, fitted for Hornby Control	7/6
No. 1 Tank Locomotive, fitted for Hornby Control	7/6
No. 2 Locomotive, fitted for Hornby Control	11/3
No. 2 Tank Locomotive, fitted for Hornby Control	12/6

HORNBY TRAINS

BRITISH AND GUARANTEED

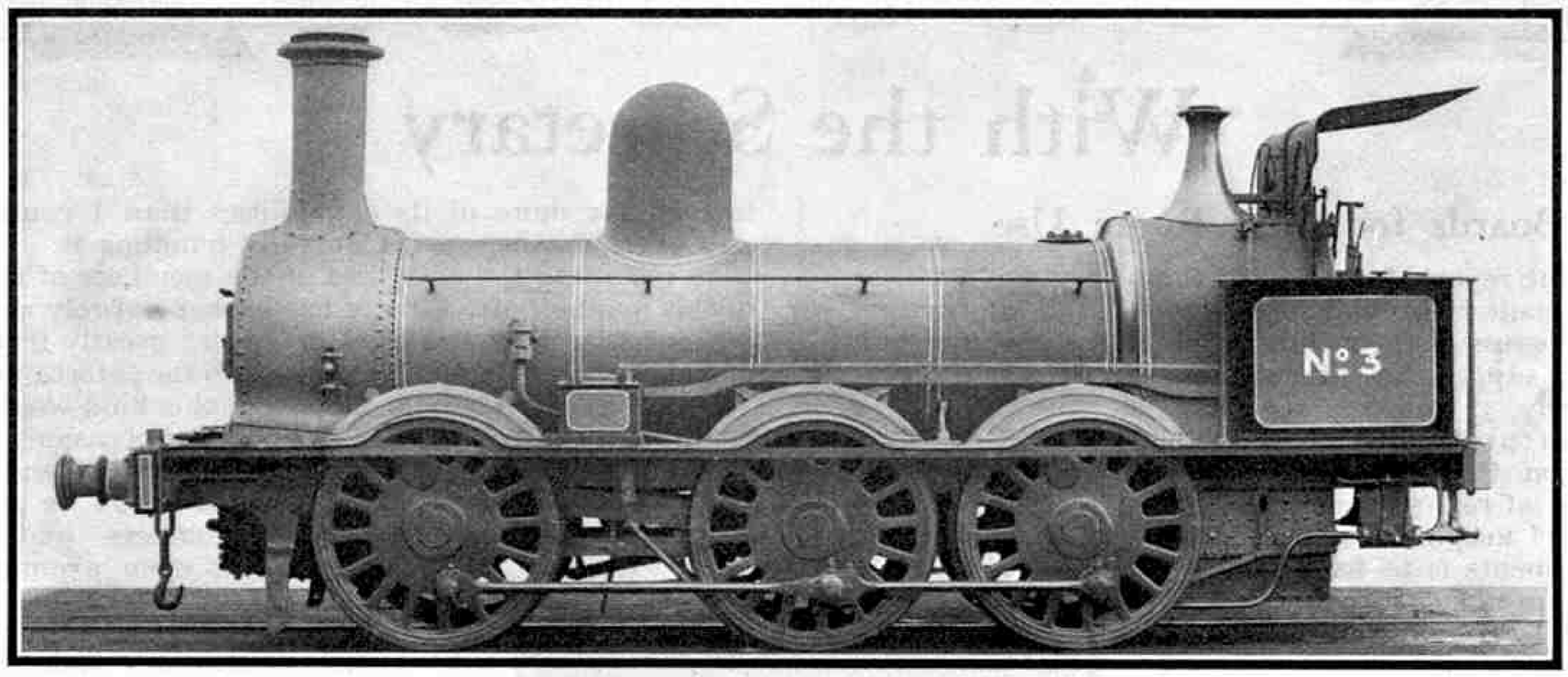
MECCANO LTD. — SPECIAL SERVICE DEPT. — OLD SWAN — LIVERPOOL

H.R.C. COMPETITION PAGE

Competitions appearing on this page are open only to members of the Hornby Railway Company. Envelopes containing entries, should have the title of the competition clearly written in the top left-hand corner and should be addressed to the Hornby Railway Company, Binns Road, Old Swan, Liverpool. The name, address and membership number of each competitor should appear in clear writing on every sheet of paper used.

LOCOMOTIVE DEVELOPMENT CONTEST

SINCE the days when the "*Rocket*," weighing 4¼ tons, hauled a train of 30 passengers at a speed of from 24 to 30 m.p.h., enormous strides have been made in locomotive engineering. To-day we have examples of engines such as the G.W.R. "*King George V*," and the L.N.E.R. "No. 10000," hauling trains of 450 tons at speeds of from 70 to 80 m.p.h. Yet engineers are still seeking to improve the efficiency of the locomotive, and many changes and developments may be expected in the near future.



On this page we illustrate a 0–6–0 locomotive built many years ago for the Manchester, Sheffield and Lincolnshire Railway. It will be seen that this locomotive differs very greatly from those with which we are familiar to-day, not only in size, but also in many details of design. These changes in detail are of great interest to all railway enthusiasts, and this month we announce a competition on this topic.

Competitors must examine the photograph carefully, and make a note of as many details as possible that appear in a changed form on a present-day locomotive. Having made this list, they must describe briefly the change that has been made in each item, and the advantage that has been gained. H.R.C. members will find that the working out of these details is a most fascinating occupation.

Prizes consisting of Hornby Railway material (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– will be awarded to the senders of the four best entries received. In addition to these a number of consolation prizes will be given. In the event of a tie neatness will be one of the deciding factors in making the awards. Competitors are therefore advised to send in painstaking efforts.

Envelopes containing entries should be clearly marked H.R.C. "*Locomotive Development Contest*" and posted so as to reach the H.R.C. Headquarters at Meccano Limited, Binns Road, Old Swan, Liverpool, on or before 31st March. The closing date for Overseas Competitors is 30th June.

Any entry that does not bear the competitor's membership number will be immediately disqualified.

H.R.C. Painting Contest

It is more than a year since we last held a painting contest on this page, and during recent months we have received numerous requests from H.R.C. members for another competition of this nature. We have pleasure, therefore, in announcing a Painting Contest this month. Competitors can choose either of the following three subjects:—"*Locomotive Taking Water at the Column*"; "*Locomotive on the Turntable*" or "*Under Repair in the Shops.*"

For the four best efforts received prizes consisting of Hornby Railway material (or Meccano, if preferred) to the value of 21/–, 15/–, 10/6 and 5/– will be awarded. In addition to these a number of consolation prizes will be given to those boys whose entries show neat and painstaking efforts.

Envelopes containing entries should be clearly marked H.R.C. "*Railway Painting Contest*" and posted so as to reach Headquarters at Meccano Ltd., Binns Road, Old Swan, Liverpool, on or before 31st March. The closing date for the Overseas Section is 30th June.

All entries must bear the competitor's H.R.C. membership number, omission of which will result in disqualification.

Voting Contest

The various competitions put forward on this page continue to be immensely popular, and the splendid response of H.R.C. members month by month suggests that all the subjects are favourites. However, to help us in deciding what particular type of Contest is most popular with the majority of H.R.C. members, we have decided to announce this month a Voting Competition on this point.

Every entrant for the Competition is required to state:—

(1) Which of the Contests is his favourite.

(2) What he considers are the eight most popular Contests in the order of their popularity. It should be noted that competitors need not necessarily include in this forecast the Contest that happens to be their own personal favourite.

Prizes of Hornby Goods (or Meccano, if preferred) to the value of £1/1/–, 15/–, 10/6 and 5/– respectively, will be awarded to the four competitors who give the most accurate forecasts of the final order of voting. In the event of a tie for any of the prizes preference will be given to the entry displaying the neatest or most novel presentation. In addition, there will be a number of consolation prizes.

Each competitor's name, address, and H.R.C. number must be clearly written on the back of every sheet submitted, and envelopes should be marked *H.R.C. "Voting Contest,"* in the top left-hand corner. Closing date, 31st March. The closing date for the Overseas Section is 30th June.

Competition Results

HOME

January "Canadian Locomotive" Contest.—First J. L. Lee (19305), Bolsover, Nr. Chesterfield. Second R. Barbary (5580), Mevagissey, Cornwall. Third: E. Potton (9801), Bocking, Essex. Fourth: O. J. Lawton (9415), London, N.11. Consolation Prizes: T. Middlemass (21393), Falkirk; K. H. Beales (14024), London, S.E.23; G. T. Harris (9133), Lincoln; J. D. Hamilton (12216), Cheltenham Spa; S. Stamford (17558), Merstham, Surrey; A. Feltham (14634), Worthing; C. A. Munro (17690), Oxford.

January "Questions" Contest.—First: J. T. Trotter (11447), London, S.E.21. Second: A. Burst (21133), London, S.W.1. Third: R. Towler (9341), Lytham. Fourth: D. Spray (12734), London, S.W.16. Consolation Prizes: F. Turner (13863), Crieff; P. H. English (2398), Lancaster; A. Dallaway (12662), Pevensey, Sussex; A. Whitesmith (808), Glasgow; R. G. Dodsworth (9246), Weaste; G. E. Feesey (16699), Billericay, Essex; S. Winnard (7843), Wigan; J. Allen (3308), Buxton; C. Kerr (21147), Glasgow, S.2; R. E. Batten (9089), London, E.16; R. A. Gates (916), Farnham, Surrey; C. R. Woodward (14074), West Kirby.

OVERSEAS

October "Jumbled Signals" Contest.—First: G. E. Schulz (15425), Australia. Second: A. Johnstone (16298), Australia. Third: A. G. Saunders (9822), New Zealand. Fourth: F. Van Bulck (1875), Belgium.

With the Secretary

Notice Boards for Club Room Use

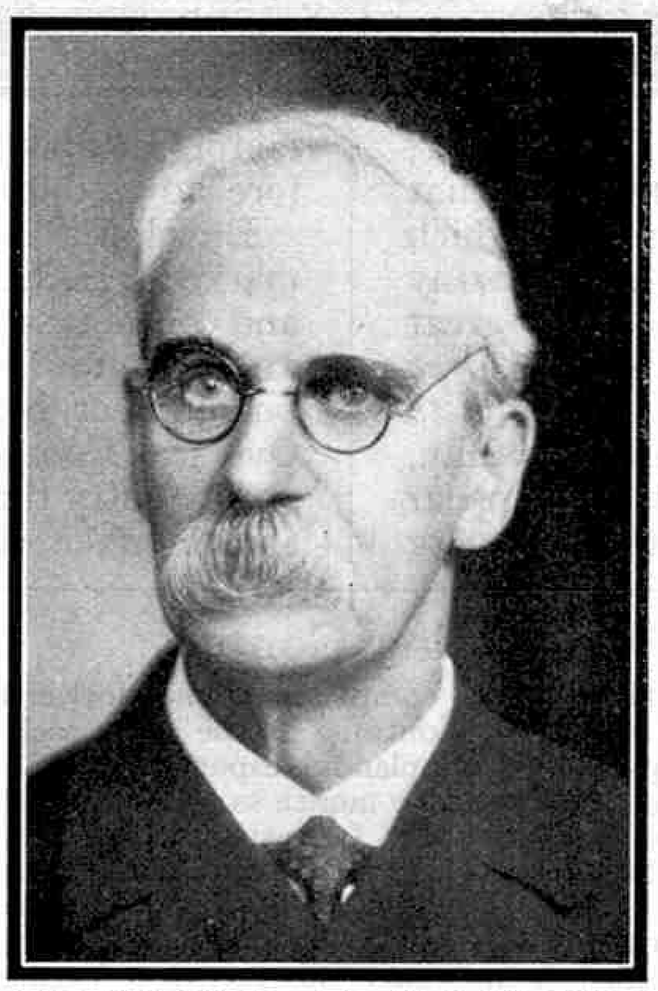
When studying club reports I have noted that in certain instances very little effort is made to provide members with full information in regard to the progress of their club. One of the purposes of a club magazine is to supply this information, and as a rule this is done very efficiently. Unfortunately a magazine only comes out at stated intervals, and the information that it gives may come too late to be of real service.

The best means of keeping members in touch with developments is to fix a large notice board in a prominent position in the club room and to ensure that the information given on it is up to date. This plan is carried out in a very efficient manner by one club in London, in which sessional prizes are awarded to the members who secure the highest total of marks during each period. The names of the members have been stencilled on a large sheet of cardboard, and the weekly points earned by each individual are entered in the appropriate column at the earliest possible moment. A member has therefore no difficulty in learning the number of marks with which he has been credited, and as a result he is far more interested than if he were compelled to wait until some uncertain date to learn the results of his efforts.

A notice board is practically a necessity in every club room. This may be made to serve many purposes. For instance, it may be used for announcements in regard to coming events, and copies of the rules and regulations regarding the use of club property should be given a prominent position on it. In the club to which I have already referred, cuttings and photographs of current interest are also pinned on it. By this means members are kept closely in touch with events of outstanding interest in the world at large. Most of the cuttings deal with topics of an engineering character, of course, but general news events are by no means ignored, for these often suggest suitable subjects for very interesting debates and discussions at club meetings.

Meccano Club Presidents

No. 8. Mr. B. M. Barbour



Mr. B. McCall Barbour is President of the XXVIII (Edinburgh) M.C. He was instrumental in founding it and takes a very active share in its work. The club was affiliated in March, 1930, and its splendid all-round programme has attracted a large and enthusiastic band of members.

Film Records of Club Events

Recently I had the pleasure of witnessing a cinematograph entertainment kindly arranged for my benefit by the Leader of a Meccano club. The film shown was taken by Mr. R. W. Shooter, Leader of the Hornsea M.C., and it enabled me to see the members of the club at work building and demonstrating their models.

To see Meccano working models on the screen was a remarkable experience. One that interested me greatly was a Traction Engine. I had already seen an ordinary photograph of this model and had admired its construction, but I derived infinitely greater pleasure from seeing it travel across a lawn, and at the same time I learned far more of its capabilities than I could have done by any other means, except actually handling it.

In recording the activities of the members of the Hornsea M.C. in this manner, Mr. Shooter has broken entirely new ground. The possession of a cinematograph camera greatly increases the scope of club work, particularly in regard to the entertainment. Naturally a camera of this kind would be used on all suitable outdoor occasions, and the records of excursions, picnics, and visits to works thus obtained would be great attractions, both to members and visitors when exhibited at open evenings or at social events.

I may point out that clubs owning a projector also may make good use of it in exhibiting the films included in the list of lantern lectures issued from Headquarters. This gives details of a large number of interesting lectures that may be obtained on loan, from industrial firms and railway companies, and a copy will be forwarded to the Leader or secretary of any club who does not already possess one. In addition, entertainment films of standard size may now be hired, and with the aid of these a very enjoyable entertainment may be given.

Clubs Not Yet Affiliated

I should like to remind officials of unaffiliated clubs that I am always pleased to hear of their progress, and to receive from them reports that will enable me to mention their activities on the "Club Notes" page of the "*M.M.*" I always follow the proceedings of clubs of this kind with the greatest interest, whether they are new ones striving to establish themselves firmly, or larger organisations that only need a Leader or a permanent club room to enable them to take full advantage of the privilege of official association with the Meccano Guild. I am very glad to find that recently the patience and perseverance of the members of a number of these clubs has been rewarded, gentlemen interested in their hobbies having kindly undertaken the duties of Leaders, thus enabling these organisations to secure affiliation. I hope that other unaffiliated clubs will shortly overcome their difficulties in a similar manner. The appearance of good reports will help to make their wants known and I hope to receive more of these.

Proposed Clubs

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

BURY ST. EDMUNDS—H. Minns, 35, Melbourne Terrace, Out. Risbygate Street.

CANADA—E. Vernon, Sorrento, B.C., Canada.

CLUB NOTES

Cecil Road (Gravesend) M.C.—A Lecture on "*Electrical Distribution and Cable Construction*" has been given by Mr. F. Phillips. A Debate on the question "*Were The Good Old Days Better Than The Present?*" proved very amusing. At one meeting a special Hornby Train Layout was constructed in order to give members an opportunity of testing their locomotives and comparing them for speed and pulling power. A Talk on "*Rubber*" was given by one of the members, and the Hornby Train section of the club have built a large model of West Street (Gravesend) Railway Station. Club roll: 23. *Secretary:* G. N. Cottle, 53, Cecil Road, Gravesend.

Alton M.C.—Interesting evenings have included a Mock Trial, in which each member was given a part. Debates on "*Rail v. Road Transport*" and "*Airships v. Aeroplanes*" have been held, in addition to Competitions in which small prizes were offered for the best solutions to problems. Interesting Lectures on "*Railways*" and "*The Coal Mining Industry*" have been given by Mr. A. W. Exton, Leader of the club. Competition in Model-building Contests continues to be very keen, and the prizes are fully earned by those who are successful. Club roll: 18. *Secretary:* H. F. Pitt, 53, Queens Road, Alton, Hants.

Headington (Baptist) M.C.—A Lantern Lecture, "*Missionary Work in South Africa,*" has been given. There was a good attendance and proceeds were devoted to the Missions Fund. Members have built the Big Wheel, and this has been displayed in the window of a local Meccano dealer, where its working attracted great attention. Club roll: 35. *Secretary:* Mr. H. Jacob, The Nurseries, High Street, Old Headington, Oxford.

Earlsfield M.C.—The former club room has been regained and members have again taken up model-building with great enthusiasm. The Football Team continues to have a very enjoyable season, and has worked its way into the semi-final of the Escritt Bennet Cup. Club roll: 30. *Secretary:* D. S. Dye, 15, The Drive, Grantham.

Blackburn No. 1 M.C.—The Annual Exhibition and Sale of Work was very successful, the models loaned from Headquarters being a great attraction. A large number of excellent models constructed by members were also on view, and Side Shows and Stalls for Cake, Fruit, etc., were kept busy. The proceeds are to be used for securing a new club room. The Football Team also continues to be successful and has won most of its engagements after hard struggles. Club roll: 23. *Secretary:* F. Hulme, 23, Primrose Bank, Blackburn.

Ken (London) M.C.—This was formerly St. John's (Oval) M.C., which amalgamated with the Ken Youths' Association. Improved facilities for meetings and games are now available. A Duplicator has been purchased for printing club notices, and with its aid the club bulletin has been enlarged into a Magazine. A good Library is being assembled and a Museum has been formed. A popular club feature is a board on which a selection of pictures and photographs of current interest is displayed. Marks earned by members in various competitions are also notified on it. Club roll: 25. *Secretary:* L. G. Butler, 46, Smith Street, London, S.E.5.

Lindisfarne College M.C.—A very successful Exhibition has been held. The models constructed by members were of a high standard and included a Dragline, Bagatelle Table, and Ship Coaler in addition to 30 models of Aeroplanes, Motor Cars, Cranes and Bridges. Clockwork and Electric Hornby Train Layouts attracted great attention, and a Televisor and several Wireless Receivers also aroused interest. A Gramophone and Amplifier supplied music during the Exhibition. School prefects and club members acted as guides, and a very efficient Guild Information Bureau was organised. Club roll: 80. *Leader:* Mr. J. B. Wiseman, Lindisfarne College, Westcliff-on-Sea.

Harpenden M.C.—Mr. T. Chamberlain gave an interesting Lecture on Science. This was illustrated by experiments with steam and concluded with a miniature Firework Display. Interesting operations are now carried out on the club's Hornby Train Layout. The scope of this has been extended by means of Meccano models and accessories constructed by members. Club roll: 15. *Secretary:* F. V. Grant, Station Road, Harpenden.

Herne Bay M.C.—Meccano Model-building and other hobbies are being steadily pursued by members, the programme also including Games Tournaments and Whist Drives. A Lantern Lecture on "*South Wales*" has been given, and a "Farewell, 1930!" Supper and Jollity Evening was held to mark the end of last year. The Blue Triangle Football Club continues to make a creditable show in League football and other activities of the Senior Section are being enthusiastically pursued. Club roll: 54. *Secretary:* Mr. C. W. Russell, 4, Clifton Villas, Herne Bay.

Sligo (Ireland) M.C.—"Meccano Week" in Sligo was a great success. The Exhibition arranged by the club was very attractive, the models displayed by members attracting much interested comment. The proceeds amounted to more than £3, and the finances of the club now allow of the purchase of a No. 6 Meccano Outfit. Club roll: 17. *Secretary:* K. McMenamin, 78, John Street, Sligo.

Our photograph shows a group of members of the Hornsea M.C., with Mr. R. W. Snooter, Leader of the club, seated in the middle of the second row. This club was affiliated in April 1930. It has been excellently organised by the Leader. Members are divided into "Engineers" and "Apprentices," and each section follows an interesting programme of Model-building, Lantern Lectures and other activities.

Constantine M.C.—A successful Social Evening was held. The attractions included a Cinematograph Exhibition by Mr. F. Lee and a Display of Conjuring by Mr. H. Drake. A splendid orchestra was in attendance and members greatly enjoyed dancing and refreshments. Club roll: 16. *Secretary:* W. G. Trethowan, The Villa Constantine, Falmouth.

Ramsey M.C.—The club is divided into three sections, members of which deal with rail, road and sea affairs respectively. Each section is responsible for the decoration of a portion of the club room. The Exhibition held at the close of last session was a great attraction. Among excellent models built by members was one of the Ford Tri-motor Monoplane recently illustrated in the "*M.M.*" The Tank Locomotive loaned from Headquarters attracted much attention from visitors. Club roll: 14. *Secretary:* C. Butcher, Princess St., Ramsey.

Hackney M.C.—Recent evenings have included Model-building Contests, Contractors' Nights, and Talks on "*London's Newspapers,*" "*Steamships*" and "*Locomotives.*" In an excellent competition, entrants were required to give their ideas of "*The Aeroplane of Fifty Years Hence.*" This gave rise to great amusement and equal interest was taken in members' ideas of "*London Five Hundred Million Years Ago.*" The excellent models prepared for the Exhibition included a Six-wheeled Motor Lorry and a Cantilever Bridge. Games feature prominently in the programme, and a Billiards Contest attracted a large number of entrants. Club roll: 25. *Secretary:* A. T. Field, 76, Lavender Grove, Dalston, E.8.

Kendal M.C.—An Exhibition organised by the club was well advertised by means of neat programmes and was a great success. The models exhibited included the Transporter Bridge, a Leyland "Buffalo" Lorry, an Overhead Rotating Crane and a Motor Break-down Crane. A Hornby Layout run to a timetable was a great attraction, each series of operations occupying 15 minutes. Club roll: 12. *Secretary:* A. Brown, 29, Crescent Green, Kendal.

Bedlington Secondary School M.C.—A successful Exhibition was held at the close of last session. The chief attraction was a Hornby Layout that included a Meccano Arch Bridge and other interesting models. Colour light signalling was employed and at intervals trains were run in darkness except for the lights on them and on the layout itself. The proceeds of the Exhibition have been given to the School Pavilion fund. At other meetings Model-building Contests have been held and Hornby Train Nights arranged. Club roll: 18. *Secretary:* J. W. Dobson, 1, Portland Terrace, Ashington, Northumberland.

CANADA

Moose Jaw (Saskatchewan) M.C.—The club's first Exhibition was very successful, the display of models constructed by members being strengthened by a Meccanograph loaned by Meccano Ltd., Toronto. A Radio Section has been formed and an attractive all-round programme arranged. Club roll: 30. *Secretary:* Mr. Sam Baxter, 804, Athabasca St. E., Moose Jaw, Saskatchewan.

Victoria (B.C.) M.C.—Interesting Talks have been given by members on "*A Trip Across Canada,*" "*The Story of the Motor Car*" and "*Aviation in the British Empire.*" In a Debate on "*Airships v. Aeroplanes,*" the advocates of airships won a narrow victory. Interesting Model-building Competitions are arranged regularly. In one for models of scientific apparatus the winner exhibited a splendid reproduction of a Physical Balance. In a second competition, models of Racing Cars driven by clockwork motors were constructed from scale drawings of cars picked out of a hat by members. The models were tested in races held on the drive in front of the Provincial Legislative Buildings. Interesting models are usually demonstrated at each meeting, one of special interest being an Anti-Aircraft Gun that fires Meccano Washers. Club roll: 6. *Secretary:* Mr. Murray D. Bryce, 908, Heywood Avenue, Victoria, B.C.

NEW ZEALAND

Dunedin Meccano and Hobbies Club.—Great interest was shown by parents and friends of members in the display of models prepared for an Open Evening. Other interesting features of this were a Lantern Lecture on "*Japan,*" and a Hornby Railway that carried sand dredged from a miniature harbour. A printing machine has been purchased. This has already been put to good use in the production of recruiting leaflets, and it is hoped to publish a club magazine. Club roll: 44. *Secretary:* Mr. R. W. Millis, 28, Clifford Street, Dalmore, Dunedin.

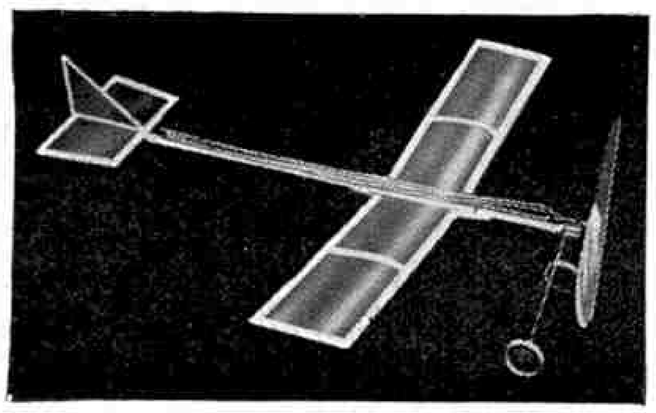
Kaiapoi M.C.—Members continue to be active in Model-building, and in order to stimulate their interest prizes were offered in a recent Contest by Mr. S. Simpson. Mr. T. Childs, the Borough Electrical Engineer, kindly gave a lecture on "*Electricity.*" The working models built in various competitions were displayed at a Social at which Rev. O. Burnet, President of the Club, reviewed the year's work, and explained the aims of the club to visitors. Club roll: 14. *Secretary:* L. Allison, North Road, Kaiapoi, Canterbury.

Dunedin M.C.—Meetings continue to be held regularly for Model-building, Hornby Train operations and Games. Frequent displays of models constructed by members have been arranged, and visitors have been invited to most of them. Club roll: 8. *Secretary:* Tony MacLachlan, Art Studio, 66, Albany St., Dunedin.

SOUTH AFRICA

New Durban M.C.—Members have constructed a splendid variety of models, including an Electric Toaster and a Dentist's Chair that worked in a gruesomely realistic manner! In one of the monthly Model-building Competitions, members were required to construct models without gears or wheels. The chief entries were Bridges—two of which demonstrated the strength of Meccano structures by supporting a member of the club weighing about 7 st.—and Ships, the prize-winning entry in one section being a splendid model of a Destroyer. A Talk by Mr. C. Rodliffe, of the S.A.R., on "*Signalling on the South African Railways,*" and a triangular Debate on the respective merits of transport by Air, Sea and Rail were other popular features of the programme. Mr. R. Wallace, Secretary of the club, gave the first Lantern Lecture to figure on the programme. The slides were illustrations of Meccano models built by members of the club, and these were explained in detail by the lecturer. Club roll: 70. *Secretary:* Mr. R. A. Wallace, 29, Bell Grove, Durban.

WARNEFORD MODELS



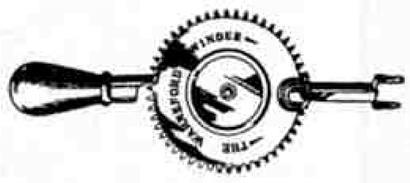
THE "MOTH" TRACTOR. *Price* 4/6

Length 19 in., span 18½ in., fitted patent double-bearing and shock-proof chassis, 8 in. hand-carved and balanced propeller, covered red proofed silk. A splendid flyer, and beautifully finished, this model at the price is undoubtedly the finest value ever offered. (Patent No. 296946).

THE "SWIFT" TRACTOR. *Price* 10/6

Length 30 in., span 26½ in., fitted 11 in. hand-carved and balanced propeller. Patent double bearing and shock-proof chassis. Covered yellow proofed silk with identification discs. A long and very steady flight is obtainable with this model, and though of large dimensions is very easy to handle. (Patent No. 296946).

USE "RUBERLUE" (Doubles the Flight) 6d. TUBE



THE WARNEFORD WINDER.
Universal Fitting for all Warneford Models. Price 2/6.

BUILT TO FLY WELL!

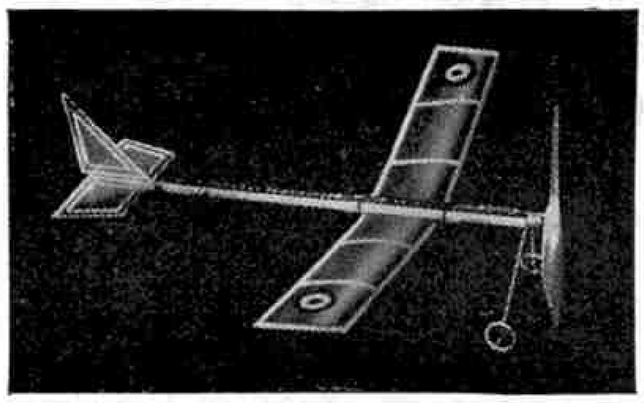
FORM A FLYING CLUB AT YOUR SCHOOL

Have Duration Contests, Speed Trials, Stunt Flying—it's great fun, and join the

WARNEFORD JUNIOR AIR LEAGUE.

(Full particulars are in every box).

Spare Parts for Warneford Aeroplanes may be obtained from all good stores and toy shops. If you have any difficulty in obtaining your requirements write to the manufacturers for name of nearest stockist.



THE "DEMON" TRACTOR. *Price* 7/6

Length 25½ in., span 23 in. Fitted 10 in. hand-carved and balanced propeller, patent double-bearing and shock-proof chassis, covered yellow proofed silk with identification discs. Weight and wind resistance are reduced to a minimum in this model, giving the utmost duration of flight. (Patent No. 296946).

THE "WIZARD"
CONSTRUCTION SET.

Low Wing. Full Cantilever Monoplane.

Builds a replica of machine that won the Sir Charles Wakefield International Cup (1929) and the S.M.A.E. Freshmen's Competition (1930).

Speed 16 m.p.h. Ceiling 120 ft. Glide 1 in 10. Landing speed 14 m.p.h. Length 32 in. Span 48 in. Weight 10 oz.

Full set of parts with full-size working drawings and complete instruction book. Packed in strong leather board box. Price **35/-**

SOLE MANUFACTURER: F. J. MEE, GREENWICH, LONDON, S.E.10. PRICE LIST POST FREE.

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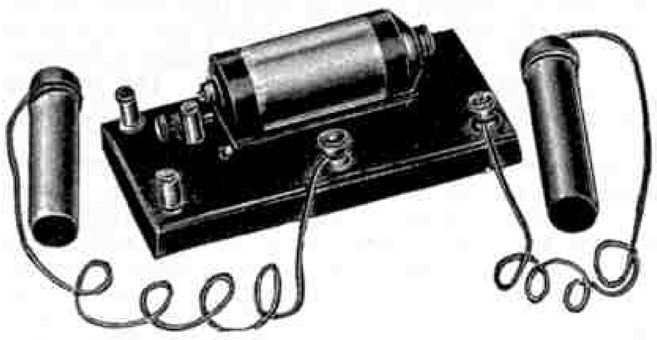
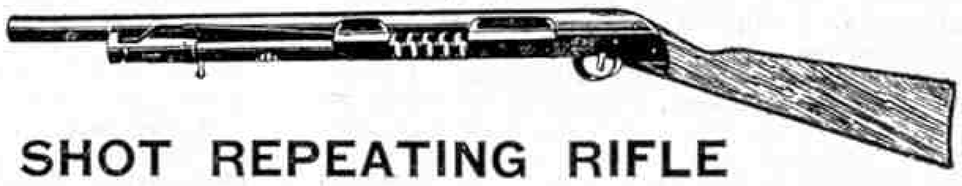
We stock all Hornby Train and Meccano Parts and send them Carriage Paid to any Station U.K.

GAMAGES NEW TOY AND MODEL CATALOGUE
Bigger and brighter than ever. 140 pp. illustrated in colour and crammed with all the latest Toys, Models and Games. Send for your copy now.



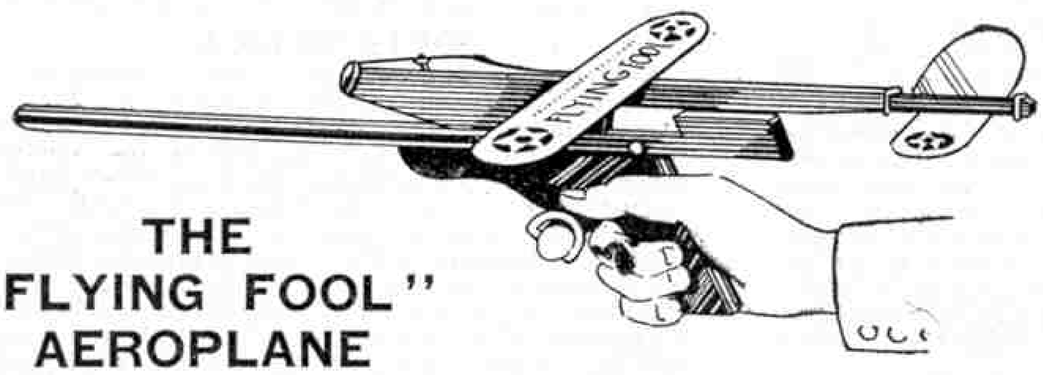
Medical Shocking Coil

Exceptional value, mounted on stained and polished Beechwood base with scaled draw-tube for intensifying current. Size of base 5 in. by 2¾ in. Price, complete with cords and handles, **3/9** Batteries to work same, 4½d. each. Postage 4d.



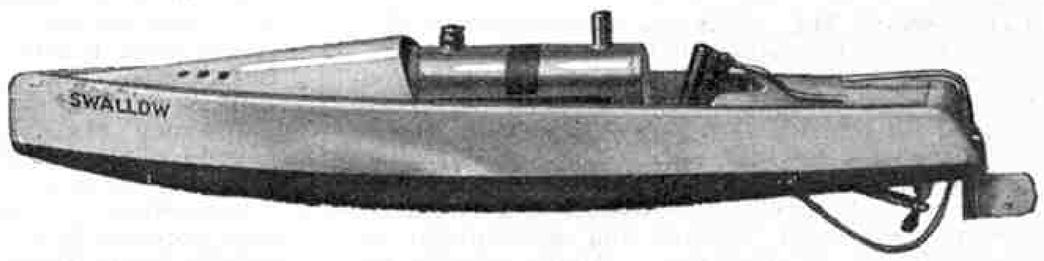
5 SHOT REPEATING RIFLE

Fires harmless cork balls by means of compressed air, guaranteed against defective material and workmanship. Quite harmless but very good sport. Post free. Price **12/6**



THE "FLYING FOOL" AEROPLANE

This is a very clever and exceedingly fascinating toy, comprising an aeroplane 17 in. long by 14 in. wingspan fired into the air by means of a 20 in. Catapult gun. The forepart of the machine has two adjustable weights so that the machine can be made to loop and perform various stunts. Price **5/6** Postage 6d.



BOWMAN SUPER STEAM LAUNCHES

These fast racing craft embody the very latest principles of model steam boat construction and are unsurpassed in quality and performance at their respective prices. Quality and finish are the same in all models, difference in price being due to size only.

"The Swallow." Length 20 in., beam 3¾ in., steams ¾ mile. Post Extra.		**17/6**
"The Snipe." Length 23 in., beam 4½ in., steams 1 mile	... ...	22/6
"The Eagle." Length 28 in., beam 5 in., steams 1½ miles	... ...	32/-
"Sea Hawk." Length 28 in., beam 5 in., steams 2 miles	... ...	42/-

All boats excepting the "Sea Hawk" are fitted with single engines of appropriate sizes. The "Sea Hawk" is fitted with twin engines and is exceedingly fast and powerful.

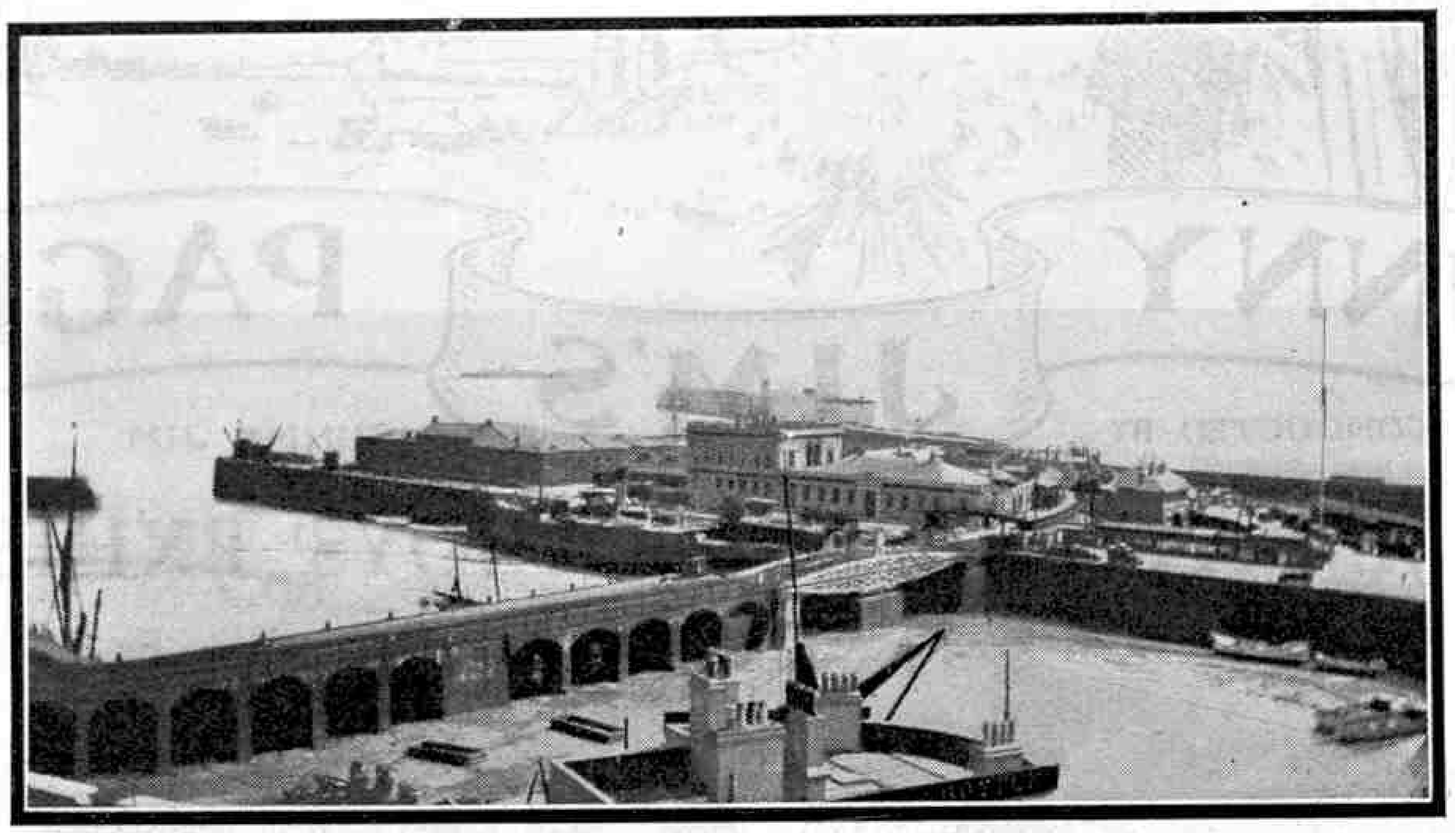
GAMAGES, HOLBORN, LONDON, E.C. 1. *City Branch: 107, Cheapside, E.C. 2.*

Powerful Searchlight—(*Continued from page 211*)

case of a battleship in action the searchlight is likely to come in for rough usage and a great deal of thought has been given to the problem of producing the most robust mechanism possible. A modern battleship searchlight is not only capable of withstanding the heavy vibration of gunfire, but even if hit by a shell the mirror is merely fractured and the efficiency of the beam is not seriously affected.

Another interesting type of searchlight is that used for the navigation of the Suez Canal. This gives a split beam with a dark space between. In this manner the sides of the canal are illuminated, but the light is not thrown upon oncoming vessels, so that pilots are not blinded by the glare. Searchlights are also used in fire brigade work for lighting when the usual sources of illumination have been extinguished.

A Famous Harbour



View of Folkestone Harbour, showing the swing bridge that carries the railway to the harbour station. The bridge is 270 tons in weight, of which the swinging section accounts for 260 tons. It is supported on a central pier and the moving portion runs on roller bearings. The bridge is about 132 ft. in overall length and when open leaves two channels into the Old Harbour each 50 ft. in width.

You can't avoid having to mend punctures but you **CAN** make it easy and sure. This Outfit contains the famous "Chemico" Sticky Patches as well as sheeting, canvas, solution, chalk, sandpaper and pencil. The finest value ever offered — ASK ANY CYCLE SHOP.

To The County Chemical Co. Ltd., Chemico Works, Birmingham.

Send me a copy of the 1931 "Chemico" Catalogue

NAME .....

ADDRESS .....

.....

Six-Wheeled Chassis—(*Continued from page 225*)

Steering is by means of Ackermann type linkage, and the change-speed lever for the gear-box is placed at the driver's left-hand side. The special Garner front wheel articulation system is faithfully reproduced in the model, and it is interesting to note that, by incorporating two quarter-elliptical springs arranged in V formation and working in combination with a radius rod, a considerable difference in front wheel level is possible. The springs are centrally pivoted to the chassis and give free articulation of the front wheels within a limit of 1½ in.

The rear axle suspension consists of two inverted semi-elliptical springs built up from Strips of various lengths on each side of the frame; and these also incorporate the bogie mounting system. An important feature of this method of suspension is that the front wheels are mounted in practically the same position fore and aft as when the usual semi-elliptical spring system is provided; thereby reducing the total length of the chassis and wheelbase without reducing the available loading space. The body is of the "well" type, and is equipped with small hooks, to which a canvas covering may be attached. A hinged tailboard also is provided.

The model chassis is 2 ft. in length overall and 8 in. in width, the track width being 7 in. The overall measurements of the body are length 15½ in., width 8 in., and height 8 in.

Every part of the chassis consists of standard Meccano parts. The transmission incorporates several Universal Couplings in order to provide flexibility of the inner bogie axle for travelling over uneven ground. The six road wheels consist of 3 in. Pulleys fitted with 3 in. Meccano Dunlop Tyres, and these give to the model a very finished and realistic appearance.

There is no doubt that many readers will wish to construct for themselves a model chassis of a similar type. In order to encourage originality in this class of model-building, we have decided to offer prizes of £1-1s. for the best model of an articulated six-wheeled vehicle, of a similar type to the Garner lorry, submitted by Home and Overseas readers respectively. Prizes of 10/6 and 5/- respectively will be awarded to the two models that come next in order of merit in each Section, and in addition several Meccano Engineer's Pocket Books will be awarded in recognition of other good models.

Competitors should note that actual models must not be sent. All that is required is a photograph and a brief description of the design and construction of the most important features of the model.

The age, name and address of the competitor must be written clearly on the back of all photographs or sheets of descriptive matter submitted, and the envelopes should be addressed: "Garner Chassis Competition," Meccano Ltd., Old Swan, Liverpool. The entries from Home readers must reach headquarters not later than 30th May, 1931, and those from Overseas readers not later than 31st July, 1931.

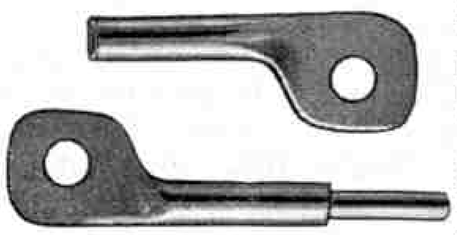
It should be noted that photographs of the prize-winning models become the property of Meccano Ltd., but photographs of unsuccessful entries will be returned to the senders if desired, providing that a stamped addressed envelope of the necessary size is enclosed with the entry.

New Meccano Part

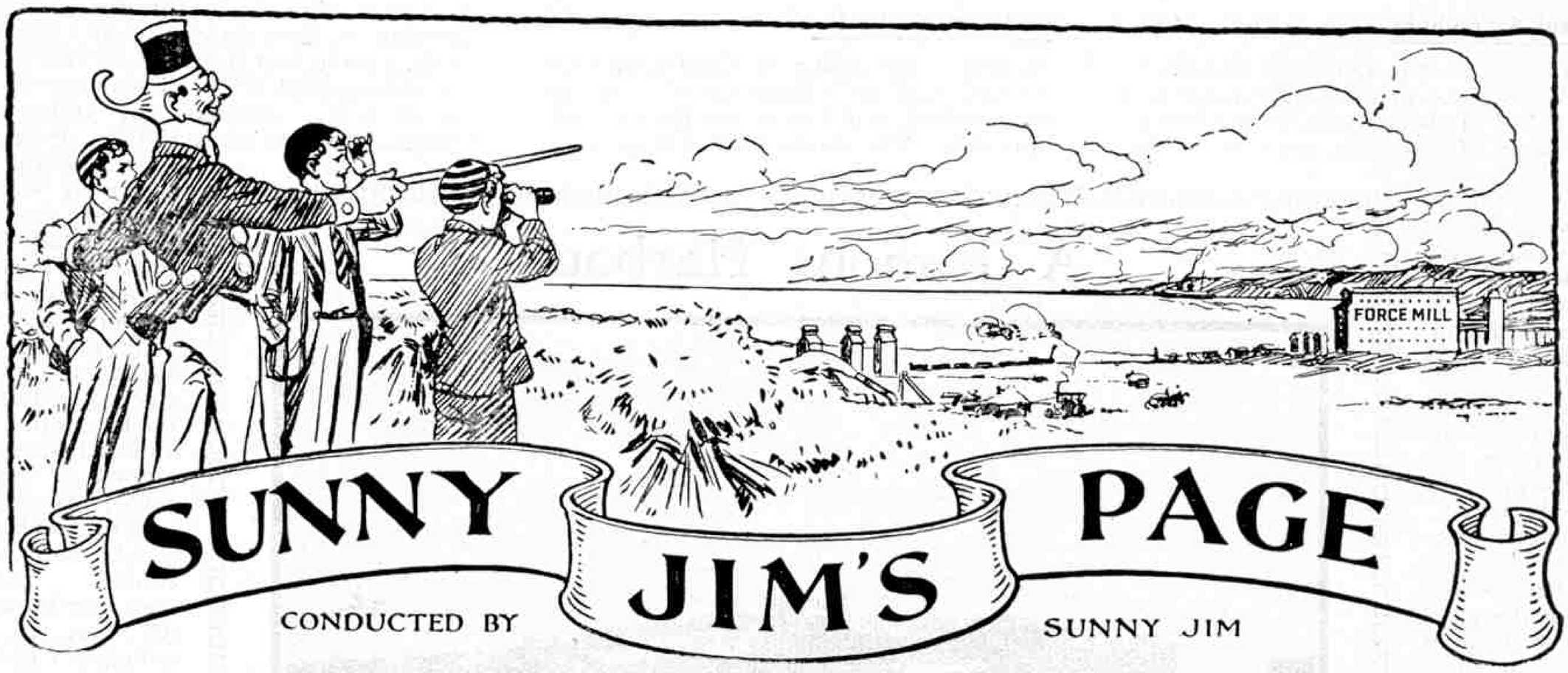
No. 173 Rail Adaptor, per pair 6d.

This new unit has been designed to enable Hornby Rails to be connected to rails built up from Meccano parts, such as Strips, Angle Girders, etc.

As shown in the accompanying illustration the Adaptor consists of a pair of connecting pieces, one fitted with a pin that is inserted in the socket of a standard Hornby Rail, and the other provided with a socket to take the projecting pin on the Hornby Rail. The connecting pieces are fitted with perforated lugs that are pushed over the ends of the Strips or Girders forming the Meccano rails, and secured to them by means of bolts so that a rigid connection is made.



The Adaptor will be found very useful by constructors who have a supply of Meccano Strips, etc., and also of Hornby Rails, as they will now be able to employ both materials in the construction of track for Hornby locomotives or Meccano models.



SUNNY JIM AT THE SCHOOLBOYS' EXHIBITION

"Hurry up, Jack, we're ready to go now."

Jack was always the last one, and Bob, his brother, was fuming with impatience to be off.

The two brothers had been eagerly looking forward to this day for a long time past, for Dad had promised to take them to the Schoolboys' Exhibition at Olympia, London.

At last they were in the train for Addison Road, the Station for the Exhibition. Having paid their entrance money at the turnstile, they soon found themselves inside the huge Empire Hall, which houses the most marvellous collection of things a fellow ever dreamt of.

"My word," said Jack, "look at these amazing radio gadgets," and he was lost in the crowd inspecting with awe the most up-to-the-minute wireless instruments.

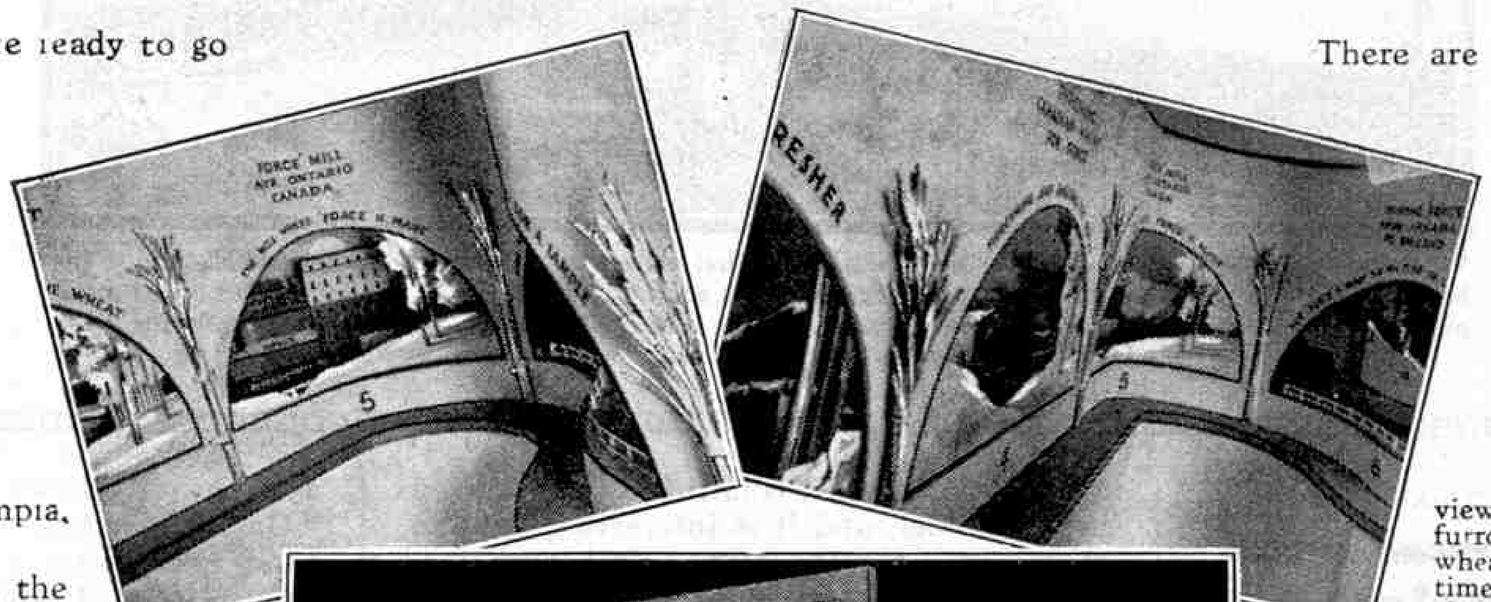
From there a wild dash to the Stand, where the boys queued up for a thrill in the "Aerobat" monoplane, which gave them all the sensations of the most realistic air stunts.

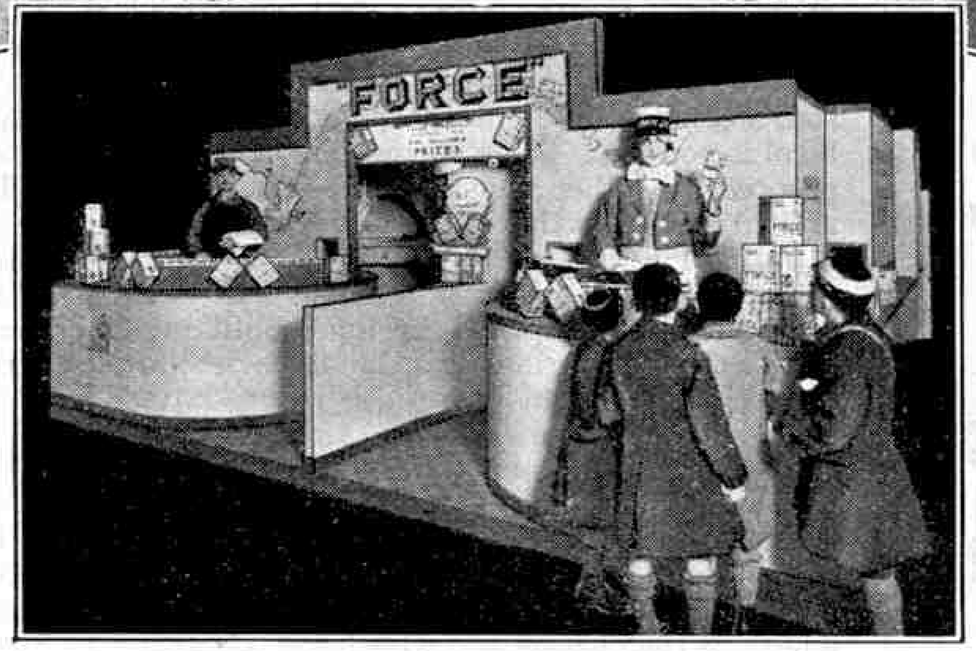
Now up the stairs to the first floor and Jack and Bob were enthusiastically inspecting all kinds of sports materials.

But there was a new thrill awaiting around the next gangway, and it was Jack who discovered it. He came running back: "Quick, Bob, who do you think is around the corner? Why, none other than our old friend 'Sunny Jim,' of 'Force' Food fame."

The two brothers rushed off, leaving Dad puffing along good humouredly in the rear. "Hullo, Sunny Jim," said Bob, "I didn't expect to see *you* here."

"Well," laughed Sunny Jim, "where there are boys you'll always find me. I'm glad you came along because I'm sure you'll be interested in my 'Force' stand."





Above: *Two views of the inside of the "Force" Stand, showing the panoramas which so delighted Bob and Jack.*

Below: *The outside view of Sunny Jim's Stand, showing Sunny Jim and, on the left, The Canadian Farmer.*

There are six scenes, and through all of them runs a miniature model of the big Canadian Pacific Railroad, with a C.P.R. freight engine pulling its way through the ever-changing scenery.

"*Sowing the wheat*" is the inscription over the first view. Here is a scene of Canadian prairie land, now tilled ready for the wheat seed. In the next scene the view is transformed from brown furrowed earth into waving, golden wheat fields, when in harvest time, the reaping machine cuts and ties the wheat ready for the threshing machine. Scenes three and four show the wheat being tied in neat sheaves, and taken to the thresher. As it leaves the threshing machine the golden grain is run into sacks ready for transportation to the "Force" Mill. This is shown in scene five and it is here that the wheat undergoes the most marvellous transformation of all.

By a special steam process every little grain of wheat is cooked whole, so that *all* of its wonderful nourishment is retained. Barley malt is added to render the wheat more easily digestible. After this process the grains of wheat are pushed between heavy rollers which roll them out flat so that they can be toasted in the electric toasting ovens.

Thus the golden wheat becomes "Force," the finest of all foods for boys and girls because it contains all the wonderful health-making qualities of the original wheat.

The last of the panoramic scenes in the "Force" Stand shows a big liner at the dockside loading up cases of "Force" to bring to England for the breakfasts of many thousands of English boys and girls.

"Can you imagine," said Bob, suddenly, after they had been gazing at these wonderful scenes in silence for a time, "what a terrible loss it would be if those ships were prevented from bringing "Force" across to us from Canada?"

"I don't want to imagine anything as bad as that," said Jack. "Look, here we are back with old Sunny Jim again." "Have you enjoyed it?" said Sunny Jim, as the boys came out. "Rather," they replied in unison. "Don't forget then, to have 'Force' for breakfast every day."

"We certainly shan't forget," said Bob, "we couldn't possibly find a better way of starting the day. Goodbye, Sunny Jim. We're ever so glad to have seen you, goodbye." Those Meccano boys who weren't able to get to the Schoolboys' Exhibition missed a big treat, but if they write to Sunny Jim, he'll send them a free sample packet of his wonderful whole-wheat food, "Force." Write to "Sunny Jim" (Dept. M.C.2), 197 Great Portland Street, London, W. 1.

This offer applies only to Gt. Britain & Northern Ireland.

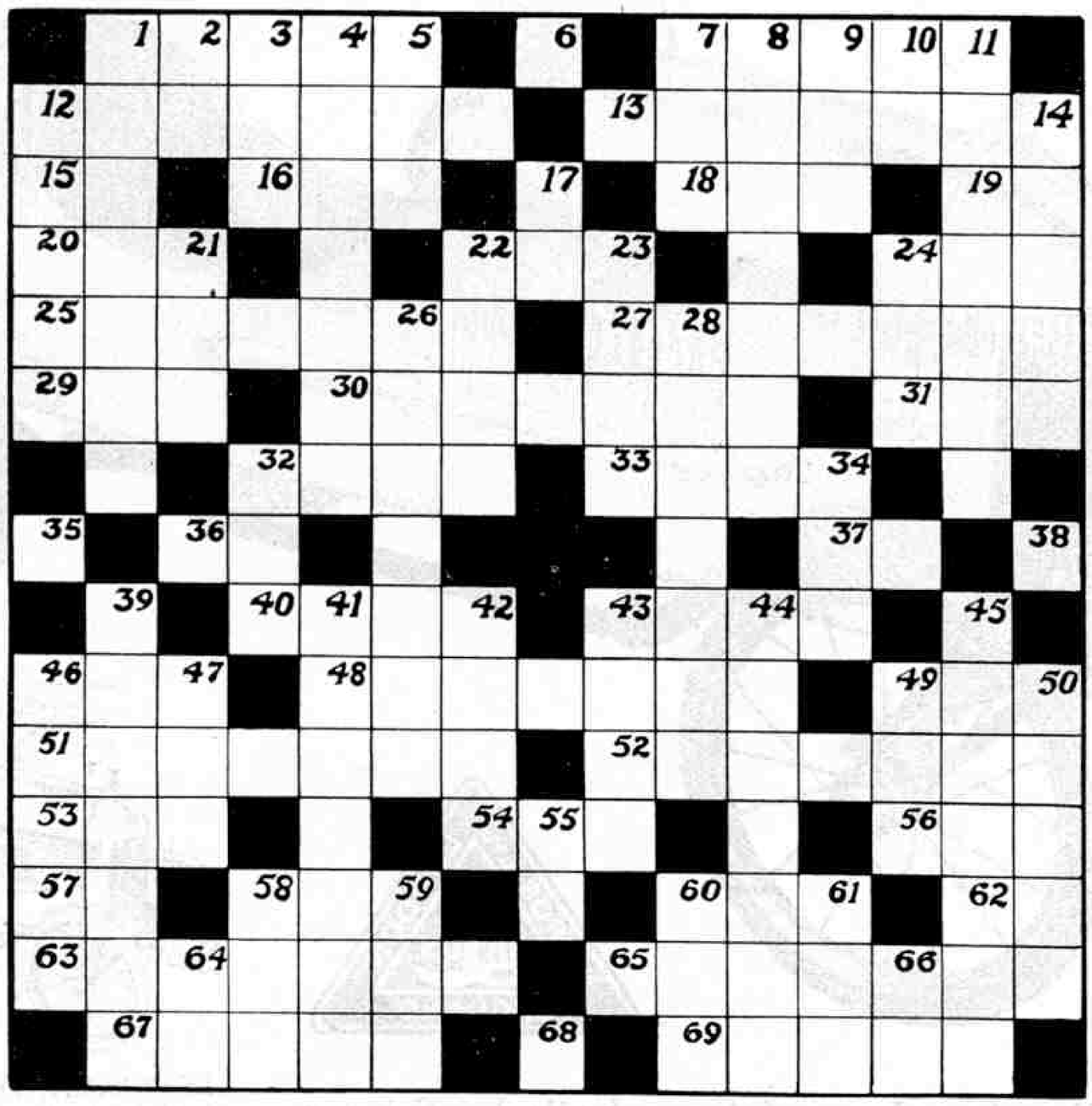
RESULTS OF SUNNY JIM'S SCHOOLBOYS' EXHIBITION ESSAY COMPETITION

(From Schoolboys' Exhibition, Olympia, London).

	SECTION 1	SECTION 2	SECTION 3
1st PRIZE	R. G. Watling, The Croft, Iver Village, Bucks.	G. Bramhall, 71 Greenleaf Rd, Walthamstow, E. 17.	D. C. Lloyd, 6 Southwood Lawn Road, Highgate, N.6
2nd PRIZE	K. P. Whitehorn, 205 Hither Gr'n Lane, Lewisham, S.E. 13.	J. A. Unwin, 270 King Street, Hammersmith, W. 6.	W. J. Swift, 79 West Street, Ryde, Isle of Wight
3rd PRIZE	J. R. Freeman, "Treholme," 3 Avenue Road, Harold Wood, Romford, Essex	S. W. Johnson, 1 Duke's Ctges, Duke of Connaught's Rd N Aldersh't, Hants	G. C. Warner, 16 Lewestoo Place, Stamford Hill, N 16.

Competition Page

MARCH CROSSWORD PUZZLE



CLUES DOWN

1. Struck with 46 down
2. Parent
3. Skill
4. Platform
5. Bribe
7. Curve
8. Forebears
9. Girl's name
10. Royal Marines (Abbrev.)
11. Places of Worship
12. Scorch
14. Slightest
17. Part of verb " To be "
21. Prohibition
22. Grief
23. Check
24. Coin
26. Antennae
28. Supplanter
32. Spring or Climbing Plant
34. Metal
39. Chairs of State
41. Conceit
42. Strip
43. Place
44. Precious Metal
45. Basket
46. Native Weapon
47. As 53 across
49. Prosecute
50. Given Away
55. Pronoun
58. Bleat
59. Governor
60. Deer
61. Sphere
64. Part of verb " To be "
66. Note of Tonic Solfa scale

CLUES ACROSS

1. Footwear
6. Point of Compass
7. Aside
12. Bird
13. Hamper
15. That is (Abbrev.)
16. Extremity
18. Appeal
19. Personal Pronoun
20. Snap up
22. Animal
24. Health Resort
25. Slow
27. Subterranean Passages
29. Evening
30. Closest
31. Catch
32. Possessive
33. Emphatic
35. Point of Compass
36. Away
37. Surrounded
38. Point of Compass
40. Loud Volley
43. Twist
46. Feminine Pronoun
48. Mass of Ice
49. Bag
51. Principal
52. Same as 4 down
53. Time
54. Go
56. Limit
57. One
58. Drink
60. River
62. Same as 15 across
63. Reconstructed
65. Enticed
67. Doubtful
68. Point of Compass
69. Sea Fowl

Once again we are being pressed by enthusiastic readers to give them a crossword to puzzle their brains, and once again we are glad to comply.

The rules governing the solution of crossword puzzles are so well known that it is scarcely necessary for us to do more than set a puzzle, but we would like to make it quite clear to new readers that, in setting the clues, it has been our endeavour throughout to avoid creating unfair traps. There is one simple catch, but we feel sure that the hint we give will be sufficient for our keen competitors, and that very few will be trapped by it. Every word will be discovered in Chambers's 20th Century Dictionary or any other good dictionary.

Prizes of Meccano Parts or Hornby Train Accessories (to be chosen by the winners) to the value of 21/–, 15/–, 10/6 and 5/– respectively, will be awarded to the senders of the first four correct solutions in the order in which they are opened on the morning following the closing date. In addition there will be a number of consolation prizes and, in awarding these, neatness and style of presentation will be taken into consideration.

Competitors who wish to preserve their "*M.M.'s*" intact need not cut out the crossword illustration. It will be in order to make a copy of the illustration and fill that in.

Entries should be addressed to "March Crossword Puzzle, Meccano Magazine, Binns Road, Old Swan, Liverpool," and must be sent to reach this office not later than 31st March. Overseas closing date, 30th June.

My Favourite Competition

One of the most interesting features of our competitions is the regularity with which certain readers take part in one type of competition, and avoid completely other equally interesting types. In very many cases, we know that the reason is not a lack of skill. For example, certain readers will not take part in Essay competitions, but they can and do write beautifully-phrased letters. Others, who can sketch and paint really well, avoid drawing contests, but take part in Essay contests and other competitions involving the use of words.

Examination of the competition records over a period of several years has brought to light several very interesting facts concerning this participation in certain types of contests and avoidance of others. We are so curious to gather more information that we are offering prizes this month for letters on the subject of "My Favourite Competition." Readers are asked to state briefly why they like certain contests and dislike others.

To give the younger boys an opportunity to air their views, the letters will be divided into two sections: A for those from readers aged 16 and over, B for those from boys under 16. Prizes of Meccano Products (to be chosen by the winners) to the value of 21/– and 10/6, respectively, will be awarded to the best and second best letters in each section, and in addition there will be a number of consolation prizes.

For convenience in judging, letters must be written only on one side of each sheet of paper used and the competitor's name, age and address must be written at the head of the first sheet.

Letters should be addressed to "My Favourite Competition, Meccano Magazine, Binns Road, Old Swan, Liverpool," and must reach this office not later than 31st March. Overseas closing date, 30th June.

COMPETITION RESULTS

Farmyard Drawing.—It was not anticipated that there would be a big number of entries for this contest, but they certainly proved far more numerous and of far higher standard than might reasonably be expected. The original drawing and selections from the winning entries will be published after the Overseas section has closed. In the meantime, the prizes have been awarded as follows:—1. H. Lane (Stokesley, Yorks.); 2. G. A. Smith (Croydon); 3. R. D. Clark (Chatham) 4. G. Garvey (Redcar).

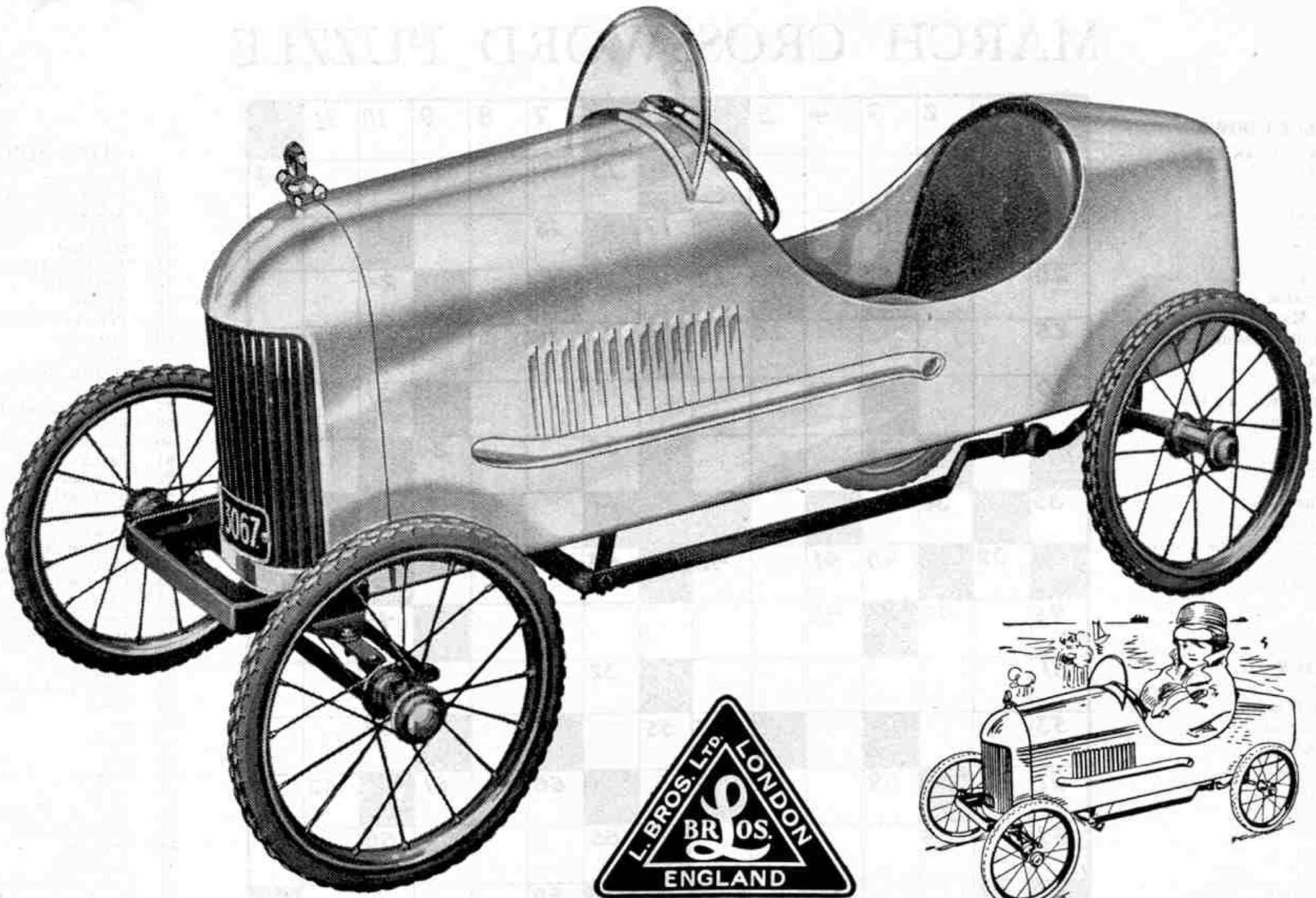
Engineering Jokes.—A most remarkable collection of humour was brought together in connection with this competition, and in due course selections from the entries will be given in the Fireside Fun page. The prizes for Home Section readers have been awarded as follows:—1. R. Norris (Ebbw Vale); 2. H. Rutter (Consett, Co. Durham); 3. A. F. Milburn (Chingford, E.4); 4. E. Thompson (St. Leonards-on-Sea).

OVERSEAS

September Photo Contest.—First Prizes: Section A, K. T. Khandwala (Karachi); Section B, W. T. Loke (Clarens, Switzerland); Second Prizes: Section A, F. van Bulck (Brussels); Section B, W. D. Siddons (Wainwright, Alberta).

Air Mail Contest.—1. H. M. Carey (Cape Town, S.A.); 2. J. Rodriguez (Montreal); 3. F. Whyte (Ipswich, Queensland); 4. R. Garcia (Trinidad).

This car is the real thing!



Yes, it's a Brooklands model car built by Tri-ang engineers. They said: "Let's make this Brooklands car sporty and splendid; let's make it strong—and let's make it *safe*." So they fitted it with a polished aluminium body and radiator and gave it a stunningly smart finish by covering the chassis and wheel rims with brilliant red enamel. Then they fitted it with a ball-bearing back axle, double crank drive and real rubber pedals. And they added that long natty exhaust pipe because they knew you would like it. Now when is your birthday?

BROOKLANDS No. 6 . 63/-
Polished aluminium body, red chassis and wheel rims, tangent spoke wheels with 1" imitation pneumatic tyres, windscreen, seat padded in red cloth. For ages 4-8yrs.

BROOKLANDS No. 8 . 105/-
As No. 6, but with 2¼" Dunlop balloon pneumatic tyres, heavy tubes and Schrader valves. For ages 4-8 yrs.

BUICK EMPIRE 95/-
A chain drive motor with every possible detail of equipment. Ball bearing back axle and pedal bracket. Side door opens. Safety glass adjustable screen, balloon wheels. For ages 4-8 yrs.

CHEVROLET REGAL . 32/6
A beautiful car with steel chassis and moulded steel body. Easy running double crank drive with rubber pedals, back axle is ball bearing. Balloon wheels with ⅝" rubber tyres. For ages 4-7 yrs.

ROVER REGAL 42/-
All steel body is mounted on steel chassis with four cantilever springs. Model of Rover radiator with correct badge gives a very handsome appearance. Full complement of accessories is included. For ages 4-7 yrs.

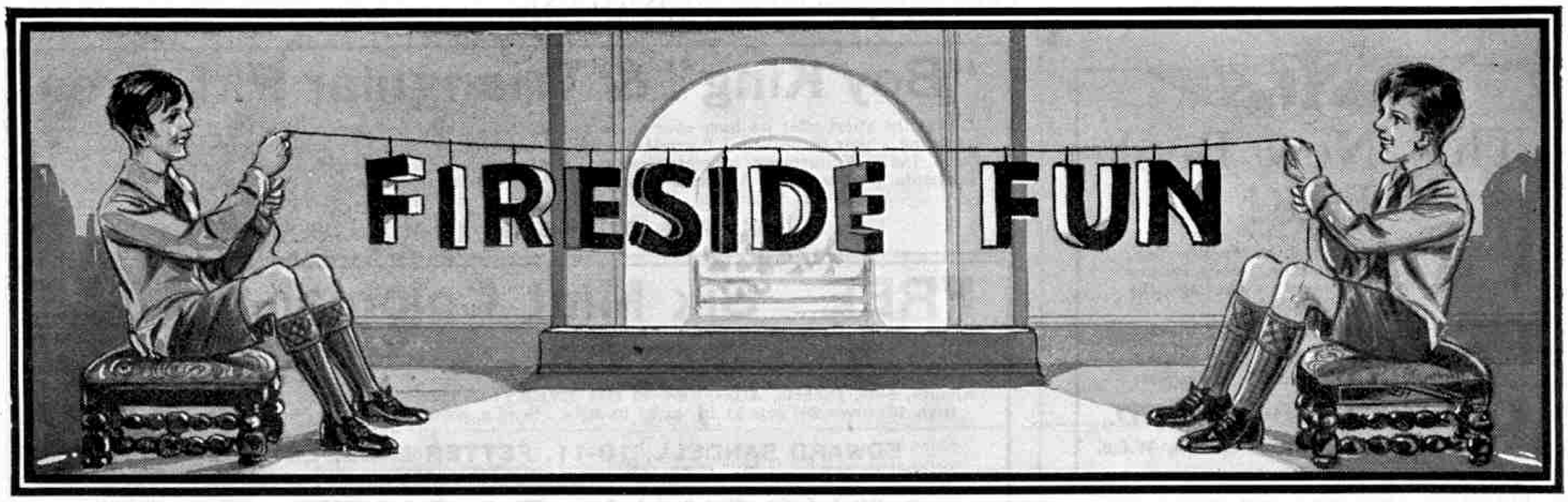
TRI-ANG

MOTOR CARS 15/- TO £15-15-0

Count them on the pavement!

★ Tri-ang cars are on view at most Toy shops. Write for folder of Tri-ang Cars and other Tri-ang Toys, illustrated in full colours. **Free on request.**

LINES BROTHERS LIMITED, MORDEN ROAD. LONDON S.W. 19



FIRST FOR HARE SOUP

Mr. Newrich was dining at a very exclusive restaurant, and to the manager's horror he tied his serviette round his neck.

A page boy was immediately ordered to try to make the diner understand that such a thing was not done, but was told to carry out his task tactfully. He approached the cause of the trouble with a very innocent look.

"Shave or hair-cut, sir?" he asked brightly.

* * * *

"I am afraid our gramophone guarantee does not last for a year, and so we cannot replace the machine for you. However, we might be able to repair the machine for you at a moderate charge. Can you tell me what is the matter with it?"

"Aye, the needle is broken."

* * * *

Nervous Traveller (as train travels over high bridge): "Suppose there is a derailment, and the train is dashed to pieces?"

Conductor (cheerfully): "You needn't worry about that, ma'am, the company has got plenty more trains."

* * * *

Mistress (to new maid): "We have breakfast generally about eight o'clock."

New Maid: "Well, mum, if I ain't down, don't wait."

* * * *

The Irish farmer's cow was very restive, and consequently it was almost impossible to milk her. On account of this the farmer decided to get rid of her, and so he sent her to be sold at the nearest market. The man who took her to the sale returned with much more money than the cow was expected to fetch.

"Did you tell the truth about the cow?" asked the farmer in surprise.

"Begorrah, I did," replied the man. "The man asked me if she gave plenty of milk, and I said 'Man, you'll be tired to death with the milking of her!'"

* * * *

Office Manager (on tour of inspection): "This place is getting rather dirty and dusty again."

Office Boy: "Right, sir. Shall I ask the vacuum people to give us another demonstration?"

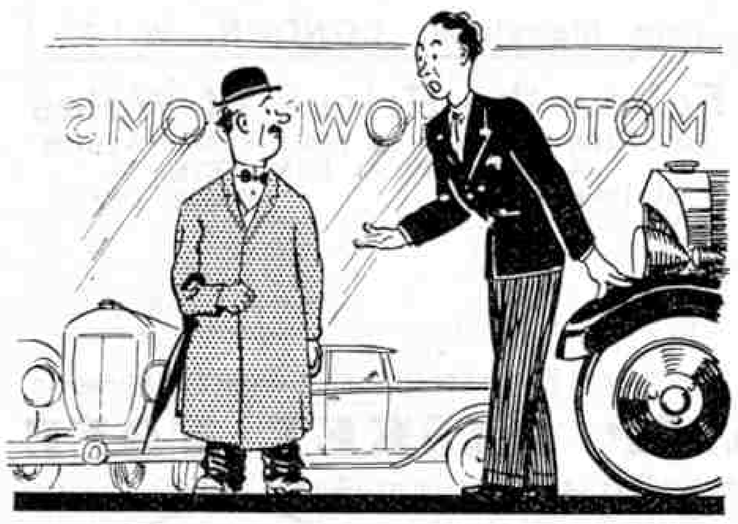
* * * *

Diner: "What! You print all those dishes on the menu and yet you say you've only got sausage and mash? What on earth are all the others down there for, then?"

Waiter: "They're just to encourage the diners' appetites, sir."

* * * *

SANCTUARY AT LAST



Motor car salesman: "Are you interested in any particular make of car, sir?"

Pedestrian: "No! I just came in here to enjoy being among a few that I didn't have to jump away from."

* * * *

Nerve Patient: "Doctor, I frequently feel like killing myself. What shall I do?"

Doctor: "Oh, nothing! Leave it to me."

IT PAYS TO ADVERTISE

Advertisement canvasser: "I can assure you, sir, that an advertisement inserted in our publication will have immediate results!"

Business Man: "I am quite aware of that. yesterday morning I advertised in it for a night watchman and last night my shop was broken into."

* * * *

"Why is the fourth of July?"

"I don't know."

"Well, 'Y' is, unless you have some way of your own of spelling it."

* * * *

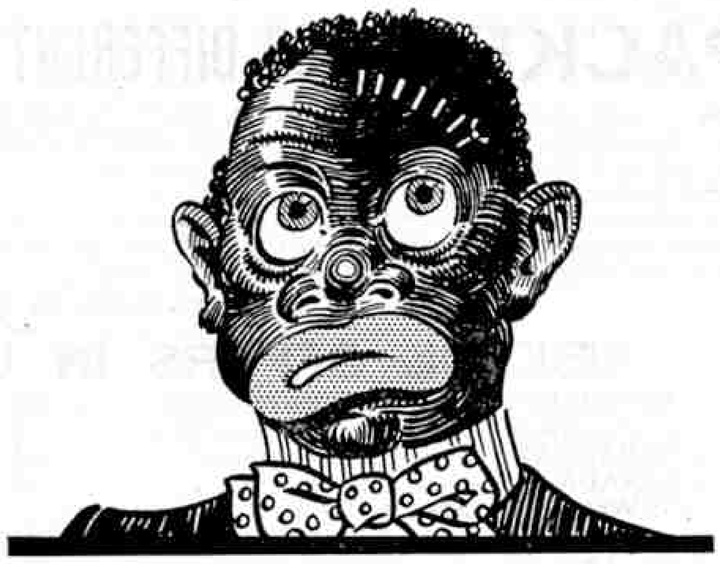
Tommy: "My teacher's got the worst memory in the world."

Father: "He forgets everything, does he?"

Tommy: "No! he remembers everything."

* * * *

LIGHT AND SHADE



"Yo' ask me why I am in such a rage, Rastus. Well look at ma' forehead. Dat doctah at de hospital has sewed up mah wound wit' white thread!"

* * * *

Tom: "My father once caught a fish as long as this road."

Dick: "Phew! It must have been a whale."

Tom: "Not likely; he used a whale as a bait."

* * * *

Father: "Now Tommy, I have not been satisfied with your progress at school for some time now. I want you to try to get above the bottom place, for once."

Tommy: "I can't, father. All the other places are taken."

* * * *

The tourist was enjoying for the first time the dry climate of Arizona.

"Doesn't it ever rain in this country?" he asked a native.

"Rain?" the native replied, "Why, say, pardner, there's frogs in this yere town over five years old that hain't learn to swim yet."

* * * *

Master: "If nine men reap a field of wheat in two days, can anyone tell me how long it would take thirteen men to reap the same field?"

Smith: "Please, sir, if the field were reaped by the nine men, it couldn't be reaped again by the thirteen."

* * * *

Smart youth (to Post Mistress): "How can I keep postage stamps from sticking together?"

Post Mistress: "Buy them one at a time!"

* * * *

"Yes," said Mr. Brown, "Jones and I are in partnership, but we don't carry the same goods."

"What do you mean?" asked his friend.

"Well, you see we work it this way. One day Jones goes round selling a stove polish that leaves a stain on the fingers, and the next day I follow up with the only soap that will take it off!"

THE SCOREKEEPER

Judge (to prisoner): "I am surprised to see you here again. How many times have I had to deal with you before?"

Prisoner: "I'm sorry, my Lord, but I have lost count. I thought you were keeping the score."

* * * *

Pupil (picking himself up wearily): "Do you think it was really necessary to knock me down in that brutal fashion."

Boxing Instructor: "No, not really. There are at least 24 other ways to choose from."

* * * *

"Eat only what a three-year-old child would," the doctor had ordered, but the patient was much worse when he came for the next examination.

"Did you follow out my instructions?" anxiously enquired the doctor.

"Yes, doctor," was the reply. "For dinner I had a handful of mud, one of coal dust, a few pins and a box of safety matches, washed down with a draught of ink."

* * * *

The very thin man and the very fat one had been having an argument, and had descended to personalities.

"From the look of you," said the fat one, "there might have been a famine."

"Yes," came the retort; "and one look at you, my friend, would convince anyone that you had caused it."

* * * *

Two Englishmen who had not been introduced to each other were shipwrecked in mid-Atlantic while returning from New York. The ship disappeared beneath the waves and the two found themselves swimming alone for dear life. They looked at each other without saying a word, but at length one broke the silence.

"Excuse me, sir," he said, "but do you mind my speaking to you?"

"Not at all," said the other. "Is there anything I can do for you?"

"Well, yes, there is," said the one who had spoken first. "Would you mind directing me to the Isle of Wight?"

* * * *

"Were you very ill, Sambo?" asked the manager of a negro employee who had been absent without leave.

"Ill, sir?" replied Sambo. "Ah was so ill dat every night ah looked in de death list in de newspapah to see if mah name was dere."

* * * *

HELD TO RANSOM

The butcher's boy had gone to deliver the week-end order at a house where a fierce dog was kept. As soon as the lad entered the backyard, he was set upon by the dog which pinned him against the wall, where he stood shaking with terror. The mistress of the house soon arrived, however, and the dog was chained up.

"Has he bitten you?" she inquired anxiously.

"No," said the boy. "I kept him off by giving him your joint, and now he's on your sausages. If you'd been much later you'd have been too late to save even your pork chops!"

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THE SECOND MILLENARY OF VIRGIL

COMMEMORATIVE stamps may be divided very sharply into two groups—those that are a blatant exploitation of the stamp collector, and those that have a genuine mission to accomplish. While many people feel that Italy in recent days has tended to overdo her commemorative issues, these definitely fall into the category of stamps with a mission, for they are designed to re-awaken interest in the glories of Italy's past, and to stimulate the rising generation to emulation.

Art, science, and religion have provided themes for previous issues and now the second millennial celebration of the birth of Virgil, the greatest of all Roman poets, provides an opportunity to feature literature.

The issue consists of a range of nine stamps for general postal use and a short air post series of four stamps. As our illustrations show, each of the stamps of the general issue illustrates an incident in one of Virgil's works and is accompanied by an appropriate quotation. The same design is used throughout the air stamp series, however.

Virgil, whose full name was Publius Vergilius Maro, was born in the year 70 B.C. on a farm on the banks of the River Mincio, in the district of Andes. From his earliest days his tastes inclined to literature, and his parents wisely gave him a really good education at Milan and Rome, where, it is said, the Emperor Augustus was a fellow pupil. In the year 41 B.C. he again went to Rome and became associated with a literary circle formed by Maecenas, a wealthy friend and minister of the Emperor. From that point onward his life was devoted to his literary work and studies, and between 42 B.C. and 37 B.C. he published the *Bucolics*, the first of the three great works that have earned him enduring fame.

The *Bucolics*, or *Eclogues*, as they are often known, deal with rustic scenes and are linked up in our stamp story with one illustration, on the 5L. +1.50L. value. The design shows the shepherd's hut and brightly burning fire of logs, described in the quotation that runs "*Hic focus et taedae pingues hic plurimus ignis*"—"Here is a hearth and rich pine torches, here ever a well-heaped fire." The quotation is taken from a description by Melibeus, a goatherd, of a singing match between the gods Thyrsis and Corydon, with Daphnis for umpire.

The *Georgics*, the second of Virgil's great works, are in three books and are chiefly concerned with simple pastoral scenes. They were published in 30 B.C. Their avowed object was to contrast the simplicity and sanctity of the yeoman's life with the luxury and lawless passions of the outside world, and to associate the ideal of a life of rustic labour with the varied beauty of Italy and the historic glories of Rome. The skill with which the topics are dignified and the beauty of the episodes of the poem, make it the most carefully finished production among the great works of Roman literature.

Inspiration for three of the stamps, 30c., 50c. and 75c., was drawn from the second book, the passages illustrated being intended by the poet to show that the misery of Italy, and the poor state of her agricultural provinces, were really Nature's punishment for the neglect of the previous generation.

The 30c. value is allegorical of a kindly earth. It shows a mother nursing her infants and takes for its theme the 174th line "*Salve magna parens frugum Saturnia tellus*"—"Hail, land of Saturn, great mother of earth's fruits." The 50c. value shows peasants labouring in the field gathering in the harvest. The quotation in this case is from the 458th and 459th lines, the commencement of what is often regarded as the most perfect passage in all Roman literature, reading "*O! Fortunatos nimium sua si bona norint agricolas*"—"O happy husbandmen! Too happy, should they come to know their blessings!" The design on the 75c. stamp, drawn from the 524th and following lines, shows a happy domestic scene—the wife at work on a hand loom, her children playing around and a calf beside her. The inscription runs "*Interea dulces pendent circum oscula nati*"—"His unstained home guards its purity."

The *Aeneid*, Virgil's most remarkable work, was commenced in 29 B.C., immediately after the publication of the *Georgics*, and was uncompleted when he died in 19 B.C. It cannot be called his greatest work, for his style was not that of a writer of epic poems, and it may well be that Virgil was aware of the many imperfections when, as he lay on his deathbed, he begged his literary executors to destroy the whole of it. The Emperor Augustus intervened, however, and ordered its publication, and thus was saved the greatest epic poem of Roman literature.

The Emperor, indeed, was responsible for the suggestion that set Virgil to work upon the *Aeneid*. Augustus desired Virgil to write an epic immortalising his own great victories. Virgil, however, was not inclined to tackle so invidious a task, and set himself to discover another subject, that would yet enable him to give to the Emperor the praise that was justly his for his work in ending the civil wars and bringing peace to Italy and the world. The problem before him was to compose a great work of art that should represent a great action of the heroic age and yet embody the glorification of Rome and its great ruler. The only subject that fulfilled these requirements was that of the wanderings of Aeneas after the fall of Troy and his subsequent settling in Latium. This story had been familiar to Romans from the beginnings of their literature, and had been officially recognised by the Senate as linked with the country's fortunes.

Much of his material he drew from Homer's *Odyssey* and *Iliad*, and, in fact, in certain phases of the *Aeneid* there are distinct resemblances to Homer's great epics.

It is impossible to describe here, (*Continued on page 259*)

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B.T.H. Gramophone Motors

We regret that owing to a printers' error the price for the B.T.H. Gramophone Motor was shown in our February issue as £3. This should have been three guineas, as is announced on page 260 of the present issue.

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HAROLD STROUD, 57, NEW BANK ROAD, BLACKBURN, LANCS.

7 Italy, Virgil Pictorial	7d.
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Post extra. Selections sent if desired.

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New Meccano Models—(*Continued from page 235*)

Sifter, the following parts are used: 2 of No. 1; 5 of No. 2; 4 of No. 8; 3 of No. 15a; 4 of No. 20b; 1 of No. 22; 1 of No. 24; 4 of No. 35; 30 of No. 37; 2 of No. 37a; 1 of No. 38; 1 of No. 45; 5 of No. 48a; 1 of No. 52; 2 of No. 54; 1 of No. 59; 9" of No. 94; 1 of No. 96; 1 of No. 96a; 2 of No. 99; 1 of No. 126; 1 Steam Engine.

Eiffel Tower

Model-builders will have difficulty in refraining from smiling after reading the caption that we have placed under Fig. 6. But although the diminutive model bears little resemblance to the world's highest tower, it nevertheless has good claim to being the "smallest," and as such will be of interest to Meccano boys. The model is very simple to build and its construction should not present any difficulty.

In order to build the model the following parts will be required: 4 of No. 2; 2 of No. 11; 1 of No. 16; 2 of No. 19b; 1 of No. 22; 9 of No. 37; 2 of No. 48a.

Truck Hoist

The final example shown this month is a model truck hoist that will please the younger constructor. This is a very simple working model, and its construction can be seen quite clearly from the illustration.

In building this model the following parts will be needed:—2 of No. 1; 2 of No. 2; 6 of No. 5; 2 of No. 16; 1 of No. 19s; 4 of No. 22; 6 of No. 35; 12 of No. 37; 1 of No. 40; 4 of No. 48a.

Great Arch Bridge Across the Tyne—

(*Continued from page 187*)

an average weighed 20 tons each, from the light railway track laid alongside the completed portion of the suspended roadway, and placed them in position for riveting.

The manner in which the cranes worked is very interesting. The first to be erected was a 20-ton crane, which was built up by means of a 5-ton derrick erected on a wooden tower at the end of the approach span. When the steelwork within reach of this crane had been placed in position, it was dismantled and re-erected further out from the bank, from which position it continued the erection of the arch ribs and also that of two 5-ton cranes. When the larger crane had completed the work possible from this post, it was again dismantled, this time by the 5-ton cranes; and these re-erected it ahead of them in order that it could carry on with the work of construction. Thus the cranes jumped over each other in turn as the sections of the arch grew toward midstream.

Work continued on these lines until 23rd February, 1928, when the two halves met with remarkable accuracy. The cables were then slackened off in order to allow the sections of the top chord to meet, and a temporary pin was placed in position between the two halves of the upper chords of the arch. At that moment the arch was of the three-hinged type, one hinge being at its crown and the other two at its ends on the opposite banks of the river. The centre panels of the lower chord were then raised into position and with the completion of the arch and the removal of the temporary pin the two-hinged condition was attained.

The bridge was opened for traffic by His Majesty the King on 10th October, 1930.

Stamp Collecting—(*Continued from page 257*)

even briefly, the story of Aeneas, as related in the *Aeneid*. It ranges through 13 books, the first six dealing with the wanderings of Aeneas after the fall of Troy, and the remainder with the settlement of the hero and his followers in Italy.

In the first book, Aeneas is sailing in search of a place to settle, when he encounters a violent storm, and is wrecked on the North African coast. He finds colonists, recently fled from Tyre, busily engaged in building the great city of Carthage, and their Queen prevails upon him to tell the story of the fall of Troy. The design for the air stamps of the commemorative series is drawn from this book and depicts an allegory of flight. The quotation is from the 278th line and runs "*His ego nec metas rerum nec tempora pono*"—"For these I set neither bounds nor period of Empire."

The second book is taken up largely by Aeneas' narrative of the fall of Troy, while the third, from which two quotations are taken, deals with the further voyaging of the fugitives and their fruitless attempts to settle in Thrace, Epirus and Sicily. The 15c. stamp takes its design from the meeting of Helenus, King of Epirus, and

Anchises, the father of Aeneas, in the course of which Helenus prophesies that the voyagers' future home lies in the land of Ausonia (Italy). The quotation is from the 477th line, "*Ecce tibi Ausoniae tellus; hanc arripe velis*"—"Lo! Before thee is the land of Ausonia. Make sail and seize it." The wanderers' jubilation when they first see Italy is pictured in the design of the 1.25L. stamp, with its quotation "*Italiam laeto socii clamore salutant*"—"Italy the crews hail with joyful cry."

The action of the story moves swiftly on to the sixth book, in which Aeneas descends to Hades and converses with the unborn spirits who are to be the future leaders and generals of Rome. There he also meets his father, Anchises, who had recently died, and listens to his prophecies of the coming glory of Rome. The design of the 20c. stamp is based on this incident and bears the quotation "*Tu regere imperio populos Romane memento*"—"Roman! be thine the sovereign arts of sway. To rule and make the world obey."

In the seventh book Aeneas actually lands on Italian soil and the design of the 25c. stamp shows him kneeling to salute his future home, with the words "*Salve fatis mihi debita tellus. Hic domus haec patria est*"—"Hail, O land so long my due from fate . . . here is our home; this our country."

Aeneas was not long allowed to rest, and the remaining books tell the story of the great struggles before eventually peace was secured by a great battle from which Aeneas emerged victor over his great enemy, Turnus, described in the XIth book. The famous Fascist challenge to the world, "*Et opes nobis et adhuc intacta iuventus*"—"We have the resources and, moreover, an unsullied youth," is drawn from this book to accompany the illustration for the 10L. + 2.50L. stamp, on which the victorious Aeneas is shown astride his chariot.

In many respects this commemoration of Virgil is the best of the Italian stamp issues of recent years, and thousands of schoolboys groaning under the "tyranny" of their classical tutors, no doubt will become greatly interested in the works of the poet when he makes his appearance in the pages of their stamp albums.

There are few poets whose work will stand the searching test of popularity two thousand years hence, but Virgil had the secret, and his powers of expressing in perfect language thoughts that touch the hearts of every age, ensure for his works fame that will endure for all time, wherever literature is read.

Stamp Gossip

Plagiarism

In her newly issued Census Commemoration series, Roumania has perpetrated the most extraordinary example of plagiarism that the stamp world has encountered for many a long day. Not only the idea, but the general features of one of the designs also, have been copied from an earlier Japanese effort. Unfortunately, the copied design has been carried out very badly, and the map of Roumania is hardly recognisable. In fact, careful study is needed to assure oneself that the patch of colour is not actually a perfectly splendid reproduction of a blob of ink.

Australian Commemoratives

We are indebted to several Australian readers for advance information of the special stamps that are to be issued in commemoration of Air Commodore Kingsford Smith's record-breaking flight from England to Australia in October last.

Apparently there are to be three stamps, 2d., 3d. and 6d. The same design will be used for each stamp, and its chief feature will be projections of the Northern and Southern hemispheres, flanked by the Pillars of Fame. The design will be surmounted by a pair of wings and the letters *R.A.A.F.*, the initial letters of the title of the Royal Australian Air Force.

The completion of the Sydney Harbour Bridge is another great Australian event that is to be celebrated by the issue of a special stamp, but beyond the bare fact that the issue is to appear, very little information is available. It is certain, however, that the principal feature of the design will be the great arch of the bridge.

Soviet Propaganda Stamps

The stamp collector who specialises in engineering designs has had occasion in recent years to bless the Soviet Russian Government for its steady flow of propaganda issues. These are intended to stimulate public interest in what is known as the Five Years Plan, a scheme inaugurated early in 1930, under which the whole of the Russian heavy industries—iron, steel, coal, shipbuilding—are to be re-organised and placed on a sound basis by the end of 1934. Many of the stamps have remarkably fine designs and all have been of interest.

The occasion of the flight of the "*Graf Zeppelin*" from Friedrichshafen to Moscow has been taken to introduce a new "Five Years Plan" stamp. This features a heavy engineering works. It is of an unusual character, for in the foreground of the design is shown a workman bearing a huge figure four, with which he clearly intends to obliterate the figure five. The significance is the commencement of the second year of the plan, of course.

Two other designs have followed in quick succession, one showing a view of the modern Central Telegraph office at Moscow and the other the Lenin Hydro-Electric Power Station. We have chosen to illustrate the latter because it provides a most striking contrast with the recent Irish Free State Shannon Power House stamp. From the point of design, the contrast is all in favour of the Russian stamp. The great black pile of buildings and its brightly gleaming windows suggest an activity and force that is completely absent from the delicate but rather tame design of the Irish stamp.

The Designer Slips Up

Some extremely curious errors have crept into stamp designs from time to time, and in our December issue we referred to an almost inexplicable slip in the design of the current Belgian air series, in which the Italian International registration letters are shown on the wings of the monoplane instead of the Belgian lettering.

A correspondent draws our attention to an extremely curious feature of the Roumanian air series issued in September, 1928. It was intended to pay a compliment to a famous Roumanian pilot, Captain C. G. Craiu, whose biplane was the central feature of the design, by adding his name to the fuselage of the machine as it appeared on the stamp. Unfortunately, the designer appears to have mistaken the idea and the aviator's name appears as *C-RAIU*, an international registration mark that could legitimately be employed on a Roumanian machine.

We take this opportunity of making acknowledgment to Stanley Gibbons Ltd., for their courtesy in loaning the stamps from which the illustrations used in our stamp pages have been prepared.

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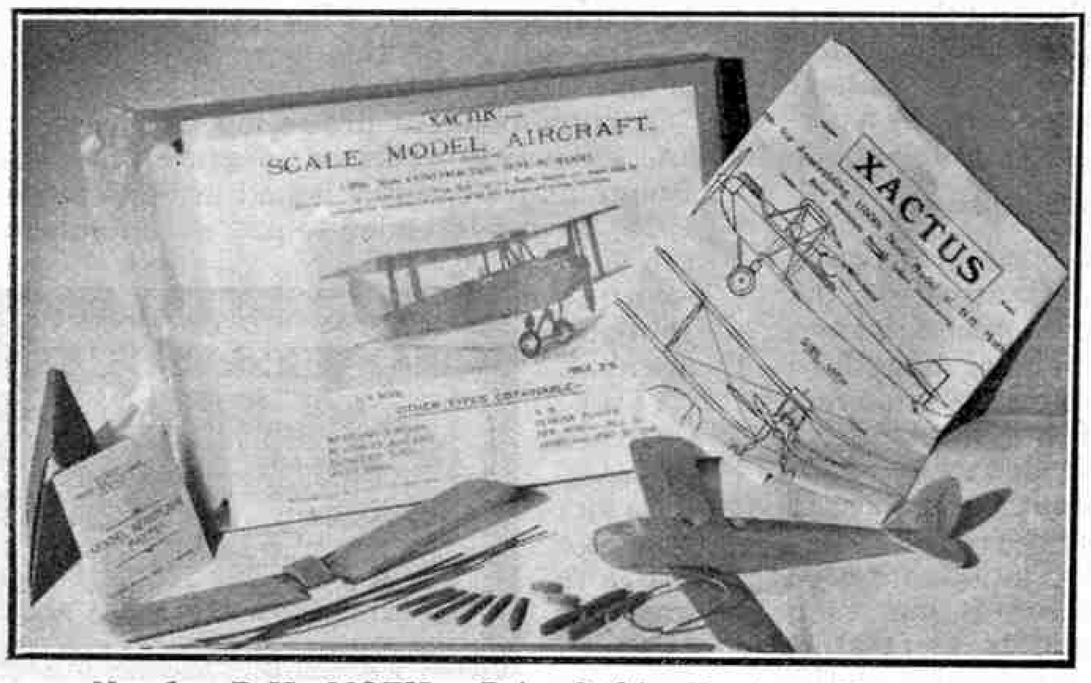

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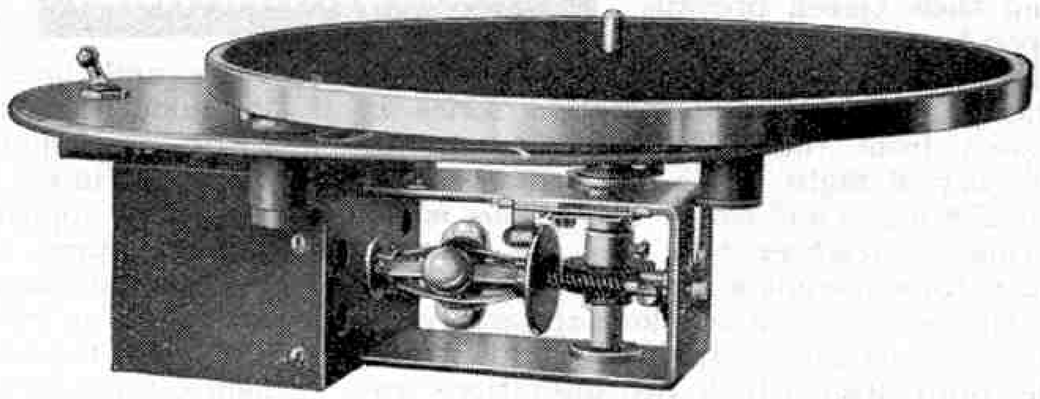

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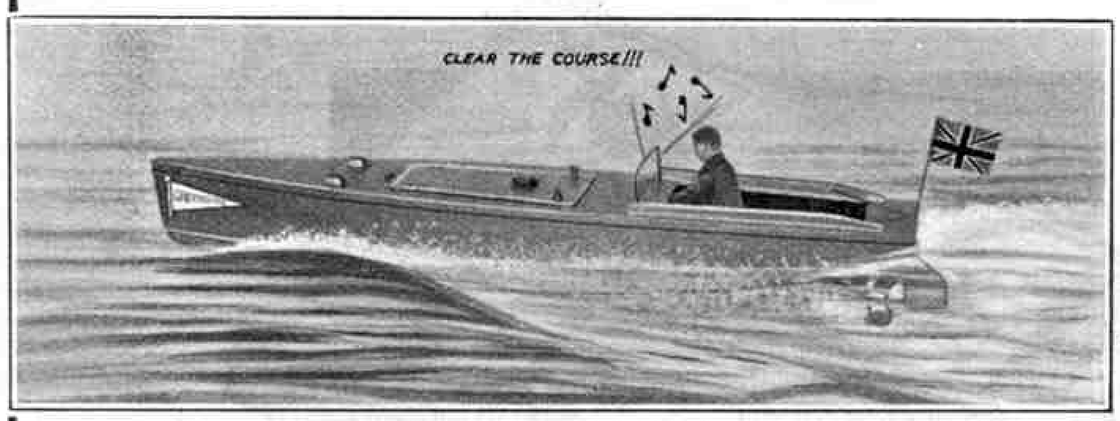

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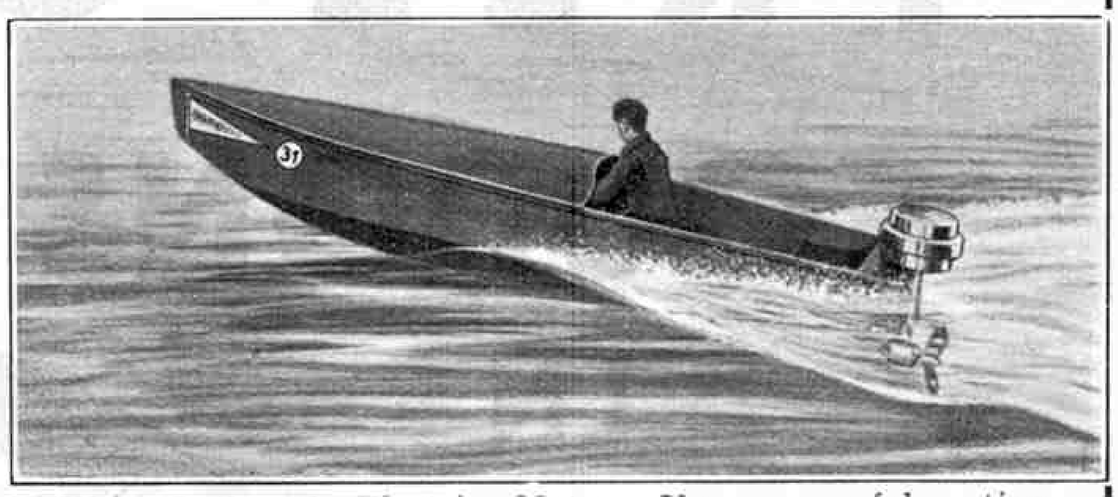

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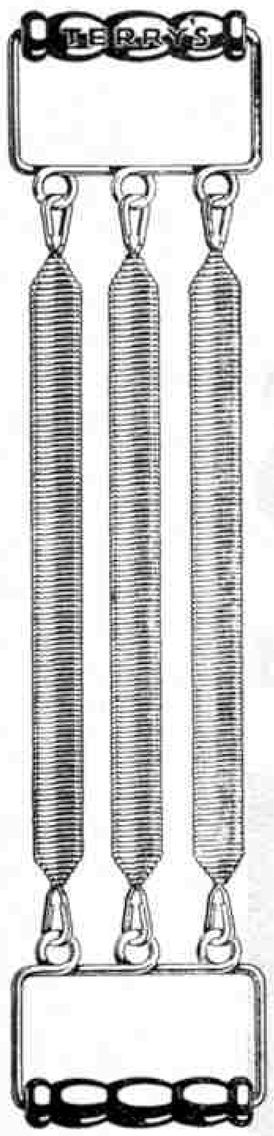

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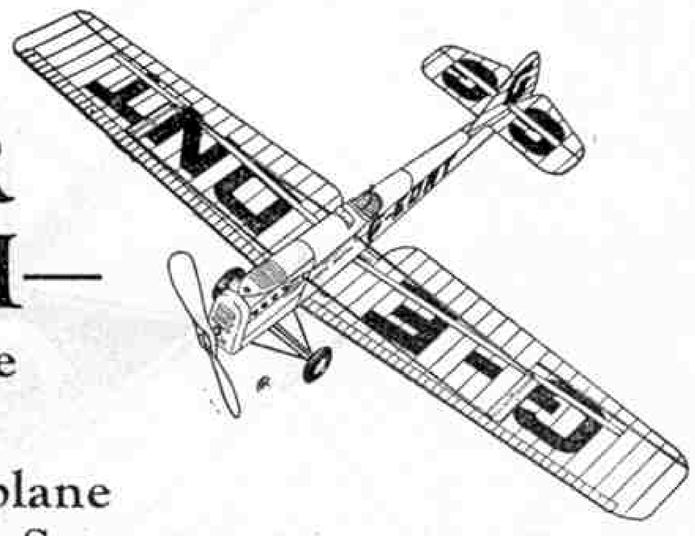

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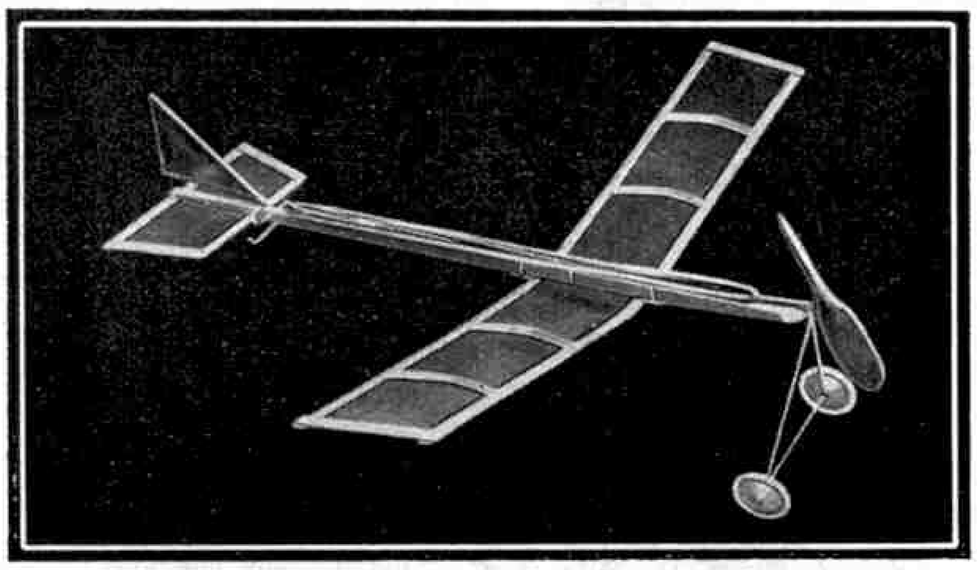

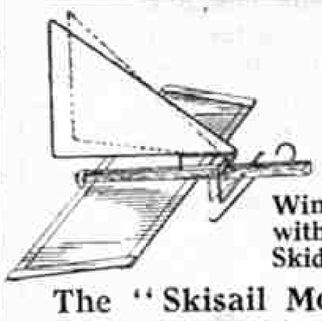

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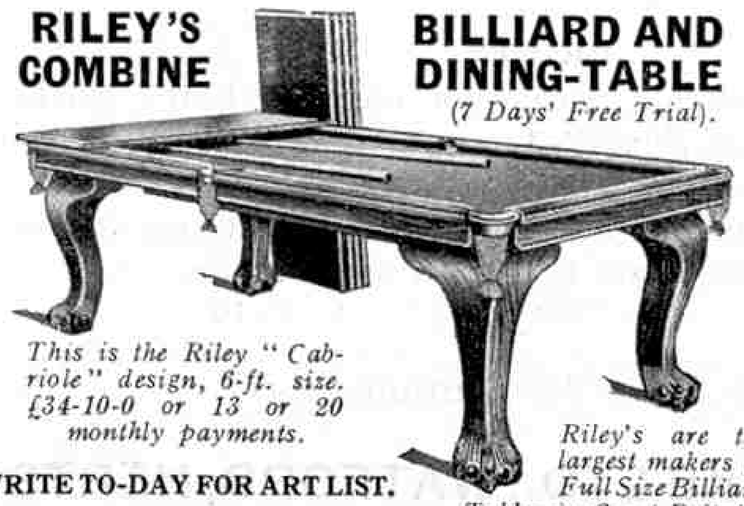

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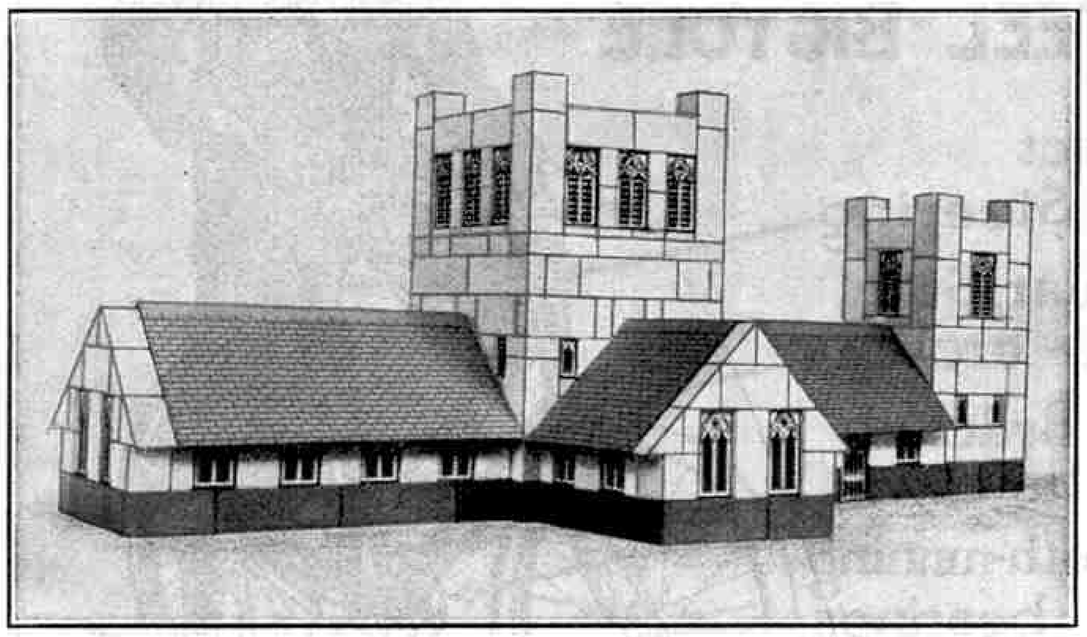

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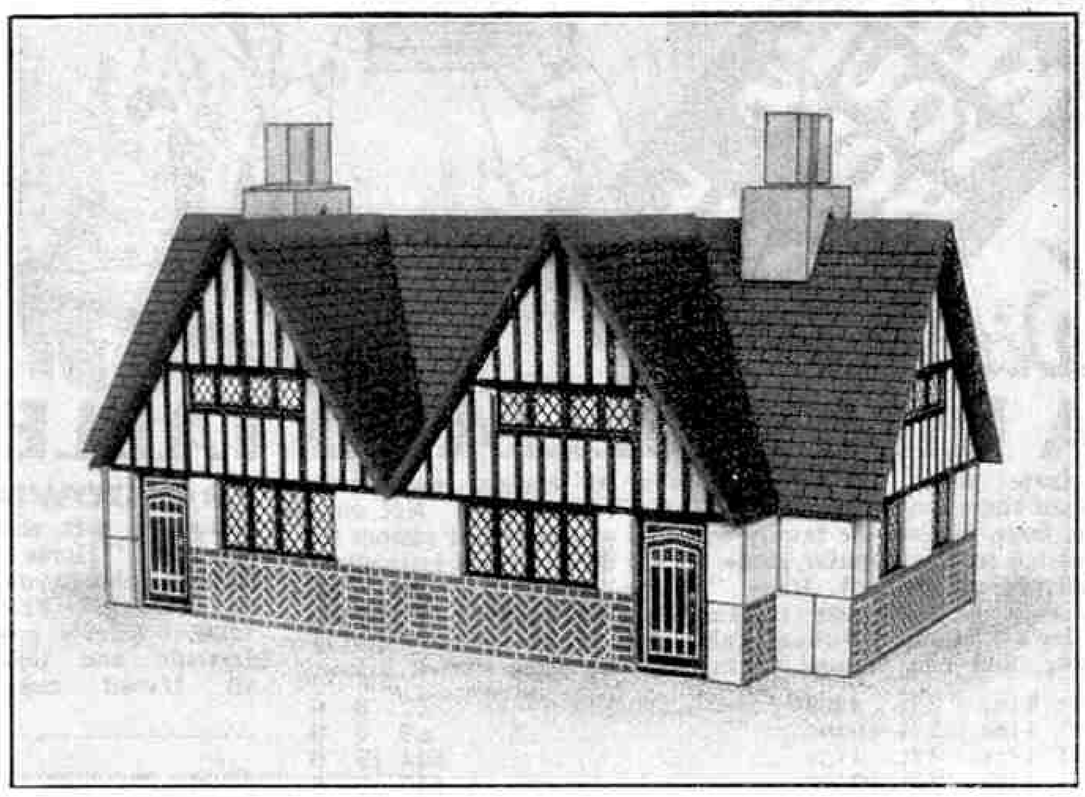

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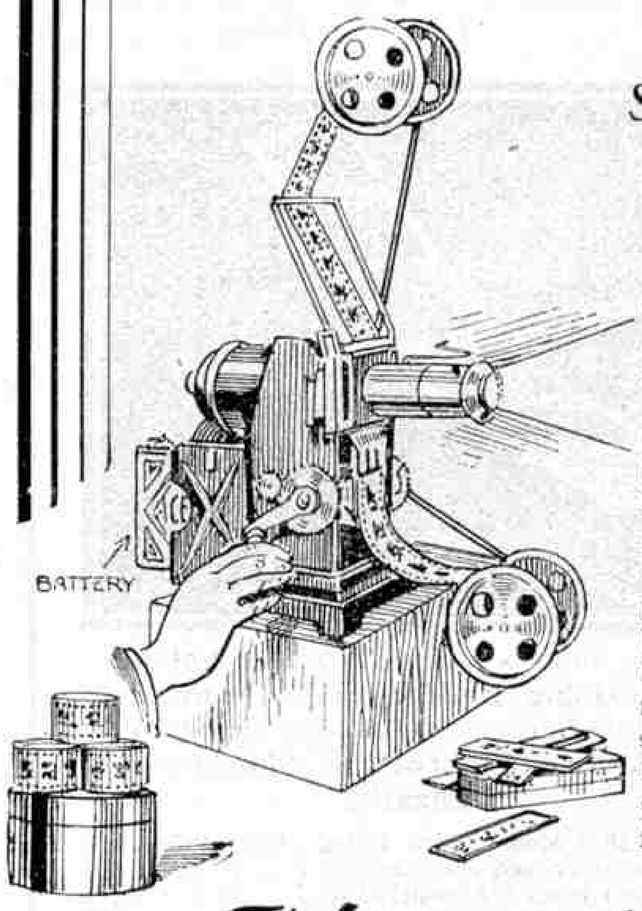

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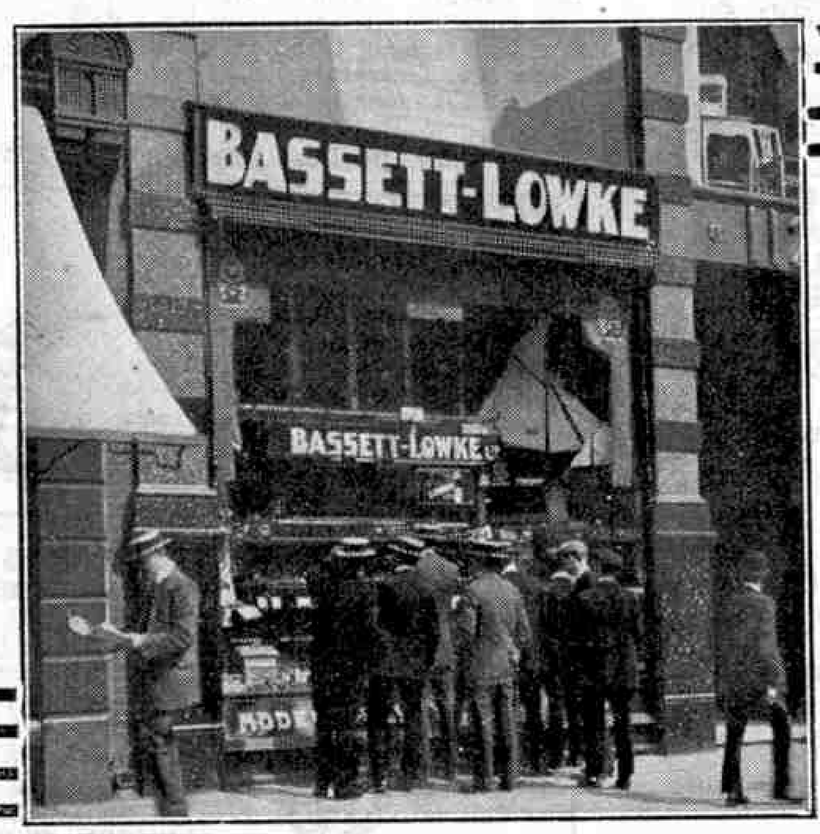

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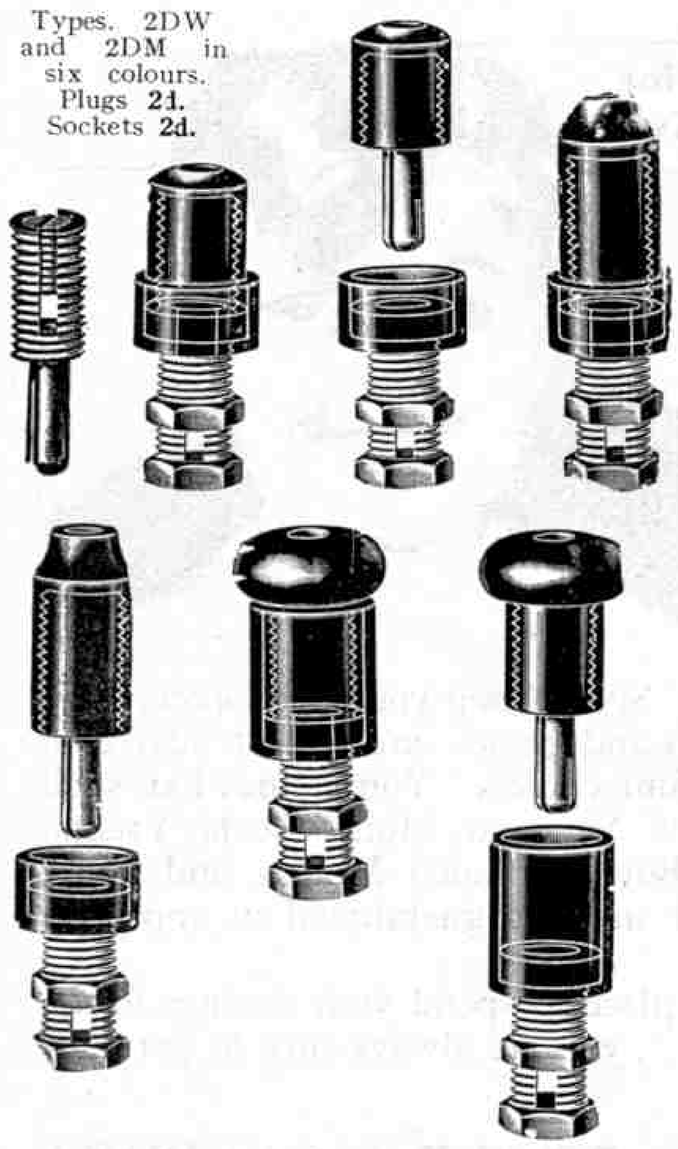

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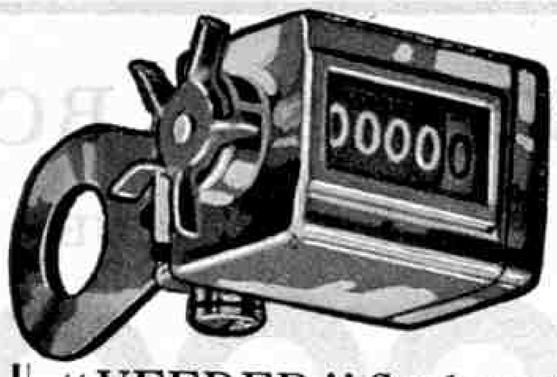

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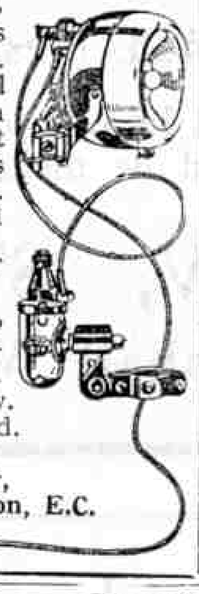

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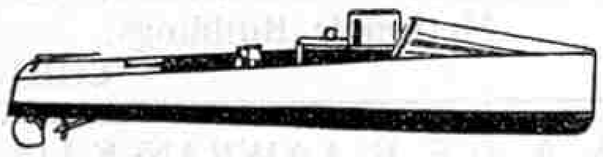

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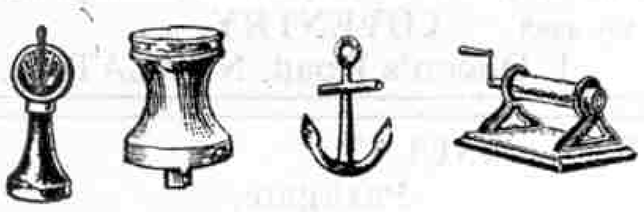

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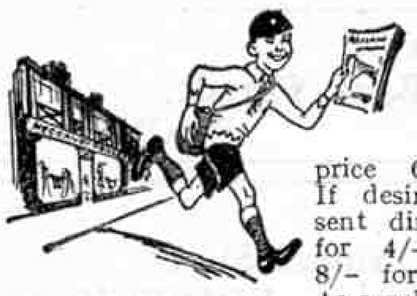

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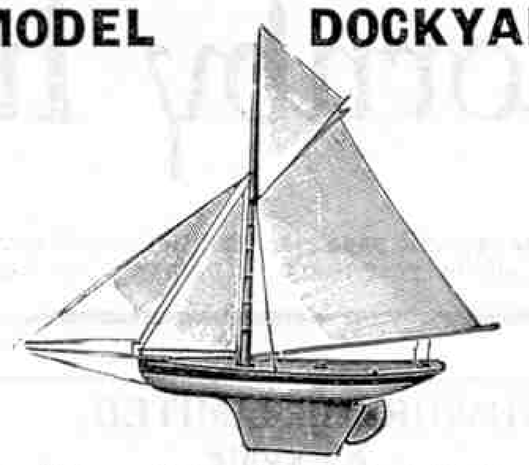

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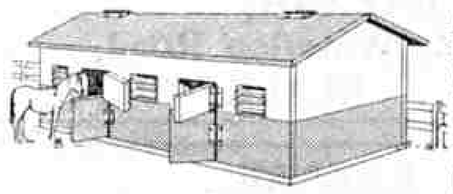

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Tel. 3587 SOUTHAMPTON.

RAVEN'S STORE,
90-92, High Street,
Tel. 67665 SOUTHEND-ON-SEA.

The London Cycle & Sports Co. (H. W. Ginn), 106, High Street,
Tel. 252 STAINES.

WRIGHT & CO.,
365 & 367, High Street,
Tel.: Maryland, 2942 STRATFORD, E.15.

DARNBROUGH & SONS LTD.,
59, High Street,
Tel. 66671 STOCKTON-ON-TEES.

DAN MORGAN, The Meccano Centre,
218, Oxford St.,
Tel. 2346 SWANSEA.

GOLDSMITH'S,
18, High Street,
Tel. 392 SWINDON.

FREDK. HARVEY,
4, Wellington Street,
Tel. 75 TEIGNMOUTH.

S. MAKIN,
120/124, Thatto Heath Rd.,
THATTO HEATH.

BATHE'S RADIO & GRAMOPHONE STORES, 19, Abbey Road,
Tel. 2934 TORQUAY.

WEBBERS' SPORTS DEPOT, EXETER. Tel. 3344 13/14, Victoria Parade, TORQUAY. Tel. 2453.

E. M. COLLINS,
12, Lower Castle Street,
TRALEE.

L. MYERSCOUGH, 57, South Rd.,
WATERLOO.
Branches: Crosby & Litherland.

W. L. LEWIS & SONS,
51, Church Street,
Tel. 210 WEYBRIDGE.

PATES BROS.,
10, Royal Cres., and
12, Frederick Pl., WEYMOUTH.

GILLITT & CO.,
26b, Lowther Street,
Tel. 318 WHITEHAVEN.

W. SHERWOOD MILLER,
34/7, Central Arcade,
Tel. 779 WOLVERHAMPTON.

W. JACKSON,
56 & 58, High Road,
WOODFORD GREEN.

H.R.C. WRITING PADS

Every member of the Hornby Railway Company should make a point of using the special H.R.C. writing paper for correspondence with his friends and with Headquarters. It is available in two sizes and is supplied in pads, each consisting of 50 sheets of superfine buff paper, and cover.

Prices—Large Size 1/- each (post free). Small Size 6d. each (post free).

ENVELOPES

Special envelopes, attractively printed and matching the writing paper in colour, are also available. These are suitable for both the large and the small sheets of writing paper.

Price, per packet of 50, 8d. post free.

Meccano Ltd., Old Swan, Liverpool.

WRITING PADS FOR MECCANO BOYS

These Writing Pads are very popular with Meccano boys as is shown by the large number of letters we receive each day written on the familiar tinted paper.

The Pads are supplied in two sizes, each consisting of 50 sheets and cover.

Prices—Large Size 1/- each (post free). Small Size 6d. each (post free).

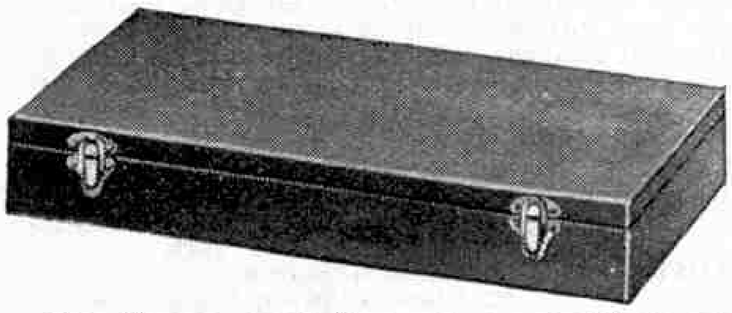
ENVELOPES

Special envelopes, attractively printed and matching the writing paper in colour, are also available. These are suitable for both the large and the small sheets of writing paper.

Price, per packet of 50, 8d. post free.

Meccano Ltd., Binns Road, Old Swan, Liverpool.

Storage Boxes



We have for disposal a number of wooden boxes. Although these boxes may be used for a variety of purposes, they are particularly suitable for storing Meccano parts.

The boxes are strongly made and are fitted with two strong spring clasps.

Price 2/9, post free.

Meccano Ltd., Old Swan, Liverpool.

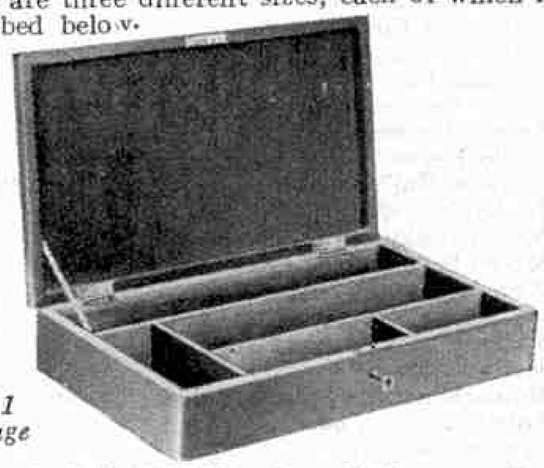
OIL CAN No. 1 (Ordinary Type)

This miniature Oil Can will give every satisfaction. It may be used for general purposes but it is particularly suitable for oiling Meccano Models and Hornby Trains. Price 6d.

Meccano Ltd., Binns Road, Old Swan, Liverpool.

STORAGE BOXES FOR MECCANO PARTS

Almost every Meccano boy purchases additional Meccano parts from time to time, but there is sometimes difficulty in finding suitable accommodation for them. The storage boxes that we supply are strongly made and have been specially designed for the purpose of keeping Meccano parts orderly and neatly. There are three different sizes, each of which is described below.



No. 1 Storage Box

No. 1 STORAGE BOX. Beautifully enamelled in red and fitted with partitions as shown in the illustration. The lid is hinged and is secured by means of lock and key. Dimensions: Length 15½ ins. Width 8¾ ins. Depth 2¾ ins. Price 10/6.

No. 2 STORAGE BOX. Finished as No. 1 Box and provided with lock and key. The tray with which it is fitted enables a much larger quantity of parts to be accommodated. Dimensions: Length 14½ ins. Width 11 ins. Depth 3¾ ins. Price 21/-.

No. 3 STORAGE BOX. A perfect receptacle for Meccano parts. Finished similarly to the No. 1 and No. 2 boxes and provided with lock and key. Fitted with two partitioned trays. Dimensions: Length 20 ins. Width 14 ins. Depth 5½ ins. Price 30/-.

Meccano Ltd., Binns Road, Old Swan, Liverpool.

MECCANO ENAMEL

Meccano enamel has been introduced to enable model-builders to convert nickel parts to colour or to touch up coloured parts should such treatment become necessary through mishandling. It is available in red, grey or green, each colour being identical in shade with the enamels used in the Meccano Factory for spraying Meccano parts.

Price per tin 8d.

Meccano Ltd., Binns Road, Old Swan, Liverpool.

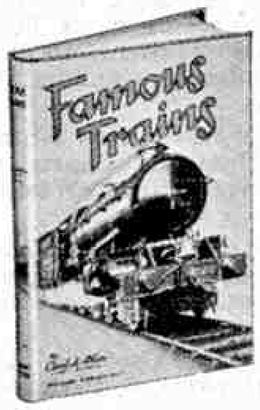
BINDING THE "*M.M.*"

Binding cases for back numbers of the Magazine may be obtained from Messrs. O. H. Bateman and Co., 23, Hanover Street, Liverpool. These are supplied in two sizes (1) for six copies price 3/6 and (2) for twelve copies price 5/3, post free in each case. The binding cases are supplied in what is known as "Quarter Basil, full cloth"—that is to say three-quarters of the sides are dark crimson cloth and the back and a quarter of the sides are dark crimson leather as shown here. The case is tastefully embossed in gold with the name "Meccano Magazine," and on the back is the name and volume number.

Binding 6 or 12 copies. These binding cases are supplied so that readers may have their Magazines bound locally, but where desired, the firm mentioned above will bind Meccano Magazines at a charge of 6/6 for six issues or 8/6 for twelve issues, including the cost of the binding and also return carriage. The covers of the Magazines may be included or omitted as required, but in the absence of any instructions to the contrary they will be included.

Whilst the binding of the twelve Magazines is quite satisfactory, they form a rather bulky volume and for that reason arrangements have been made to bind six months' Magazines where so desired, as explained above. Back numbers for any volume can be bound and the case will be embossed with the volume number.

FAMOUS TRAINS



Thirteen chapters of Mr. C. J. Allen at his best!

All Railway enthusiasts should have this book. It contains much reliable and valuable Railway information, including the leading dimensions of many of the most famous express passenger locomotives in this country.

Price now 1/9 post free
from
MECCANO LIMITED,
Old Swan, Liverpool.

MECCANO CARTONS

We are frequently asked to quote prices of empty Meccano Cartons by boys who have damaged their own, or who, having purchased an Accessory Outfit, require a single carton or Wood Cabinet to hold all their parts. We therefore give below a full list of both Cartons and Cabinets with prices.

Carton	Price	Postage
No. 00	4d.	4d.
" 0	4d.	4d.
" 1	1/-	6d.
" 2	1/4	6d.
" 3	1/8	9d.
" 4	2/11	9d.
" 5	7/9	1/-
" 6	10/10	1/3
" 00A	4d.	3d.
" 0A	8d.	3d.
" 1A	8d.	4d.
" 2A	1/4	6d.
" 3A	1/5	6d.
" 4A	1/2	6d.
" 5A	2/5	9d.

WOOD CABINETS (with lock & key)

	Price	Postage
No. 5	40/-	1/-
" 6	45/-	1/3
" 6A	52/6	*
" 7	145/-	*

* Carriage Forward.

Meccano Ltd., Binns Road, Old Swan, Liverpool.

"MECCANO MAGAZINE" SPRING BACK BINDER

There is no better way of keeping your Magazines clean and tidy than by binding them in one of the special binders we supply.

These binders have strong stiff backs, covered with black imitation leather, tastefully tooled, and are lettered in gold. The large binder holds 12 Magazines—price 4/6 post free. The small binder holds 6 Magazines — price 3/- post free.

Meccano Ltd., Old Swan, Liverpool.

MECCANO LUBRICATING OIL

Before commencing to operate a Meccano model, or to run a Hornby Train, all gears and bearings should be oiled thoroughly with Meccano Lubricating Oil. This oil is specially prepared and is of the right consistency for the purpose. Price per bottle 6d.

Meccano Ltd., Binns Road, Old Swan, Liverpool.

READERS' SALES

As New. Gauge 1 Express Clockwork Engine, cost £5/5/-; 2 Coaches, 8 Rolling Stock, 2 Pneumatic Buffers, 90 Electric Lines, 2 Crossovers, 3 Points. Cost £15. What offers? Magic Lantern, 10 Boxes Plates. Cost £6/16/-. What offers?—Cunliffe-Lister, Swinton Castle, Masham, Yorks.

Concertina, 20 Key, and Tutor, 7/-. New 5-Strand Expander, Sandow 7-Spring Dumbells, Charts, new condition, 11/-.—J. Kean, Newport Road, Westport, Mayo, I.F.S.

Wanted. Baby Adana Press, or one similar. Cheap. Sale. Ensign Junior Developing Tank. Used twice. Cost 6/6. 4/- complete.—Browne, 30, Bennett Road, Cleethorpes.

Bowman Tank Engine for sale. Used six times. Will take 12/6 or offers.—H. Hopkins, 6, Park Mews, Kilburn, London, N.W.6.

Sale. Films, Slides. Stamp for list.—Cooke, 90, Woodwarde Road, Dulwich, London.

Wanted. B.D.V. Gift Coupons, 2/6 per 100.—Bowen, "Myrddin," Woodhill Road, Colwyn Bay.

For Sale. No. 3 Elector at 5/-, also 26 Novels at 3d. each, and 12 others at 6d. each.—H. Kelly, 82, Ocean Street, Heyham, Devonport.

Selling Stamp Collection and Duplicates, all Mediterranean, mostly Maltese, Tunisian, Algerian, Liban, Palestine in packets of 60 for 6d.—Agius, 88, Strada Mercanti, Valletta, Malta.

Sale, 1,000 ft. Film, Comic, Drama, 3/9. Separate or exchange.—Finn, 7, Raglan Road, Edgbaston, Birmingham.

Wanted. March, July, August, and September copies of 1927 "Meccano Magazine." Offers. Actual copies not to be sent.—Box 302.

Snip 34/- Express, 18/-; 5/- Coaches, 3/6; £1 Rails, 10/-. Lot 30/-. B-Lowke.—English, Barnes, Christ's Hospital, Horsham.

Sale. "M.M.'s," May-December, 1930, excellent condition, 4d. issue, 3/- lot. Pair Ball-bearing Roller Skates, brand new, cost 6/-. Take 3/6. Leather Wallet, new, 2/-.—Collier, Blackley Golf Club, Blackley, Manchester.

"World Wide" Album, containing over 4,700 British and Foreign Stamps, all different and classified. Fine Collection, £5/5/-.—C. Neate, 276, Coldharbour Lane, London, S.W.9.

27 "M.M.'s," Sept. 1928-Dec. 1930, perfect, 6/-. Complete Wonder Books—Ships, Aircraft, Engineering, etc., 13 perfect volumes. Cost 78/-. Sell 30/-.—42, Oughton Road, Highgate, Birmingham.

Sale. Einemann Cinematograph, standard size, 30/-. Also unused Lillywhite Cricket Bat, Harrow size, 10/-.—Brampton, Southborough, Tunbridge Wells.

Wanted. Tram Tickets from all parts. No Price given.—Breach, 16, St. Pauls Road, St. Leonards.

Sale. "M.M.'s" for 1928. Bound. What offers?—Brown, 26, College Road, Clifton, Bristol.

"Meccano Magazines," 1925-30 inclusive, for sale. Good condition. Three Copies missing. Also six Hornby Books of Trains. Offers.—Wilkins, 99, High Street, Cinderford.

Exchange. Wormar Steam Engine D, for Cinematograph.—J. Horne, Dorn, Moreton-in-Marsh.

Stamps. Exchange Stamps with any country.—Alan Hutchinson, 39, Strathallan Boulevard, Toronto 12, Ontario, Canada.

Must sell Meccano and Railway Magazines, also excellent Folding Camera. Apply—Russell, 68, Coniston Road, Croydon.

Sale. Model Yacht, 27 in., excellent condition, worth 60/-. Take 27/6 or offer.—Tyrrell, 7, The Grove, Wandsworth, London.

48 ft. Bowman Steel Rails, unused, 2½d. ft. S.T. Steam Plant, 6/-. Cost 17/6.—Wilkinson, 2, Crescent, Belmont, Surrey.

Wanted. Stamp Collectors to exchange Stamps at catalogue values.—P. Mytton, Groomsport, Down.

Sale. Large Clockwork Cabin Launch, 25/-. Cost 75/-. Also Football, 3/6.—11, Grisham Road, Bournemouth.

For Sale. £3. New B.S.A. Air Rifle. Value £4.—12, Rixsen Road, Manor Park, E.12.

"Meccano Magazines," Bound, 1925-6, 1927, 1928. Excellent condition, £1.—A. A. Joyce, 4, Carnleigh Villas, Kenton, Middlesex.

For Sale. Birds' Eggs. Write for Free List.—A. Forbes, Clutton, Chester.

Sale. Two Cylinder Vertical Steam Engine, Air Gun, Cigarette Cards, Books, Educational and Fiction, Modern Boy, Autocar. 2d. Stamp for Catalogue.—W. Kirby, 2, Hughenden Road, High Wycombe, Bucks.

Sale. 6,000 Cigarette Cards, including 55 Sets. Enquiries welcomed.—Culverhouse, 74, Rupert Road, Sheffield.

Cigarette Cards, Sets, Odds, Lots. Lists—Thornton, 159, Grosvenor Road, Wavertree, Liverpool.

Sale. "Meccano Magazines," 1927-30 inclusive, perfect condition. Offers?—Souter, Station House, Monifieth, Dundee.

Sale. Ten years' Collection, 1,800 Stamps, mounted in Triumph Album, Approval Catalogues included. Catalogued £8. Take £4 or nearest offer.—Letterfield, Windyridge, Willaston, Birkenhead.

This Month's Special Articles

	Page
Across The Andes by Rail	196
Air News	222
Arch Bridge Across the Tyne	186
Automatic Train Control on the G.W.R.	198
Books to Read	216
Competition Page	253
Discovery of the Ninth Planet ...	202
Electro-Hydraulic Transmission ...	208
Engineering News	212
Exploring the Antarctic	200
Famous Trains—"*The Gold Coast Limited*"	191
Fireside Fun	255
Friese-Greene, Kinematograph Pioneer	188
From Our Readers	218
Guild Pages	248–9
Hornby Railway Company Pages ...	236–247
In Reply—Meccano Section	233
Model-Building Contests	229
Model-Building Contests Results ...	230
New Meccano Models	234
Of General Interest	214
Parnall "Peto" Seaplane	220
Railway News	194
Remarkable Six-Wheeled Motor Chassis	224
Spirit of "*St. Louis*"	190
Stamp Collecting	257
Stamp Gossip	259
Suggestions Section	226
"What Shall I Be?"	206
World's Most Powerful Searchlight ...	211

RAILWAY PHOTOGRAPHS.

We have just added a complete set (ten) of the "Schools" class to our list. Send 4d. for Specimen Photograph and list **M.10.** All Photographs postcard size, 3d. each, 2/6 doz.

Railway Photographs, 23, Hanover St., Liverpool.

For Sale. High Voltage, Gauge 1, Electric Railway. Particulars apply—J. Lewin, Canons, Ware.

Sale. Bowman Stationary Engine. Cost 37/6. In perfect order. Only used five times. Also three Models and Shafting. Whole Outfit cost £2/10/-. Selling for 25/-.—Phelan, The Square, Bagenalstown, Co. Carlow, I.F.S.

Sale. Bargain. Complete Gauge 0 Railway, Toys, etc. Stamp for List.—Bain, 8, Victoria Road, Elgin, Scotland.

Stamp Collectors send 6d. for bundle interesting Stamp Magazines.—Rhodes, Chestergate, Macclesfield.

Kolster Brandes, "Masterpiece" 2-Valve Wireless Set complete with Loud Speaker £5/5/- Model; New, 55/-, also "Modern Electrical Engineering," 6 Vols., cost 75/-, 36/-; and "Chums," 1922, 3/6. The lot together, 92/6.—R. Tatner, Beacon Hill, Hindhead.

Air Rifle, as new. Cost £1. Must sell. Further particulars.—Barlow, Castle Lane, Devizes.

Jazz Band, 17 inch, Single-sided Drums, 12/-.—E. Caleno, 142, Streatham Vale, London, S.W.16.

Wanted! Ardath Coupons.—Write P. Lang, 52, New Road, S. Chingford.

CIGARETTE CARDS SPECIAL NEW YEAR OFFER

5 sets (200 cards) with Slip-in Album to hold 200 cards, **2/9** post free. New list of nearly 300 sets free.

THE BRITISH CIGARETTE CARD CO., 47, Lionel Road, Brentford, Middlesex.

FILMS of every description from 5/-.—Baers, 176, Wardour Street, W.1. Est. 1907. We buy, sell, and exchange.

Why Trains are Double-Headed—

(*Continued from page 245*)

Double-heading may be carried out with great success in miniature railway practice. With clockwork as the motive power the ideal arrangement is of course for two similar engines to be used, as they will then be practically identical in speed and length of run. Where a locomotive of a certain type is noticeably faster than the other with which it is proposed to be run, it is probably better to place the more speedy locomotive first, as this will obviate the trouble that might occur through the slower of the two being pushed by the other, especially when rounding curves. Trains of considerable length and weight may be dealt with in this manner, and the performance of the two engines is extremely interesting to watch. We strongly recommend Hornby Railway owners to experiment with double-heading, and we should be glad to hear of the results they obtain.

MECCANO MAGAZINE

Registered at G.P.O., London, for transmission by Canadian Magazine Post.

EDITORIAL AND ADVERTISING OFFICE:—

OLD SWAN, LIVERPOOL, ENGLAND.

Telegrams: "Meccano, Liverpool."

Publication Date. The "*M.M.*" is published on the 1st of each month and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price 6d. per copy. It will be mailed direct from this office, 4/- for six issues and 8/- for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

Readers' Sales and Wants. Private advertisements (i.e., not trade) are charged 1d. per word, minimum 1/-. Cash with order. Editorial and Advertising matters should not be dealt with on the same sheet of paper.

Advertisers are asked to note that private advertisements of goods manufactured by Meccano Limited cannot be accepted.

Small Advertisements. 1/6 per line (average seven words to the line), or 16/- per inch (average 12 lines to the inch). Cash with order.

Display. Quotations for space bookings, and latest net sale figures, will be sent on request.

Press Day, etc. Copy should be sent as early in the month as possible for insertion in following issue. We usually close for press on or before 6th of each month for following issue. Half-tone blocks up to 100 screen.

Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher copies. Sent free to advertisers booking one inch or over. Other advertisers desiring vouchers should add 8d. to their remittance and should order voucher copy at same time.

Remittances. Postal Orders and Cheques should be made payable to Meccano Ltd.

Ordering the "M.M." Overseas

Readers Overseas and in foreign countries may order the "*Meccano Magazine*" from regular Meccano dealers or direct from this office. The price and subscription rates are as above, except in the cases of Australia, where the price is 1/5 per copy (postage extra), and the subscription rates 9/6 for six months and 19/- for 12 months (post free); Canada, where the price is 15c. per copy, and the subscription rates 75c. for six months, and $1.50 for 12 months (post paid).

The U.S.A. price is 15c. per copy, and the subscription rates $1 and $2 for 6 and 12 months respectively (post free).

Overseas readers are reminded that the prices shown throughout the "*M.M.*" are those relating to the home market. Current Overseas Price Lists of Meccano Products will be mailed free on request to any of the undermentioned agencies. Prices of other goods advertised may be obtained direct from the firms concerned.

CANADA: Meccano Ltd., 34, St. Patrick St., Toronto.
UNITED STATES: Meccano Co. of America Inc., New Haven, Conn. Meccano Co. of America Inc., 200, Fifth Av., New York.
AUSTRALIA: Messrs. E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W.
NEW ZEALAND: Models Ltd., Kingston & Federal Streets, Auckland.
SOUTH AFRICA: Mr. A. E. Harris (P.O. Box 1199), 142, Market Street, Johannesburg.
INDIA: Karachi: Bombay Sports Depot, Elphinstone Street, Bombay; Bombay Sports Depot, Dhobi Talao. Calcutta: Bombay Sports Depot, 13/C, Old Court House Street.

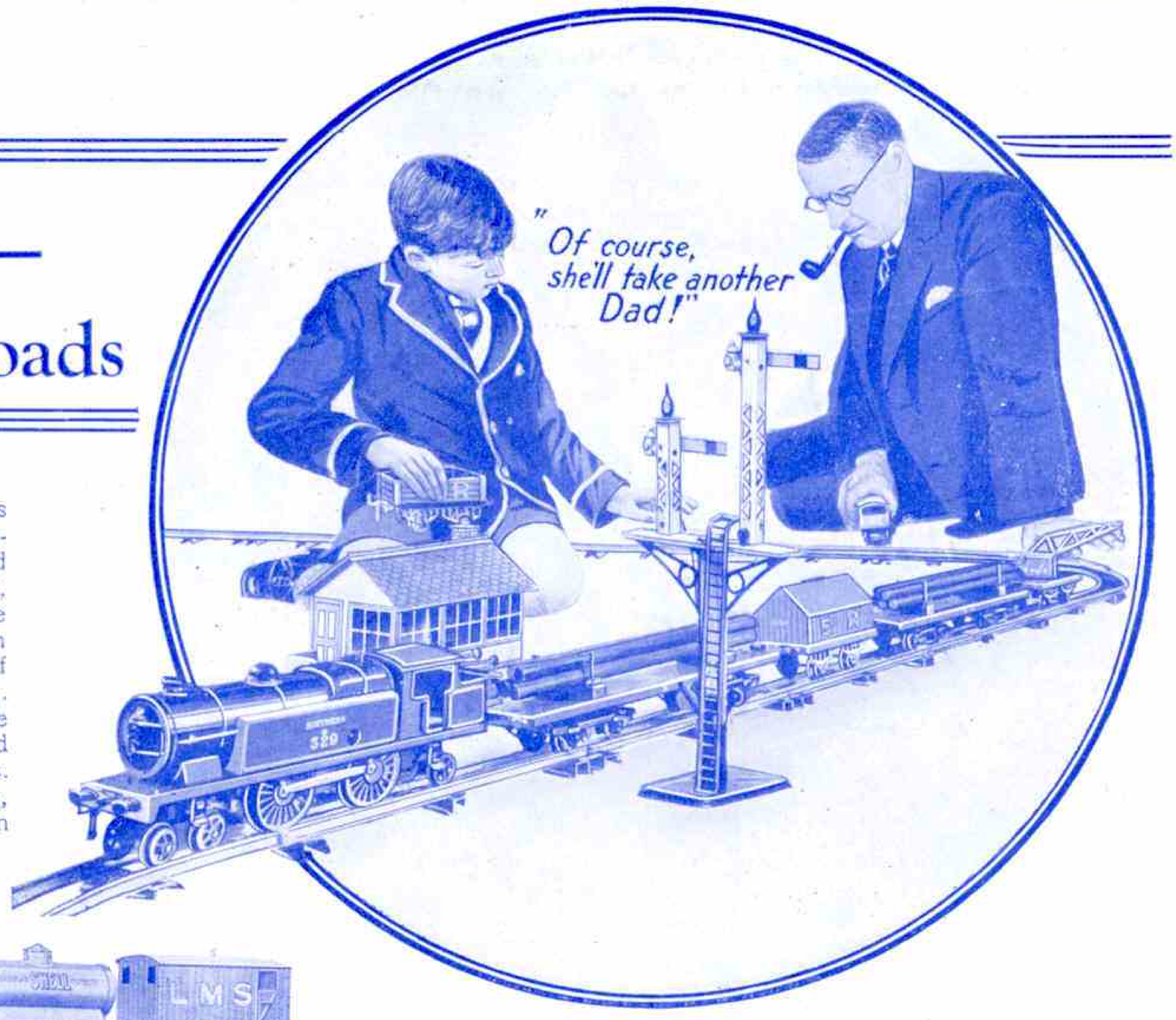
The Editor wishes to make known the fact that it is not necessary for any reader to pay more than the published price. Anyone who is being overcharged should lodge a complaint with the Meccano agent in his country or write direct to the Editor.

CINEMATOGRAPHS British Made from 37/6
CINEMATOGRAPH FILMS
from 5/- per 1,000 ft.
Write for our Catalogue, post free, or send 1/- for sample length of Film and Catalogue.
Filmeries Co., 57, Lancaster Rd., Leytonstone, E.11

Cinematographs, Standard Films, Cheap. Join our Film Library. Lists—"Cinema," 109, Kenlor, Tooting.

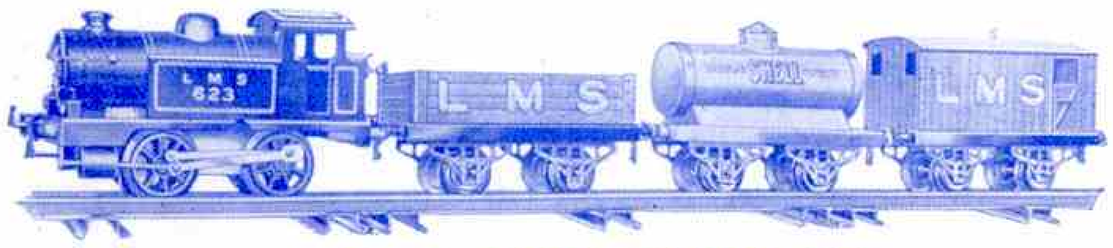
CINEMA FILMS FOR SALE. Cheap. Standard size only.—Skelhorn, Greystones, Gaskell Rd., Altrincham.

Longer Runs— with Heavier Loads



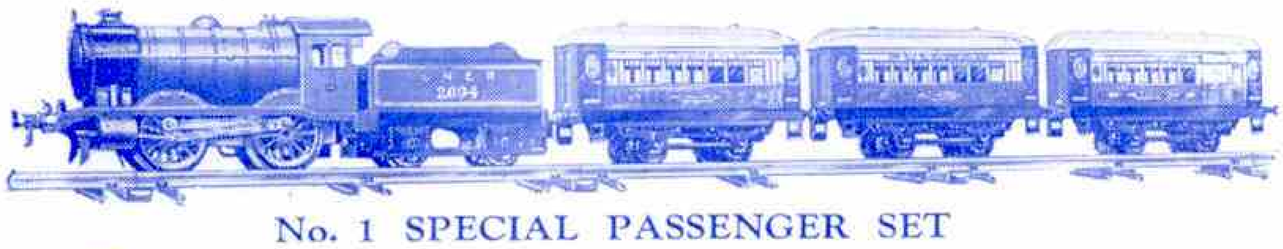
Hornby clockwork and electric trains are the best that you can buy. The Locomotives are built for heavy loads and long runs; the Rolling Stock is strong, smooth running and durable; the Accessories are realistic and correct in proportion. Every article is made of the finest material, by British craftsmen.

It will be a great moment in your life when you have a Hornby Train Set, and are able to play the great game of railways. Nothing could give you greater pleasure, there is no other game you'd be as keen to play.



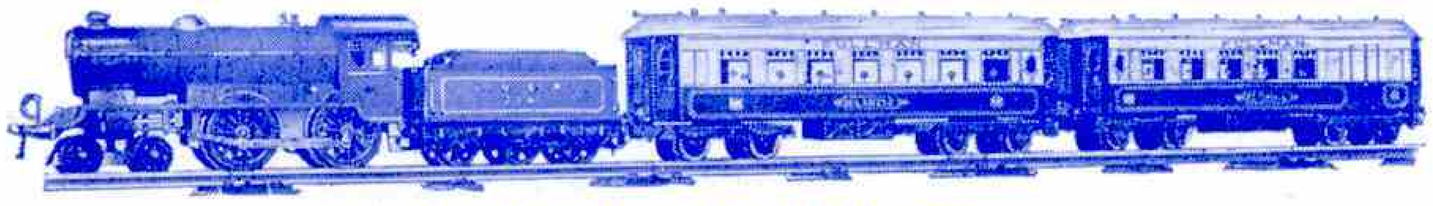
No. 1 TANK GOODS SET

No. 1 SPECIAL GOODS SET



No. 1 SPECIAL PASSENGER SET

No. 2 MIXED GOODS SET



No. 2 SPECIAL PULLMAN SET

Tell Dad what you think of these fine models of modern engines and rolling stock. Tell him what every boy knows—that Hornby Trains are the best, strongest and most efficient model trains in the world!

PRICE LIST

CLOCKWORK TRAIN SETS

M0 Goods Set	5/–
M0 Passenger Set	5/9
M1 Passenger Set	9/3
M1 Goods Set	10/–
M2 Passenger Set	10/6
No. 0 Goods Set	15/–
No. 0 Passenger Set	15/–
No. 1 Goods Set	20/–
No. 1 Tank Goods Set	22/6
No. 1 Passenger Set	25/–
No. 1 Special Goods Set	32/6
No. 1 Special Passenger Set	35/–
No. 2 Mixed Goods Set	40/–
Metropolitan Train Set C	45/
No. 3C Train Set "Riviera Blue"	62/6
No. 2 Special Pullman Set	67/6
No. 3C Train Sets, "Flying Scotsman," "Royal Scot," "Cornish Riviera," or "Continental Express"	67/6

ELECTRIC TRAIN SETS (6-VOLT)

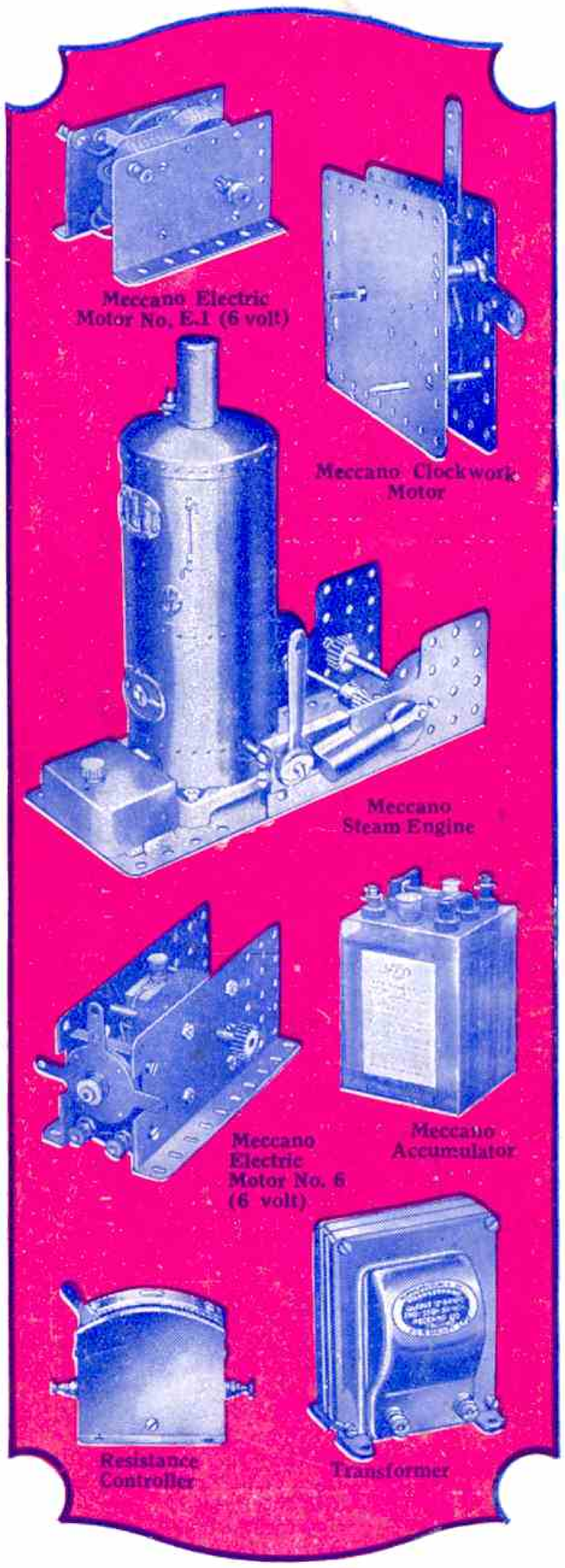
No. 3E Train Set "Riviera Blue"	80/–
No. 3E Train Sets, "Flying Scotsman," "Royal Scot," "Cornish Riviera," or "Continental Express"	85/–
Metropolitan Train Set L.V.	85/–

HORNBY TRAINS

BRITISH AND GUARANTEED

MANUFACTURED BY MECCANO LIMITED OLD SWAN LIVERPOOL

Run your Model with a Meccano Motor



If you want to obtain the fullest possible enjoyment from the Meccano hobby you should operate your models with a Meccano Motor or Steam Engine. You push over the control lever of the motor or engine and immediately your Crane, Motor Car, Ship Coaler or Windmill commences to work in exactly the same manner as its "big brother" in real life. Could anything be more exciting?

The Meccano Motors and Steam Engine are strongly made and the utmost care is taken in their manufacture to ensure that they will give satisfaction. The side plates and bases are pierced with the standard Meccano equidistant holes, which enables a motor or engine to be built into any Meccano model in the exact position required.

Particulars and prices of the Steam Engine, Motors and Accessories are given below.

Meccano Clockwork Motor

This splendid Motor, which is specially designed for operating Meccano models, is a compact self-contained power unit.

An efficient governor controls the spring that is fitted on the motor and ensures a long steady run at each winding. Brake and reverse levers enable the motor to be stopped, started and reversed as required. Supplied complete with winding key and full instructions. Price **7/6**

Meccano Steam Engine

This is a particularly powerful steam unit designed for driving Meccano models. On actual test it has lifted over 56 lbs. A single cylinder of the oscillating type is employed, steam being admitted to it through a special reversing block. Operation of the reversing lever enables the crankshaft, which is fitted with a special compensating flywheel to run in either direction.

The spirit container for the lamp is placed well outside the boiler-casing, eliminating all risks of the spirit becoming heated. The boiler is fitted with an efficient spring safety valve of heavy gauge brass and there is no danger whatever of the boiler exploding. Price **25/-**

Meccano Electric Motor No. E.1
(6-volt)

This highly efficient electric motor (non-reversing) gives excellent service. A 6-volt Accumulator will operate it, but it may also be driven from the main (alternating current only) through the Transformer described in the next column. Price **7/6**

Meccano Electric Motor No. 6
(6-volt)

This 6-volt Motor is specially designed to build into Meccano models. It may be run from a 6-volt accumulator or, by employing the Transformer described below, from the main. It is fitted with reversing motion and provided with stopping and starting controls. The gearing is interchangeable. Price **15/6**

IMPORTANT.—Meccano 6-volt Motors will not run satisfactorily from dry cells.

Accumulator (6-volt, 20-amps)

The Meccano Accumulator is of substantial construction and is specially recommended for running the Meccano 6-volt Electric Motors. Price **28/6**

Transformer

By means of this transformer the Meccano 6-volt Electric Motors may be driven from the house supply (alternating current only). It is available for all standard supply voltages, from 100 to 250 inclusive, at all standard frequencies. The supply voltage and frequency must be specified when ordering. Complete with length of flex and adapter for connection to an ordinary lamp socket. Price **30/-**

Resistance Controller

By employing this variable resistance the speed of the Meccano 6-volt Electric Motors may be regulated as desired. The controller is connected in series with the motor and accumulator, or with the motor and transformer if a transformer is used as the source of power. It will not regulate the speed of a high-voltage motor connected to the main. Price **4/6**

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