VOL. XIX. No. 9

SEPTEMBER 1934

MECCANO MAGAZINE

GIANT MOULD FOR TUNNEL LINING
(see page 682)

6D.

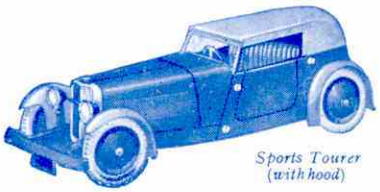
MECCANO

MOTOR CAR CONSTRUCTOR OUTFITS

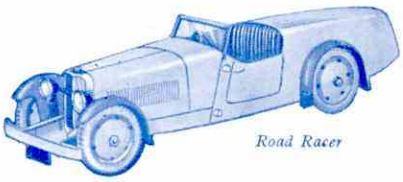
Meccauto 538189

One of the most fascinating of all boys' hobbies, either indoor or outdoor, is model car operation with cars built from Meccano Motor Car Constructor Outfits. Perfect miniature reproductions of many different types of car can be built with these splendid Outfits, including sports four-seaters, speed cars, sports coupés and others.

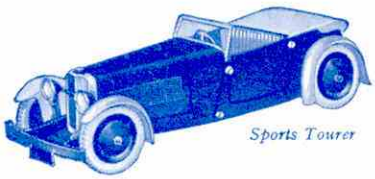
Now is the time to get a Meccano Motor Car Outfit. You will never grow tired of building and running the superb models that you will be able to build.



Sports Tourer (with hood)



Road Racer



Sports Tourer

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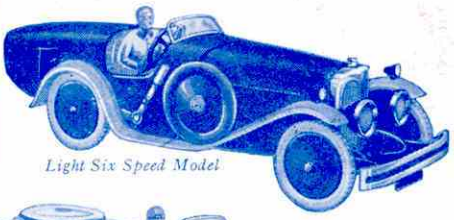
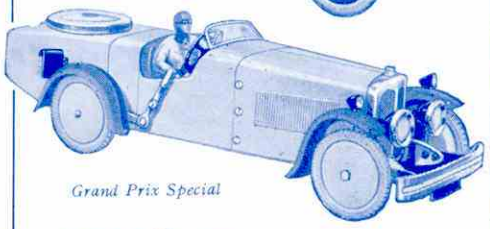
The motor car models that can be built with this Outfit are the finest you ever saw. Look at the examples illustrated above and think of the fun you could have building these and other types equally realistic.

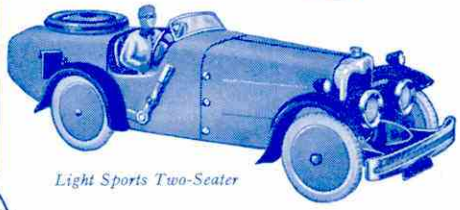
No. 1 Outfit is available in four different colour combinations and is supplied complete with powerful Clockwork Motor. Price **14/6**



Light Six Speed Model



Grand Prix Special



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No. 1 Meccano Motor Car Outfit

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The Meccano Motor Car Garage provides accommodation for any Meccano model motor car or other cars of suitable size. Inside dimensions: Height 5 in., Length 13 in., Width 7¾ in. Price **7/-**

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NEXT MONTH: "THE PLANETS AND THEIR ATMOSPHERES." READY 1st OCTOBER

MECCANO MAGAZINE

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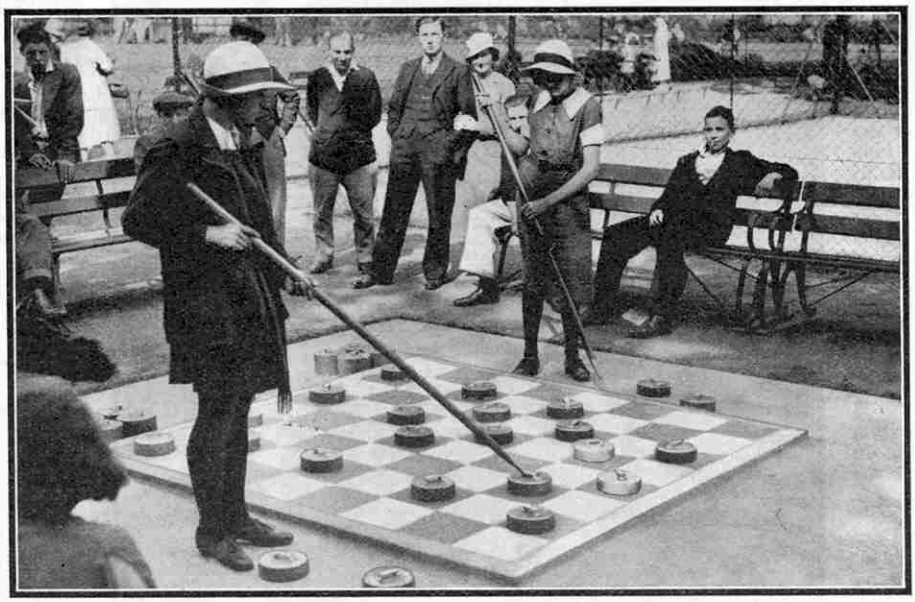
September, 1934

With the Editor

Treasure Hunting—New Style

I see that a well-equipped expedition has sailed from London in search of the immense treasure that is supposed to lie buried on Cocos Island, a lonely spot in the Pacific Ocean some 500 miles from Panama. This island was once the resort of many notorious pirates, and the organisers of the expedition are convinced that fabulous wealth, amounting possibly to as much as £25,000,000, awaits discovery.

The most important pirate hoard said to be buried there consists of life-sized gold statues of the Madonna and of the Twelve Apostles that once adorned the wonderful Cathedral of Lima, Peru, together with an immense mass of church plate and other valuables. When Spanish America was in revolt about 120 years ago the city was threatened with assault, and in fear and trembling the citizens added their private hoards to the treasure from the Cathedral, which was removed for safety to a British ship then lying at anchor in Callao. Captain Thompson, the commander of the British ship, seems to have had in him some of the spirit of the old buccaneers, however, for under cover of darkness he and his crew overpowered the guard and carried off the treasure to Cocos Island, where they buried it.



Is this the largest draughtboard in regular use? It is to be seen in a park in North Tottenham, London, where it is a popular feature. The large pieces on the far side of the board are "kings."

The pirates did not live to redeem their hoard, for they were captured by a Peruvian gunboat and all hanged except Thompson, who was spared in the hope that he might be made to reveal the whereabouts of the treasure. He escaped, however, and the Peruvians never found the hiding place. Thompson was rescued by a whaling vessel and died some years later in St. John's, Newfoundland, when he was fitting out a ship in order to return to Cocos Island.

We have all heard of the expeditions that originated with a roughly-sketched map on a piece of parchment, handed over by an old seadog on his death-bed to someone who had done him a good turn. As a rule the indications given on the map were helped out by more or less cryptic instructions to dig at a certain place that was to be recognised by some unusual feature of the ground. This latest expedition scorns dying mariners and their maps, and sets out boldly to search Cocos Island by scientific methods. An aeroplane is to be employed to make an aerial survey of the island, making use of infra-red photography for the purpose; and elaborate instruments, capable of detecting minerals to a depth of 300 ft. or more, will be used to find the gold. If this expedition fails to find the treasure, Cocos Island might well be left in peace.

Machinery and Unemployment

On previous occasions I have referred to the opinion held by many people that the serious unemployment of to-day is due to the widespread introduction of machinery, and that the steadily-increasing use of mechanical methods and processes will necessarily throw still more men out of work. This fear of the machine is an old one. In the past it has led to riots and the wrecking of factories, and inventors such as Arkwright, Jacquard and others have been in actual danger of their lives. The opponents of machinery point to many instances where mechanised processes have led to the displacement of manual labour, but they ignore the fact that in other directions machinery has opened up new spheres of work.

The truth seems to be that, in the long run, inventions actually create work by founding new industries or extending existing ones; and that the amount of new employment far outweighs the amount of unemployment created. This has been emphasised recently by Professor K. T. Compton, the distinguished American who was awarded a Nobel Prize in 1927 for his electrical discoveries. He points out, for instance, that in the United States the number of persons employed in the manufacture of road vehicles before 1900 was 976,000. To-day the number is over 2,400,000, and this figure does not include the vast numbers concerned with the petrol and oil required by modern road vehicles.

Telford and Railways

Thomas Telford, the great road and bridge builder whose career is described in this issue, took no part in any railway schemes. When the Liverpool and Manchester Railway was projected he refused the appointment of engineer, and it has been stated, on the authority of Sir John Rennie, that his refusal was due to his disbelief in railways. This is very unlikely, for Telford used railways for hauling materials. Further, Smiles, in his biography of Telford, refers to a paper on the "Inland Navigation of the County of Salop," in which Telford speaks of the judicious use of railways, and recommends that, in future surveys, "it be an instruction to the engineers that they do examine the county with a view of introducing iron railways wherever difficulties may occur with regard to the making of navigable canals." It seems probable that Smiles is correct in stating that Telford refused the appointment because he could not conscientiously assist a scheme that must seriously affect the canal companies for whom he had worked.

The Story of Hoover Dam

III.—The World's Largest Concrete Barrier

BEFORE we commence our description of the actual erection of the world's largest concrete barrier, a few words must be said in regard to its name. Originally the structure was known all over the world as the Hoover Dam, and consequently we adopted this name for our series of articles. It now appears that the official name is Boulder Dam. When the scheme was first planned it was described as the Boulder Canyon Project. Ultimately it was decided to construct the dam, not in Boulder Canyon but in Black Canyon, a similar steep-sided gorge farther down the Colorado River. In spite of this, however, the original name of the undertaking prevailed, and thus the dam became known as Boulder Dam. The name is misleading, but as it evidently has official standing we shall use it in this and any future articles. For the sake of preserving continuity, however, we retain the old name for the present series.

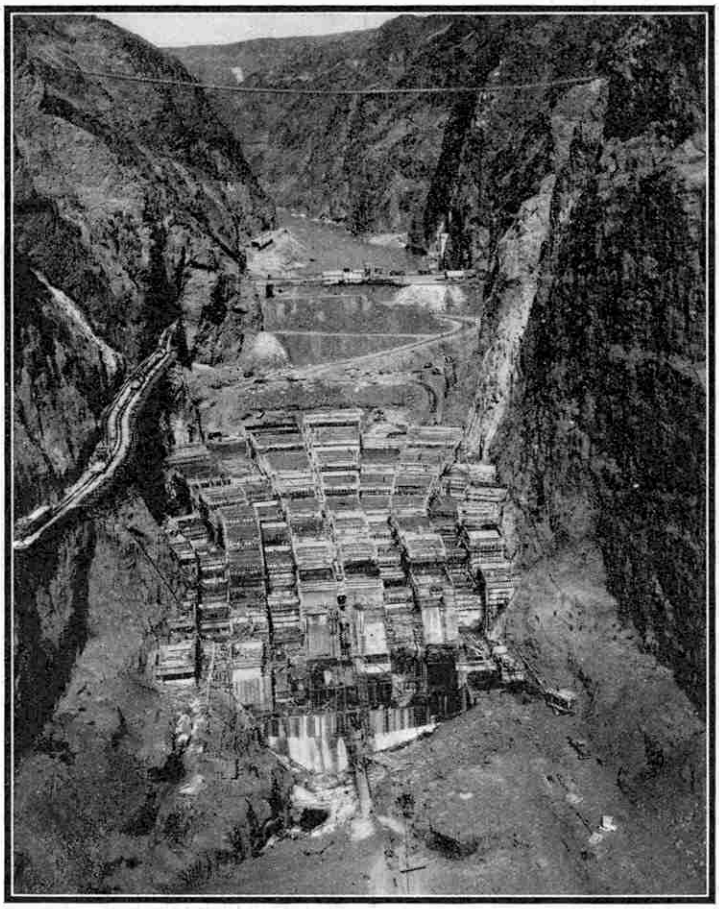
The most important part of the preliminary work described in previous articles was the diversion of the Colorado River through tunnels bored through the solid rock walls of Black Canyon in order to uncover the site of the dam. There are four of these tunnels, each 50 ft. in diameter. Their total length is nearly four miles, and their construction was the greatest rock tunnelling task ever undertaken. The walls of their great bores were covered with concrete 3 ft. in thickness in order to provide smooth surfaces for the flow of water through them, and the placing of the immense amount required necessitated the use of giant travelling carriages, one of which is shown on our cover, to support the forms in which the concrete was placed to set.

When finished Boulder Dam will be a gigantic arched wall 727 ft. in height, containing more than three million cu. yds. of concrete. Its outer face, directed upstream, will have a length of 1,180 ft. and at the top it will be 45 ft. in width, while it will measure 650 ft. across its base. Such a gigantic mass of concrete has never previously been erected. The Bureau of Reclamation, the department of the United States Government responsible for its design, has erected 50 great dams since it was created in 1902, and Boulder Dam will contain more concrete than the whole of these together!

A firm base of course was necessary for the weight of this enormous mass, and the bed of the Colorado was excavated to a depth of 150 ft. below ordinary low water level in order to reach solid rock. In the centre of the gorge the excavation was taken to a further depth of about 50 ft., for there the river had at one time scoured out an inner gorge. This work and that of preparing the site involved the drilling, blasting and removal of more than 100,000 cu. yds. of rock, and the bottom of the deep canyon was filled with smoke when charges of dynamite tamped into the holes drilled deep into it were exploded.

The material excavated was carried by motor lorries up a broad roadway on the slope of the great cofferdam that had been erected upstream to hold back the water of the river, as explained in the previous article in this series, and then it was either dumped at special docks for removal by train or used to widen the embankment on the Nevada side of the river by means of which access to the site of the dam was obtained. These lorries moved in a continuous procession, night and day, and sometimes as many as 7,000 loads of spoil were disposed of in 24 hours.

The whole of the rock removed in this manner from the site of the dam did not represent work necessary for the actual building of the concrete structure, however, for some of the spoil consisted of rock scaled away from the walls of Black Canyon at the points where the ends of the arched dam are to rest upon it, and part was removed in order to make room for the spillways, outlet works and power houses that are to be built.



The columns of Boulder Dam rising from the bed of Black Canyon. This photograph was taken from a skip suspended from a 150-ton cableway that spans the Canyon. We are indebted to Six Companies, Inc., the builders of the dam, and the "Compressed Air Magazine," for the illustrations to this article.

Work on all parts of the great project was carried on simultaneously. The central feature of course was the pouring of concrete for the dam itself, and this began on 6th June, 1933, 27 months after the commencement of the preparatory work already described in this series. It was clearly impossible to pour the whole of the concrete in one mass, and instead the dam is being constructed of no less than 232 great square columns keyed together. These columns are being raised in steps, each in turn being built higher than its neighbours, which are then raised to a greater height.

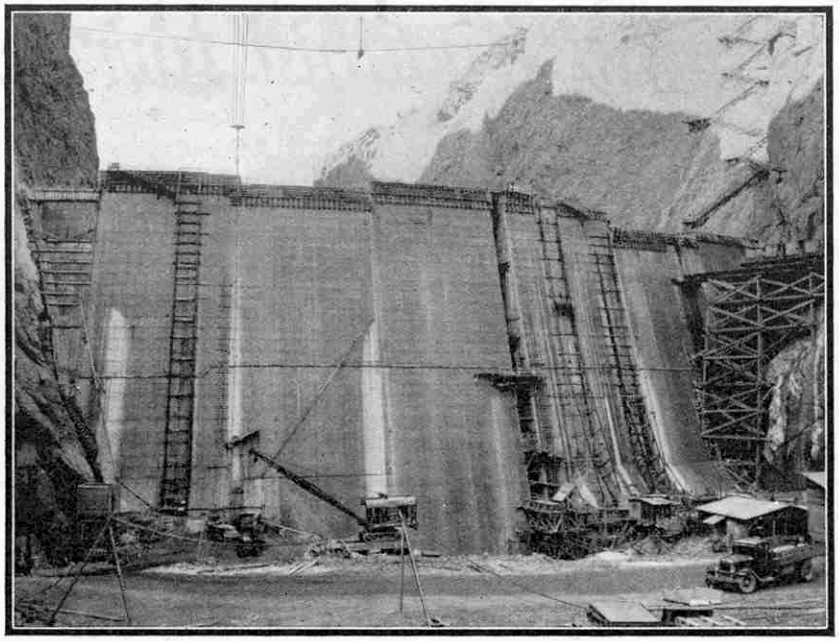
There is another and very important reason for building the dam in sections. Portland cement, the basis of concrete, is a complex mixture of chemicals, and its setting is due to the absorption of water, with the formation of tiny crystals that interlock to give a mass offering great resistance to compression and to forces tending to alter its shape. A considerable amount of heat is developed during the setting, but this usually is quickly lost by radiation and does not greatly affect the structure concerned, for cracks produced when the concrete cools and shrinks are afterwards filled with a mixture of Portland cement and water, a process to which the name "grouting" is given.

If the dam had been built up as a single giant block of concrete, and left to cool naturally, it would have been necessary to wait 125 years before being certain that no further cracks would develop! The columns of which it is composed of course lose heat more quickly than that, but are themselves so vast that artificial cooling is neccessary in order to make sure that there will be no further lowering of temperature, with the formation of weakening cracks and fissures, when the dam is completed. The concrete pile therefore has been transformed into a vast refrigerator. As each column of the dam rises into the air, one inch pipes are embedded horizontally into it at distances of 10 ft. apart, and these are joined up to form loops for the flow and return of cooling water derived from 6 in. header pipes placed in a slot, eight feet in width, left along the centre line of the dam.

The cooling is begun six days after concrete is poured round the pipes. Water taken from the river is first employed, and this is followed by water circulated through refrigerating plant in order

to reduce its temperature, the cooling being carefully graded so that the temperature of each column is reduced to its correct level in about two months. The tubes through which the water circulates of course cannot be removed, but they provide valuable reinforcement for the concrete and are filled with grout after they have fulfilled their chief purpose. Before the dam is completed no less than 662 miles of tubing will have been placed in position in it.

Each column of the dam is raised 5 ft. at a time, and 36 hours are then allowed to elapse in order to give the material already poured time to cool and set. Before work on the next layer begins, pipes for the circulation of cooling water are placed in position, together with other pipes through which grouting afterwards will be forced. The surface is then thoroughly scoured by means of a jet of water mixed with compressed air, and the forms that give the concrete block its shape are raised to their new position, where they are very accurately aligned by the engineers.



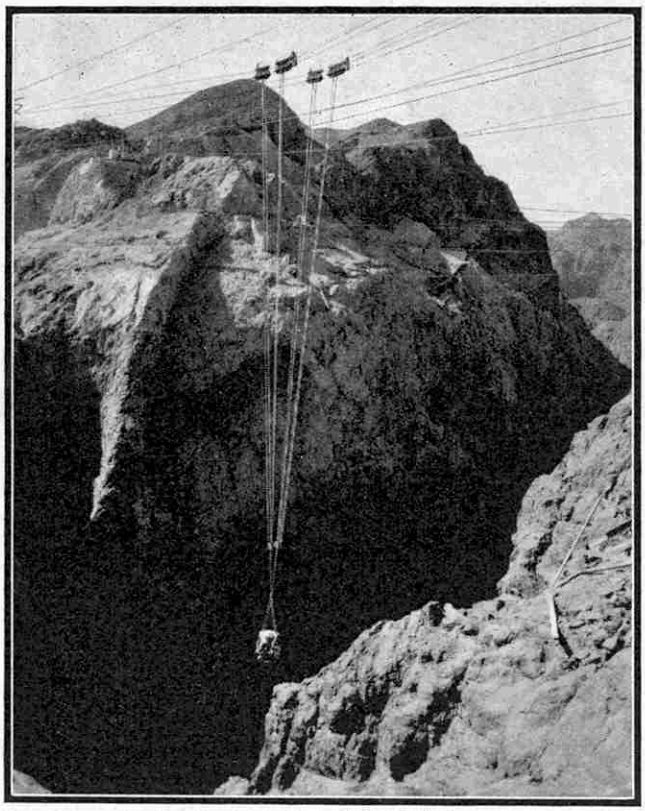
The upstream face of Boulder Dam during erection. Above it can be seen sections of the overhead cables used for lowering concrete to the tops of the columns under construction.

While work was being carried on in the depths of the canyon, the concrete required came from the plant at Lomix, on the Nevada bank of the river, that is described in the previous articles in this series. It was carried in gigantic steel buckets, each holding 16 tons of concrete, that were transported to and from the site of the dam on a railway that ran along a shelf partly blasted out of the cliff. The trucks employed were hauled by miniature locomotives and each was of such a length that its compartments were under the concrete mixers when the vehicles were run under the plant at Lomix. There were only two concrete buckets on each truck, however, and these were in alternate compartments, half their load being supplied from one pair of mixers and the remainder from the other pair.

On arrival at the dam, an empty bucket descended upon the truck, apparently from the sky, for it was slung from a cable spanning the canyon, and was guided into one of the vacant spaces. One of the full containers was then whirled upward, swung along the cable until it was above the section in which concrete was being poured, and lowered in obedience to signals transmitted by telephone to the cable controller, who from his place behind the rim of the canyon often was unable to see the results of his manipulation of the controls. Workmen then knocked out the safety catches of the bucket with their shovels and sprang back hastily as the hinged base swung down and the concrete fell out. The empty bucket was then whirled away, and the men spread the concrete, walking over it in rubber boots and working it round pipes and into corners with rakes and with compressed air vibrators that helped it to settle.

When the dam rose to the level of the railway along the cliff side on which concrete was brought from Lomix, part of the mixing plant was dismantled and rebuilt at a point on the Nevada side of the canyon to which the name Himix was given. Some of the concrete required for the dam then was brought from the mixers in the new position. It reached the site in exactly the same manner as that from Lomix, a short constructional railway providing transport to points where the steel buckets could be picked up by cableways and lowered on the section on which work was in progress. Both plants continued in use for some time, but the whole of the concrete for the highest portion of the dam will be produced at Himix, which is above the level at which the material is to be deposited and thus avoids the necessity for excessive lifts.

The plans for the construction of the dam allow 32 months for the pouring of the 3,220,000 cu. yds. of concrete required. The efficient methods adopted undoubtedly will bring the work to an end before the scheduled time, however, for the amount of concrete poured daily is 6,000 cu. yds. and thus is well in excess of the average of 5,207 cu. yds. required. Work proceeds without intermission, the canyon being brilliantly illuminated at night by banks of 1,000 watt and 1,500 watt lamps, set on brackets in its walls or slung on the two catwalks that span the chasm, and by portable floodlights mounted on tripods, and all existing records for work of this kind have been broken. During a test run made when work was in full swing 6,150 cu. yds. of concrete were placed in the great tapering tower and the amount poured in other work connected with the scheme brought the total for the day to more than 7,000 cu. yds. This was more than twice as much concrete as had ever previously been handled within 24 hours, but only a fortnight later a new record was created by the pouring of 7,170 cu. yds. in the same time.



Lowering a mechanical shovel into the depths of Black Canyon by means of two 20-ton cableways working in unison.

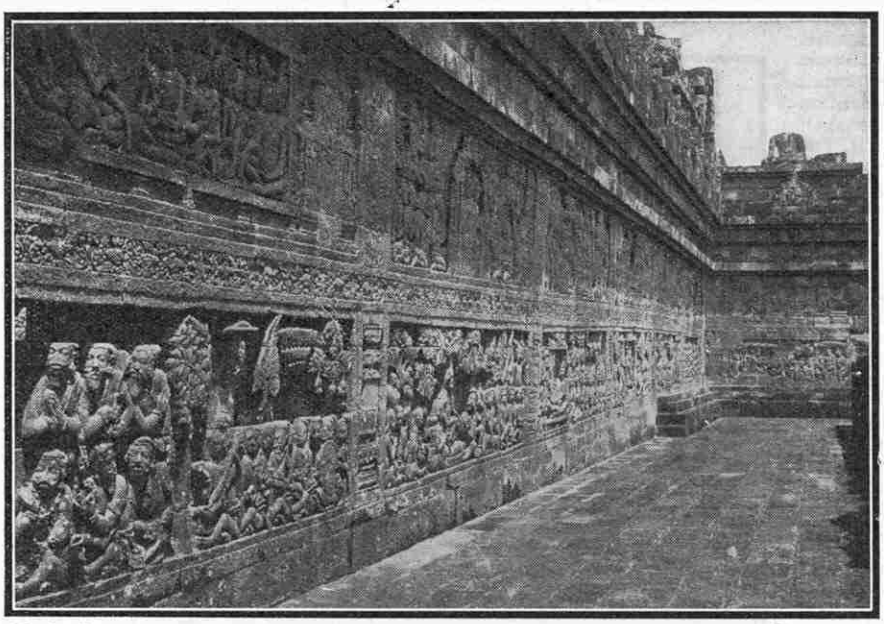
Perhaps the most fascinating feature of the intense activity now proceeding in Black Canyon is the use that is being made of great cableways. The difficulties of access to the site of the dam, in the depths of the canyon and between its almost sheer walls, have been overcome by the installation of no fewer than ten of these cableways, and the ease and speed with which they handle their loads are playing a great part in the progress of the erection of the dam.

Five of the cables are being used in the construction of the dam itself. Their great wire ropes are 3 in. in diameter, and their lengths vary from 1,305 ft. to 2,575 ft. Four of them are stretched between gigantic steel towers nearly 100 ft. high that run on tracks parallel to the sides of the canyon so that the cables may be moved upstream or downstream to enable the concrete to be delivered readily to any position in which it is required. The fifth cableway is of the radial type, the tower on the Nevada side of the river being fixed, and that on the Arizona side being moved as

(Continued on page 693)

A Wonderful Buddhist Ruin in Java

THE finest ruins of Buddhist and Hindu temples are in the islands of the Dutch East Indies, which stretch over the ocean between India and Australia; and the most magnificent of these ancient relics is undoubtedly the temple of Borobudur, on the island of Java. This island is long and narrow, with an area of about 50,000 sq. miles, so that it is about the size of England. Borobudur is about 15 miles north-west of the important town of Djokja, and as it is situated on the summit of a hill it forms a striking landmark for many miles around. It is 118 ft. in height and covers an area of 2,500 sq. ft., or about the same area as the famous Pyramid of Gizeh in Egypt. A magnificent view is obtained from the topmost tier of the monument, the plain of Djokja lying stretched out below like a great map, bounded on the horizon by the impressive volcanoes of Merbabu and Merapi.



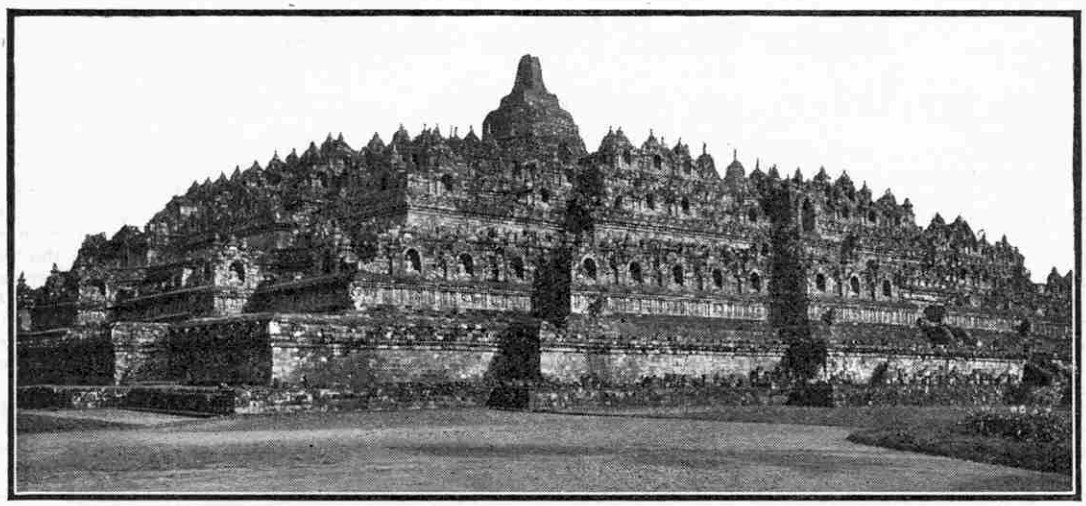
The heading photograph shows the circular terraces which surmount the top gallery of the Borobudur Temple. In the lower photograph are seen some of the marvellous carvings on the galleries of the Temple.

Borobudur is shaped like a flattened half globe, and when viewed from a distance it appears to be simply a series of terraces built one above the other, with a huge bell-shaped erection rising from the centre of the pile. Closer examination shows that it consists of a broad platform roughly square in shape, from which rise in succession four galleries of decreasing size but conforming to the shape of the platform. The smallest or top gallery is surmounted by three circular terraces, also of decreasing size, and from the middle of the topmost one there rises the bell-shaped structure just mentioned. This is known as a stupa, the name given to monuments worshipped as the grave of Buddha himself.

Buddha died about 480 B.C., and his followers assert that after cremation his ashes were divided among eight towns and buried in tombs. Seven of these tombs were afterwards opened by order of Asoka the Great, the famous Hindu Emperor who became a Buddhist, and the ashes were distributed in 84,000 stone or metal urns. Wherever a new settlement of Buddhists was formed one of these urns was buried and a memorial monument or stupa erected on it. In their simplest form these monuments were half globes, but later more ornamental forms were developed. In some cases the half globe was lengthened or flattened, and in others the pedesta gave place to a series of terrace that sometime occupied more spac than the half globe but the latter al ways remained the essential part of the whole.

The four sides of Borobudur are intersected midway by flights of stairs leading up to the broad platform and the successive galleries. The platform is at the head of the first flight, and although less spectacular than the higher levels of the temple, it is of particular interest as it did not form part of the building as originally planned. When the present covered base was excavated, as explained later, it was seen that on it were sculptured series of reliefs, some of which had been left unfinished. It is surmised that, when the construction of the temple had reached this stage, the discovery was made that the base would not be strong enough to support the whole, and therefore to strengthen the base a large band of masonry was built around it like a gigantic stone ring. This forms the platform.

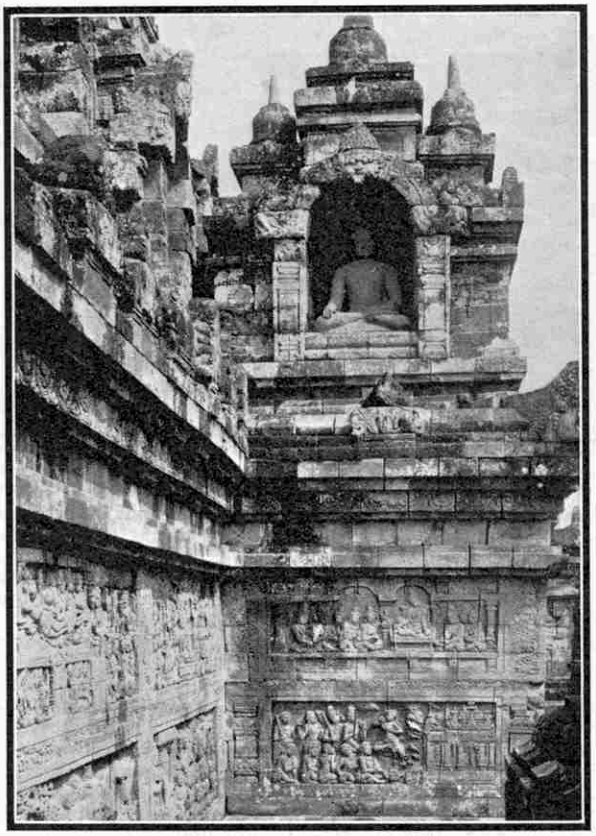
The four galleries built on the platform are protected by massive balustrades, the inner sides of which are adorned with a row of bas-reliefs, designs sculptured on the face of the stone. Opposite to them are two rows of similar bas-reliefs that extend along the lower part of the gallery walls. In addition to the innumerable human figures in these reliefs, there are sculptured ships propelled by banks of rowers, similar in this and other details to the ships seen in ancient Egyptian sculpture. The reliefs also show houses on piles, bullock carts, elephants in State scenes, and seasonal events such as seed-time, harvest, ploughing and reaping.



General view of the Buddhist Temple of Borobudur, in Java, built over 1,000 years ago.

It is not yet possible to explain all the reliefs, but by following the text of some of the Sanskrit books giving accounts of the different incarnations of Buddha, the meaning of some of the reliefs on the galleries of the temple has been discovered. Those on the covered base depict scenes from daily life, followed by pictures from Heaven and Hell. Speaking generally it may be said that these reliefs first give a sketch of the misery of life's eternal turning, and go on to illustrate the way to redemption. On the galleries this is continued with narratives from former lives of Buddha, and concluded with stories relating to the future.

The gallery walls are surmounted at regular intervals by beautifully ornamented niches to the number of 432, each of which contains, or once contained, a life-size image of Buddha seated on a throne. On each side of the stairways already mentioned are statues of sitting lions, and there are gateways with elaborately carved portals where the stairways cross the galleries.



A corner of one of the galleries of the Temple, showing the carvings and one of the niches containing an image of Buddha.

The circular terraces are adorned at regular intervals with bell-shaped ornaments of great size called dagobs. There are 72 of these domed structures, in each of which there is or was an image of Buddha. These images represent him as preaching the doctrine, and include all the images of him known in history. The giant stupa erected at the centre of the topmost terrace is 50 ft. in height, and towers impressively above the smaller dagobs arranged around it in the three concentric circles formed by the three terraces. The incomplete image of Buddha that at one time occupied this shrine is now mounted on a dais at the base of the monument. This image is most probably an exact replica of the unfinished image of Buddha that was erected on the spot where it is recorded that he saw the vision that led to his life work.

Nothing definite is known of the history of Borobudur, as no inscriptions or other records have been found that mention its construction, but an indication of the date when it was founded is given by inscriptions above the reliefs on the covered base. The Sanskrit characters used for these inscriptions confirm the supposition that the latter were made about 850 A.D., and therefore at that time the building of the temple must have already been begun. Thus close upon 11 centuries have passed over this colossal monument. The downfall of the Hindu Empire in Java about 925 A.D. was followed by the Mohammedan invasion, the temple became neglected, and all knowledge of its existence was practically lost until last century. In the meantime earthquakes, volcanic eruptions, tropical rains and heat assisted in its decay.

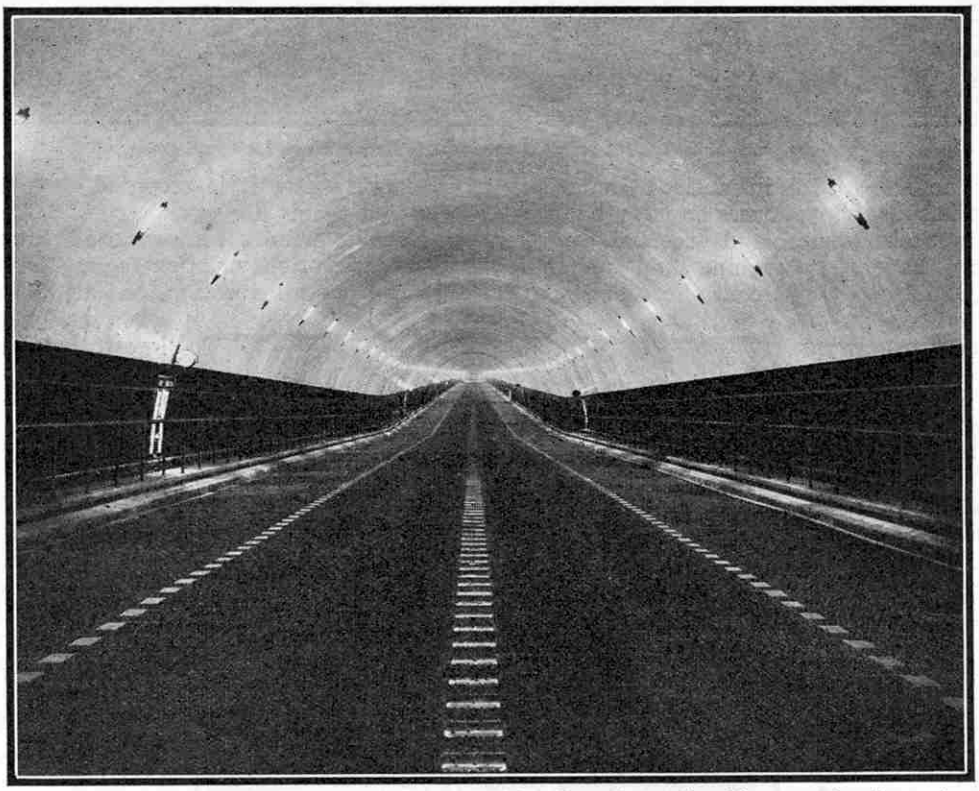
In 1812 Thomas, afterwards Sir Thomas, Stamford Raffles, Governor of Java from 1811 until 1816, heard about Borobudur and other remarkable temples on the island. He sent Col. Mackenzie, who was familiar with Hindu antiquities, and Capt. Bell, of the Bengal Service, to survey, measure and sketch outlines of them. The survey party found Borobudur almost obscured by centuries of dense tropical undergrowth and volcanic deposit. Raffles ordered a clearance of these, and it took 200 coolies, working under the direction of English engineers, six weeks to remove all the giant creepers and bushes from around the (Continued on page 758)

The World's Greatest Under-Water Tunnel

Motor Road below the Mersey

THE new Mersey Tunnel, opened by the King on 18th July of this year, is the first under-water road tunnel to be built in this country since the coming of the motor car, and is the largest of its kind in the world. It has an internal diameter of 44 ft., or 12 ft. more than that of the tunnel connecting Oakland with Alameda on the shores of San Francisco Bay, California, which previously was the widest in the world. The diameter of the actual excavation in the case of the Mersey Tunnel was 46 ft. 3 in., while that of the Californian tunnel was 37 ft. The main Mersey Tunnel and its approaches have a total length of 11,254 ft., which is practically 2,000 ft. more than the length of each of the different bores of the famous Holland Tunnel, New York. Branches bring the total length of covered tunnel to 13,800 ft., or more than 2½ miles.

The Mersey Tunnel provides the only means by which motor vehicles pass directly between Liverpool and Birkenhead under their own power. Before it was built such vehicles could only cross the Mersey estuary by means of comparatively slow ferry services of limited capacity, and this greatly hindered communication between Liverpool and Cheshire, North Wales, and an immense tract of the English Midlands. It is expected that about 3,000,000 vehicles actually will pass through the tunnel during its earlier years, and there is little doubt that the increasing use to which it will then be put will justify its cost, which has reached the immense sum of £7,077,800.



The brilliantly lighted under-river section of the Mersey Tunnel. The illustrations to this article are reproduced by courtesy of the Mersey Tunnel Joint Committee. Photographs by Stewart Bale, Liverpool.

The first steps in the construction of the Mersey Tunnel were to sink shafts on both sides of the river in order to give access to the line the tunnel itself was to take. Each shaft was 21 ft. 2½ in. in diameter, and the bore on the Birkenhead side was carried downward to a depth of 195 ft., that on the Liverpool side being 160 ft. deep. Special precautions were taken to avoid the flow of water into the workings while these shafts were being sunk. A liquid cement mixture was forced into bore holes on each side and below the working face in order to fill up fissures and cavities in the sandstone to be penetrated and chemicals also were injected to form a gelatinous precipitate that lined very fine cracks, allowing the cement then to pass more easily through them. This process is called cementation and similar precautions were taken where necessary in all the borings of the great undertaking.

The vertical shafts were driven well below the level at which the tunnel was to be constructed, and boring operations began about half way down. Pilot headings were commenced from both banks of the river. In each case there were two of these bores, one near the top and the other near the bottom of the future full-sized tunnel. Each was of about the diameter of one of the tubes in which London's underground trains run, and the fact that these were merely the preliminary borings for the Mersey Tunnel gives an excellent idea of the magnitude of the project.

In the earlier stages, the boring was carried out by means of pneumatic drills, which broke the rock into fragments that could easily be removed in wagons brought up to the working face on special tracks. Later it was decided to use explosives, and this decision halved the time required for completing the work. The lower of the two tunnels was always kept about 150 ft. in advance of the upper one, and special borings were made from its roof in order to avoid the danger of cutting into the gravel bed of the river. These borings showed that throughout both tunnels would be carried through solid rock, but as they showed the rock heading to be comparatively thin below the middle of the Mersey the upper tunnel in that section was lined with cast iron segments in order to ensure safety and to prevent the inflow of water as far as possible.

The four pilot tunnels gradually approached each other and at length only a thin wall of rock separated the two lower bores. This was broken through with some ceremony by Sir Archibald Salvidge, at that time Chairman of the Tunnel Committee, and the Lord Mayor of Liverpool and the Mayor of Birkenhead then shook hands through the opening. The tunnel had met with practically no differences in level and direction, and the remaining obstacles were quickly removed in order to complete the first through under-water section of the great tunnel. The upper pilot bore was completed shortly afterwards, and in the meantime a drainage tunnel had been driven from the lower bore to the bottom of one of the vertical shafts.

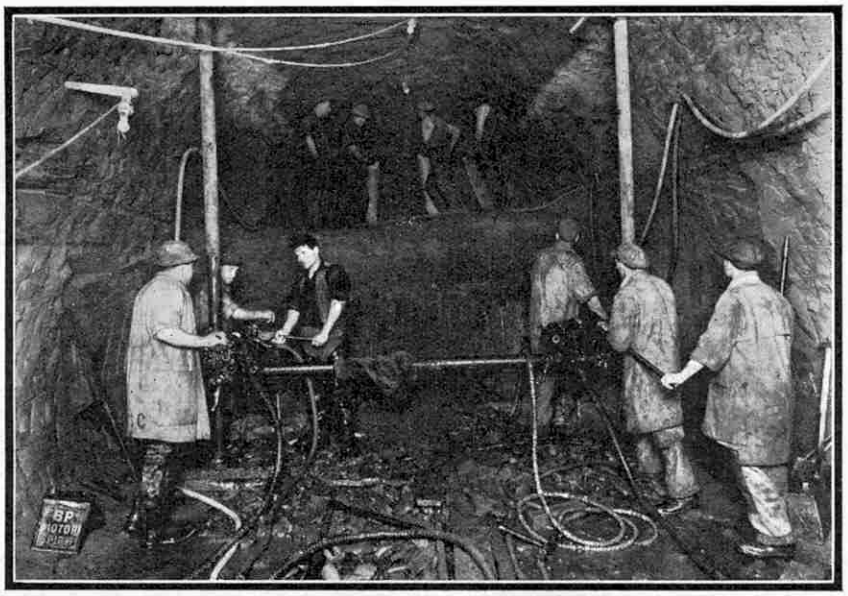
Long before the pilot headings were finished a short section 300 ft. in length on the Birkenhead side was opened out to full width by various methods in order to decide how the work could best be completed, and work on the full sized tunnel then began at several points along the line of the tunnel. At each working place the upper pilot heading was enlarged into a chamber of the dimensions required for the upper half of the tunnel, and the cast iron lining was erected by hand. A mechanical erector mounted on a truck was then built up in the chamber and the excavation of the rock and the erection of the cast iron lining were begun at each face.

Holes 4 ft. in depth were first drilled, and gelignite charges were inserted in them. The workmen then withdrew to a safe distance and the fuses were ignited electrically, the resulting explosions making deafening noises that reverberated through the section of the tunnel already completed. The blasted rock was then broken

up by means of pneumatic hammers and shovelled through chutes that were driven down to the lower trial bore. There it was received in skips on a narrow gauge railway track and these were hauled by electric battery locomotives to the working shafts, where the debris was hoisted to the surface by means of lifts. When the lower half of the tunnel was excavated it was impossible to dispose of the spoil in this manner, and the skips then were accommodated on a temporary roadway suspended from the roof of the tunnel.

When work was in full swing under the Mersey, the excavation of the approach tunnels on both sides was taken in hand. These are approximately semi-circular and correspond to the upper half of the river tunnel, where the roadway occupies only the upper half of the completed bore, the lower half being intended for traffic at some future time.

Junction chambers of impressive size were excavated at the places where the branch tunnels diverged from the main route. Exceptional care was taken during their construction to ensure the safety of the rock above them, and of the buildings resting on it. The side walls actually were built before the chambers themselves were excavated, the rock occupying the position of the walls being removed and the space filled with reinforced concrete 5 ft. in thickness.



Excavating one of the two pilot headings, each as large as a London Underground tube, that were afterwards incorporated in the completed tunnel.

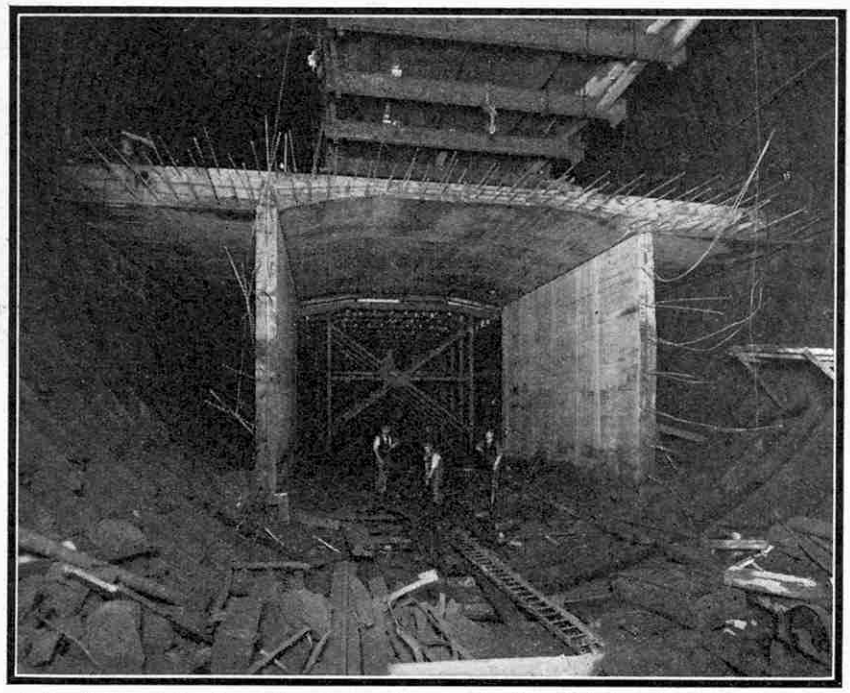
When the great tunnel was completed the roadway was built at its largest diameter, dividing it into upper and lower sections. The roadway is of reinforced concrete and is supported by two side walls beneath it that separate a central portion, reserved for future traffic use, from two side ducts, which are much narrower and play an important part in the ventilation system of the tunnel, to which special reference is made later in this article. A gantry travelling on rails laid at the sides of the tunnel was used to support the forms in which the concrete slabs of the roadway were placed and this was long enough to allow successive lengths of 30 ft. to be provided with a network of steel reinforcement and concreted.

The road surface in the tunnel consists of cast iron paving blocks, about 12 in. square and $1\frac{7}{8}$ in. thick. The centre line is marked by amber coloured rubber blocks, having V-shaped projections rising about $1\frac{1}{2}$ in. above their surface, and rubber blocks divide each half of the roadway, giving four traffic lines in a total road width of 36 ft. The road surface is built entirely of rubber blocks where the tunnel crosses that of the Mersey Railway in order to reduce to a minimum vibration and possible damage to the lower tube.

The cast iron lining was then covered with a layer of concrete and a perfectly smooth surface given to the walls and roof of the tunnel by spraying them with gunite, a mixture of sand and cement forced on to them by means of a compressed air gun in which water in the form of a fine spray is mixed with the cement as it is discharged. A dado consisting of sheets of black glass supported by a network of stainless steel rails protects the walls to a height of 6 ft. 3 in. The glass forms a durable and easily cleaned lining and helps to give a finished and attractive appearance to the interior of the tunnel.

Owing to the immense length of the tunnel the greatest care had to be taken to ensure a continuous supply of fresh air throughout, and to guard against the danger of the accumulation of an excessive proportion of carbon monoxide, the poisonous gas present in motor car exhausts. Six ventilation towers, three on each side of the river, have been equipped with powerful fans that blow fresh air into the side ducts in the lower section of the tunnel and thence through adjustable openings into the traffic space, or pump out vitiated air through openings in the roof that lead to the ventilating stations.

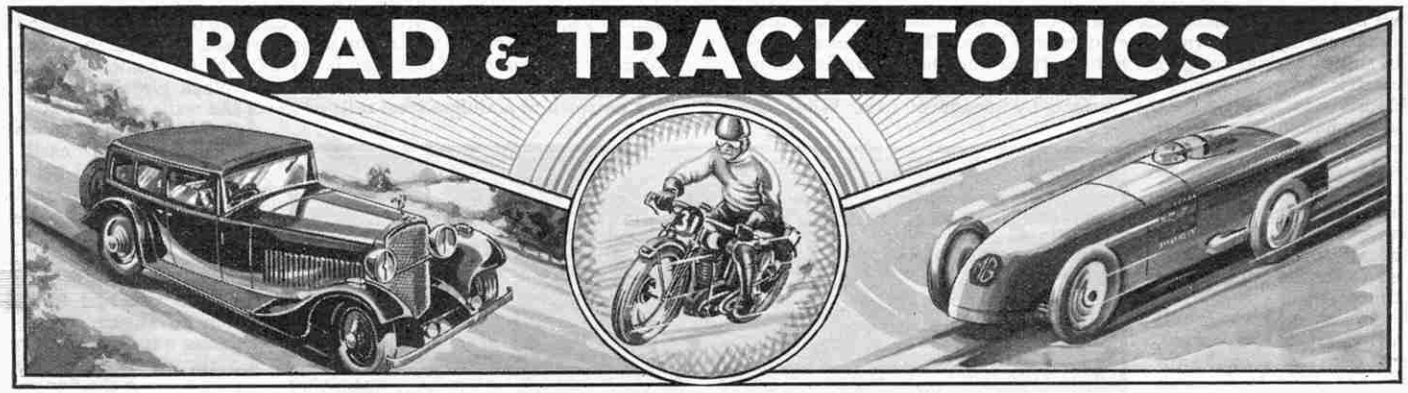
The total number of fans installed in the great ventilation towers is 30, of which 18 blow in fresh air, the remaining 12 being exhaust fans, and their combined capacity is no less than 10 million cu. ft. of air per minute. Only half of the plant is in use at any time, however, the remaining half being held in reserve in order to provide for emergencies, and every minute $2\frac{1}{2}$ million cu. ft. of fresh air are delivered to the tunnel, and an equal volume of vitiated air is removed.



Constructing the reinforced concrete roadway and its supporting side walls in the under-river section. Above is the temporary roadway suspended from the roof for use while the excavation of the lower half of the tunnel was being carried out.

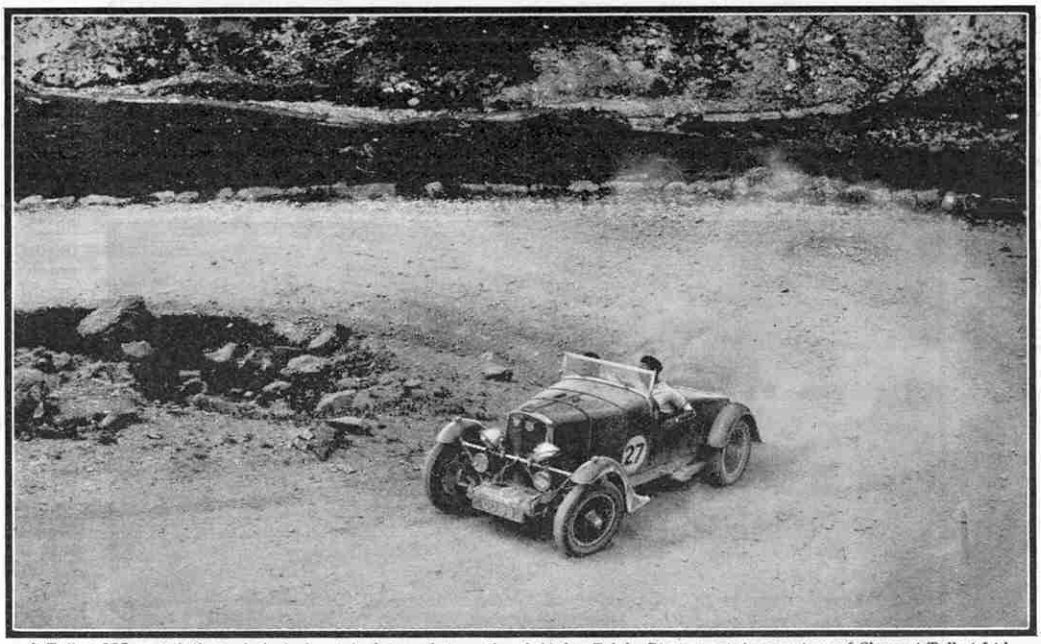
The interior of the great tunnel presents an impressive spectacle. Motor vehicles of all kinds run along the traffic lanes of the iron roadway, and on each side is a raised gangway protected by railings, along which officials and patrol men can pass freely. At intervals of 20 ft. on each side are 150-watt lamps fitted in flush casings with glass fronts. There are 160 of these lights in the traffic section of the tunnel, and they are placed closer together near the entrances in order to avoid sudden changes from daylight to the standard illumination of the tunnel. Special precautions have been taken to prevent the complete failure of lighting. Separate circuits are used for alternate lamps, and only a widespread breakdown involving more than one generating station can deprive the tunnel of light. Even if this unlikely event occurred, the lights of cars passing through would be as effective as they are on a very dark night in open country.

Fire stations distinguished by red doors and equipped with chemical extinguishers and other fire-fighting appliances have been installed at intervals of 150 ft. and above them are illuminated signs, for giving traffic directions in emergencies, that (*Continued on page 760*)



ON page 529 of the "*M.M.*" for July last I mentioned that French engineers are now engaged on the stupendous task of constructing a road over the Col de l'Iseran, in the Savoy Alps, the highest point of which will be 9,085 ft. above sea level. When completed, this will be the highest road in Europe, a distinction that is now held by the road over the Stelvio pass in Italy, a photograph of which is reproduced on the opposite page. This pass is 9,050 ft. high, and the wonderful road that has been built over it has 49 hairpin bends in a distance of only 14 kilometres or about eight miles.

The Stelvio pass road, which was constructed as a carriage road by the Austrian Government during the years 1820 to 1825, leads from the Adige Valley, above Meran, to Bormio in the Adda Valley. The drive up the pass is one of the hardest tests to which any motor car or driver can be put, apart from actual racing; and its difficulty of course is increased when high speed must be maintained, as in the annual International Alpine Trial. This was shown in 1933 when out of 30 competitors who had not lost a point until theyattempted the ascent, only seven maintained the average speed required.



A Talbot 105 negotiating a hairpin bend during an International Alpine Trial. Photograph by courtesy of Clement Talbot Ltd.

British Successes in Famous Alpine Trial

During recent years British cars have always done fairly well in the International Alpine Trial, which is held over a gruelling mountain course. Last year a Frazer Nash was the only non-supercharged car to climb the Stelvio pass and the equally formidable Pordio and Galibier passes at the required average speed and to complete the course without losing a single mark, and the Frazer Nash team was placed second in the 1,500 cc. class in the contest for the Coupe des Alps, or Alpine Cup, won by the Riley team. In the previous year a team of three standard "105" Talbot Vanden Plas Tourers was awarded the Alpine Cup in its class, completing the six-day trial without the loss of a single mark. Incidentally, the Talbot team was the first British team to win the Alpine Cup for 18 years.

British cars were very successful this year. In the under three-litre class the Talbot and the French Adler teams were equal with the maximum points, and the British Standard Swallow team was second. In the under two-litre clsas the Riley team secured second place; in the 1,500 c.c. class, the Frazer Nash team was second, and in the under 1,500 c.c. class, the Triumph team was first and the Singer team second.

Progress in Streamlining

During the last few months the question of streamlining cars has been occupying the attention of motor car designers, and there are now many cars with bodywork designed on these lines. An excellent example of the modern style is a Bentley that has been fitted with a body tapering towards the rear in both the vertical and the horizontal planes. The roof of the car is swept back from the windscreen in a pleasing line right to the back of the car and the sides are curved inward slightly; while special attention has been paid to designing wings that offer as low wind resistance as possible. The result is a car that is very pleasing in appearance, although it must be admitted that the desire to keep its lines more or less orthodox has prevented the proper streamlining of the front of the vehicle. In spite of its novel form there is plenty of room for four passengers, and for their luggage, which is accommodated in the tapering tail.

Much research has been devoted during recent years to the problems involved in making motor cars simple to drive and maintain, and the introduction of hydraulic clutches, synchromesh and preselector gearboxes, and efficient means of lubrication, have done much to achieve this end. The latest development in this direction is the introduction of a carburetter in which the jet is automatically adjusted to the best position for easy starting, and altered to the most favourable running position as soon as the engine is warm. This device is known as the R.A.G. Thermostat de Luxe carburetter. In general design it is similar to the standard R.A.G. carburetter, but in addition to the hand-operated choke it is provided with a special choke consisting of a vertical slide operated by a thermostat. This gives complete automatic control of the mixture supplied to the engine cylinder, and prevents a careless driver from overchoking his engine. A similar carburetter made by the same firm does not incorporate thermostatic control, but a whistling noise reminds the driver when the choke is in action, and warns him to open it when its services are no longer required.

An interesting device to prevent dazzle has been produced by a Grimsby inventor. This is a special reflector provided with cylinders of translucent material carried on a frame so that they can be projected towards the bulb, and later withdrawn, by the action of a solenoid operated from the steering column. The cylinders absorb the beam of light and make it impossible to dazzle other drivers.

Travelling 1,700 Miles for Fifteen Shillings

Seven people recently travelled 1,727 miles at a total cost of five guineas, or about fifteen shillings per person, in the course of an interesting test carried out by the Hillman Motor Car Co. Ltd. The purpose of the test was to ascertain how far the Hillman 20-70 h.p. seven-seater limousine could travel with a full load of passengers with running costs of only five guineas. This sum was to cover all petrol and oil requirements, but naturally could not include insurance and tax.

The test was carried out under observation by representatives of the R.A.C. In running condition the all-up weight of the car, including the passengers, was 41 cwt. A circuitous route from London to Bournemouth, Bath, Oxford, Shrewsbury, Manchester, Carlisle, Glasgow and Edinburgh was followed, the car returning south by way of Newcastle, Saltburn, Lincoln, Norwich and Cambridge. An average speed of 31 m.p.h. was maintained, and the average petrol consumption throughout the run was one gallon for every 21 miles.

Gates that Open Automatically

One of the minor discomforts of motoring on little-used routes in the country is the frequency with which it is necessary to dismount in order to open gates. This is particularly annoying to a driver who is travelling alone, for it is necessary for him to get out and open the gate, get back into the car, start the engine and drive through the gate, stop, get out, and then shut the gate before resuming his journey! Trouble of this kind would be eliminated by the installation of automatic gates of a type that has just been introduced, for these are opened by the passage of one wheel of a car over a small plate set in the road a short distance away. The gates are opened by means of rods and springs actuated by the weight of the car, and closed by driving over a similar plate set on the other side of the gate. Automatic gates can be of either the single or double type, and they can be opened and shut by pedestrians or cyclists without interfering with the automatic mechanism. The system can be applied also to garage doors, and car owners who make use of it will find it a saving of time and trouble.

The wonderful motor road over the Stelvio Pass, in the Italian Alps. This road has 49 hairpin bends in its ascent of 12½ miles to a height of 9,050 ft. Photograph by courtesy of Frazer Nash Cars.

Mr. J. R. Cobb's New Record

Mr. J. R. Cobb recently set up another record in his famous Napier-Railton when he completed a lap at Brooklands at a speed of 140.91 m.p.h., an amazing figure in view of the nature of the Brooklands course and the fact that at the time Mr. Cobb was taking part in a race. This was the championship race of the Brooklands Automobile Club, which was won by Mr. Cobb. Only four cars were entered and none of the other three gave the winner any anxiety, his Napier-Railton taking first place from the start and maintaining its position throughout, the lap record being secured on the second time round. The second place in the race was gained by Dudley Froy driving Kaye Don's Bugatti. He crossed the line only eight yards in front of O. H. J. Bertram, who drove the ten-year old Delage in which he regularly races.

Mr. Cobb's Napier-engined Railton car is probably one of the most interesting racing cars in the country at the present time as, unlike most of the others seen at Brooklands, it was designed and built specially for racing and is equipped with an aeroplane engine. This is a 12-cylinder Napier engine of the broad arrow type which, although unsupercharged, is of course very heavy. In order to keep the weight of the car down, therefore, a relatively light gear-box and back axle has been fitted and front wheel brakes have been omitted.

The car was built to attack various long-distance records that would necessitate driving during the dark, and consequently it had to be fitted with provision for lamps. A set of head lamps can be put in position in less than a minute, a battery and dynamo being permanently installed in the machine.

In the first race in which the car was entered it set up a standing lap record at Brooklands, covering a mile at a speed of 102.52 m.p.h. It has also taken the world's 500 and 1,000 km. records, the 200 mile and 500 mile records, and the records for distances covered in three and six hours. It is interesting to note that in its first race much confusion among other competitors was caused through the car catching them up before it was thought possible for it to have completed the lap!

The car is owned by Mr. Cobb, who is a well-known member of the British Racing Drivers' Club and has driven at Brooklands for many years. His favourite mount before the Railton was a 12-cylinder Delage, but he has also raced in a Talbot and a Sunbeam.

This Month's Events

The motor racing season is now drawing to a close although there are still several events to take place. The most important of these for British drivers is the 500-mile race of the British Racing Drivers' Club, to be held at Brooklands on the 22nd of this month. All the most famous British drivers will take part in this event which should provide many thrills; it was won last year by Mr. E. R. Hall driving an M.G. Magnette. Another famous British meeting will be the hill climbing at Shelsley Walsh organised by the Midland Automobile Club and to be held on the 29th of the month. Of the foreign events this month the most important are the Grand Prix d'Italie to be run off on the 9th, and the Grand Prix d'Espagne to be held in Spain on the 23rd.

Thomas Telford, Civil Engineer

Famous Builder of Bridges, Roads and Canals

THOMAS Telford, the centenary of whose death occurs on the 2nd of this month, was one of the greatest civil engineers of his time. He carried out many works of national importance, and his experience ranged over almost every branch of civil engineering.

Telford was born on 9th August 1757 at Westerkirk, in the Eskdale district of Dumfriesshire, Scotland. Before he was four months old his father died, leaving his widow and child altogether unprovided for. The warm-hearted farmers of the dale took pity on the fatherless child and by turns had him to live with them, and also gave his mother such employmnet as they could in the way of milking or hay-making. Telford grew up a happy, smiling lad, so full of fun and good spirits that he became known in the valley as "Laughing Tam." As soon as he was old enough he assisted a relative to attend sheep on the hills in the summer, and in winter he helped the farmers with the cows, ran errands, and made himself generally useful. Later he attended a parish school at Westerkirk, where he learned reading, writing and some arithmetic.

At the age of 15 Telford was apprenticed to a stone mason at Lochmaben, a small town a few miles away across the hills, but the man treated him so badly that he ran away and returned home. His cousin Thomas Jackson, who was land-steward to Sir James Johnstone of Wester Hall, then induced a mason at the neighbouring town of Langholm to take the boy for the remainder of his apprenticeship. This venture proved a great success, and Telford obtained much useful experience in erecting walls and farm enclosures, and in building road bridges across streams.

Thomas Telford (1757–1834).

An amusing incident occurred during Telford's life at Langholm. His master and he had been employed upon a bridge across the Esk, and soon after this was finished a great flood came roaring down the valley and everybody thought the bridge would be carried away. The master-mason happened to be away at the time, and his wife "Tibby," knowing that he was bound by contract to maintain the bridge for seven years, was in a state of great alarm. Telford did his best to reassure her, but it was no good, for she insisted that the bridge was shaking and was doomed. Presently she declared that she heard the bridge rumbling, and set her back against the parapet as if to hold it up. The absurdity of this action tickled Telford immensely, and the sight of him standing there shaking with laughter convinced Tibby that there was no danger.

Having learned all that his native valley could teach him in the art of masonry, Telford went to Edinburgh, where extensive building operations were then in progress. He found abundant employment and remained there for two years, during which he had the opportunity of taking part in first-class work. He then determined to go to London, and returned to his birthplace to take leave of his mother and his friends, one of whom gave him a letter of introduction to a prosperous London merchant named Pasley. On arrival in the capital Telford sought out Pasley, who in turn gave him a letter of introduction to Sir William Chambers, the architect of Somerset House, which was then being erected, and on which there was a great deal of fine masonry work to be done. Sir William was in need of good workmen and he at once employed Telford, whose ability and steady perseverance soon singled him out as being fitted for something better than the work of an ordinary mason.

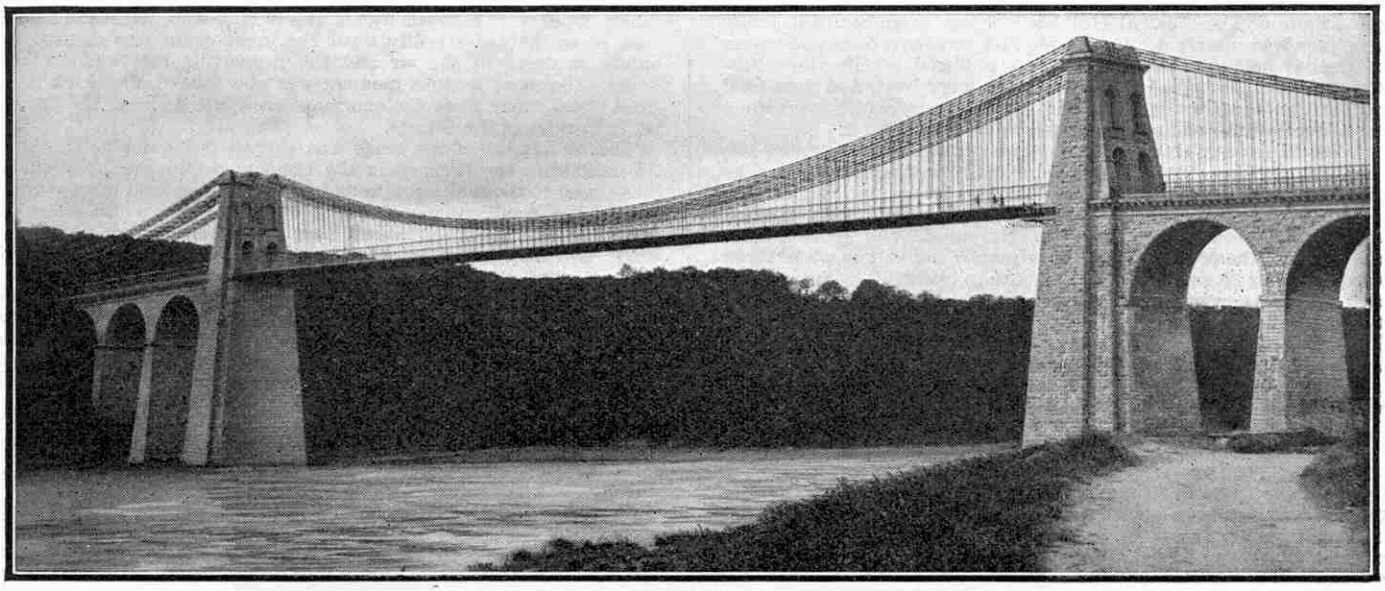
Telford's next move was to Portsmouth, where in July 1784 he was engaged in superintending the erection of a house for the occupation of the Commissioner at Portsmouth Dockyard. His work at Portsmouth finished at the end of 1786, and shortly afterwards he was employed by Mr. Pulteney, the second son of Sir James Johnstone, to superintend alterations necessary to fit up the castle on the former's Shrewsbury estate as a place of residence. While engaged on this work Telford was fortunate enough to obtain the appointment of Surveyor of Public Works for the County of Salop. From this time his labours became much wider in scope, and he was occupied in surveying and repairing roads, bridges and gaols, and in supervising all the public buildings under the control of the magistrates of the county.

The experience in building and repairing bridges that Telford had gained at Langholm proved of great value to him in his duties as county surveyor. The first bridge designed and built under his supervision was a stone bridge across the Severn at Montford, four miles west of Shrewsbury. It was executed in red sandstone, and consisted of three elliptical arches, one of 58 ft. span and two of 55 ft. each. The bridge was completed in 1792, and proved a very serviceable part of the high road from Shrewsbury into North Wales.

In 1793 Telford was appointed engineer to the Ellesmere Canal Company at a salary of £500 a year, out of which he had to pay a clerk and a foreman, in addition to his own travelling expenses. The company had been formed to construct and operate the Ellesmere Canal, a series of navigations joining the River Dee to the Mersey and the Severn, the total length, including the Chester Canal, being about 112 miles. As regards masonry work Telford felt himself competent to deal with all difficulties, but as he had had little experience of earth-work, and none at all of canal-making, he obtained advice on these matters from William Jessop, an eminent engineer of that day. The most difficult portion of the canal to construct was that through the rough hill-country between the Rivers Dee and Ceriog, in the vale of Llangollen. The only alternative to building numerous and costly locks was to carry the canal on the same level from one side of the respective valleys of the Dee and the Ceriog to the other, and this was accomplished by constructing the fine aqueducts of Chirk and Pont-Cysylltau.

The aqueducts consisted of stone piers and arches surmounted by a cast iron trough with path and side rails. The Chirk aqueduct, begun in June 1795 and completed in 1801, carried the canal across the valley of the River Ceriog, and had 10 arches each of 40 ft. span. The piers were built solid up to a certain height, and above this were hollow, with cross inner walls. The level of the water in the canal was 70 ft. above the level of the river. The Pont-Cysylltau aqueduct was of even greater dimensions, and Sir Walter Scott spoke of it as the most impressive work of art he had ever seen. It was situated about four miles to the north of Chirk at the crossing of the Dee, and it was carried across the valley on piers supporting 19 arches, extending for a length of 1,007 ft. The height of the piers above the low water in the river was 121 ft. The lower part of each pier was built solid for 70 ft., all above being hollow; and the outer walls of the hollow portion were only 2 ft. thick, with cross inner walls. The foundation stone of this aqueduct was laid in July 1795 and the work of construction occupied nearly eight years.

Telford had long been convinced of the great possibilities of cast iron for bridge building, and he took an early opportunity of putting his ideas into practice. His first iron bridge was built in 1796 across the River Severn at Buildwas, between Shrewsbury and Bridgnorth, to replace the old bridge that had been swept away by a great flood in the previous year. It was a handsome structure consisting of a single arch of 130 ft. span, and it served



successfully until 1906, when it was pulled down and replaced by a wider structure. He erected also several iron road bridges, and he gained such confidence in the possibilities of iron that in 1801, when it was found necessary to re-build or remove Old London Bridge, he proposed the daring scheme of a cast iron bridge of a single arch of 600 ft. span, having a clear headway of 65 ft. above high water. The boldness and the originality of this design were greatly admired, but eventually the scheme was abandoned, apparently owing to the difficulty of constructing the approaches to a bridge with such a headway.

In 1802 Telford was called upon by the Government to make a survey of Scotland and to report upon the measures necessary to improve the roads and bridges, and also to promote the fisheries on the East and West coasts. His report formed the basis of a great scheme of development, especially in regard to the Highlands, where the absence of roads and bridges was a serious handicap to progress of any kind. The effect of his report was such that in the next year a Parliamentary Commission was appointed and a series of improvements was commenced, resulting in the construction of over 900 miles of roads and bridges throughout the Highlands, half the cost being defrayed by the Government and half by local assessment. As soon as this work was in progress, attention was given to the improvement of harbours around the coast. It would require too much space to describe the many harbours constructed or improved by Telford, but mention may be made of those at Aberdeen and Dundee which, after Leith, the port of Edinburgh, form the principal havens along the East coast.

The upper photograph shows the Menai Suspension Bridge across the Menai Straits, probably the best known of Telford's works. It is 1,710 ft. long, and the road deck is 100 ft. above high water mark. The lower photograph shows the Ellesmere Canal, on the top of Chirk Aqueduct, and on the left is Chirk Viaduct.

The construction of a navigable highway through the chain of lochs crossing Scotland diagonally from the Atlantic to the North Sea had long been looked upon as a work of great national importance. In 1801 Telford was requested to report on the project, and early in 1804 work was begun by the formation of a dock or basin adjoining the intended tide-lock at Corpach near Bannavie. This basin formed the southernmost point of the intended canal. The difficulties of the undertaking were very great. For instance, the difference between the levels of Loch Eil and Loch Lochy was 90 ft., while the distance between them was less than eight miles, and it was necessary to climb up the side of the hill by means of a flight of eight huge locks that Telford named "Neptune's Staircase."

Between the two extremities of the canal, Corpach on the south-west and Clachnagarry in the north-east, extended the chain of fresh-water lochs. The whole length of the navigation was over 60 miles, of which the navigable lochs constituted about 40 miles, leaving only some 20 miles of canal to be constructed, but of unusually large dimensions and through a very difficult country. The construction of these works in such wild territory involved vast labour and a great deal of anxiety, and many years elapsed before the task was completed. In the meantime the cost of construction had greatly exceeded the original estimate, and after all, when the canal was opened, it was comparatively little used. This was a bitter disappointment to Telford, but of course he was not in any sense responsible for the commercial success or failure of the canal.

In 1808, at the wish of the King of Sweden, Telford was consulted as to the best method of constructing the Gotha Canal from Lake Wenern to the Baltic Sea in order to complete communication with the North Sea. He visited Sweden, spent two months in surveying the district, and prepared a report that was immediately adopted. Two years later he revisited the country to inspect the progress of the preliminary excavations. He supplied drawings for the various locks and bridges and, with the consent of the British Government, provided the Swedish contractors with details of the latest tools and appliances used in canal construction. He also arranged for a number of English canal workers to go over to instruct the local workmen. The length of the canal was 55 miles, the width at the bottom was 42 ft., and the depth of water 10 ft. The locks were 120 ft. long and 24 ft. wide. The Gotha Canal proved a great success, and in recognition of Telford's services the King of Sweden conferred upon him the Swedish order of knighthood and presented him with his portrait set in diamonds.

An interesting canal improvement carried out by Telford was the cutting of a new and larger tunnel through Harecastle Hill to supplement the original tunnel of the Grand Trunk Canal built by Brindley about 50 years earlier. The new tunnel is 2,926 yds. long, 16 ft. high and 14 ft. wide, and the accuracy of its construction is shown by the fact that it is so straight that its whole length can be seen through at one view.

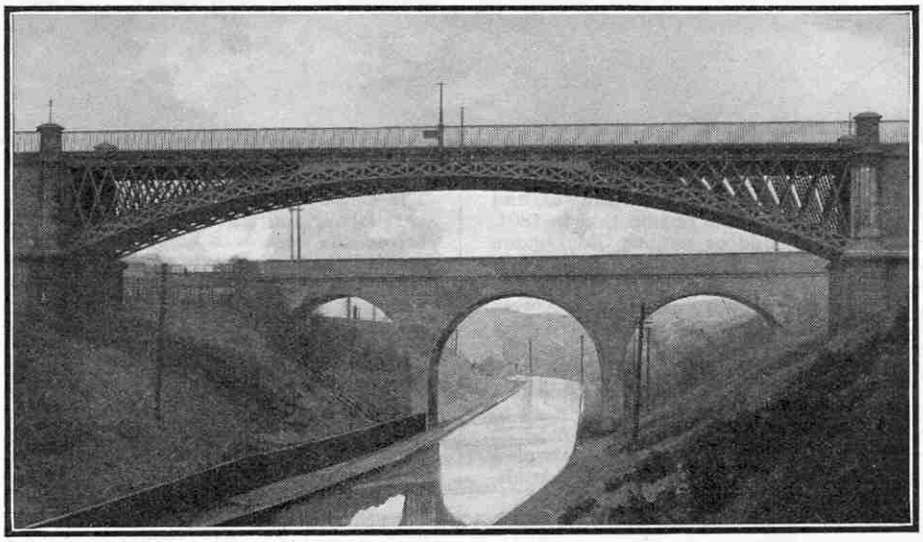
Telford achieved a high reputation as a road-maker. When the Government undertook the reconstruction of the road between Carlisle and Glasgow, which a Parliamentary Committee in 1814 declared to be in such a bad state as to delay seriously the mail coaches and endanger the lives of passengers, Telford was placed in charge of operations and he constructed nearly 70 miles of new road of a quality not previously attained.

The most important road scheme carried out under Telford's immediate supervision was undertaken to improve communication between London and Dublin by way of Holyhead. At that time this journey was a very serious undertaking involving considerable danger. On the Irish side there was nothing worthy of the name of a port, and after crossing the Irish Sea passengers were simply

put ashore on the rocks at Holyhead. From there the road across Anglesey was merely a rough track, and accidents to coaches were of regular occurrence. On reaching the Menai Straits the unfortunate travellers had to cross in an open ferry boat, and their final ordeal was the traversing of the Welsh roads, which were in a terrible condition and scarcely passable at all in winter.

With increasing traffic this state of affairs became intolerable, and the Government at length took the matter in hand. The landings on both sides of the channel were improved, and in 1815 Telford was called upon to superintend the construction of a good coach road from Shrewsbury to Holyhead. The mountainous character of the country made it extremely difficult to avoid steep gradients, but he grappled with the various obstacles so successfully that his road nowhere had a gradient of more than 1 in 20, whereas the old road in some places had gradients as steep as 1 in 6½. The most dangerous parts of the old road were dealt with first, and by 1819 the whole road was made safe and comparatively easy.

Telford's splendid work in the construction of this road met with universal praise, and the Select Committee of the House of Commons reporting on the undertaking said: — "The professional execution of the new works upon this road greatly surpasses anything of the same kind in these countries. The science which has been displayed in giving the general line of the road a proper inclination through a country whose whole surface consists of a succession of rocks, bogs, ravines, rivers and precipices, reflects the greatest credit upon the engineer who has planned them."



Telford's cast iron bridge over the Birmingham Canal at Smethwick.

A good coach road was now provided all the way from Shrewsbury to Holyhead, but the crossing of the Menai Straits still had to be made in open boats, and after long consideration it was decided to employ Telford to construct a bridge across this dangerous ferry. This bridge is probably the best known of Telford's works. He first proposed the building of a bridge at the Swilly Rock to consist of three cast iron arches of 260 ft. span, with a stone arch of 100 ft. span between each two iron arches to resist their lateral thrust; or alternatively a single cast iron arch of 500 ft. span at Yns-y-moch. Both plans were rejected, however, and he was instructed to make a further examination of the Straits. He then proposed a suspension bridge at the Yns-y-moch site, and this plan was strongly supported by Rennie and other eminent engineers.

Parliamentary sanction for the scheme was obtained in 1819, and Telford immediately set to work. The preliminary operations were quickly carried out, and early in 1820 building operations commenced. The three arches on the Caernarvonshire side and the four on the Anglesey side were undertaken first, and were completed late in the autumn of 1824. The piers were 65 ft. in height from high water line to the springing of the arches, and the span of each was 52 ft. While this work was in progress the two main piers, each 55 ft. apart and 153 ft. in height, from which the 16 main bridge chains were to be suspended, were also proceeded with. They were built with the utmost care in view of the enormous weight they would have to carry. Over these piers were built the smaller arches to carry the roadway, and upon these arches masonry was erected in tapering form to a height of 53 ft. above the level of the road.

By the beginning of 1825 the suspension piers, land piers and arches, and the land ends of the chains, were all in position. Telford decided to build the central portion of each main chain on a raft 450 ft. long and 6 ft. wide, to float this raft into the proper position, and then lift the chain into place by means of capstans. In April 1825 the raft bearing the first main chain was cast off from the Caernarvon side, towed by four boats into its position between the main piers, and there moored. One end of the chain was then bolted to the end of the chain hanging from the Caernarvon pier, and the other end was attached to ropes that passed by means of blocks over the top of the Anglesey pier, and extended down to powerful capstans fixed on the Anglesey side. These ropes were manned by about 150 men who, when the signal was given, hauled steadily until the great chain was seen to be safely swinging in the air and the supporting raft was floating away. The most anxious moment was now passed, and a tremendous cheer broke from the enormous crowds that lined the shores on both sides of the Straits.

The remainder of the work was carried out quickly. In 1 hr. 35 min. from the time when the hoisting commenced, the chain was raised to its final position and secured to the land portion that led to the Anglesey pier. Telford then climbed to the point of fastening and satisfied himself that a safe connection had been made, and the announcement of this fact was immediately followed by prolonged cheering from the workmen, echoed in still greater volume by the spectators. Three of the workmen indeed were so excited that they scrambled from one side of the Straits to the other along the upper surface of the chain, which was only nine inches in width! The remaining 15 chains were suspended without any particular difficulty, and the final bolt of the last chain was fastened on the 9th July 1825.

The construction of this bridge was a tremendous mental strain on Telford. Many engineers had predicted its failure, and in spite of the minute care with which he supervised every detail of the work, there was always the possibility of a flaw in the iron or the overlooking of some little detail that might cause disaster. For some time before the bridge was finally opened Telford's anxiety was so great that he could scarcely sleep, and when the result of the first day's experiment proved beyond doubt the strength and solidity of the bridge, his friends who rushed to congratulate him found him on his knees, praying.

The Menai Suspension Bridge is 1,710 ft., or nearly a third of a mile in length, and the distance between the points of suspension of the main chains is 579 ft. The road deck is 100 ft. above high water mark.

Soon after the Menai Bridge was begun the authorities decided that a bridge of similar design should be built over the estuary of the River Conway opposite the old castle, and Telford carried out this work, which was completed in 1826. By this time he was nearly 70 years old, an age at which most men lay aside serious work; but he still had the health and mental activity to carry out other important schemes. Among these were the St. Katherine Dock on the River Thames, several bridges, and important drainage works in the Fen district which included the cutting of a canal about six miles in length through sandbanks into the deep waters of the Wash. His last professional work was to prepare a report, at the instance of the Duke of Wellington, on the best method of improving Dover harbour. A few months later Telford became seriously ill, and he died on 2nd September 1834, at the age of 77. Telford had directed that he should be buried in the graveyard of St. Margaret's Church, Westminster, but the Institution of Civil Engineers, of which he was the first President, urged that it would be more befitting that so great a man should be interred in Westminster Abbey. The executors agreed to their suggestion, and Telford was buried near the centre of the nave in the Abbey, and the place indicated by the words: "Thomas Telford, 1834." The next grave is the resting place of Robert Stephenson, who died in 1859, and who was buried there in accordance with his wish to be interred near to Telford.

Telford's success as an engineer was due to a remarkable combination of natural ability and unceasing labour. He endeavoured to excel in whatever task he undertook, and was never satisfied with his own accomplishments but always strove to improve his work still further. He regarded his apprenticeship to masonry as having been of more value to him than passing through a University.

In June last the Institution of Civil Engineers commemorated the centenary of his death by a unique exhibition of letters and documents relating to him, and of drawings of some of his important works.

Continuous Milling Machines

A Drum Type Design for Heavy Work

IN order to cope with the high production demanded by the automobile and similar industries, the Niles-Bement-Pond Company of New York and London have developed a drum type continuous milling machine. This machine is particularly adapted for cylinder block and similar milling operations. It is essentially a single-purpose machine, and is therefore specially arranged for each job, both with regard to width and the number of spindles. The arrangement of the spindles can also be varied to meet special problems. At the same time the designers have borne in mind the point that it might be convenient to change the machine over for other work, and provision is made for doing this with the least possible cost and trouble.

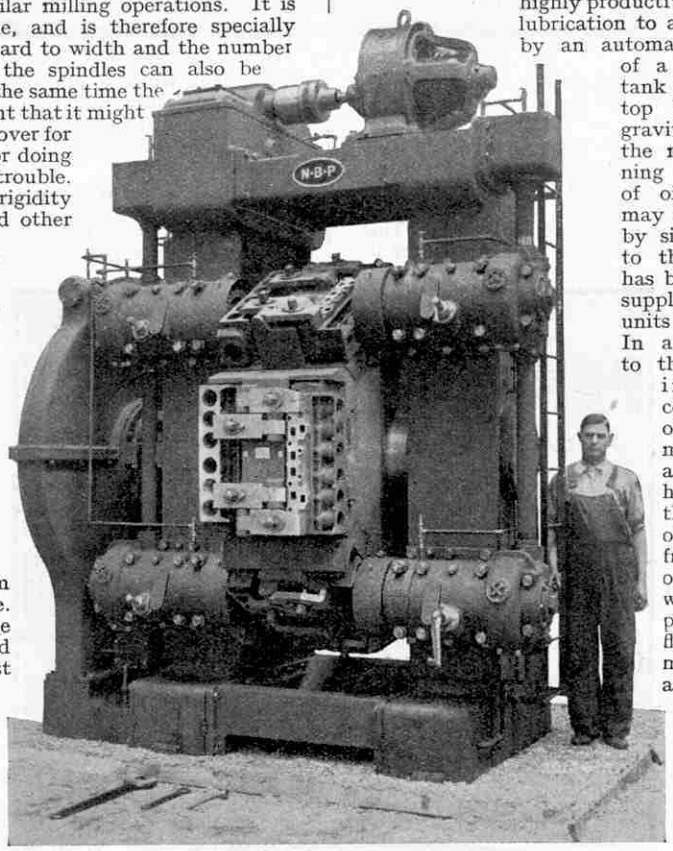
In order to ensure the necessary rigidity under heavy duty, the housings and other castings are of ample proportions. The housings are parted horizontally on the centre line of the drum, and are tied together at the top with a top brace bolted and dowelled to each housing. The base connection is also keyed, dowelled and bolted to the housings.

The spindle saddles are bolted and dowelled to the planed faces of the housings, and are set to the most suitable distance, cutter centre to drum centre, within a range of 24 in. to 28 in. for the standard machine. A special height machine is built that has a distance of 24 in. to 38½ in. from the cutter spindle to the drum centre. The drive to the spindles is by bronze worm wheels and hardened and ground steel worms. The worm thrust is taken by ball bearings directly at the worms.

The drum on which the work-holding fixtures are mounted is either round or polygonal, the shape being determined by the fixture. This drum runs on large journals in renewable bearings in the housings. It is driven by a semi-steel worm wheel 60 in. in diameter with its mating worm of steel through a smaller bronze worm wheel and hardened and ground steel worm. The thrust of each worm is taken by ball bearings directly at the worm, and a large thrust collar for absorbing end thrust of the drum is accessible from the outer side of the feed worm housing.

The question of lubrication, which is important for all machines, becomes specially so in connection with a machine of such a highly productive and specialised type. Thorough lubrication to all parts of the machine is assured by an automatic continuous system consisting of a pump that delivers oil from a tank in the base to a reservoir in the top brace, from which it flows by gravity to other reservoirs throughout the machine wherever important running parts are involved. The flow of oil to bearings and other parts may be regulated to the right amount by sight feed oilers on piping leading to these parts. Particular attention has been directed to ensuring a copious supply of lubricant to the worm gear units of the drum feed and spindles. In addition to individual pipe leads to the worms, the worm wheels dip in oil in their respective compartments, so that a film of oil on the teeth contacts is constantly maintained. Inspection windows are provided over each worm gear housing, as a visible check on the flow of oil to these parts. An oil flow gauge on the main pipe from the pump to the reservoir on the top brace also indicates whether the pump is operating properly. As a protection against flooding the various oil compartments, overflow pipes and passages are provided whereby the surplus oil is returned to the base.

The machine is driven by a 25 h.p. constant speed motor running at about 1,200 r.p.m. This motor is situated on the top brace, and is connected to the motor pinion shaft by a combination safety clutch and flexible coupling. The machine is therefore entirely self-contained, and is not dependent on any outside driving power. The accompanying illustration shows the position of the motor, and gives a good idea of the size and massive construction of the machine.



The cutter side of the drum type continuous milling machine at work on motor car engine cylinders. For this illustration we are indebted to the Niles-Bement-Pond Company, London.

Great Ports of the World—*(Cont. from page 699)*

Irish railways and by way of the Grand Canal Dock with the Grand Canal, the longest inland waterway system in Great Britain and Ireland. Barges 61 ft. long and 13 ft. wide can pass through the canal, and modern methods of traction are employed, all the company's steel barges being motor propelled.

The exports of the port in 1933 totalled 397, 312 tons of goods and 565,032 head of livestock, while 2,305,722 tons of goods were brought into the port. The exports of butter, bacon, eggs, fish and other classes of Irish produce reach immense quantities in their various seasons, and the export of eggs during the spring season, February to May, reaches a daily total of about 150 tons. Goods for shipment that are handled by the L.M.S.R. in Ireland are conveyed alongside the company's steamers for Holyhead, and lifted into the holds of these ships by hydraulic cranes. The export of livestock has long been a very important branch of the trade of the port, and is still considerable in spite of tariff hindrances. The livestock accommodation at North Wall enables about 3,500 head of cattle, horses, sheep and pigs to be handled simultaneously. Stout is exported in great quantities from the port. It is made in the city at Guinness's brewery, the largest in the world, and consignments for the cross-Channel trade are placed in the company's own barges alongside their private wharf at Victoria Quay. The barges can load up to 68 tons each, and they carry the casks of stout down the river to the deep waters of the port, where the cargoes are transferred to the cross-Channel vessels. The barges then receive their return cargoes of empty casks which are already awaiting collection on the quays.

Imports at Dublin include wheat, barley, fruit, iron, steel, oil and paper. The storing and forwarding of much of the grain, flour, feeding stuffs and general merchandise is dealt with by the Merchants' Warehousing Company previously referred to, who have four warehouses on the Port estate. The company's automatic grain discharging plant at Alexandra Wharf can handle 225 tons of grain per hour. Large quantities of coal are imported into Dublin every year. The coal consigned to Dublin merchants and manufacturers is discharged at the George's Inner Dock, while the bulk of the coal imports for transmission by rail to other parts of the Irish Free State are landed at the North Wall Extension and at the Spencer Dock.

We are indebted to the Dublin Port and Docks Board for the information contained in this article.

The Story of Hoover Dam—*(Cont. from page 683)*

required along a curved runway. This cableway will be used chiefly in connection with the construction of the power houses that will be built below the dam in order to make use of the water to be accumulated above it, and the other four deliver the concrete of which the dam itself is being constructed.

The loads carried by the cableways are supported from carriages that run along the wire ropes and are hauled backward and forward by means of continuous ropes passing round drums at the heads of the towers. These loads include not only the 16-ton buckets of concrete already referred to and other material required in the erection of the dam, but also the skips, each holding 15 men, in which the workers are lowered into the canyon and brought out again when their shift is ended. Climbing about the dam by means of ladders would have involved great waste of time and labour. This is avoided by use of the cableways, and also by the erection of a hoist on the downstream side of the structure. In addition there are skipways on each face of the dam. These are vertical slides up and down which travel skips on greased skids, and they are familiarly known as "monkey slides."

Each of the five cableways engaged in concrete pouring and in work connected with it is capable of supporting a weight of 20 tons, and all are completely dwarfed by one erected a little further downstream by the U.S. Government that has been designed to convey, lower and raise loads of no less than 150 tons. The chief purpose of this special cableway is to handle heavy steel pipes for lining the penstocks through which water will flow to the power house, and later it will be used in the installation of the heavy machinery of the power houses.

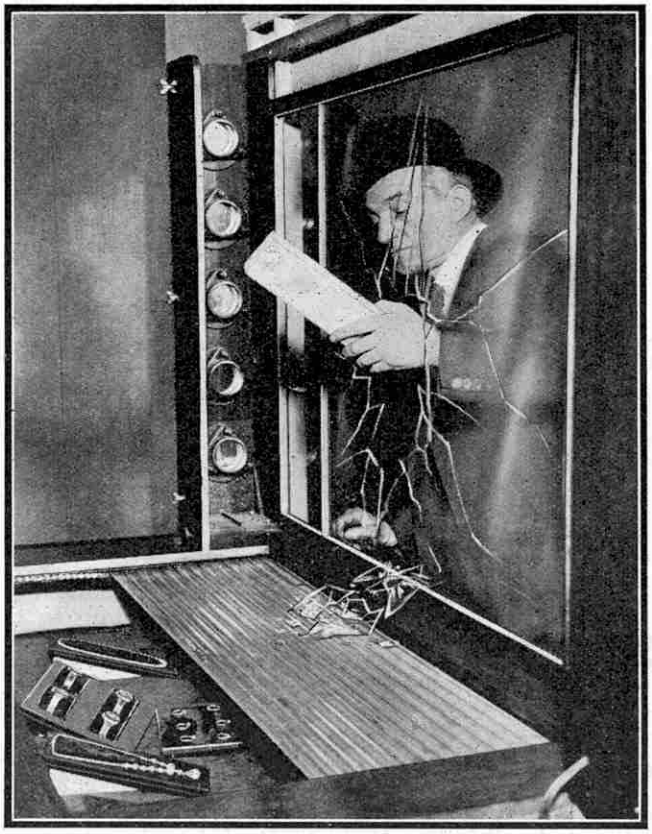
OUR BUSY INVENTORS

RECENT INTERESTING PATENTS

VARIOUS articles that have appeared in the "*M.M.*" have shown how valuable photo-electric cells can be in industry and elsewhere. I may remind readers that a cell of this kind is similar in form to an electric light bulb or wireless valve and contains two electrodes, one of which is coated with potassium or some other substance that gives out electrons when light falls upon it. These electrons are attracted towards the second electrode, which is positively charged, and a current thus flows across the cell. This current can be amplified and made to ring an electric bell, or to bring various types of mechanism into action by means of a relay; and photo-electric cells have been designed to respond to the invisible beams of infra-red light.

Electric Eye Foils Smash and Grab Raids

The photo-electric cell has been applied to the protection of valuables. A beam of light is directed across the approach to these and then upon the cell, and the interruption of this beam by the hand or body of a would-be thief causes a disturbance of the electrical circuit in which the photo-electric cell is included, and this releases a switch to set alarm bells ringing. A system of this kind is installed in the room at the Pioneer Goldmine, Ontario, Canada, in which the gold is melted and poured into moulds before being sent to the Royal Mint at Ottawa. Recently a robber succeeded in cutting through the metal wall of this room, but as he entered it he momentarily crossed the invisible protecting light beam and set the alarm bells ringing. Apparently he did not hear the bells, for on responding to the warning the Superintendent of the mine found him in the bullion room, seeking the gold with a flashlamp. He welcomed the Superintendent with a hail of bullets and escaped after a struggle, but his designs on the treasure had been foiled by the watchful electric eye.



How a "smash and grab" thief is foiled. Valuables displayed in a jeweller's window are lowered and covered by a steel shutter as he breaks the window. Photograph by courtesy of the General Electric Co. Ltd.

The illustration on this page shows a demonstration of a similar system intended for the prevention of "smash and grab" raids. The speed and cunning with which these raids are carried out makes it difficult to prevent them, and only the electric eye, which detects intruders instantly and responds with the speed of light, can guarantee complete protection. The beam of light employed is invisible, and is reflected backward and forward across the window immediately behind the glass by means of banks of mirrors placed at the sides. From the last mirror the beam passes into a photo-electric cell, and when it is disturbed, as by the passage of a brick thrown through the window, an electrical relay causes the window bottom to sink from view and a steel spring shutter to fly forward to cover the valuable articles contained in it. The movement is so swift that everything of value is removed from the reach of the thief by the time he can put his hand through the broken window, and simultaneously sirens sound the alarm.

This interesting apparatus has been introduced by the General Electric Co. Ltd. It is operated entirely from the ordinary electric mains, and its installation does not interfere with the usual window display.

Toy Submarine to Reap Harvest of the Sea

A large proportion of the Earth's surface has never been explored. This is the part covered by the oceans, no less than 9,000,000 square miles of which are at depths of less than 300 ft. Untold riches may await us there, for apart from the possibility of salvaging valuable cargoes from lost ships, enormous quantities of valuable shellfish, pearl oysters and sponges could be gathered if certain tracts of the sea floor were accessible. It has been claimed that shellfish to the value of £600 can be obtained from every acre of enormous tracts beneath the Atlantic Ocean off the shores of North America.

At present the only means of gathering the harvest of the sea bed is by means of trawls and dredges. These are not very efficient, and Mr. Simon Lake, the famous submarine inventor, has designed an under-water craft only 22 ft. in length to replace them. This tiny vessel, which is named the "*Explorer*," can be towed along the sea floor or driven by means of a small electric motor fitted to it. It receives the necessary supplies of electric current and air from a surface ship, but sufficient compressed air is carried to make it self-sustaining for 48 hours in case of need. There are 22 windows in its hull and its conning towers through which the bottom of the ocean can be illuminated by means of 5,000-watt searchlights that are sufficiently brilliant to enable photographs to be taken. An extending derrick operated from inside has a reach of 8 ft. and carries a grab bucket that can lift weights up to 500 lb. This can be used to drag out of the sandy floor of the ocean large shellfish that defy the efforts of trawlers and dredgers to move them from their homes.

The new submarine is also an under-water diving station. Full diving kit is carried, and when a diver wishes to leave the vessel it is adjusted to remain balanced just above the sea floor and the air pressure within it is raised to that of the water outside. A hatch in the bottom of the hull is then slid open. No water enters the submarine, for the increase of pressure transforms it into a diving bell, and the diver steps out through the opening. The submarine can follow him as he moves about, and his movements can be directed by telephone by those within the vessel.

When the diver returns, the pressure is slowly reduced in order to avoid the development of "bends," and while this process is taking place, he is at ease in the submarine, in which he can continue

his work; whereas the ordinary diver who must work from surface craft has to dangle uncomfortably during a slow ascent to the surface in order to avoid the dreaded diver's disease.

Scientific expeditions will find the new submarine useful in studying the life of the oceans and securing a record of the strange creatures inhabiting it, of which at present we know comparatively little. It can be employed also in the survey of harbours and coastal waters, the inspection of piers and docks, and the laying of cables in water of depths up to 300 ft.

A Petrol-Ignition Lock for Motor Cars

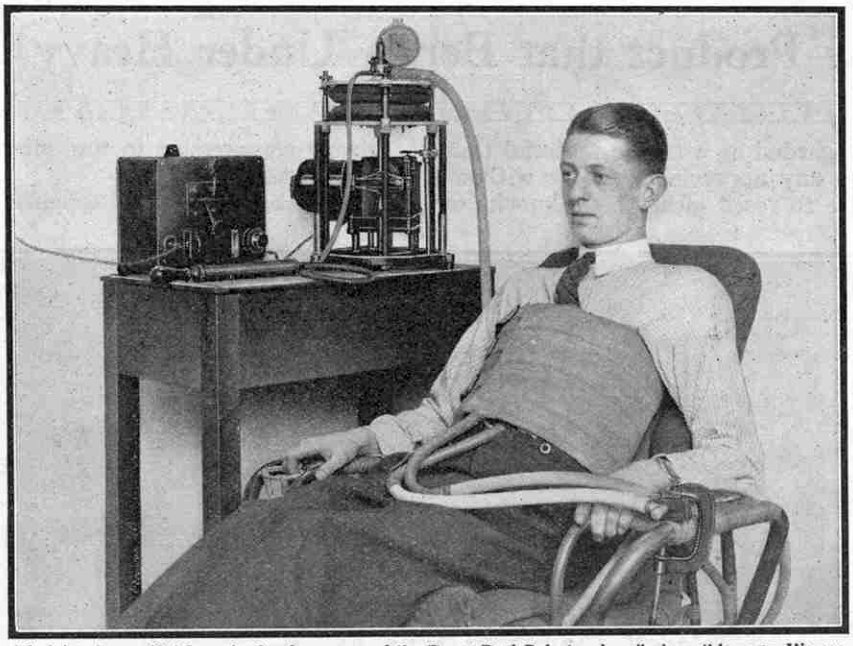
Inventors are constantly at work on devices to foil the car thief, and for this purpose have produced complicated locking mechanisms and devices for producing discordant screeches and other forms of alarm when a car is started or driven away by an unauthorised person. Many of these schemes depend upon the use of an ignition lock, but this does not give adequate protection, for anyone with a knowledge of the manner in which a motor car works can easily cut the wires and reconnect them outside the lock. A new device known as the "Featherstone" Automatic Petrol-Ignition Lock therefore will be of interest to many owners of motor cars, for it not only locks the ignition, but also shuts off the petrol supply, and its design makes a car practically immune from theft.

The "Featherstone" lock is fitted on the dashboard or instrument panel, where it takes the place of the ordinary ignition switch, and the car is started by giving a quarter of a turn to the key of a Yale lock incorporated in it. This action opens the petrol valve and completes the ignition circuit. The key need not be left in the lock when the car is running, and the engine is stopped when necessary by turning a lever that automatically shuts off the supply of petrol and switches off the ignition.

A would-be motor thief cannot start a car protected by the "Featherstone" lock by cutting the wires and reconnecting them, for the petrol supply then remains closed. He cannot overcome this difficulty by rapidly fitting a temporary by-pass for the petrol, because the pipes leading to and from the petrol valve are on opposite sides of the dashboard; and he cannot even take the lock to pieces, for this is so designed that the manufacturers themselves cannot begin to disassemble it without the use of the key.

Breathing by Machinery

A machine that illustrates the wonderful simplicity of many of the most remarkable inventions is the result of an idea that occurred to Sir William Bragg, F.R.S., one of the most distinguished of British scientists. It is said that a friend of Sir William who was attacked with paralysis gradually lost the use of the muscles controlling his breathing. Artificial respiration became necessary, and as this had to be continuous it was very laborious. Sir William hit upon the idea of making use of compressed air in order to ease matters. A football bladder strapped tightly round the patient's chest was connected with a second bladder placed between two boards, and a treadle action on the upper board drove air in and out of the bladder fastened round the patient's chest, and thus alternately compressed his chest and allowed it to expand.



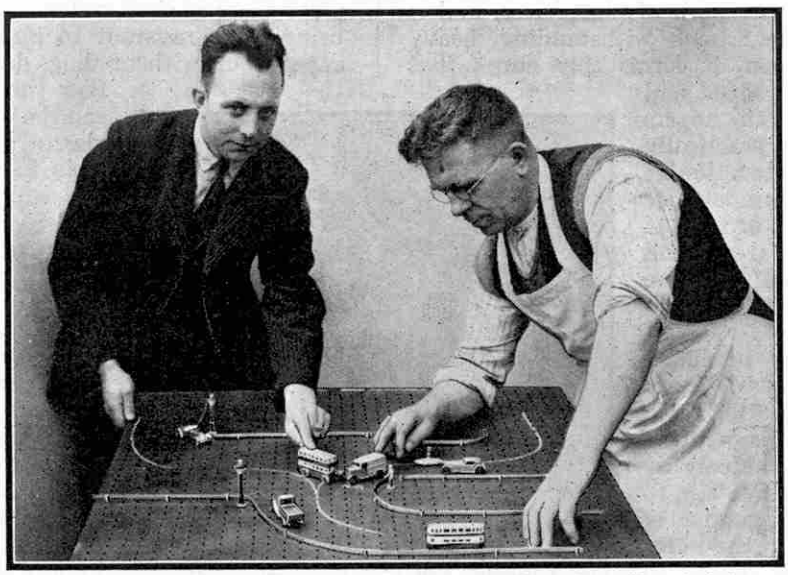
Administering artificial respiration by means of the Bragg-Paul Pulsator described on this page. We are indebted to Siebe, Gorman and Company Ltd., for our photograph.

The result of this ingenious plan has been the development by Mr. R. W. Paul of the electrical pulsator shown in use in the accompanying photograph. An air bag connected with a small bellows is adjusted round the patient's chest, and the air pressure inside this system is raised by means of a handpump. A small electric motor is then switched on to drive a crankshaft connected with a plate under the bellows that moves upward and downward at speeds varying from 15 to 30 strokes per minute, alternately increasing the pressure in the air bag and allowing it to fall, just as in Sir William Bragg's original contrivance. It is not necessary that the bag should fit exactly, the required effect being produced when it merely encircles the thorax below the armpit.

The Bragg-Paul pulsator can be used to assist in the recovery of persons who have apparently been drowned, or of those suffering from electrocution or the effects of gas. It is remarkably efficient in action, and in one case where ordinary breathing is impossible has been used continuously for eight months with great success. It can be worked by hand in the event of failure of power supply.

Model Helps to Solve Traffic Problems

Week by week we are appalled by the number of deaths that occur on our roads, and any device that can help even in the smallest degree to reduce the toll exacted by modern traffic is worthy of the closest attention. Many accidents no doubt are due to the fact that as yet we have not become sufficiently accustomed to the greatly increased speeds that the coming of the motor car has brought with it, and fatal accidents probably will occur with distressing frequency until the entire population of the country is completely in tune with modern conditions.



A simple device for demonstrating how road accidents occur and for testing traffic control schemes at complicated crossings and junctions.

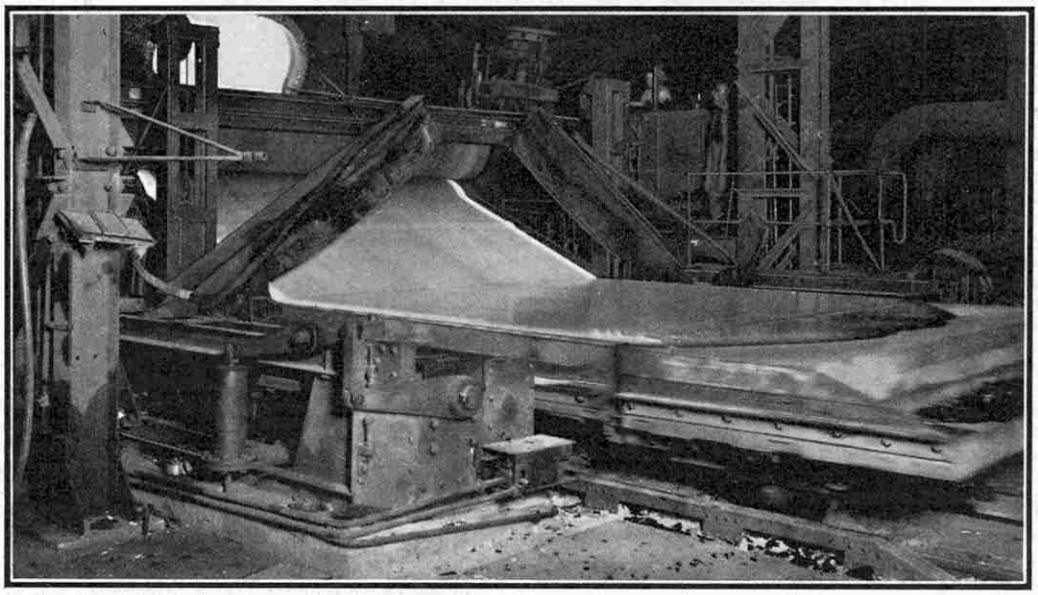
These considerations lend special interest to the invention by two Newcastle men of a device for teaching school children road sense. This device is illustrated on this page, and consists of a board of hard plywood pierced with holes in which steel pegs can be placed. On this board road crossings and junctions can be represented by means of flexible steel tapes held in position by the steel pegs, and models of different types of vehicle can then be moved along them in order to demonstrate how accidents occur, and to show what precautions should be taken by motor car drivers and pedestrians. Meccano Dinky Toys are very suitable for use with the device.

The invention can be used also in courts of law for demonstrating accidents and explaining their cause, and will be helpful in devising traffic control schemes for busy and complicated roads and crossings.

Marvels of Armourplate Glass

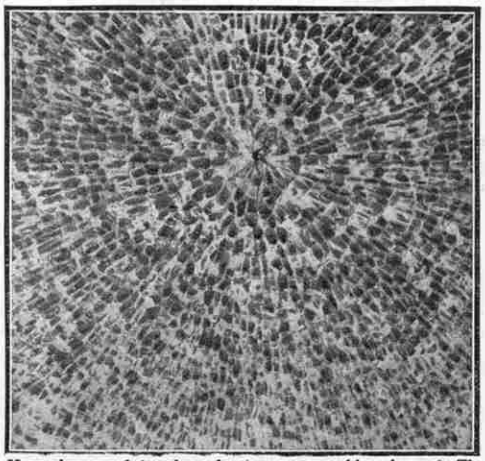
New Product that Bends Under Heavy Loads

GLASS usually is regarded as a brittle material that cannot be bent to any appreciable extent without breaking and is unable to resist either hard knocks or high temperatures, both of which cause it to break up into pieces of varying size and irregular shape that have sharp edges and are very dangerous to handle. These certainly are the properties of ordinary glass, but a new type that is now made in the Glass Works of Pilkington Bros. Ltd., at St. Helens, Lancashire, has at least three times the strength of plate glass, and is capable of resisting heat and withstanding heavy blows. When it is broken, it forms tiny cubes that are comparatively blunt edged and can be crumbled between the fingers without difficulty and practically without risk. This remarkable material is called Armourplate Glass, and it can be bent or twisted to an extraordinary extent and resists heavy blows as well in severe frosts as it does at ordinary temperatures.



Casting a sheet of plate glass. Armourplate Glass is manufactured by a special process from sheets of polished plate glass. This and other illustrations to this article are reproduced by courtesy of Pilkington Brothers Limited, St. Helens.

Armourplate Glass is manufactured from sheets of ordinary polished plate glass by heating them uniformly to softening temperature and then cooling them suddenly by a special process. This gives rise to strains, for glass is a bad conductor of heat, and at first only the outer surfaces are cooled and caused to contract. The glass in the centre of the sheet remains liquid, and resists the tendency of the surface layers to contract, with the result that these layers are stretched. Thus the sheet of glass is converted into a kind of sandwich in which the outer layers are colder than the centre, but the sheet is only slightly stressed owing to the stretching of the skins. When the glass finally reaches room temperature there is strong compression in the outer layers, with tension in the centre.



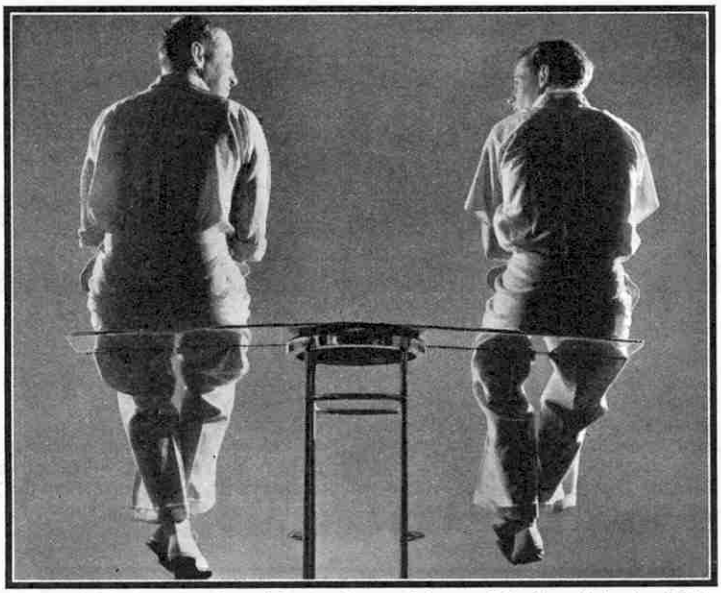
How Armourplate glass fractures on sudden impact. The fragments can safely be crumbled between the fingers.

The hardening or toughening process by which Armourplate Glass is produced gives it a remarkable increase of strength over that of the plate glass from which it is made. A sheet of the latter $\frac{1}{4}$ in. in thickness is shattered when a steel ball 1.68 lb. in weight is dropped upon it from an average height of about 13 in., but a drop of 96 in. usually is necessary to break a piece of Armourplate Glass of similar size and thickness. In addition to being more resistant to impact, Armourplate Glass is capable of withstanding dead weight loads three or four times greater than those that can be carried by ordinary plate glass. Pieces of glass 45 in. in length, 10 in. in width and $\frac{1}{4}$ in. in thickness, and supported at their ends, were used in interesting tests of this. In each case the supports were 40 in. apart, and the load was applied to the glass between them steadily and without shock. In these conditions Armourplate Glass did not break until loads of from 230 lb. to 280 lb. were applied to it, but ordinary plate glass collapsed under a weight of about 50 lb.

A sheet of any type of glass bends when under load, and the extent to which Armourplate Glass is bent by any given weight is the same as that to which ordinary plate glass of equal thickness is deflected. Since Armourplate Glass can withstand a much greater load than ordinary glass, however, it can be bent farther without breaking, and the sheets of Armourplate and plate glass employed in these tests sagged in the middle to the extent of about 3 in. and $\frac{1}{2}$ in. respectively.

The amazing strength of the new glass is strikingly

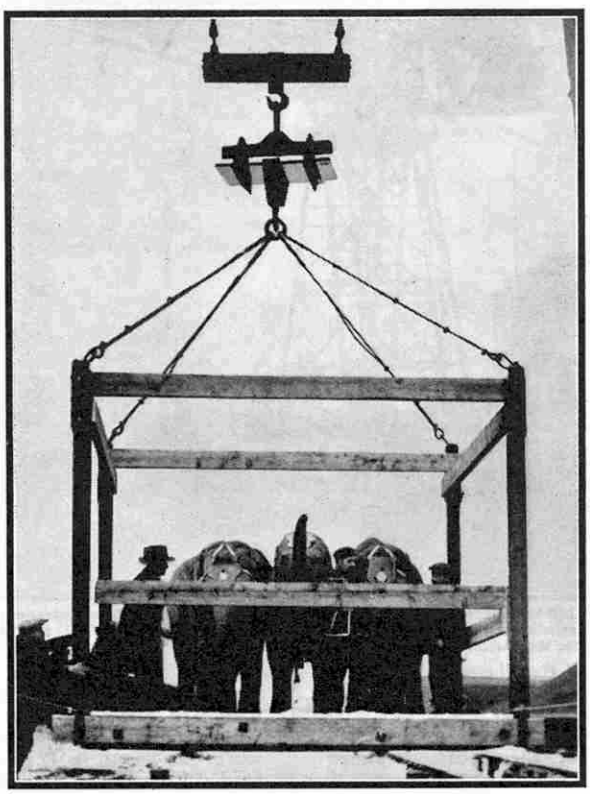
shown in our illustration, which shows a piece of Armourplate Glass supporting three baby elephants, weighing 3 tons 16 cwt., standing with three men on a platform that with the accompanying tackle itself weighs 1 ton 3 cwt., making a total weight of more than 5 tons. The piece of glass from which this enormous load is suspended is 44 in. long and 24 in. wide, and is only 1 in. in thickness, and in another trial a motor lorry weighing $3\frac{1}{2}$ tons on which seven men were seated was suspended without mishap from a similar sheet of Armourplate Glass.



A remarkable demonstration of the toughness of Armourplate Glass. It bends slightly when subject to loads that would shatter plate glass of equal thickness.

The remarkable toughness of Armourplate Glass makes it of great value in the manufacture of ships' port-lights. The shock of a wave on a port-light causes momentary pressure over the whole of the surface and it has been revealed in tests reproducing sea-going conditions as closely as possible that Armourplate Glass $\frac{1}{2}$ in. in thickness can withstand a pressure at least four times as great as that required to break plate glass 1 in. thick. Board of Trade regulations now allow the use of 1-in. Armourplate Glass to replace ordinary plate glass half as thick again.

The strength of Armourplate Glass also is shown by its resistance to breakage when heated. Since glass is a poor conductor of heat, it expands unevenly as its temperature rises, and is then subject to stresses that may cause it to crack, or even fly to pieces. For this reason ordinary plate glass cannot be used for making the inspection windows of electric ovens, or in positions in which it is exposed to jets of steam. Armourplate Glass is safe under both these conditions and indeed can be incorporated in the doors of ovens working at very high temperatures, for a sheet of the material will not break when one side of it is heated to a temperature of nearly 300 deg. C. while the other remains at ordinary atmospheric temperature.



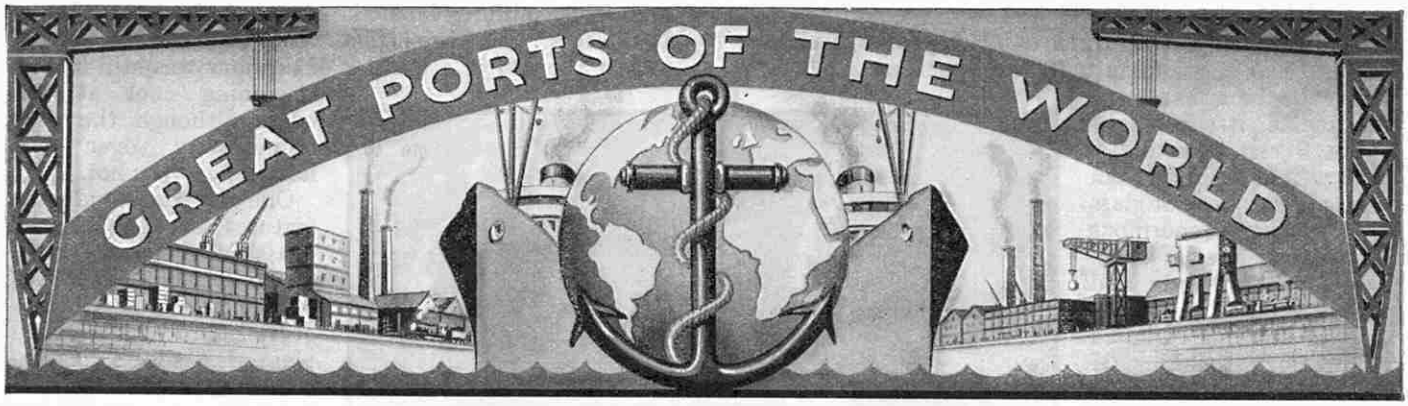
Three baby elephants on a heavy platform supported by a sheet of Armourplate Glass only 1 in. in thickness and 2 ft. in width. The total weight suspended from the glass exceeds 5 tons.

In one interesting experiment designed to show how differently the two kinds of glass behave when heated, a piece of $\frac{1}{4}$-in. Armourplate Glass measuring 14 in. by 10 in. was placed on an electric heater with a piece of plate glass of the same size and thickness on top of it. The heater was switched on, and seven minutes later the sheet of plate glass broke into pieces. The Armourplate Glass then was unaffected, and at the end of a quarter of an hour was still intact, remaining cool at the edges although the part immediately over the heater was very hot.

One of the most valuable features of Armourplate Glass is the manner in which it breaks when subject to impact or load too great for it. Ordinary plate glass sheets collapse into large splinters with razor-like edges when they are broken. These can be very dangerous, and there have been many cases in which people have been severely injured when a window has been broken, or when a motor car or other vehicle with glass windows has been involved in an accident. Armourplate Glass on the other hand disintegrates into innumerable small pieces that have no edges sharp enough to cause injury. The fragments are almost rectangular in shape, and each is about the size of a pea. Armourplate Glass therefore can safely be used for any purpose where the employment of ordinary glass would involve risk, for its toughness and the harmless manner in which it breaks up make it a very valuable protective material, and it has the added advantage that it does not contain any inner layers of organic material to reduce its transparency. It is particularly suitable for the windscreens of motor cars, and for this purpose a similar glass is marketed under the trade name of "Triplex Toughened."

In spite of the remarkable difference in properties between Armourplate Glass and the polished plate glass from which it is made, there is no loss of transparency or brilliance and it retains the characteristic flat surface and vision through it is not distorted. It cannot be worked after manufacture, but variety is provided by the use of black glass of this type and both black and ordinary Armourplate Glass can be embossed, brilliant-cut, or sand-blasted, provided that the necessary working does not go deeply into the glass.

The introduction of Armourplate Glass marks another step forward in the use of glass for architectural purposes, for it is proof against climatic change and accidental damage and readily lends itself to decorative schemes.



XI.—DUBLIN

ON the east coast of the Irish Free State there is a bay six miles long and 5½ miles wide that receives the waters of three rivers, the Liffey, Dodder and Tolka. Astride the river Liffey and about two miles from the mouth is Dublin, the chief port of the Irish Free State.

Very little is known of the history of Dublin up to the ninth century, when it was one of many places captured by the Danes who invaded Ireland. The Danes held sway over the eastern seabord of the country for 300 years. They built a fortress at Dublin in 840, and were probably the first to commence the work of making dock and harbour accommodation there. It is known that as late as 1177 the old Danish bridge at Dublin, probably the first to span the Liffey, was still standing, and that the Viking ships came up to it to discharge their cargoes and take back to Scandinavia the collected plunder of the land.

The Anglo-Norman invasion of Ireland in 1170 put an end to Danish rule in that country. Dublin benefited by the change, as the Normans opened up a brisk and profitable trade with Bristol and other ports on the English side of the Channel. In October 1172 HenryII landed at Waterford with a large army, and proceeded to Dublin, where he held his court in a wickerwork pavilion erected for him outside the walls of the town, near the eastern gate. In this quaint structure the Irish chiefs were entertained with great pomp and their homage to the king was secured.

The requirements of shipping in the 16th century were slight, and at Dublin two quays known as the Merchant's and Wood quays were sufficient. A report of about 1590 that is preserved in the State Paper Office, Dublin, mentions that the depth of the Liffey opposite these two quays varied from 3 ft. to 6½ ft. The earliest printed account of the port was written in 1649, and it discloses that at that time there was only 6 ft. of water at the bar at low tide, and that vessels of 5 ft. draught could not get further up the river than Ringsend, 1½ miles below Dublin, where they became stranded at low tide.

When increasingly larger ships came into use, navigation of the estuary of the Liffey became more and more difficult. The situation was made worse by the fact that the three rivers already mentioned, which cut out a natural harbour, were unable to cope with the counteraction of the sea, and the estuary was gradually becoming silted up, with a dangerous bar and with shoals that yearly increased in size. Two great sandbanks to north and south of the fairway were an additional peril to shipping. These two banks have long been known as North Bull and South Bull, from the noise made by the waves breaking over them.

The 100-ton electric crane at North Wall Extension, Dublin. The illustrations to this article are reproduced by permission from "The Port of Dublin," published for the Dublin Port and Docks Board by Wilson Hartnell & Co., Dublin.

In the time of Charles II, Dublin harbour was regarded as sufficiently important to be made the subject of a special report, and this, together with a map, was made in 1693 by Sir Bernard de Gomme, who was responsible for devising the defences of Tilbury and Dunkirk. He recommended the building of a strong fortress with accommodation for 700 men and officers, a Governor's house, and other equipment, on what is now Merrion Square, up to which in those days the waters of the estuary came. De Gomme's map shows that the approach to Dublin harbour was a complexity of winding channels and very dangerous to navigation.

Eventually the city authorities and the trading community realised that something must be done. A start was made in 1707 by the erection of a Customs House, and in the next year the Ballast Office was established. This office had charge of the dredging of the river, and the sale of sand from the river strand to ships requiring ballast. It became the headquarters of the port administration, under whose direction a straight and navigable channel was formed in the river from Ringsend to the city, and other important improvements to the port were carried out. The old records preserved there give an interesting insight into these early works. Entries made in 1710 tell of conferences to consider piling the north side of the channel, and they are followed by reports of dredging and of procuring vast quantities of stone and faggots to wall in the channel. Mention is made of the laying of "kishes," crates made of bolted piles and filled with stone, to form a solid foundation for the wall.

By 1715 considerable progress had been made in the construction of this North Wall, and on "the fourth Friday after Christmas" of that year the merchants of Dublin record their opinion that the south side of the channel should be taken seriously in hand. The lack of shelter for ships in the estuary made such an undertaking very necessary, and the Ballast Office decided to drive a row of piles in order to form a sandbank that would protect the shipping. This work was begun in 1717 and completed by 1735. The bank extended from Ringsend to Poolbeg and was named the South Wall. A lightship was stationed at the seaward end of the wall, and continued in use until 1768 when it was superseded by the Poolbeg lighthouse.

In 1787 the adminstration of the port was reorganised, and the Ballast Office became the Corporation for Preserving and Improving the Port of Dublin. This change was sanctioned by an Act of the Parliament of Ireland.

During the period 1787 to 1867 great progress was made in developing the port. Probably the most important work carried out was the construction of a long granite breakwater eastward

of the South Wall. The breakwater stretches out 3¼ miles into Dublin Bay and protects shipping in the harbour from the south-east winds to which previously it was exposed. A solid foundation was obtained by sinking "kishes" in the deeper parts of the course and driving rows of piles in the shallower parts. Storms and high tides caused many setbacks to the work, and many lives and much material were lost. When John Rennie, the famous engineer, visited Ireland in 1802 concerning a private canal then being made to connect the navigation of the River Liffey with that of the River Shannon, he remarked in his report that "the improvement of Dublin harbour is perhaps one of the most difficult subjects which has ever come under the consideration of a civil engineer."

One end of the Alexandra Basin, which has a total water area of 60 acres and is deep enough to enable ships up to 32 ft. draught to lie afloat at all states of the tide.

The prospect of success was so poor that the idea of abandoning the Liffey as the site of a commercial port was seriously considered for many years. Other sites were suggested, and ranged from Sutton and Howth on the north side of the bay to Kingstown and Sandycove on the south, with connecting canals to bring the landed goods to Dublin. The breakwater was completed, however, and by 1805 the progressive improvement of the channel enabled ships of 300 tons to berth at the port. Other important works completed up to 1867 were the north, south and east quay walls, timber jetties on the north quay and sheds on the North Wall. The graving dock and graving slips Nos. 1 and 2 were built, and the construction of the North Wall Basin and quays were begun. A regular dredging of the channel was also carried out.

A further re-organisation took place in 1867 when the port became vested in the Dublin Port and Docks Board. Under this revision the administration of the lighthouses round the coast passed to a body known as the Irish Lights Commissioners.

Since 1867 a course of constant dredging and a systematic study of the habits of the river, the sea and the shifting sandbanks have been carried on, and additional retaining walls and embankments have been constructed where necessary to ensure a deep-water and easily navigable approach channel to the port. The bar has gone, and in its place there is a depth of 20 ft. of water at low water of ordinary spring tides. The sandbanks also have been considerably reduced, and at high tides ships of 12,000 tons and 32 ft. draught can berth at the port. The straight, wide and deep approach channel, penetrating to the heart of the city, is marked out by international day marks and lighted by buoys and lighthouses at night. The North Bull lighthouse at the end of the North Bull Wall and the Poolbeg lighthouse at the end of the South Wall mark the seaward entrance to the channel, which at this point is 1,000 ft. wide. The lighthouses within the port are provided with fog signals which, in three of the structures, are automatically controlled, being set in operation when the fog reaches a dangerous intensity and ceasing immediately the fog lifts. The lighthouses are opereated entirely by electricity that is automatically produced in them.

It is estimated that since 1860 a total of about 50,000,000 tons of debris has been dredged out of the Liffey. This material has been dumped behind retaining walls on both sides of the estuary and made into good solid land. Part of the city now stands on the reclaimed land on the south side, and great oil storage tanks, a large modern grain elevator, milling concerns and shipbuilding yards have been built on the reclaimed land on the north shore, where some 50 acres have been won from the sea. The work of reclamation is still going on, and it is estimated that within the next 10 years a total area of about 110 acres will have been reclaimed.

The port possesses 25,016 ft., or almost five miles, of quayage, and five docks, of which the largest, the Grand Canal Dock on the south side of the river, has a water area of 24 acres and 5,300 ft. of quayage. The other four docks, all on the north side of the river, are much smaller and in water area range from 1½ acres to four acres. They have a total quayage of 8,212 ft. The construction of Alexandra Basin at the seaward end of the North Wall was initiated in 1870 and its completion is still in the future. It is on a much larger scale than the docks just mentioned, having a water area of 60 acres and being deep enough to enable ships up to 32 ft. draught to lie afloat at all states of the tide. Privately owned pipelines extend from the wharfside of the Basin to oil depots about 100 yards inland, where there are numerous storage tanks with a total capacity of over 12,024,600 gallons of oil, and to the adjacent grain elevator of the Merchants' Warehousing Company.

Transit sheds and railway sidings, North Quays. On the left is the River Liffey and on the right the Alexandra Basin.

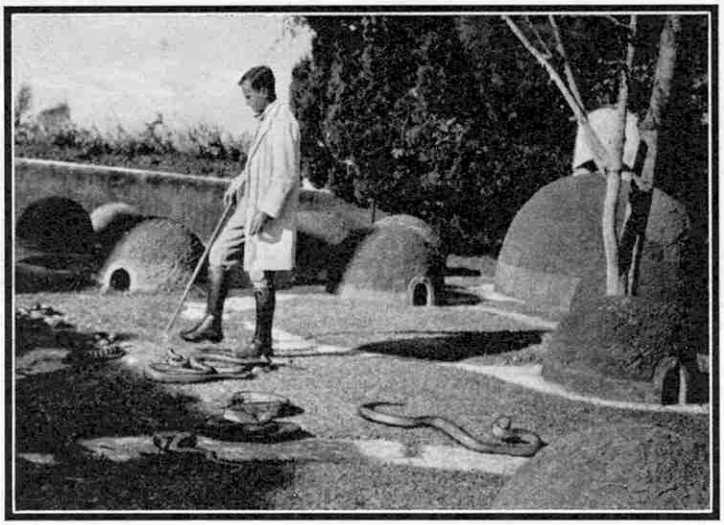
The quays and wharves of the port are equipped with cranes of from three to six tons capacity, and there is also a 100-ton crane with a clear lift of 75 ft. above water level for heavier loads. There are many acres of storage sheds, some of which are owned by the Port and Docks Board and others are private property. The Board's warehouses are at the Custom House Docks, at the city end of the port, and they can accommodate 22,000 tons of grain, 9,000 hogsheads of tobacco, and 10,000 tons of general merchandise. Spacious vaults provide storage room for 40,000 casks of wines and spirits. In addition there is wharfage accommodation at these docks for 30,000 tons of coal.

The port connects directly with the principal (*Continued on page 693*)

Rearing Snakes For Their Venom

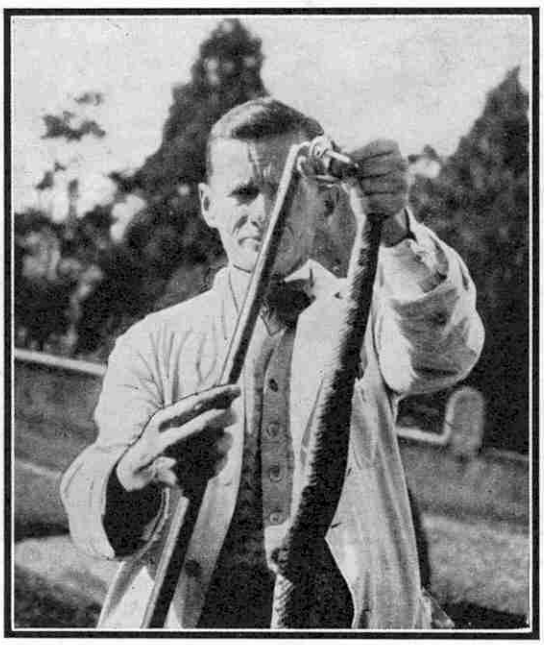
An Interesting Brazilian Farm

IN the British Isles, where the only venomous snake is the viper or adder, the risk of serious injury from snake bite is extremely small. Not only is the adder comparatively rare, but its bite very seldom has fatal results, except in the case of small children and adults in a delicate state of health. In many parts of the world, however, there is a serious death roll from snake bite. In India alone the deaths from this cause total many thousands every year, and there are heavy casualties in Africa, Central and South America, the West Indies, and elsewhere.



The Snake Farm at Butantan, Sao Paulo, Brazil, showing some of the snakes and their concrete huts.

After all that has been said and written on the subject, it should not be necessary to explain that a snake exerts its poisonous effects by means of a bite and not of a sting. Some people are still firmly convinced, however, that the slender, bifurcated tongue of a snake, which is such a conspicuous object as it darts in and out of the reptile's mouth, is its sting. Actually no snake has a sting of any kind, and the venom of poisonous species is injected into their victims by means of modified teeth or fangs, down which the poison is forced by muscles that are brought into operation by the action of biting. Certain African snakes are able to eject their venom from their mouths without biting. One of these, the ringhals snake, is able to eject its venom for a distance of as much as 9 ft., and it always aims, and with considerable accuracy, at the eyes. In most snakes the teeth are directed backward, so that after a bite has been made the reptile is not easily able to let go. The effect of a bite varies not only with different kinds of snakes, but also with the condition of the snake. If it has recently bitten another victim its supply of venom will be reduced.



An attendant makes a snake bite his stick.

It is fortunate that, of the 2,000 or so different kinds of snakes, only about one-third are venomous, and of these only some 150 are capable of inflicting a bite fatal to man. There is no external feature that can be relied upon to distinguish immediately a venomous snake from one of a harmless species.

The most venomous snake of India is the hamadryad or king cobra, which attains a length of 15 ft. It is a fierce and aggressive creature, and feeds entirely on other snakes. In tropical and southern Africa the mamba is greatly dreaded by the natives. It is not so large as the hamadryad, seldom attaining more than 10 ft., but it does not hesitate to attack human beings, and its bite is almost invariably fatal within a few hours. Another death-dealing African snake is the puff adder, so called on account of its habit, when angry, of swelling out its body with air. The fer de lance of the West Indies, which attains a length of 8 ft., causes a heavy death roll among the labourers in the plantations.

One of the most venomous of all snakes is the bushmaster of South America. This handsome reptile, which may be as much as 14 ft. in length, is fierce and fearless, and when disturbed will almost invariably attack rather than try to escape. Charles Waterton, the famous naturalist, in his "*Wanderings in South America*," says of this reptile: "Unrivalled in his display of every lovely colour of the rainbow, and unmatched in the effects of his deadly poison, the counacouchi glides undaunted on, sole monarch of these forests; he is commonly known by the name of the bushmaster. Both man and beast fly before him, and allow him to pursue an undisputed path."

In North America the rattlesnake causes a considerable number of deaths, but its venom is nothing like so poisonous as that of the snakes already mentioned. Much more deadly than the rattlesnake is the beautifully-marked copperhead.

In various parts of the Pacific and Indian Oceans there are many kinds of sea snakes, all of which are extremely venomous, and so savage that if taken out of the sea they immediately commence to bite fiercely at anything within reach.

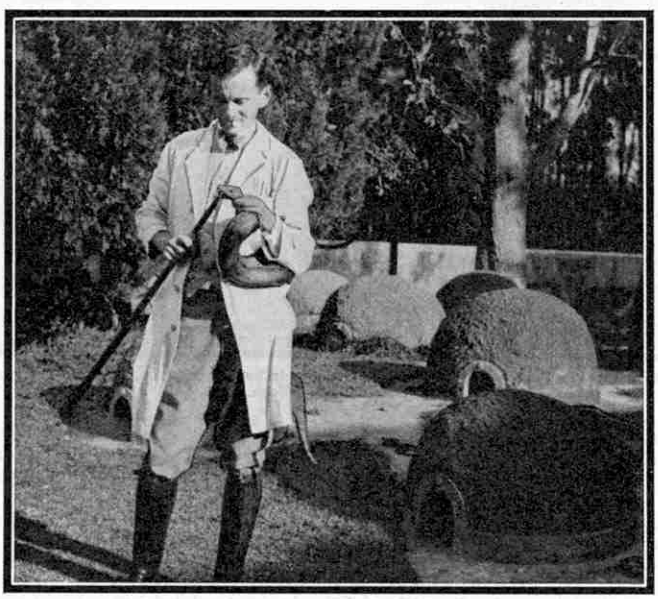
It is said that in their frantic rage they will even bite their own bodies.

Very little is known in regard to the chemical composition of snake venom, and there is no known antidote. Until recently the usual method of treatment of a bitten person was to prevent the venom from circulating through the blood vessels by means of a bandage placed round the limb above the wound, and tightened as much as possible by a short stick, and at the same time cut deeply round the wound so as to produce a flow of blood to carry away the poison. If the wound is in a fleshy part, a drastic but effective method is to cut round the wound, place gunpowder in the cavity and fire it. In some cases a red hot iron or strong acids are used. It is usual also to give strong stimulants to maintain the action of the heart. In recent years serious attention has been given to the problem of producing an absolute antidote in the form of a serum that will be effective against the poison of any snake. In order to maintain the necessary supply of venom to enable this work to be carried out on an adequate scale it has been found necessary to rear snakes specially for the purpose. Thus has come into being one of the strangest of all institutions, the snake farm. Our illustrations give some idea of the snake farm at Butantan, Sao Paulo, Brazil, run in connection with the Butantan Institute of Serum Therapy. On this farm the venomous snakes are housed in small concrete huts that resemble old-fashioned beehives or miniatures of the igloos inhabited by Eskimos. Arched openings at the base of these huts enable the snakes to enter and leave at will. The huts are placed in a grass enclosure surrounded by a moat 2 ft. wide, at the far side of which is a concrete wall 3 ft. in height. A snake that wished to escape would find no difficulty in swimming across the moat, but it would be quite unable to surmount the smooth concrete wall. The food bill of the snake farm is large, for the menu includes such items as sheep, dogs, cats, poultry, rabbit and rats.

A miscellaneous collection of venomous snakes basking in the sun.

The work of the attendants is not one that many people would be inclined to envy. When in the enclosure they are in constant danger of being bitten by the snakes, and they wear thick leggings to provide as much protection as possible. When a snake is required for the extraction of its venom, the attendant pins it to the ground by means of a long forked stick applied just behind its head. The snake is thus rendered helpless, and can be grasped at the back of the head and lifted from the ground. This procedure naturally annoys the snake, and it becomes angry enough to bite at anything. A second assistant holds a small glass vessel covered with a piece of American cloth or parchment close to the mouth of the snake. The reptile is induced to bite the cloth, so that its fangs penetrate it, and the exuding venom drops into the glass. The poison sacs of its head are pressed to force out as much of the venom as possible.

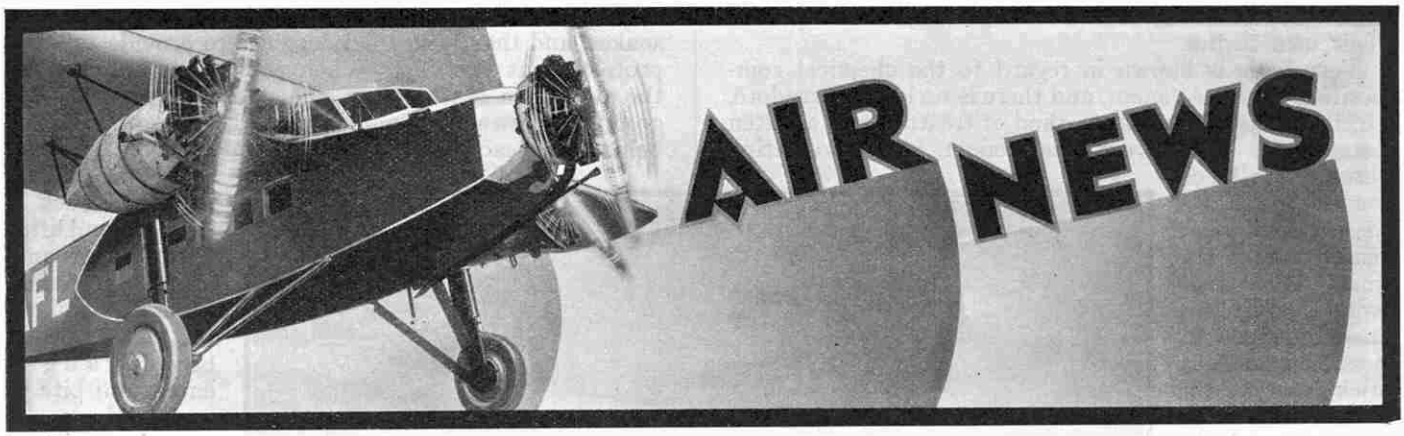
The venom extracted in this manner is dried and prepared in a dilute form for injection into horses kept for the purpose. The quantity injected at first is so small as to cause no inconvenience to the animal, and in subsequent injections the amount is gradually increased, so that finally the horses become immune to the effects of the poison. From the blood of these animals is obtained an antitoxin which, after being purified, is stored in sealed glass tubes ready to be despatched to wherever it may be required.



Another snake made to waste its venom on the stick.

Snake bites have been treated with antitoxin obtained in this manner, with considerable success, and serums have been prepared that are effective against the venom of some half dozen species of snakes. Much further research and experiments will be required before the ideal of an absolute antidote is attained.

The Pasteur Institute of India is doing valuable work of this nature, and has prepared an antitoxin that is employed successfully against the bites of cobras and Russell's vipers, the snakes that are responsible for most of the deaths from snake bite in that country. Investigations on similar lines are now being carried on also at institutes in France and Japan, in Pennsylvania and elsewhere, and it is hoped that the combined research will result in the discovery of an absolute antidote.



The End of the "*Los Angeles*"

The U.S. naval airship "*Los Angeles*" has been condemned as unairworthy owing to deterioration, and consequently no more flights will be made in it. When this decision was announced the American National Research Council applied for permission to take the vessel to Akron, Ohio, where it could be used for important experimental work; but as no method of towing it could be thought of, and permission to fly it to Akron could not be obtained, the airship has had to be kept at the mooring mast at Lakehurst, New Jersey. Experimental work will be carried out on it there.

Readers will remember that the "*Los Angeles*" was built by the Germans as part of the reparations scheme after the Great War. The vessel has a capacity of 2,470,000 cu. ft., is 656 ft. in length and 90 ft. 6 in. in diameter, and has accommodation for 20 passengers and a full crew. It was propelled by five engines, each developing 400 h.p. and giving her a maximum speed of 76 m.p.h.

British Internal Air Services

In our issue for July last we published an article dealing with British internal air services, in which we described a network of lines operated by Midland and Scottish Air Ferries Ltd. Since that article was written these services have been discontinued, as the company have ceased operations.

Further information is to hand with regard to the services of Jersey Airways Ltd. This company operate services between London and Jersey and between Portsmouth and Southampton and Jersey, in addition to a service between Jersey and Paris. These lines are operated all the year round, and not, as was stated in our article, only from April to October.

The services of Jersey Airways Ltd. have proved very popular, and from Friday to Monday of each week the company's eight machines are all filled to capacity. A site for an aerodrome at St. Peters, Jersey, has now been approved and negotiations for the purchase of the land have been commenced with the Jersey state authorities. It is hoped to have the aerodrome ready early in 1935, after which the frequency of the services will be greatly increased. Negotiations are meanwhile proceeding for the acquisition of landing grounds in Guernsey, Alderney and Sark and it is probable that by the end of next year the whole of the Channel islands will be linked up with a direct service to London. This will bring practically all parts of the Islands within about two hours' journey of London.

Refuelling a troop carrier in the Punjab. This photograph is by our reader, Alexander Chesney, of Millhouse, Huntingdon, York.

New Machine for French Services

An aeroplane that has been designed specially for economical operation on feeder air lines is now being built by Caudron Ltd., the well-known French aircraft constructors. It is known as the C.440, and is a twin-engined cantilever low wing monoplane with accommodation for six passengers and a crew of two. The wing, which is 57 ft. 9 in. in span, is made of wood and is in one piece; while the fuselage is also of wood and is 43 ft. 7 in. in length. The main wing and the tail span are covered with plywood in such a manner that they are water-tight and automatically serve as flotation bags in the event of a forced landing on water.

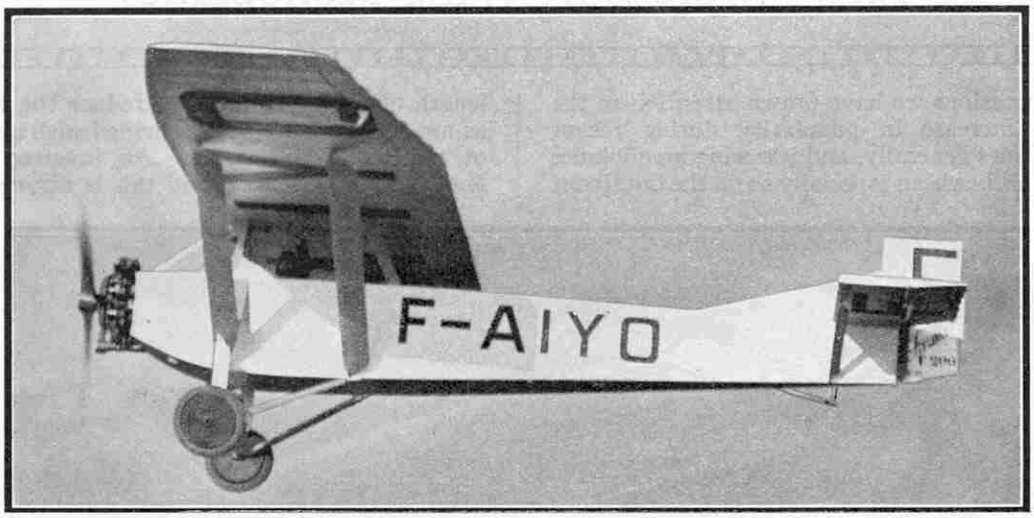
The machine follows the modern trend of design in using a retractable undercarriage. This is operated hydraulically and is made up of two independent forks each carrying a separate wheel. The tail wheel also is retractable. Two Renault engines each developing 210 h.p. are carried in nacelles built into the wings, and it is estimated that they will give the C.440 a maximum speed of 180 m.p.h., a cruising speed of 162 m.p.h., and a landing speed of 59 m.p.h. The fuel tanks should give a range of about 1,250 miles on one filling.

Making the Timor Sea Safe

In organising the Singapore - Brisbane section of the England - Australia air mail service, the chief problem has been one of making the 512-mile crossing of the Timor Sea safe for passengers and crews, and no effort has been spared to bring a satisfactory scheme into existence.

The four-engined D.H.86 type of aeroplane, with its high performance and outstanding reserve power, was specially designed to cope with conditions over the Timor Sea and, with the necessary accompanying ground organisation, it should render the crossing as safe as flight on any recognised air route over land. If it is assumed that the risk of a forced landing by a single-engined aeroplane crossing the Timor Sea is 1 in 100, it is computed that the risk for a twin-engined machine able to fly on one engine is 1 in 500, and for a three-engined machine able to fly on two engines, 1 in 1,650. The chances against a forced landing by a four-engined machine able to fly on any two engines, such as the D.H. 86, are 1 in 41,250. This is a high degree of safety, especially as the risk of failure for a single-engined machine is not actually as great as 1 in 100. A rubber life-boat capable of being quickly inflated from a compressed air bottle will be carried in all machines making the crossing—not that a forced landing is expected, but for the same reason that ships carry life-boats.

The ground organisation, to be arranged by the Civil Aviation Department of the Australian Government, includes radio stations at Darwin and Koepang; a weather report bureau at Darwin, where details of the strength and direction of the winds in the upper air will be available; and the provision of a fast patrol boat capable of cruising at more than 20 knots. The service aeroplanes making the sea crossing will keep in constant touch with Darwin by radio, and by the use of direction-finding equipment they will be able to ascertain their exact position at any time during the crossing.



This photograph shows the Farman F.200, a popular French parasol monoplane that is equipped with a Salmson engine.

Heavy Transport in New Guinea

One of the best examples of the value of air transport is found in New Guinea, where aeroplanes are practically the only method of communication and transport used by the gold-producing companies. The goldfields are some distance from the coast, and the use of aeroplanes makes it possible to avoid the enormous expense that would be involved in laying a railway, or even building a road, over the wild hills and forests that lie between the coast and the goldfields. An example of the work done was given recently when a big Diesel excavator was carried by air to the fields. The excavator was sent out from this country in 29 cases for convenience in carrying in the aeroplanes, the heaviest of the cases being as much as 2 tons 1½ cwt. in weight, while the case in which the jib was packed was 21 ft. 2 in. in length and weighed 1 ton 11 cwt. The 29 cases altogether had a total weight of about 30 tons.

At present there are about 12 machines employed on the services from the coast of New Guinea to the goldfields. These consist of Junkers G31 monoplanes, a Fokker, and several D.H. machines, including three "Gipsy Moths" and two "Fox Moths."

Pennant for Mail Aircraft

For many years it has been the practice for ships carrying mails under contract with the Postmaster General to fly at the mast a special pennant bearing the royal crown and the words "Royal Mail." The flying of the mail pennant has always been considered as placing a ship that carried it in the very highest category of merchant shipping. As overseas mails are no longer limited to shipping, however, but are carried also by aeroplanes, it has now been decided that the Royal Mail pennant may be flown by all aircraft carrying mail, and that a Royal Air Mail flag may be flown also over buildings dealing with air mail. The pennant is of the usual triangular shape and has a deep blue ground with a device in yellow representing the crown, above a post horn. The device is surrounded by the words "Royal Mail" in white letters. The first aeroplane to fly the new pennant was the Handley Page "Heracles" named "*Hengist.*"

The customs office at the Berlin airport, immediately after the arrival of several air liners. For this photograph we are indebted to Deutsche Luft Hansa, A.G.

Aeroplanes to Aid Police

Two "motor bandits" were captured by the police after having been traced by an aeroplane during a demonstration given a short time ago by Marconi's Wireless Telegraph Co. before a number of high police officials. A telephone message was received at the aerodrome that a bank had been robbed and that two men were escaping in a Riley car. A D.H. "Fox Moth" immediately took off and was able to discover the Riley in about 25 minutes. Radio communication was quickly established with a specially-equipped car, which immediately set off in pursuit and was told exactly where to go to find the bandits. The aeroplane experienced no difficulty in keeping the bandit's car in sight when flying at a height of between 600 ft. and 800 ft., and its occupants were able to give instructions to the police car so that it got ahead of the "bandits" and drew broadside across the road to stop them.

The experiment showed that there is a great field for development in the use of aeroplanes to assist the police, although there are many difficulties in the way. One is that it is impossible to see the number plate of a car from the air, and thus it would be difficult to identify a criminal's car. In the experiment we have described, the top of the Riley was painted white to assist those in the aeroplane.

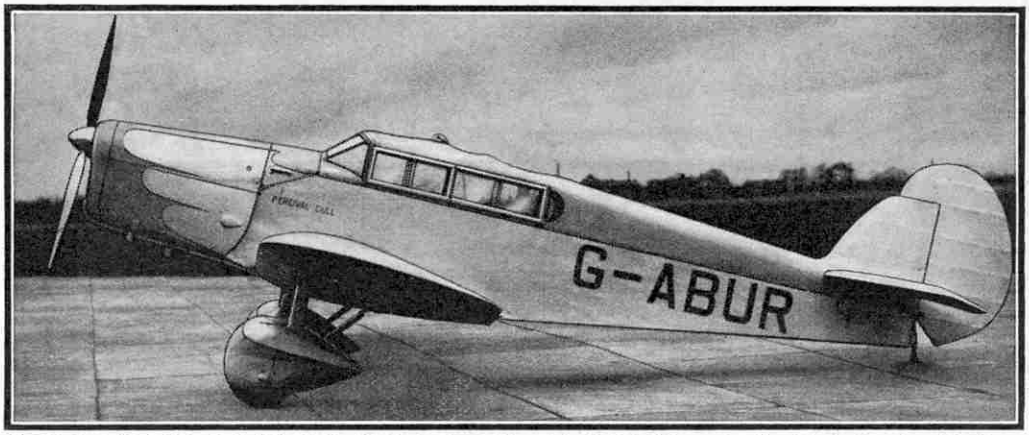
New R.A.F. Fighter

Details are now available for publication of the Gloster "Gauntlet" single-seater fighter that has recently been adopted by the Royal Air Force as the standard day and night fighter. The machine is powered with a Bristol "Mercury" engine and has a speed of 228 m.p.h. at about 16,000 ft. This speed is higher than that of the specialised interceptor fighters that were produced a few years ago, in spite of the fact that the "Gauntlet," being a standard fighter, carries far more military equipment, and is provided with night flying gear and wireless transmitting and receiving apparatus. The new machine stalls at 59 m.p.h., and is capable of climbing to an altitude of 20,000 ft. in 9 minutes. It weighs 3,950 lb. in service condition. The "Mercury" engine used in the "Gauntlet" uses a special new fuel and develops 605 h.p. at 2,400 r.p.m. It is similar to the well-known Bristol "Pegasus" engine in general arrangement, but is of the fully supercharged type and in addition runs at a higher speed. It is fitted with a combined Townend ring and exhaust collector.

British Aircraft Developments

XII.—More Low Wing Monoplanes

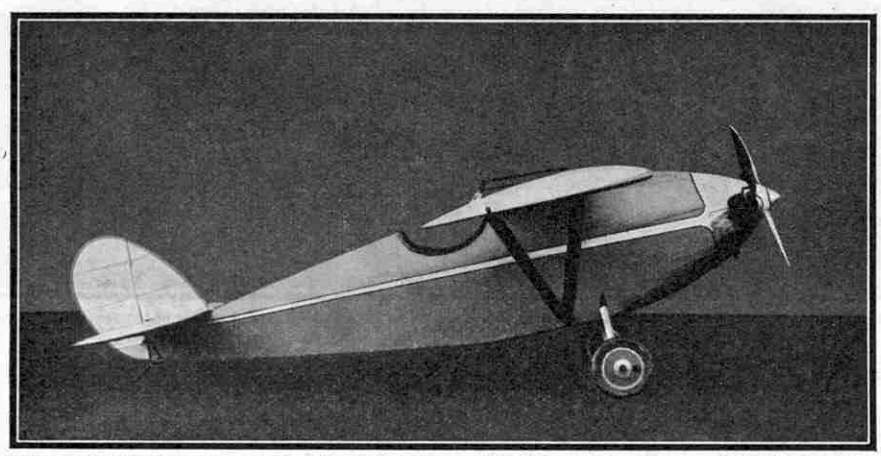
ON various occasions we have drawn attention to the remarkable increase in popularity during recent years of monoplanes generally, and low wing monoplanes in particular. This has been especially so on the Continent where biplanes are probably now in the minority! and even in this country where for many years it was an unusual sight to see a monoplane, the general trend is becoming increasingly evident and most of the new types produced take the single wing form.



The Percival "Gull," the first of Mr. Edgar W. Percival's machines to be built in this country. For this photograph and the lower one on the opposite page we are indebted to the Percival Aircraft Co.

This state of affairs was particularly noticeable in this year's race for the King's Cup. For this event 41 machines were entered, and of these only 13 were biplanes, the remaining 28 comprising 19 low wing monoplanes and nine high wing monoplanes. It is perhaps significant that the first and second machines home in the final of the event were of the low wing type, and that a low wing machine achieved the highest speed in the contest.

Two companies that have done good work in popularising the monoplane form of construction are the Comper Aircraft Co. Ltd., and the Percival Aircraft Co., and it is our intention in this article to deal with two of the latest products of these firms, the Comper "Streak" and the Percival "Mew Gull." These machines have both been designed and built for racing and high-speed work generally, and both are single seaters. They are entirely dissimilar in construction and external appearance, although their performances are about the same.



This photograph shows an early version of the Comper "Swift," a high-performance light single-seater. Photograph by courtesy of the Comper Aircraft Co. Ltd.

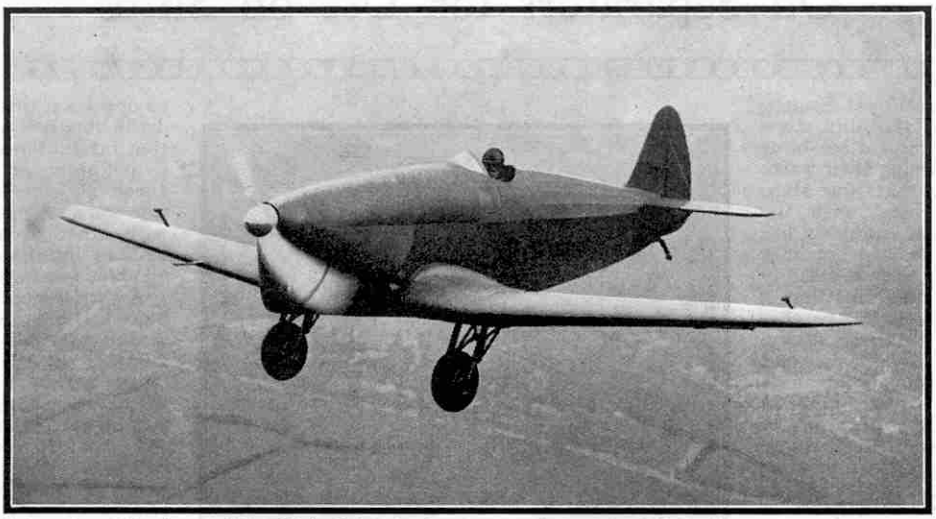
The Comper "Streak" is a small low wing light monoplane with a wing span of 23 ft. 6 in. and an overall length of 18 ft. In order to reduce the wind resistance as much as possible, it is provided with an undercarriage of the retractable type. An inverted D.H. "Gipsy Major" engine is used, and this is arranged in the nose in such a manner that the fairing fits in with the general lines of the machine and gives a good clean streamline effect.

The "Streak" is of all-wood construction, the fuselage being made up of a number of spruce longerons, or longitudinal members, rigidly braced together by means of spruce struts arranged in "W" form. This framework is covered in with three-ply and the whole is covered with fabric. The engine mounting is made up of welded steel tubes, and to prevent any danger of fire in the case of an accident a fireproof bulkhead is provided between it and the cockpit. The wing of the machine is made in a somewhat similar manner to the fuselage, being a complete unit in itself, built round spruce spars and covered with plywood and fabric.

The undercarriage may be stowed into the bottom of the wing when the machine is in flight, the two wheels being carried in forks that can be lifted simultaneously by turning a wheel in the pilot's cockpit. When the undercarriage is raised, parts of the wheels are still left protruding below the housing in order to form a safety device to prevent undue danger if the pilot should forget to lower them when landing. It is also useful for them to be in this position if a forced landing has to be made on soft or bad ground. In such circumstances the pilot should not lower the undercarriage, and a landing can then usually be made which, although it may slightly

damage the bottom of the fuselage, will not cause the machine to overturn and injure the occupants.

Most of the fuel carried in the machine is accommodated in a central tank of 29-gallons capacity, mounted in the fuselage in front of the pilot. Seventeen more gallons of petrol are also carried in fuel tanks mounted in the centre section of the wing and on either side of the fuselage. The "Streak" is 880 lb. in tare or empty weight, and when loaded up to the maximum capacity weighs 1,500 lb., in which condition it has a maximum speed varying between 180 and 200 m.p.h. and cruises comfortably at between 160 and 180 m.p.h. It lands at 60 m.p.h.



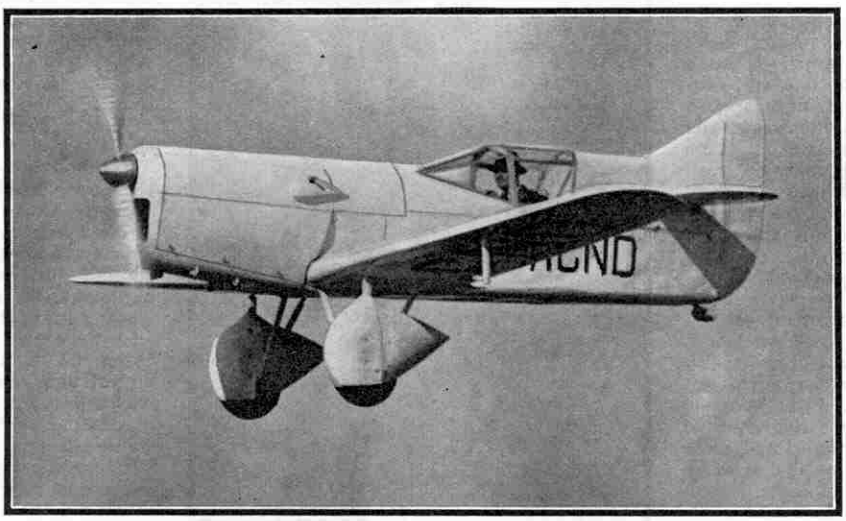
A fine view of the Comper "Streak" in flight, showing the exceedingly clean fairing of the engine. Photograph by courtesy of "Flight."

The constructors of the "Streak" are the Comper Aircraft Co. Ltd. This company was formed in March, 1929 to produce the well-known "Swift" single-seater light high wing monoplane designed by Flt. Lt. Nicholas Comper, R.A.F., who, incidentally, was the designer of the "Cranwell" range of light aircraft. The works of the company were for some time situated at Hooton Park Aerodrome, near Liverpool, but recently they were moved to Heston Airport, near London. So far, seven aeroplanes have been produced by the company, including four versions of the "Swift," known respectively as the standard "Swift"; the commercial "Swift," for transport of small quantities of mails; the intermediate training "Swift," a machine adapted for military training; and the speed "Swift," which is equipped with a D.H. "Gipsy Three" or "Gipsy Major" engine.

A three-seater cabin monoplane suitable for the private owner, or for air-taxi work or for other commercial operation, is also built; and the latest product of the company is the "Kite," a two-seater version of the "Streak" that has been put on the market as a result of numerous requests for a two-seater "Swift." It was not possible to convert the "Swift" into a two-seater owing to the general layout of the fuselage and the fact that the machine was a high wing monoplane, although it would have been quite powerful enough to carry a passenger. When the "Streak" was built and it was found to have excellent flying qualities, it was decided to adapt it for two-seater work. The "Kite" is in every respect similar to the "Streak" that we have described, apart from the provision of two cockpits and alteration of the engine cowling to take a Pobjoy "Niagara" radial engine. Actual performance details are not yet available, but it has been calculated that the maximum speed will be 155 m.p.h. and the cruising speed 140 m.p.h.

The Percival "Mew Gull" is claimed to be the fastest aeroplane of its size and power built in Great Britain, and an excellent demonstration of its exceptional qualities was given during the King's Cup air race this year, when one entered by Prince George achieved the highest speed in the contest. This was an average of 191 m.p.h. round the course, although owing to the handicapping the machine only finished fifth in its heat and did not get into the final.

In appearance the "Mew Gull" is definitely one of the most unusual aeroplanes that have been produced in this country for some time. It is very small, being only 24 ft. in span and 18 ft. 3 in. in length; and thus, as a comparatively heavy engine is used, the pilot has had to be accommodated much farther back than is usual in British types, in order to balance the weight of the engine. The cockpit, which is enclosed, is in fact so far back that the covering is faired in with the rudder. The engine is a Napier "Javelin," which develops 165 h.p. The machine has been designed for use as a racer, or a fast tourer, and is highly suitable also for such special charter work as the economic transport at high speed of urgent press photographs or small quantities of valuable and urgent mails.



Mr. Percival at the controls of the "Mew Gull." This machine maintained an average speed of 191 m.p.h. round the King's Cup course this year.

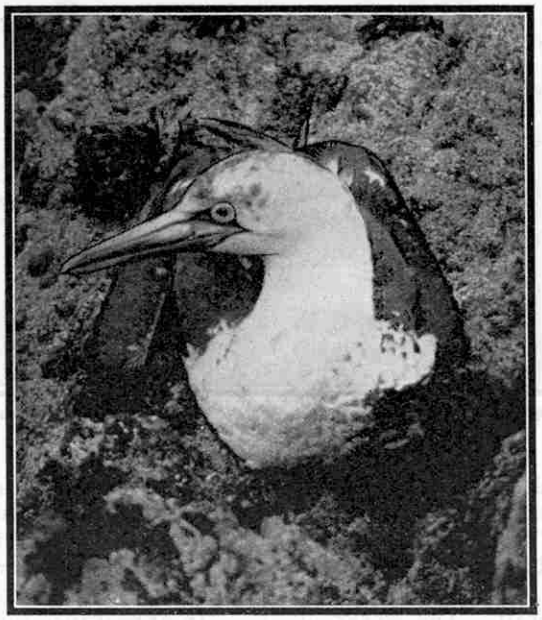
The machine is a low wing cantilever monoplane of wood construction, and it is in general design somewhat similar to the "Gull" that was described in our issue for August 1933, and is illustrated on the opposite page. The new machine is a single-seater. It has a cruising speed of about 185 m.p.h., a maximum speed of 205 m.p.h., and a fuel capacity that gives a range of 550 miles.

Saving the Sea-Birds

Oil Separators for Use on Ships

SOME years ago the Royal Society for the Protection of Birds drew attention to the sufferings of sea-birds caused by ships discharging their waste oil into the sea. Since that time steps have been taken to deal with the trouble, but up to now the problem has been tackled in so half-hearted a manner that the pollution of the sea is steadily growing worse. The oil forms first a film, and then thick sheets and patches of a floating black sludge of sticky, tar-like consistence, that soaks and clogs the plumage of any unfortunate birds that happen to become trapped in it. The birds are then unable to fly or obtain food, and gradually they die of starvation or suffocation. Guillemots, razorbills, puffins, gulls, cormorants and other sea-birds made helpless in this manner are cast ashore round our coasts in thousands, many already dead and others dying after weeks of slow starvation; and similar scenes occur in America, West Indies, Egypt, Australia and other parts of the world.

Apart from the danger to sea-birds, floating oil is a great menace to the world's fish supplies, for it leads to the destruction of fish ova and of the plankton on which fish largely subsist. At some seaside resorts filthy oil deposits are frequently left on the shore and shingle by the ebb tides, thus making the beach unpleasant to walk upon, and bathing disagreeable, if not absolutely impossible. The accumulation of floating oil also is very dangerous to shipping on account of the highly inflammable nature of this liquid, and slight carelessness, especially in harbours and narrow waters, may cause serious fires.



A victim of oil pollution. Unable to move its oil-soaked wings and fly in search of food, this gannet is lying helpless on the rocks. For the photographs on this page we are indebted to The Royal Society for the Protection of Birds, London.

The chief source of oil pollution is discharges of oil-contaminated water from oil-burning or oil-carrying ships. In such vessels ballast water is sometimes put into oil storage tanks when the oil has been burned. This water is contaminated by the residual oil in the tanks and must be discharged before the vessel takes on fresh oil fuel, or before she goes into dry dock for hull repairs. Tankers or oil-carrying ships have to be cleaned out after unloading their cargo, and the cleaning operation is performed by flushing the tanks with water, which of course has to be discharged somewhere before fresh oil can be loaded. The water used in these operations contains a residue of oil which, when agitated with sea water, forms an emulsion consisting of oil, water and air. This emulsion is very viscous and adhesive and resembles a heavy grease, and once it is formed it floats about until, driven by wind, tides and currents, it is thrown upon the shore.

With the increase in the number of oil-driven ships, trouble from floating oil grew to such an alarming extent that in 1922 an Act of Parliament was passed prohibiting all discharge of oil in British territorial waters, that is within a limit of three miles off the coasts. Unfortunately in a matter of this kind one country cannot effectively protect its shores without the co-operation of other countries, for oil drifts hundreds of miles. It was realised that international action was necessary if pollution of the sea were to be effectively prevented, and steps therefore were taken to discuss the problem with other countries with a view to making international regulations that all ships must obey.

Another tragedy of the sea. A photograph taken in the Isle of Wight showing oil-soaked birds washed up on the shore. Note how the feathers are matted together by the sticky sludge.

A Conference held in 1926 in Washington, U.S.A., was attended by representatives of all the principal maritime nations, but apart from fixing coastal limits within which ships must not discharge oil, and making various suggestions, its members did very little to solve the problem of sea water pollution. The limit fixed was 50 miles from the coast, but this distance was subject to increase where peculiarities of the coast line, tides and current demanded.

The fixing of limits within which oil must not be discharged is useless as a preventive measure, however, because even when oil is discharged well out at sea it very soon reaches the shore, while no matter where the discharge takes place fish and sea-birds are at the mercy of the floating sludge.

One of the proposals put forward at the Washington Conference was that all oil-driven and oil-carrying ships should be equipped with devices known as oil separators, but unfortunately agreement could not be secured to make this compulsory. Many of the big British, American, and other foreign shipping companies have adopted the suggestion, however, and have equipped their vessels with separators that are proving very effective. If all oil-burning ships were equipped with separators the pollution problem would soon disappear, and the misery and suffering now caused to birds, and the spoiling of the beaches of holiday resorts, would be avoided.

A separator is a device that separates the heavy oil from the intermingled water. The oil so saved can be used again, while the water itself is sufficiently pure to be discharged into the sea without risk.

There are many different types of oil separators on the market, some designed specially for dealing with oily ballast water, and others for use with contaminated bilge water. One of the best known is the Stream-Line Separator made by the Stream-Line Filter Co. Ltd., London. The world's largest ship, the *"Majestic,"* is equipped with separators of this kind that are capable of dealing with 150 tons of oily refuse water per hour. These are illustrated on the opposite page, and below is a reproduction of a sectional model of a 50-ton separator that shows how the separation is effected.

The mixture of oil and water to be dealt with enters at one end of the separator at the oily mixture inlet mark. This mixture may contain anything from a mere trace up to perhaps 5 per cent. of oil, and the separation of most of this oil presents no difficulty. It floats up through the water that already fills the separator,

into the oil collecting chamber. The small particles of oil, however, which have become broken up through the rolling of the vessel and passage through the pump, have very little tendency to rise out of the water through their buoyancy, because the smaller the particle the greater in proportion is the viscous drag that resists its rise through the water. If the water is eddying at all, as is bound to be the case in the first chamber of this separator, the small oil particles are carried forward with the water.

The water with the fine oil particles passes underneath the first baffle shown and then through the nest of tubes. These tubes have the effect of producing steady streamline flow in which each particle of water travels steadily forward in a straight line instead of eddying from side to side of the containing vessel. Under these quiet conditions of flow the small oil particles float up through the water and stick to the tops of the tubes. There they remain until numbers of particles join together to produce large globules of oil, which are then pushed forward by the flow of water. When these large globules emerge into the chamber beyond the tubes they float up through the bulk of the water quite readily, in spite of the fact that eddying sets in again; and they also collect in the oil collecting chamber.

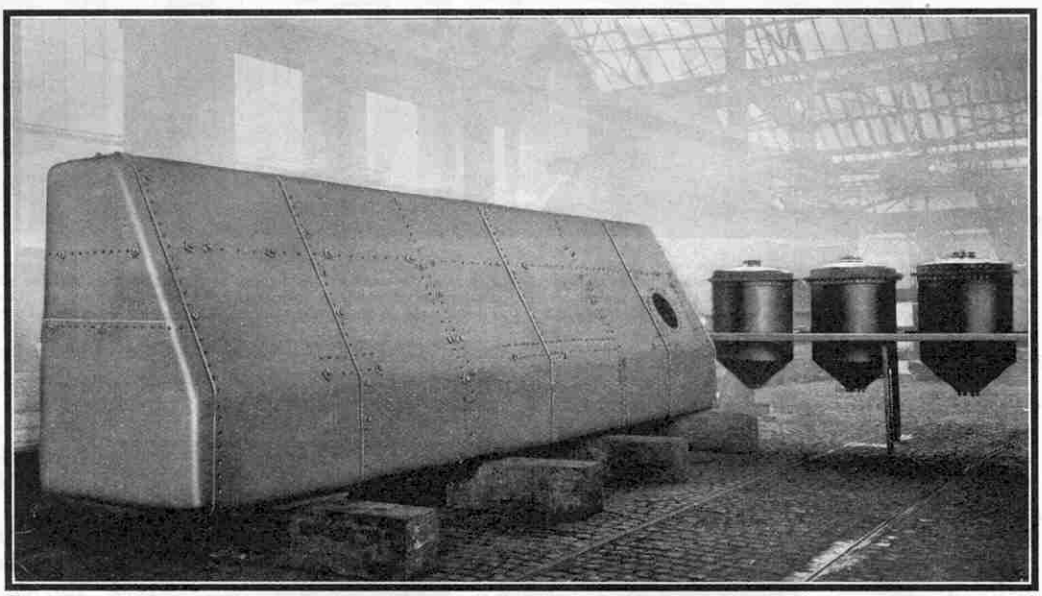
By this means the amount of oil in the water is reduced to about one part in 10,000, but it is still desirable to remove further traces of the oil before discharging the water into the sea if pollution is to be avoided. The water passing out of the separator is therefore introduced into a filter, the cages of which are packed with glass-silk. This material presents an enormous surface area of glass to the flow of the water, as it consists of exceedingly fine threads of glass having the general appearance of cotton-wool. The water passes from the outside to the inside of the cages, and clean water flows up to the top and out into the sea while the oil remains adhering to the glass in the cages.

The bulk of the oil that collects in the oil collecting chamber of the gravity separator is removed from time to time by opening the recovered oil outlet valve and allowing the oil to flow into the ship's storage tanks. The comparatively small amount of oil that becomes entangled in the filter cages is allowed to stay there until the end of a day's operation, and is then removed by reversal of flow with steam. The steam warms the oil and enables it to be detached from the glass-silk, and the oil with the condensed steam flows back to the ship's bilges from which later on it is pumped through the separator again. By this routine no appreciable amount of oil at all ever gets into the sea.

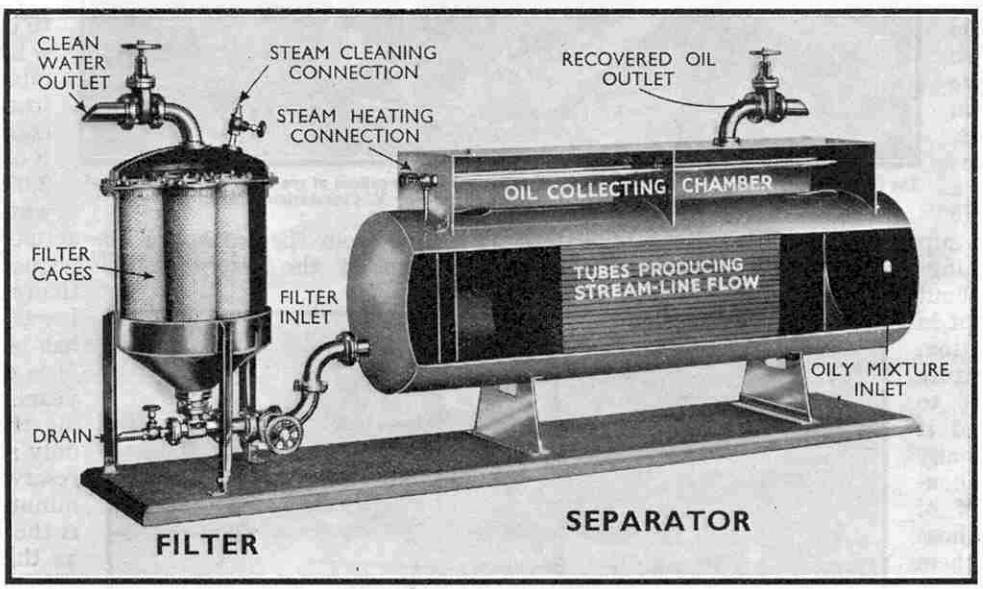
The special feature of the Stream-Line Separator is the use of a large number of small tubes in parallel to produce stream-line flow. If the tubes were removed, although the water would flow with the same speed, it would have an eddying motion and very little separation would take place.

Oil separating barges into which ships can pump oily waste when in harbour are provided at many big ports. The gravity separator of one of these vessels usually is fitted in the hold, and the filters are mounted on top of the separator so that their working parts can be handled from deck level. Large tanks for the storage of the recovered oil are provided, together with pumps for delivering this oil to other vessels when necessary. A barge of this kind, fitted with Stream-Line separators capable of dealing with 200 tons of oily waste water per hour, was supplied recently to the Imperial Japanese Navy by the Stream-Line Filter Co. Ltd. This plant is larger and is provided with more filters than would be required for an installation for ship use, and is specially designed to deal with the oily water mixture from oil tankers, which usually is in a far worse condition than is found on an ordinary ship.

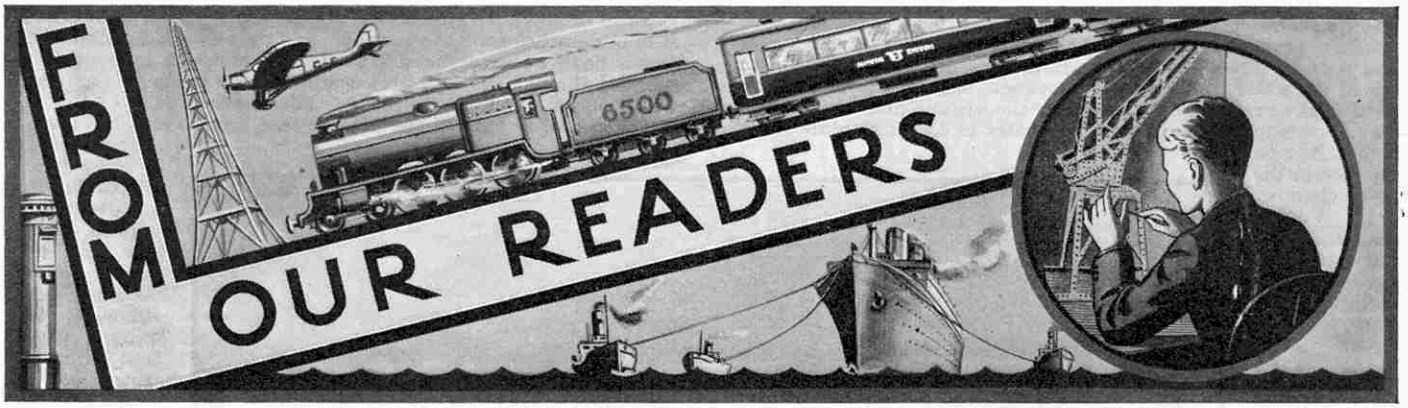
As it was impossible to test the plant in a barge at sea, special provision had to be made to ensure that the conditions of the specification were satisfied. It was required to test each separator cylinder for a five-hour period for each filter in it, using mixtures containing 5, 10 and 15 per cent. oil respectively. These conditions were met by providing a large mixture supply tank, and circulating through the system a mixture of oil and water at a rate sufficient to test each of the six filters separately. The proportion of oil in the mixture circulated was varied by adjusting the level of the liquid in the supply tank, so that the pump sucked either more or less oil, as was required. The plant passed all tests with complete success, the proportion of oil remaining in the water after passing through the plant being considerably less than one part in a million parts of water!



The "Majestic," the world's largest ship, is equipped with Stream-Line Oil Separators and Filters, which are here shown assembled before installation in the vessel. For this illustration and the one below, we are indebted to the Stream-Line Filter Co. Ltd., London.



A sectional scale model of a Stream-Line Separator capable of dealing with 50 tons of oily refuse water per hour. Its action is explained in the accompanying article.



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

Mineral Springs in Bath

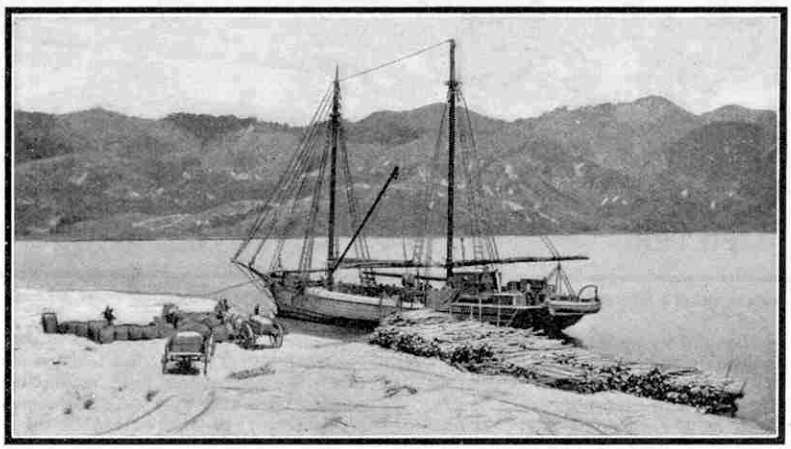
There is no drought in Bath as far as the famous radioactive springs of the city are concerned, as I found during a tour of what can be described as the finest natural hot water system in England. I commenced my tour at the boiler house, where there are two large boilers, with a tank above them that holds 16,000 gallons of the mineral waters. Steam raised by the boilers works two pumps that have been in operation for about 100 years, and these veterans share with a modern electric pump the task of supplying 100,000 gallons of water a day to the bathing establishment. This water is at a temperature of about 120 deg. and is kept in constant circulation. Its high temperature is due entirely to natural causes, and it is not heated by any artificial means, contrary to the belief of many visitors whose curiosity has led them into the boiler house.

The subterranean passage through which pass pipes carrying 4,000 gallons of spa water daily to the Royal Mineral Water Hospital, Bath. Photograph by V. Chamberlain, Bath.

There are at least five miles of 4-in. lead piping supplying the Public Swimming Baths and the Royal Mineral Water Hospital, and the accompanying photograph shows my guide in front of the entrance to a subterranean passage under Stall Street and Union Street that is 500 yds. in length and leads to the Hospital. Steam pumps draw as much as 4,000 gallons of spa water daily through the pipes laid in this passage, which are examined every few weeks by the Hospital Engineer. The task of inspection cannot be a pleasant one, for the engineer has to walk astride the pipes, and the roof is so low that he has to crouch all the way, his underground journey of 500 yds. occupying about 40 minutes.

I then proceeded to examine the place where the hot mineral water flows from the reservoir constructed by the Romans nearly 2,000 years ago. The water cannot be seen issuing from the earth, for the actual spring is at the bottom of the reservoir. This structure holds more than 60,000 gallons, and I was informed that it has only been emptied once during the last 25 years. My guide told me that then he could only stay in the empty reservoir about 20 minutes, for above it is the King's Bath, and as this was full of hot water the temperature was very high.

V. CHAMBERLAIN
(Bath).



Loading a scow with wool at the jetty in Wainui Bay in the South Island of New Zealand. Photograph by S. Bunny, Masterton, N.Z.

Shipping Wool in New Zealand

In New Zealand there are many remote places where settlers have to cart their wool for days along mere tracks in order to take it to

the nearest railway station or to the coast for shipment. When I lived at Golden Bay, South Island, settlers in the neighbourhood made use of a little jetty that had been erected in Wainui Bay for their benefit. When the sheep had been shorn, arrangements were made with the Wellington Shipping Company to send a scow, and on the appointed day settlers carted their bales of wool across the mudflats to the jetty. They could only do this at low tide, for at other times the mudflats were impassable except by means of a launch or rowing boat. The task was slow and tiresome, and hauling the heavy carts across the wet sand was hard work for the horses.

When all the bales of wool had been hoisted on board, the scow pushed off from the jetty and sailed out into the middle of the bay, where the current of the Wainui River served to carry her into Golden Bay.

To-day an excellent road has been built over which the wool is carted on its way to Nelson. It is now five years since the little jetty went out of regular use, and the accompanying photograph is an interesting reminder of pioneer days in New Zealand.

S. BUNNY (Masterton, N.Z.).

An Indian camel cart fitted with rubber tyres. Photograph by M. P. Gandhi, Karachi.

Rubber Tyres for Indian Camel Carts

Although there are more than 100,000 motor cars on the roads of India, carts hauled by camels, bullocks and horses predominate, and even if the use of the motor car continues to expand, it will be many years, and perhaps centuries, before the traditional vehicles of the country are replaced. Meanwhile rubber tyred wheels have been introduced in order to lighten the work of India's beasts of burden, and the accompanying photograph shows the first camel cart fitted with Dunlop tyres.

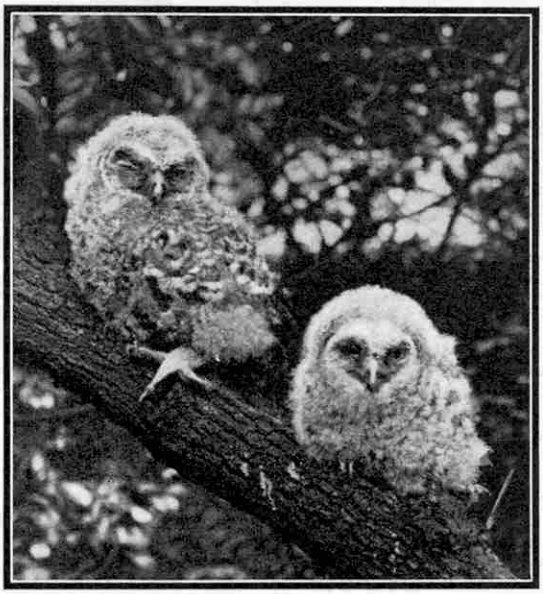
Tests have shown that the loads of carts can be greatly increased when the vehicles are fitted with rubber tyres, and at the same time the bullocks or camels that haul them are given easier tasks. The cart shown in our illustration is fitted with complete assemblies of wheels and axles fitted with Dunlop tyres, and drum brakes complete the resemblance of these to motor car fittings. The tyres are of existing standard sizes, and extensive trials are being carried out in order to find if they are suitable for the trying climate and road conditions of India.

M. P. GANDHI (Karachi).

The Brown Wood Owl

Although it is believed that the graceful white owls of farm buildings and church towers are declining in numbers, the brown or tawny wood owls appear to be multiplying. These interesting creatures are really more brown than tawny, and are better known by sound than by sight, for it is the brown owl that utters the long-drawn-out and beautiful, if somewhat melancholy, cry "Hoo-oooo-oooooo," which usually is rendered absurdly in print as "Tu-whit, tu-whoo."

Brown owls spend most of the day in woods, and even when darkness falls are much less inclined to hunt in the open fields than are the barn or white owls. They are generally persecuted by gamekeepers. No doubt they do occasionally take young pheasants, both when these birds are small chicks and afterwards when they begin to roost on trees in the coverts; but the crimes of brown owls in this respect are exaggerated and their good works often forgotten. On balance, the feeding habits of these birds are beneficial. They swallow their prey whole, afterwards ejecting the bones, feathers and other indigestible parts in pellets, and an examination of 210 pellets of this kind disclosed the remains of 296 field mice, 42 common mice, 48 moles, 33 shrews, 18 small birds, six rats, and countless beetles. A similar test revealed traces of 106 shrews, 96 field voles, 38 mice, 17 rats, 20 sparrows, four rabbits, three frogs and a mole.



Tawny, or brown owls, that are not old enough to have lost their baby feathers. Photograph by J. D. U. Ward, Reading.

In Spring brown owls lay from two to five round white eggs almost anywhere, even on the ground, but they prefer old nests of grouse, magpies or hawks. Occasionally they attack human beings prying into their nests, and have been known to be provoked by interference into carrying their young away to a safer position.

There is a record of a brown owl living in captivity for 26 years. This bird actually laid eggs in its 17th and 18th years, and showed great affection for a common chicken given to it when its own eggs proved infertile.

There are two other British species of owl. These are the long-eared owl, a forest dweller whose voice is seldom heard, and the short-eared owl, which lives in the open fields and moors. The second of these species rarely breeds in this country but is a common migrant, while the snowy owl and the eagle owl are occasional visitors.

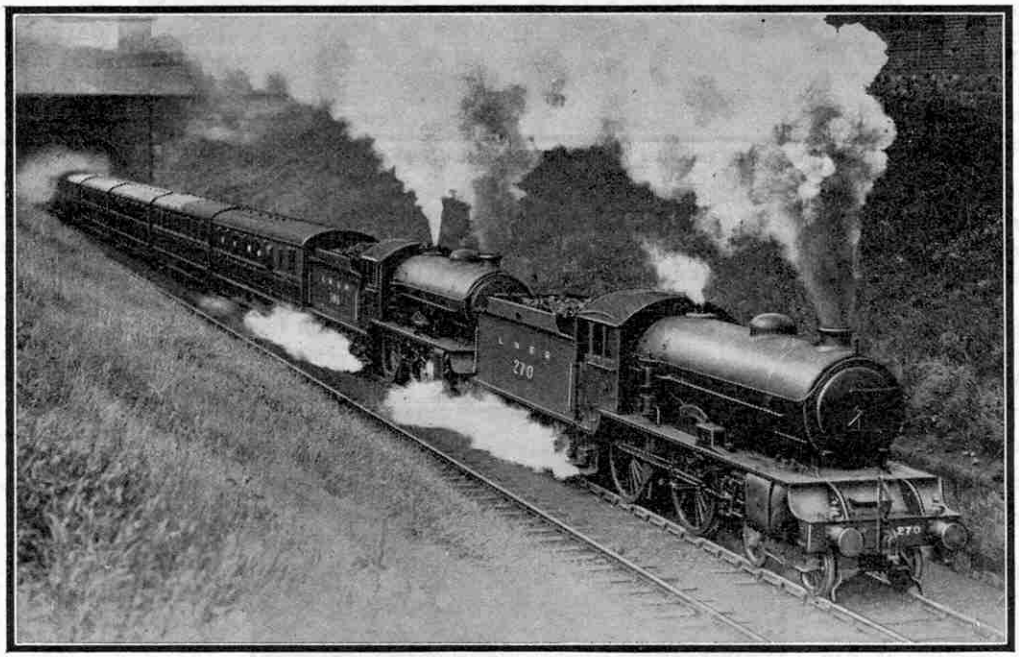
J. D. U. WARD (Reading).

Railways and Gradients

The Working of Steep Inclines

IN the earliest days of railways, when the steam locomotive was far from powerful, it was generally believed that it would not be of any use for climbing gradients. For this reason, on lines that incorporated more or less steep slopes, haulage of the trains up the inclines by means of stationary engines was usually intended. On the Liverpool and Manchester Railway the gradients from Edge Hill down to the original passenger terminus at Crown Street, Liverpool, and to the Wapping Goods Depot, were worked by stationary engines; and prior to the success of the "*Rocket*" at the Rainhill Trials this method was intended to have been employed throughout the line. In the report of Rastrick and Walker to the directors of the company on this question of motive power stationary engines were preferred, and they were recommended for the inclines even if locomotives were used elsewhere.

It was usually held in the early days that a ruling gradient of 1 in 330 was about the limit for normal steam locomotives, and in order to follow this idea in laying out the London and Birmingham line Robert Stephenson found it necessary to undertake earthworks of considerable magnitude. To take a well-known example, the remarkable depth of the cutting north of Tring summit resulted from the desire to maintain the same 1 in 330 slope as is found on the south side. The incline from Euston Square, as the terminus was first known, up to Camden Town, where the line had originally been intended to terminate, was worked by stationary engines and cable haulage, and this method was not superseded until 1843.



An excursion from Glasgow to Whitley Bay climbing Cowlairs incline. This photograph is of particular interest as two "Shire" locomotives are not normally allowed to run coupled together in the Scottish area except between Berwick and Edinburgh. The engines are No. 270 "Argyllshire" and No. 306 "Roxburghshire." Photograph by J. M. Craig, Glasgow.

On the present L.M.S.R. on a portion of the Sheep Pasture incline on the Cromford and Parsley Hay branch, cable haulage is still in use, for the gradient here is 1 in 8 for 550 yards and 1 in 9 for half a mile. This line is only used for goods traffic. The Hopton incline, however, on the same branch, which rises for 500 yards at 1 in 14, is worked by locomotives, but the loads taken up are strictly limited, five loaded wagons being about the maximum allowed. It sometimes happened with the 2–4–0 locomotives once employed that the leading wheels were just over the top of the gradient when the locomotive was unable to proceed farther, and therefore had to run back and try again.

Lickey incline, which is well known for its 1 in 37 slope, is situated on an important main line, so that special arrangements are necessary in order that the heavy traffic may be operated over it with safety and reasonable speed. The remarkable 4-cylinder 0–10–0 locomotive No. 2290 was specially constructed by the former Midland Railway for banking service on this incline. This monster, known among the railwaymen as "Big Bertha," is very different from the diminutive 4–2–0 locomotives that first essayed the climb. These were built by the American firm of Norris of Philadelphia, and were the first American engines built for a British railway. Similar locomotives for the same duties were subsequently supplied by English makers, but the type met requirements by only the narrowest margin. It has been stated that no less than seven of them were known to be used to haul one heavy train to the summit.

Such methods obviously were far from satisfactory, and in 1845 Mr. J. E. McConnell, who was then locomotive superintendent on the Birmingham and Gloucester Railway, built for the work a powerful 6-coupled tank locomotive named "*Great Britain*." This engine performed its duties well for many years, and until the advent of the monster No. 2290, 6-coupled tank engines had practically a monopoly of the banking work. They still take a share in it. Trains ascending the incline halt at the bottom for the assistant engine to come up behind, while those descending stop at the summit at Blackwell, the brakes being tested in the case of passenger trains. Goods trains have sufficient wagon brakes pinned down to ensure a safe descent.

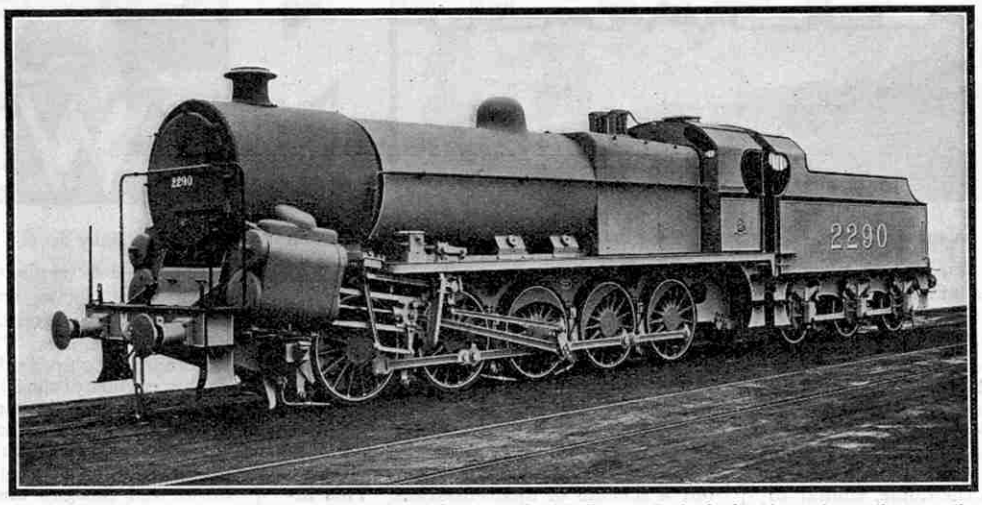
A severe incline up which cable haulage was not discontinued until as recently as 1908 is that at Glasgow, between Queen Street Station and Cowlairs on the North British Section of the L.N.E.R. The Edinburgh and Glasgow Railway, opened in 1842, was so laid that, while a very favourable route was obtained along the main line, the last 1¼ miles fell into Glasgow at the rate of 1 in 41 and 1 in 46. The reason is that originally the line had been planned to pass over the Forth and Clyde Canal to a high level terminus, but the canal company opposed the scheme, and as a compromise the railway was taken under the canal. This made necessary the severe incline into Queen Street and some 999 yards of tunnel which, coming soon after the start, does not add to the convenience of working.

When the line was first opened trains were hauled up the incline by means of a hempen rope. For various reasons this did not prove satisfactory, so four specially powerful 0–6–0 locomotives were built to assist trains up the slope. These giants, as they were then considered—two being suitably named "*Samson*" and "*Hercules*" respectively—proved too heavy for the light permanent way of the period. They also seem to have shaken up the tunnel to some extent, for the Forth and Clyde Canal commenced to leak in.

A return was made therefore to the cable system, and a wire rope 5 in. in circumference, all in one piece three miles long and weighing 25 tons, was substituted for the original hemp one. This was carried over pulleys between the tracks, and was worked up by a stationary winding engine situated at the top of the incline. The cable was attached by means of a "messenger" rope to the locomotive, which had an inverted hook at the front end. When the train was ready to leave Queen Street a bell signal advised a signalman at Cowlairs, who then caused a whistle to blow in the engine house. The winding engine was started, and it and the

locomotive together hauled the train to the summit. A dial fixed in the engine house showed the winding engineman how matters were progressing, so that at the right moment he could shut off steam and stop the cable. As the locomotive was now under full steam on the level, the " messenger " fell from the inverted hook and the train proceeded as if it had mounted the incline unaided. As a precautionary measure several brake trucks of a special design were attached at the rear of the train for the ascent, and these were disconnected by a slip coupling at the same time as the cable ceased hauling. These trucks were attached to the front of trains going down into Queen Street, which were thus controlled by the brakesmen, the stop for the collection of tickets at Cowlairs providing the necessary opportunity for coupling them up.

Owing to the constant increase of traffic, it became more and more difficult to operate the trains satisfactorily in this manner. The cable system limited the capacity of the line, as the interval between successive trains was necessarily longer than would be the case with normal steam locomotive haulage. Tests were carried out, and the result was that the cable system with its winding engine and brake trucks were dispensed with, and the line began to be worked in the ordinary way with banking engines to assist the trains up the incline. Tank locomotives of the numerous North British 0–6–0 class are usually employed for these duties.



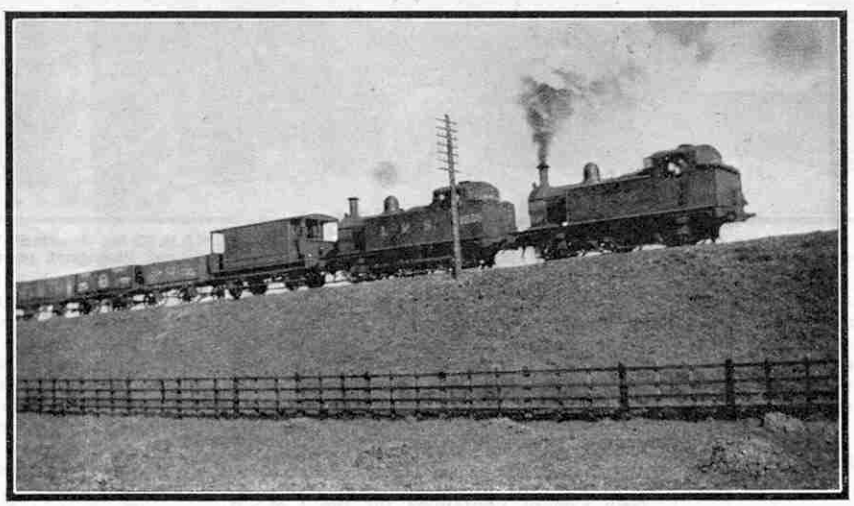
The famous " Lickey Banker " No. 2290, built by the former Midland Railway at Derby for banking trains up the two-mile Lickey incline. This monster locomotive has four cylinders and ten coupled wheels.

Gradients of similar inclination are traversed by G.W.R. " *Cornish Riviera Express* " beyond Newton Abbot, where the ascent of two miles to Dainton in the down direction is inclined at 1 in 36, while the up train has a very difficult climb in the two miles section at 1 in 42 from Plympton up to Hemerdon Box, which comes so soon after the start that up trains have no chance to get a run at it. These are the stiffest main line gradients in Great Britain, so that even the remarkably capable G.W.R. locomotives have to obtain a pilot when the loads exceed the rated figures. The famous " Kings " are allowed to handle ten 70 ft. coaches over this section, while the limit for the " Castles " is eight vehicles of the same type. The approximate tonnages are 385 and 310, which gives some idea of the quality of the work expected of Swindon products.

The presence of such exceptional gradients as this is due to the fact that the original South Devon Railway was not intended to be worked by steam locomotives, but to be operated on what was known as the " Atmospheric " principle. The ground level was therefore more or less followed, and deviations that would have been possible and desirable for a normal steam-operated line were considered unnecessary. In the atmospheric system a cast-iron pipe line was laid between the rails. This pipe had a bore of about 20 in., and a continuous slot ran from end to end along its upper side. A piston fitted the bore, and an arm connected this through the slot with the vehicles on the rails. A leather flap hinged at one edge closed the slot, and was pushed up at the other edge to allow the arm to traverse the slot by the arrangement of wheels on a frame, which had the piston at its front end and the arm at its rear. Thus when air was exhausted from one end of the pipe atmospheric pressure forced the piston along, taking the train with it. The system aroused great interest and was successful enough for a while. Defects were revealed after a period of service and exposure to the weather, however, especially with regard to the leather flap and the cupped leathers used to keep the piston airtight; and it was abandoned on 9th September, 1848, and is now almost forgotten. Unfortunately it left a legacy of doubtful worth in the gradients that have had to be surmounted ever since by the steam locomotives that have succeeded it.

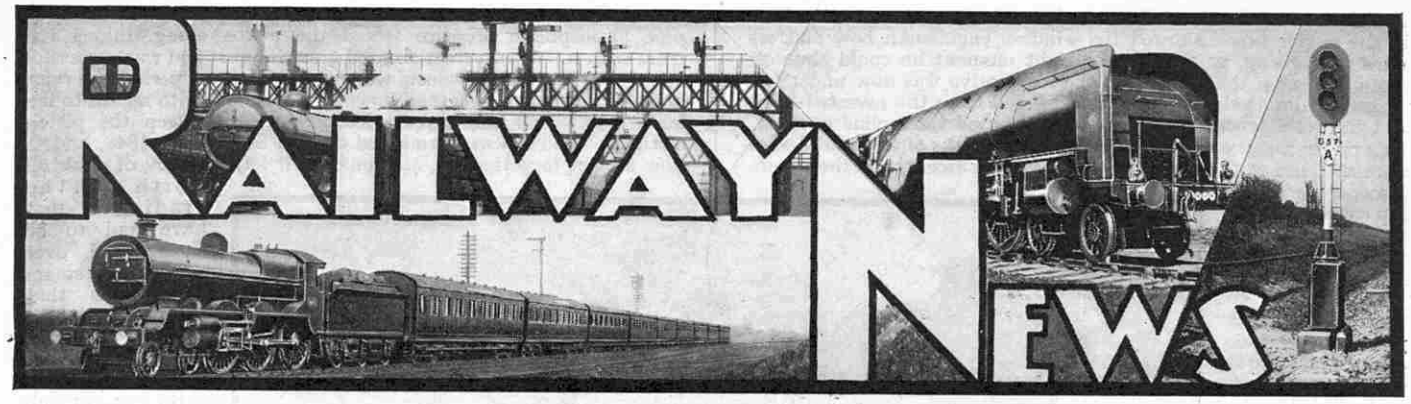
The rival " *Atlantic Coast Express* " of the S.R., or at all events the Ilfracombe portion of it, has similar slopes to negotiate on the opposite side of the county between Barnstaple and Ilfracombe. Grades of 1 in 40 are met with up to Mortehoe, and the descent from there into Ilfracombe is at the rate of 1 in 36 for over two miles. " Mogul " locomotives of the Ashford two-cylinder pattern—or " Woolworths " as these 2–6–0s are sometimes known—are used to some extent in this region of the S.R., and assistance up these grades is usually provided by 0–4–4 tanks of the L.S.W.R. " Drummond " pattern.

This line was commenced in 1871 and opened in 1874, the inaugural train service being run on 20th July. It is interesting to note that during the Parliamentary proceedings in 1870 before the Bill was passed, drawings of the proposed locomotives were submitted by Mr. W. G. Beattie, then Locomotive Superintendent of the L.S.W.R. Mr. J. E. McConnell who, as we have seen, provided the Lickey incline with its first satisfactory banking engine nearly 30 years before, gave evidence in support of the design, which was valuable in view of his early experience. The engines, as delivered, agreed closely with the initial design, but were fitted with inside instead of outside cylinders as had been planned. The preference of both J. and W. G. Beattie for outside cylinders was very marked, and if their usual practice had been followed in this instance the engines would have been among the few examples that have existed in British practice of 0–6–0 locomotives with outside cylinders. A little later the Caledonian Railway introduced some of this type, but this has not been repeated since. The Ilfracombe engines were quite successful for their period, and were found capable of taking a load of 83 tons up the incline unaided.



Two L.M.S.R. tank locomotives banking a goods train up the Lickey incline. Two such engines together work in turn with No. 2290 above. Photograph by S. M. Joyce, Tenbury, Worcestershire.

For a distance of five-eighths of a mile on the Folkestone Harbour branch there is a gradient of 1 in 30 from the Harbour towards Folkestone Junction. This necessitates careful working of heavy down Boat Expresses, and they are of course assisted up the gradient. For this work there are several 0–6–0 side tank engines of the pattern designed for the former South Eastern Railway by Mr. J. Stirling. Until some years ago main line engines could not work on the Harbour branch because of the timber bridge over the Harbour Channel; but the steel bridge since installed removes this restriction on their operation.



New "Pacifics" on the L.N.E.R.

Of the nine new standard 4–6–2 "Pacific" locomotives on order at Doncaster, two have been completed and sent into service. They are 2500, "*Windsor Lad*," and 2501, "*Colombo*," and are now working in Scotland and the North East of England respectively. In almost every detail they are identical with Mr. H. N. Gresley's earlier "Pacifics," and the only noticeable alteration is in the fitting of a steam collector extension to the dome, similar to that provided on the new "Mikado" locomotive "*Cock o' the North*." The boiler working pressure is 220 lb. per sq. in. Two additional engines of the "Shire" class also are in course of construction.

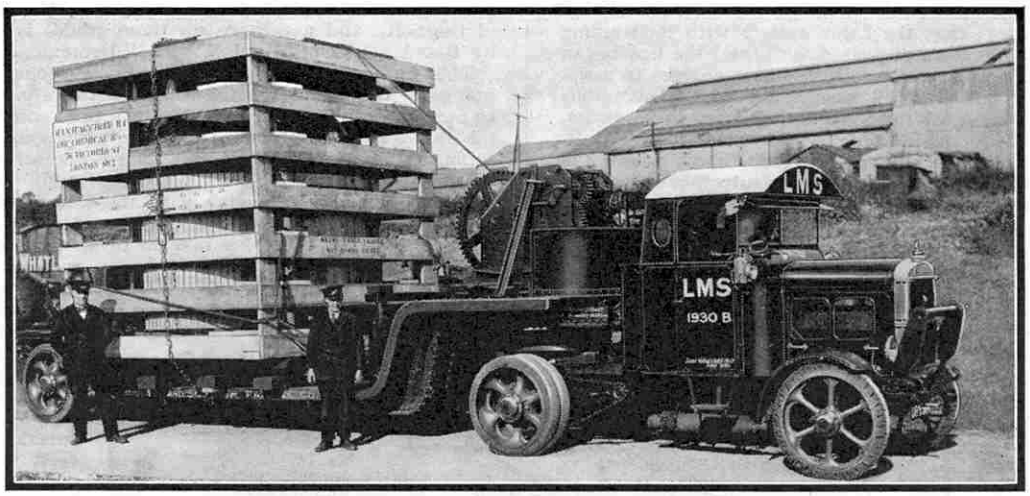
After completing an extensive series of trials, mostly in the Southern area, the new 2–8–2 express locomotive No. 2001 "*Cock o' the North*," was handed over to the running department on Monday, 30th July, and on the morning of that day worked north from Doncaster to Edinburgh, where it has since been stationed. It is now engaged daily in hauling the heaviest expresses between Edinburgh and Aberdeen. Work is proceeding on the other five engines of this class, but none has been finished as yet nor have their names been decided upon.

"Southern" Electrification Success

Interesting evidence of the effect of the electrification on traffic in new housing areas is provided by the Southern Railway's traffic figures for the Bickley Junction to St. Mary Cray portion of the line that has been operated by electric traction since 1st May of this year. During the month of May, 27,879 passenger journeys were made over this section of the line, compared with 16,058 in May 1933—an increase of over 73 per cent. It is also interesting to note that during the years from 1924 to 1934, prior to the electrification of this extension, passenger traffic for the same period had only increased by about 4,000. The St. Mary Cray extension is the first portion of the electrification scheme to Sevenoaks, the whole of which, it is anticipated, will be in operation on 1st January, 1935.

L.N.E.R. Tyneside Improvements

The L.N.E.R. are taking steps to bring the electric services in the Tyneside area thoroughly up to date. As the electrification of that area took place as long ago as 1904, it is felt that the time has come to carry out a scheme of modernisation. This includes improvements to the permanent way and stations; the provision of additional sub-power-stations; and the building of new rolling stock. Altogether 91 new vehicles, including motor coaches, trailer coaches, and motor vans, are to be built. The coaches will be of the open type, constructed of steel and decorated in the most modern style. When the scheme is complete it will be possible to accelerate the services and make them among the fastest suburban services in the country.



This interesting photograph shows a crate containing a "Saturater" being conveyed by an L.M.S.R. 25-ton (Scammell) well lorry from Hendon to West India Docks. The load, which measured 12 ft. square, weighed 12 tons 13 cwt. Photograph reproduced by courtesy of the L.M.S.R.

New Freight Containers for the L.M.S.R.

Owing to the increased quantities of bricks, tiles and other building trade traffics now being carried by rail in connection with re-housing schemes and other general building developments, the L.M.S.R. have decided to introduce 850 additional road-rail freight containers. These will bring the total stock of L.M.S.R. containers up to more than 6,400, and will comprise 750 "H" type containers of two tons capacity, specially intended for the conveyance of building materials, and 50 each of the "C" and "D" types.

New "Baby Scots" on the L.M.S.R.

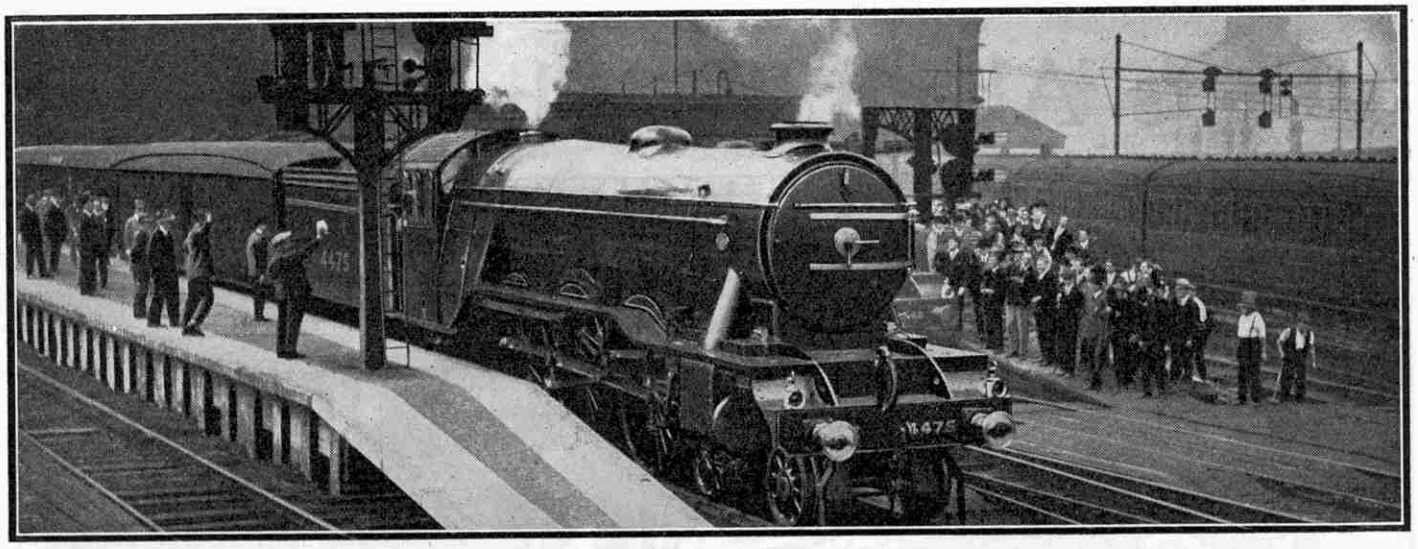
New 4–6–0 engines of the improved "Baby Scot" class, with tapered boilers, are now appearing on the L.M.S.R. in considerable numbers. The North British Locomotive Company have commenced to deliver engines of the 50 ordered from them, and the first five of these, Nos. 5557 to 5561, have been allocated to Crewe. As these engines are fitted with the larger type of tender, they will work chiefly between Crewe and Glasgow and Perth. From the L.M.S.R. Works at Crewe a second series of "Baby Scots" with tapered boilers is being turned out, and of these the first five, Nos. 5607 to 5611, are to be allocated to the Camden depot.

The first five of the improved "Baby Scots," Nos. 5552 to 5556, have been sent to Preston shed, where they share in working "*The Lakes Express*," "*The Fylde Coast Express*," and other important trains. For the inaugural run of "*The Fylde Coast Express*," on 9th July, No. 5556 was employed. Only 156 min. are allowed for the 158 miles from Crewe to Euston, but this sharp timing was cut by 15 sec., in spite of a signal stop of half-a-minute at Betley Road and two other checks. From Betley Road to Euston the average speed was 63.3 m.p.h., start to stop. A maximum of 76 m.p.h. was attained at Hademore, and the minimum at Tring summit was 63 m.p.h. The loading of this train is usually about 200 tons, and the engines easily keep time.

The first of the 50 new 2-cylinder 4–6–0 engines that are being built by the Vulcan Foundry Ltd., at Newton-le-Willows, for the L.M.S.R. is now in service.

Twelve of the new 3-cylinder tapered-boiler 2–6–4 tank engines are now out and taking a big share in working the London suburban services both on the L.N.W. and Midland sections.

Locomotive No. 6143 of the "Royal Scot" class, originally named "*Mail*" after an early single-wheeler of the Midland Counties Railway, has been re-named "*The South Staffordshire Regiment.*"



The Last of Brunel's Timber Viaducts

The timber trestle viaducts that were for long such distinctive features on the railways in Cornwall and Devon have at length been replaced by more substantial structures. Some 80 such bridges or viaducts were originally built to the designs of the famous engineer Isambard Kingdom Brunel. Although often creaking as heavy loads passed over, for many years they safely bore the traffic; but deterioration through age, and the steady increase in the weight of engines and coaches, made it necessary for them to be superseded by masonry structures or embankments. The last to be in service was the Collegewood Viaduct near Penryn, on the Falmouth branch of the G.W.R. It had a length of 974 ft. and was built with 15 spans. It was closed to traffic on Saturday night, 21st July last, and on the following day the new stone, brick and concrete viaduct that had been built alongside was brought into use. The demolition of the old viaduct is proceeding.

"Pacifics" for the Northern Railway of France

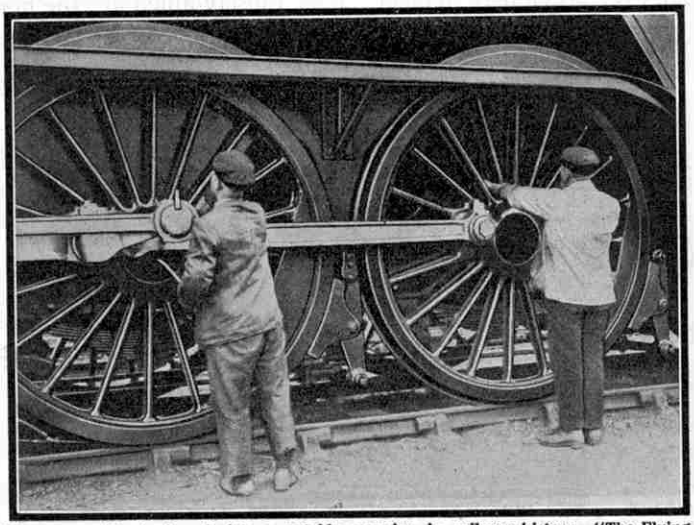
The Northern Railway of France have purchased from the Paris-Orleans Railway 20 compound "Pacifics" for which, owing to electrification, the latter company had no further use. Before being handed over the engines were rebuilt at the Tours works of the Paris-Orleans Railway, and fitted with many modern improvements, including steel fire-boxes with thermic syphons to give a better circulation; new cylinders with oscillating cam poppet valves and very large steam passages; and K.C. double blast pipes to facilitate the exhaust. The equipment includes also A.C.F.I. feed-water heaters, and large Houlet type superheaters giving a high degree of superheat.

The high-pressure cylinders of the reconstructed engines are of 16½ in. diameter and have a stroke of 25½ in., the corresponding dimensions of the low-pressure cylinders being 25¼ in. and 25½ in. Their coupled wheels are 6 ft. 4¾ in. in diameter. The total heating surface is 2,995 sq. ft., the grate area 46½ sq. ft., and the working pressure 246 lb. per sq. in. The weight of each engine in working order is 102½ tons.

More S.R. "Schools" in Service

There are now fully 30 engines of the "Schools" class at work on the Southern Railway, the last four to be turned out from Eastleigh being No. 926, *"Repton,"* No. 927, *"Clifton,"* No. 928, *"Stowe,"* and No. 929, *"Malvern."* No. 923 has been named *"Bradfield."* A further series of these popular and efficient engines is in course of construction at Eastleigh.

The locomotive No. 2329 *"Stephenson,"* one of the 4–6–4 tanks of the former L.B.S.C.R., is now in the shops being dismantled in preparation for its conversion to a 4–6–0 tender engine, as foreshadowed in the *"M.M."* of last July.



The upper illustration depicts a notable occasion in railway history—"The Flying Scotsman" leaving King's Cross on 11th July, 1927, on its first non-stop run to Newcastle. In the lower photograph is seen an L.N.E.R. "Pacific" locomotive receiving its final touches before setting off on its day's work.

New Gadgets for Locomotives

Feed-water heaters, by means of which water is pre-heated before being fed into the boilers; track sprinklers to lay the dust ahead of passenger cars, and smoke deflectors to keep the smoke out of the eyes of train crews and passengers, are some of the innovations that locomotives of the Canadian National Railways now carry. Nearly 200 locomotives have been equipped with these appliances.

Railway Air Services

In order to secure the great advantages that can be obtained by co-ordinating air and railway services, a company has been formed with the title of Railway Air Services Limited. It is owned jointly by the four main line railways and Imperial Airways, and already it has brought several services into operation. The latest of these, which has just been instituted, connects London (Croydon), Birmingham, Manchester, the Isle of Man, Belfast and Glasgow, with one flight in each direction daily on weekdays. De Havilland four-engined air liners have been built specially for the service, and they are equipped to carry mails and freight in addition to passengers. The departure time from Glasgow is 9.15 a.m., and Croydon is reached at 1.30 p.m., stops varying from five min. to 15 min. being made at intermediate airports. The return flight leaves Croydon at 3.10 p.m. and is timed to end at Glasgow at 7.30 p.m.

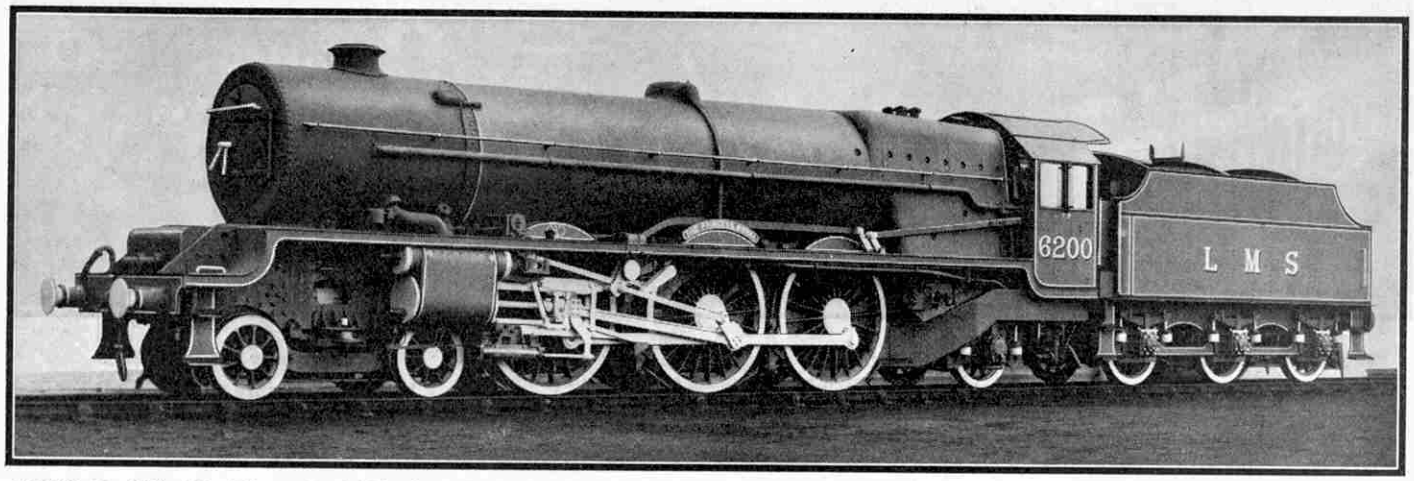
G.W.R. Locomotive News

A further batch of 10 of the "6100" class of 2–6–2 tank engines are now building at Swindon works, and it is expected that some of them will be ready for work by the end of this month.

The work of standardising the locomotive stock is proceeding steadily as the many odd types taken over at the amalgamation in 1923 are condemned and taken out of service. In recent months several tank engines that belonged to the former Rhymney, Cardiff, Barry and Port Talbot Railway Companies have been sent to the scrap heap. Among the G.W.R. locomotives to be scrapped have been another 4–6–0 engine of the "Saint" class, No. 2982, *"Lalla Rookh,"* and two more 4–4–0 "Bulldogs," No. 3309, *"Maristow,"* and No. 3340, *"Camel."* Of the once-well-known 2–4–0 engines of the "Barnum" class, only a few still survive.

Remarkably consistent work continues to be done on the *"Cheltenham Flyer."* The average time for 31 runs, timed over a period of two years, was 64 min. 15 sec., against the schedule of 65 min. for the 77¼-mile journey from Swindon to Paddington.

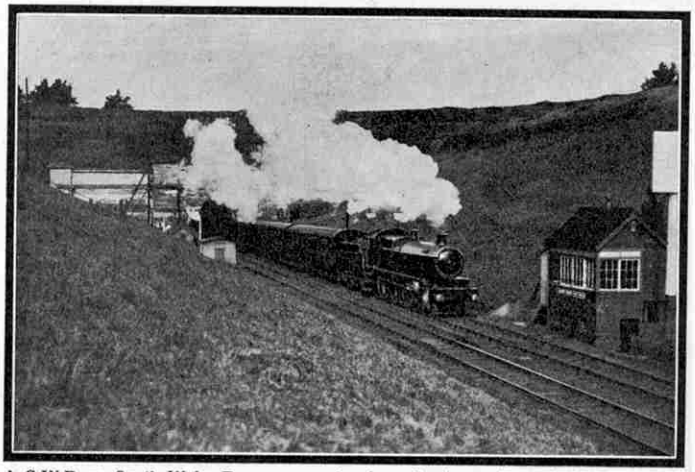
Facts About British Railways



L.M.S.R. No. 6200, "The Princess Royal," the first "Pacific" locomotive to be constructed by that company. It has a tractive effort of 40,300 lb., a total length of 74 ft. 4½ in. over buffers, and in working order with its tender it weighs 158 tons 12 cwt.

THE present year, which is the twelfth of the existence of the four great railway groups, sees the efficiency of British railways at a higher level than it has ever been before. Much of the improvement work undertaken during the past few years, in spite of depressed conditions, has been brought to completion, so that the railways are prepared to a greater extent than ever previously to meet the requirements of the trading and travelling public.

In these days of vast commercial organisations we are apt to overlook the fact that the railway industry is the largest private undertaking in the country, with an invested capital of over £1,100,000,000. Records of all kinds command a great deal of attention nowadays, and it is interesting to note the various respects in which our railways hold the premier position in the world.



A G.W.R. up South Wales Express emerging from the Severn Tunnel. This tunnel is 4 miles 624 yds. in length. It is the longest in the British Isles, and the longest underwater tunnel in the world.

Speed records always appeal to the imagination, and it is exactly 30 years ago last May that the fastest authentically-timed rail speed of 102.3 m.p.h. was reached on the G.W.R. This occurred on 9th May, 1904, when the 4–4–0 locomotive "*City of Truro*" was descending Wellington Bank with an up Plymouth Ocean Mails Express. The same company now run the world's fastest steam train, the famous "*Cheltenham Flyer*," which boasts the average start-to-stop speed of 71.3 m.p.h. between Swindon and Paddington, the distance of 77¼ miles being covered in 65 minutes.

The L.M.S.R. claim to operate more expresses timed at average start-to-stop speeds of 55 m.p.h. or over than any other railway in the world. During last summer there were over 100 trains on the system so timed, the aggregate mileage amounting to 8,693. Altogether there are 237 British expresses daily scheduled for part of their journey at 55 m.p.h. or over, and 25 at 60 m.p.h. or over. Of these 60 m.p.h. trains, 12 are operated by the G.W.R., seven by the L.M.S.R. and six by the L.N.E.R.

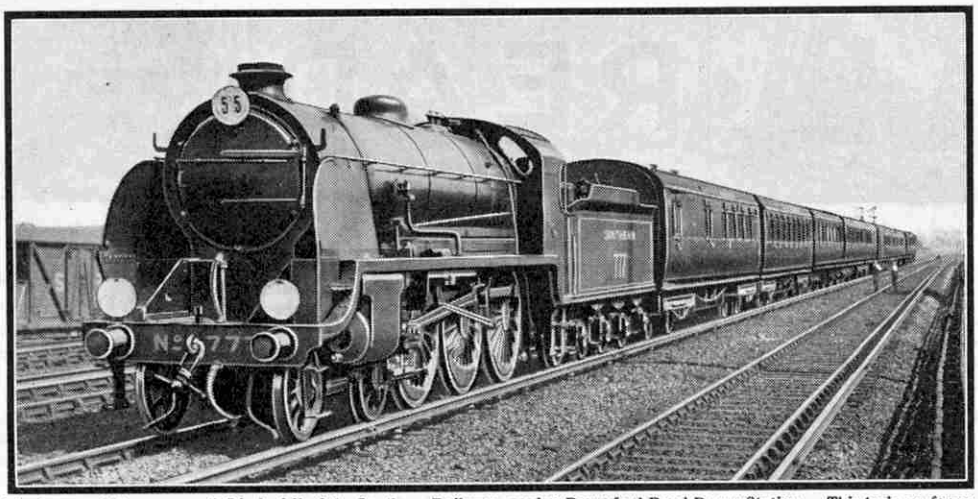
Closely allied are the non-stop long-distance records of the L.M.S.R. and L.N.E.R. groups. During the summer months "*The Royal Scot*" of the first-named company is run without a stop over the 300.8 miles between Euston and Carlisle (Kingmoor). Similarly "*The Flying Scotsman*" of the L.N.E.R. covers the 392¾ miles between King's Cross and Edinburgh without a stop.

These record runs are made on the safest railway system in the world, for the risk of fatal accident to a passenger in a British train is only one in 183 million! Efficient design and construction of equipment generally, unceasing care in its maintenance, and the reliability of the railwayman himself, are all important factors in the attainment of this result.

For comfort, as for safety, British railways have a reputation of their own. Both for day and night travel they provide rolling stock that reaches a standard of comfort unsurpassed anywhere in the world. Springing, heating, lighting and ventilation, as well as upholstery and decorations, are carefully studied in modern coach design, and intensive scientific research is constantly in progress with a view to the enhancing of the existing standards and the development of new ideas. Shower baths are available on sleeping cars, and hairdressing

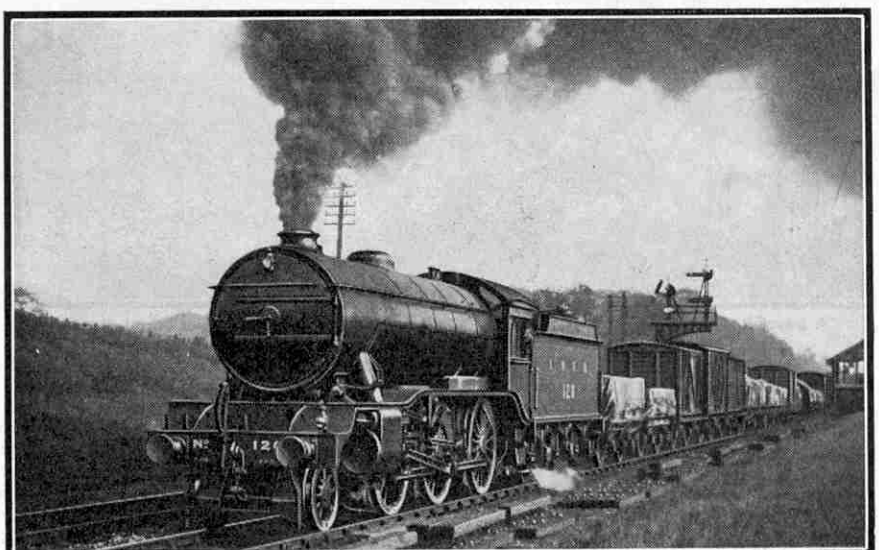
saloons, as well as radio facilities, are to be found on some Anglo-Scottish expresses.

Nor is the tourist or excursion passenger overlooked in this provision for comfortable travel, for a feature of last year was the introduction by the L.N.E.R. of a special type of tourist train provided with buffet cars. Over 600 restaurant cars are operated by our railways, in which 7,500,000 meals are served each year. Where full restaurant service is not required, buffet cars for light refreshments are provided. While dealing with catering it may be noted that railway-owned hotels, 79 in number, form the largest group of hotels in the world.



The famous "Bournemouth Limited," of the Southern Railway, passing Durnsford Road Power Station. This train performs both the up and the down journey of 108 miles in 2 hours without any intermediate stoppage.

Another interesting fact is that British railways are the largest owners of docks in the world. Many ports, indeed, owe a great deal to the foresight and enterprise of the railways serving them. The largest graving dock in the world is S.R. property and is situated at Southampton, and this place indeed is an excellent example of a railway port. It is the premier passenger port of Great Britain, deals with 550,000 passengers yearly, and is used by 25 of the world's shipping companies. The railway companies operate passenger steamships, whose appointments are such that they may be described as liners in miniature. Cargo vessels are also included in the total of 147 railway-owned steamships, and special examples are those engaged in the Irish cattle trade, and the cross-Channel motor car carrier.



L.N.E.R. 2-6-0 locomotive No. 120 hauling an express goods train. This is a typical example of the speedy freight services demanded by modern conditions.

In keeping with the demands of the times, more than 370 express freight trains run nightly between such great centres as London, Glasgow, Liverpool, Cardiff, and many others. Notable accelerations have been made in their timings during the past 12 months, and goods conveyed by them are delivered on the morning following despatch. Last year the "Green Arrow" system of registered transit for goods became adopted by all companies. By this means a consignment, no matter how large or how small, is carried according to a pre-arranged schedule and kept under special observation.

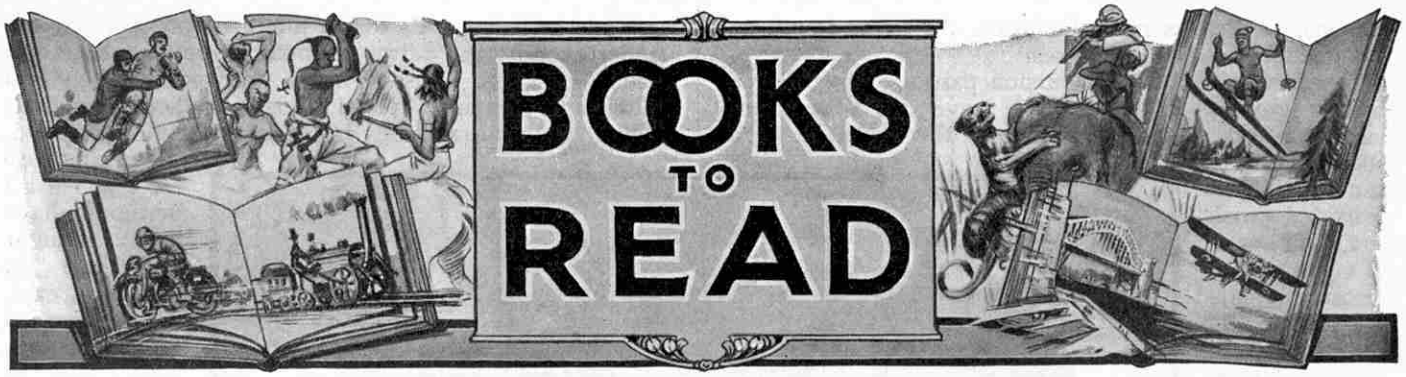
Household removals to the number of 50 per day are undertaken by the railway companies, special containers being used for house-to-house transport. The total number of containers for all kinds of traffic now exceeds 8,500. Some are specially insulated and some ventilated.

Improved terminal methods have been brought into use in recent years, and equipment generally has been and is being brought up to date. The total freight train tonnage amounted to 242,000,000 in 1933, and the total mileage to 122,000,000. Special arrangements are made for perishable and seasonal traffic, such as flowers, fruit, vegetables and fish, which require speedy transport and prompt delivery to reach markets in good condition.

In the case of flowers, for example, their conveyance is carried out by high-speed "perishable" trains, or by express passenger trains, from which they are hustled to market in motor vans. No less than 6,800 tons of flowers—one ton alone means some 60,000 blooms—are conveyed from the Channel Isles, Scilly Isles, Penzance and Lincolnshire and other districts to markets in London, the Midlands and the North. Last year the total tonnage carried of fruit and vegetables was 46,800; of fish 413,000, and of meat 18,000. Milk is another highly-perishable commodity, and is carried in ventilated milk vans or in glass-lined tanks; 187,000,000 gallons were conveyed by rail in 1933.

To carry their traffic the railways own 630,000 freight wagons, which have a capacity of 7,271,000 tons, and coupled together they would reach from London to New York. There are 43,000 passenger carriages, which could provide seats simultaneously for the entire population of Leeds, Glasgow, Manchester and Plymouth combined.

The interesting items mentioned in this article, and many others, are included in the booklet "*Facts About British Railways*" (1934), which is obtainable on application from the British Railways Press Bureau, 35, Parliament Street, London, S.W.1.

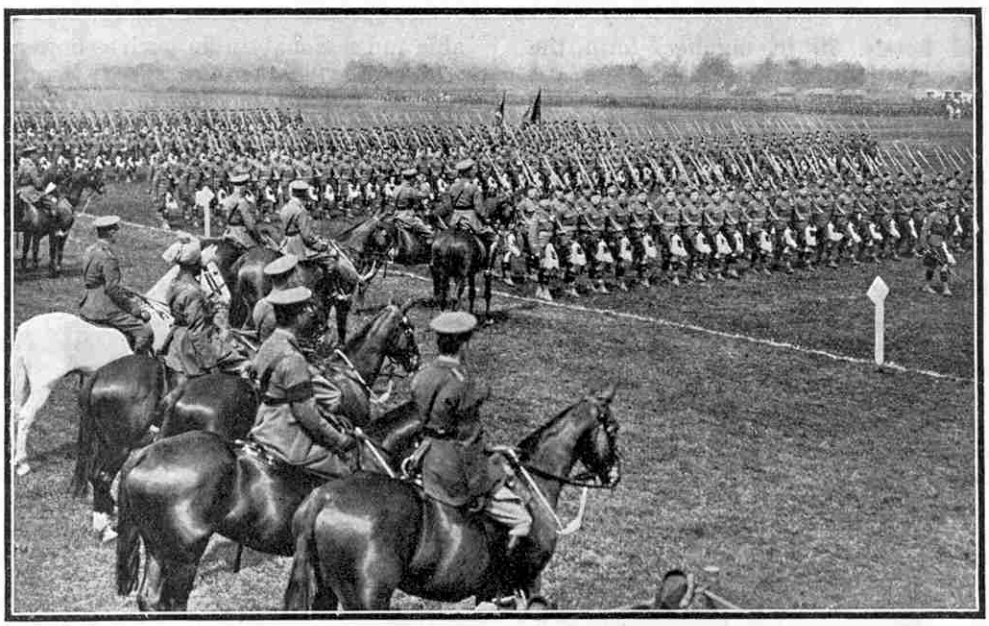


Here we review books of interest and of use to readers of the "M.M." We can supply copies of these books to readers who cannot obtain them through the usual channels. Order from Book Dept., Meccano Limited, Binns Road, Liverpool 13, adding 1/– for postage to the price. Postages on different books vary, but any balance remaining will be refunded.

"The Wonder Book of Soldiers"

Edited By HARRY GOLDING. (Ward, Lock & Co. 5/– net)

The gallantry and romance associated with the Army still make a strong appeal to the imagination of every boy. A well-illustrated account of the life of a soldier, therefore, is bound to be attractive, and the story of the British Army as told in this volume by specialist contributors will be read with keen interest. The book aims at explaining in detail the organisation and work of the Army of to-day, and it begins with a general survey of our fighting forces, followed by explanations of uniforms and badges of rank, points of great interest now that there is a tendency to revive for ceremonial occasions the brighter colours of traditional dress. The mottoes and badges of the units of the Army also are dealt with, and the curious origins of many of them are explained. Most of the mottoes and many of the badges commemorate stirring deeds in past wars in which the particular regiments were concerned.



A Royal Review at Aldershot. (From "The Wonder Book of Soldiers" reviewed on this page.)

Subsequent sections deal with the life of a present-day British soldier, whether at home or in Australia, New Zealand, South Africa, Canada, India, or elsewhere in the Empire. First comes an account of the daily round of the soldier in barracks or in camp. Next we see something of his training and of the manœuvres that accustom him to the tasks he would be called upon to perform in war. Every phase of modern warfare is dealt with in turn, and tanks and other mechanical devices are given their due share of attention to illustrate the great part played by engineering in modern military operations. The work of the Royal Air Force is described as fully as space permits, and chemical warfare also is touched on, emphasis being laid on the inhumanity of employing poisonous gases that spread death or injury indiscriminately over combatants and civilians alike.

Side by side with these sections are others dealing with the Army at play. Sport is of great importance in developing a soldier, both physically and mentally, and interesting accounts are given of the manner in which games and physical drill are employed for these purposes, and for maintaining a good collective spirit.

The sections dealing with our Army Overseas are particularly attractive, for they draw attention to phases of military life of which comparatively little is known in this country. Interesting details are given of specialised forces developed to cope with local conditions in different parts of the world. For instance, we are told something of the many diverse sections of the Indian Army, and of the native battalions organised in various parts of Africa.

At home the Territorial Army is given its share of attention. The Great War showed the enormous value of this nucleus of a citizen Army, and now that the force has been remodelled it offers a splendid opportunity to civilians to learn something of all sides of Army life.

The splendid illustrations to the book include 12 colour plates showing Army scenes of interest in peace and war, and more than 300 reproductions from photographs.

"How to See Pond Life"
"How to See Insects"

By ERIC FITCH DAGLISH. (Dent. 2/6 each net)

Mr. Daglish knows how to reveal the fascinations of Nature in simple language, and these books will be read with delight by all who are interested in country life.

The first volume deals with the queer creatures that live obscure lives at the bottom of still ponds, or hidden among the grass or weeds on their banks. Among these are frogs and toads, newts, fishes, water spiders, snails and many less familiar but equally interesting forms of animal life; and the astonishing changes that many of them pass through from babyhood to old age are explained in a most attractive style. The fascinating stories of the lives of these creatures will provide many surprises, and most readers will be astonished at the variety of life that is to be found not only in ponds, but also in ditches, swamps, marshes, and even large puddles. Most of those who become interested in pond life are seized with the desire to collect specimens to watch at leisure at home, and Mr. Daglish ends his book with a chapter explaining how to keep such creatures healthy and contented in aquaria.

The volume on insects is no less interesting. The general structure of these creatures is explained in non-technical language, and beetles, crickets and grasshoppers, dragon-flies, butterflies and moths, bees, wasps and ants are then dealt with in detail. The transformations that many of them undergo during their lifetime are no less remarkable than those of many of the inhabitants of ponds, and these changes are fully described. Special attention is given to the interesting topic of the influence that insects have on garden and farm crops.

Both books are illustrated by a large number of excellent wood-cuts and pen-and-ink drawings prepared by the author.

Popular Scientific Recreations

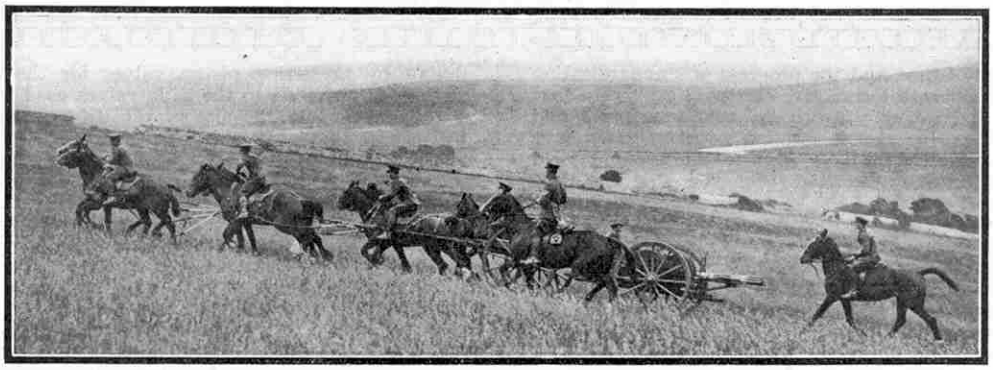
By A. M. Low, D.Sc. (Ward, Lock & Co. 6/- net)

We live in a scientific age, and every day it becomes more necessary that we should know something of the principles that underlie the various branches of technical knowledge. The best means of obtaining a grasp of these principles is by actual experiment, and in this book the author sets out to show how a large number of effective and interesting experiments can be performed with simple and homely apparatus. He emphasises the point that "Science is an everyday affair that can be studied in the home or in the street as effectively as in the highly-equipped laboratory."

The branches of science dealt with are magnetism and electricity, heat, light, sound, physics and chemistry, and in addition there are interesting sections showing how to produce fascinating optical illusions and to perform a series of interesting tricks. The experiments are cleverly devised to be at the same time attractive and informative. For instance, in dealing with magnetism, the author makes use of a variety of tricks and games, and describes the construction of an amusing "question and answer" apparatus that the experimenter controls by means of a magnet. A home-made telegraph is described in the electrical section, in which interesting feats that can be performed by means of electro-magnets are explained.

In the section on light the principles of the science are illustrated by the construction of simple but effective devices for "looking through" a block of stone, producing ghosts and other illusions such as a talking head on a table, and demonstrating the principle of the cinematograph. The explanation of many mysterious balancing feats is given in the chapter on physics, and the chemical experiments described are very spectacular and include many that can be described as chemical magic. In every case the author emphasises that the experiments are not mere conjuring tricks, but are attractive ways of illustrating important scientific principles.

The book is well illustrated by means of 16 pages of photographs and 100 diagrams that show experiments in progress and help to make clear the method of operation.



Signallers of the Oxford University O.T.C. advancing with their cable-wagon. (See opposite page.)

Scout Discipline

By Vera Barclay

(Brown, Son & Ferguson Ltd. 1/6 net)

Most books on Scouting deal only with Scoutcraft and with the practical details of Scout training. There was therefore room for a short book touching on the ideals behind the Scout movement, and Miss Barclay has attempted to supply this need in the present volume. She begins by drawing a clear distinction between inward discipline, or character formation, which is the ultimate aim of Scouting, and outward discipline, or orderly conduct, which is a necessity if Scouting is to be successful in its chief purpose; and discusses how both can be achieved, illustrating her suggestions by means of incidents in her long experience of Scout work.

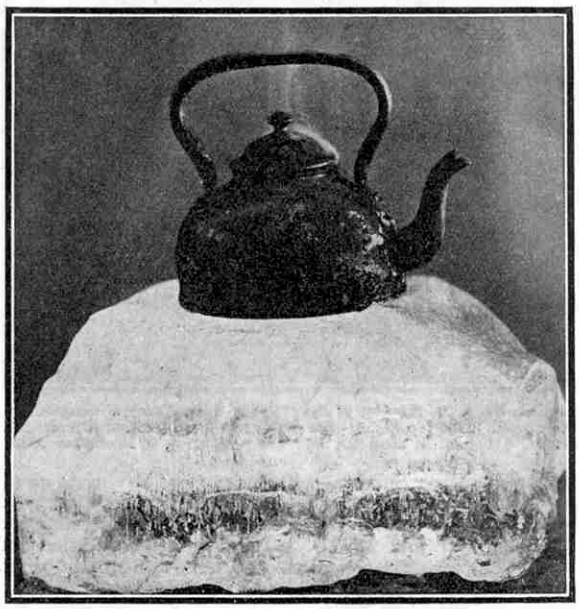
Apart from its value to those directly concerned with Scouting, the book shows with what care and thoughtfulness responsible Scout officials approach their task of developing the best that is in the boys who join the movement. It can be read with profit by all who are concerned with work of any kind among boys because of its revelations of many of the motives that govern boys' actions, and will be found useful by Leaders of Meccano Clubs and those interested in Branches of the Hornby Railway Company.

The Science of our Daily Life (Book III)

By F. J. C. Marshall. (Wheaton & Co. Ltd. 2/3 net)

This is the third of a series of books dealing with the science of our daily life. Previous volumes have been concerned with air, water, food, clothing and other things necessary for life and comfort, and in the present one the science of our health, work and pleasures is covered. The first section is novel and of great importance. It deals with bacteria and their nature, and the part they play in spreading certain diseases is illustrated by means of extremely interesting experiments that can be carried out with simple apparatus. These experiments also show how flies and dirt help to carry bacteria, and emphasise in a very practical manner the influence of sunlight, disinfectants, and other means of destruction employed in the fight for health. A simple introduction to mechanics follows, and finally there are sections on photography, the flight of balls in various games, and the construction of fireworks to illustrate science in play.

Although the book is intended for use in schools, it is far more than a mere text book, and its contents, especially the section on science in health, will be of interest to all who are attracted by the part played by science in every aspect of modern life. It is illustrated by drawings and photographs, and readers of the "*M.M.*" will be specially interested in the reproductions of Meccano models that are included in the section on mechanics.



Boiling a kettle on ice. The kettle is filled with liquid air, which boils at a lower temperature than that of the ice. (From "Popular Scientific Recreations" reviewed on this page.)

British Aeroplanes Illustrated

By C. A. Sims. (A. & C. Black Ltd. 3/6 net)

The purpose of this book is to give the reader a general idea of the principal types of British aeroplanes that are at present in everyday service. Its range covers the Royal Air Force, Imperial Airways and other air transport firms, flying schools, and the many private owners. The descriptions enable the reader to obtain a good knowledge of the uses and performances of the types without going very deeply into the various technical problems involved.

The majority of the aeroplanes described, each of which is illustrated by an excellent full-page photograph, are those which readers in this country are likely to see, and the excellent illustrations make it easy to identify the machines. These photographs have been chosen to show the most important features, and have been taken from various angles, including close-up views on the ground, while flying past the camera, and from other aeroplanes in the air.

The book is divided into three sections, the first describing the chief types of R.A.F. machines, the second dealing with record-breaking machines, and the third with the latest types of civil aircraft. The R.A.F. machines include the Bristol "Bulldog," which has been the standard single-seater, day and night fighter of the R.A.F. since about 1929; and the Hawker "Hart," the latest type of the day bomber class of aircraft introduced into service with the R.A.F.

The record-breaking machines described include the Fairey long range monoplane in which Sq. Ldr. O. R. Gayford and Flt. Lieut. A. E. Nicholetts, in February 1933, flew non-stop from Cranwell to Walvis Bay, South West Africa, a distance of 5,340 miles, in 57 hr. 25 min. The civil aircraft range from the well-known Comper "Swift," the smallest light aeroplane built in this country, to the giant Handley Page 42 of Imperial Airways, which can seat 38 passengers and a crew of four.

"Good-Bye to the Pollitt 4-4-0 Locomotives"

A Hard-Worked Class of Engines

By E. S. P. Rawstron

WITH the passage of time and the progress of standardisation the number of separate locomotive classes in use on the four groups is steadily decreasing. Probably most readers could mention various locomotive classes familiar to them that have become extinct since pre-grouping days, while the ranks of many old favourites are being rapidly reduced. On the L.M.S.R., for instance, up to the end of 1933, 4,800 locomotives had been withdrawn from service since grouping took effect, and the number of different types had been brought down from 393 to 204 during the same period. New and more efficient designs are being produced, not only for express work, but also for secondary services, thus avoiding the retention of the older locomotives that normally would gravitate to these duties. That many of the "old guard" are going out with colours flying is quite true, and a particularly good instance of this is found in the well-known "Pollitt" 4–4–0 locomotives of the former Great Central Railway that are in use on the Cheshire Lines Committee's system.

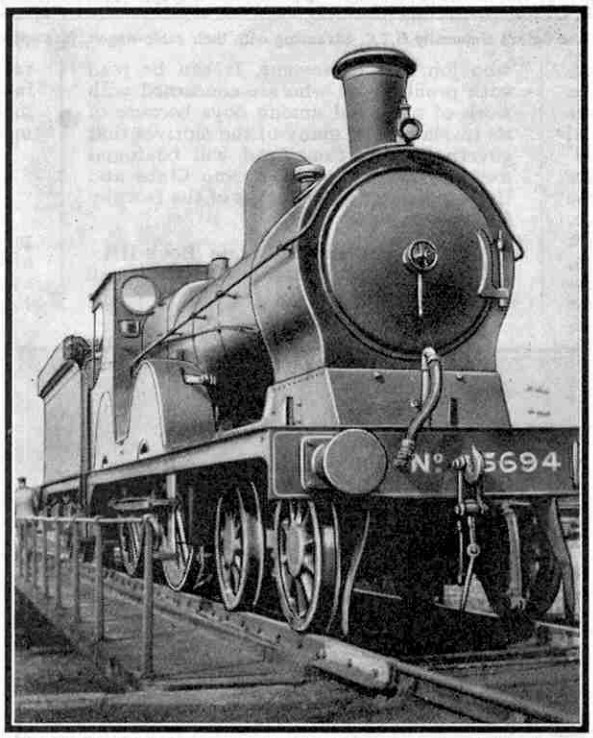
This system is a joint concern situated partly in Cheshire and partly in Lancashire, connecting Chester, Stockport, Manchester and Liverpool. There is also a branch to Southport. It is managed by a Committee of L.M.S.R. and L.N.E.R. representatives, as the pre-group companies concerned were the Midland, G.N. and G.C. Railways. The Cheshire Lines Committee has its own rolling stock, but motive power is provided by the G.C. section of the L.N.E.R., which explains the use of the "Pollitt" engines of that company on C.L.C. duties. L.M.S.R. locomotives work over the system on their own services.

It must be mentioned, too, that the former Great Central Railway had only borne this title since 1897, for previously it had been known as the Manchester, Sheffield and Lincolnshire Railway. Thus the reference to the "M.S. & L.R." in this article will be readily understood.

To find the actual origin of the so-called "Pollitt" 4–4–0 engines, it is necessary to turn back over 40 years. In 1893 when Mr. T. Parker, Locomotive Superintendent of the M.S. & L.R., was preparing a new class of express engines, he based the design on previous locomotives that he had turned out to the number of 31 between 1887 and 1892. The leading feature of the new engines was a Belpaire fire-box; the M.S. & L.R. had been the first of our railways to use a Belpaire as opposed to a round-topped fire-box, when in 1891 they built a 0–6–2 tank, No. 515 (now L.N.E.R. 5515), so fitted. Moreover, just as No. 515 was the pioneer of a class of 129 similar 0–6–2 tanks subsequently built, so No. 694, Mr. Parker's new 4–4–0 engine, was the pioneer of a very successful class of 39 locomotives. The two inside cylinders had a diameter of 18½ in. with a piston stroke of 26 in., the steam pressure was 170 lb. per sq. in. and the heating surface 1,318 sq. ft.

But—and here is an interesting point—just after Parker had prepared his new design in 1893, he was succeeded on the M.S. & L.R. by Mr. Harry Pollitt. The consequence was that to Pollitt was left the responsibility of building the locomotives that his predecessor had designed, with the unjust result that the credit for producing these fine engines is popularly attributed to Pollitt instead of Parker. Actually, after the first six engines had been built and tested, Pollitt did incorporate his own ideas in the design by preferring piston valves for the cylinders of future engines of the class to the slide valves used by Parker.

With regard to the size of the driving wheels, many readers will at once say "7 ft. of course." As a matter of fact the "Pollitt 7 ft. 4–4–0s," as they are usually termed, originally had coupled wheels with a diameter of 7 ft. 1 in., though this measurement was very likely caused by the provision of thick tyres that later were changed for thinner ones, or was the actual diameter, 7 ft. being the nominal dimension more commonly used. One point seems certain, and this is that the first six engines, Nos. 694–9, were later rebuilt with 6 ft. 9 in. driving wheels; all modern authorities are agreed on this.



L.N.E.R. No. 5694, the first of the "Pollitt seven-footers" described in this article. This locomotive was afterwards fitted with smaller driving wheels, 6 ft. 9 in. in diameter, and was broken up in November 1932.

The official building dates of the Pollitt 4–4–0s—really Parker's engines, it must be remembered—show Nos. 694–6 and Nos. 697–9 to have been built at Gorton in the years 1894 and 1895 respectively. Of the 33 others, with piston valves, 13 were constructed at Gorton, No. 268 in 1897 and Nos. 269, 270, 852–61 in 1898, and the remaining 20 by Beyer Peacock and Co. Ltd., Nos. 862–4 in 1898 and Nos. 865–81 in 1899. Some of the actual building plates carried by the engines themselves disagree with the dates just listed by one year, but this is only because engines built in December on one year are often not put into service until January of the next. Inaccurate building plates—and some very inaccurate ones are known to exist—are only one example of the many obstacles that confront the recorder of locomotive history.

These rather tedious details have been necessary to prevent any misunderstanding on the part of readers, and we can now proceed with the account of the lives of the famous "Pollitt 7 ft. 4–4–0s."

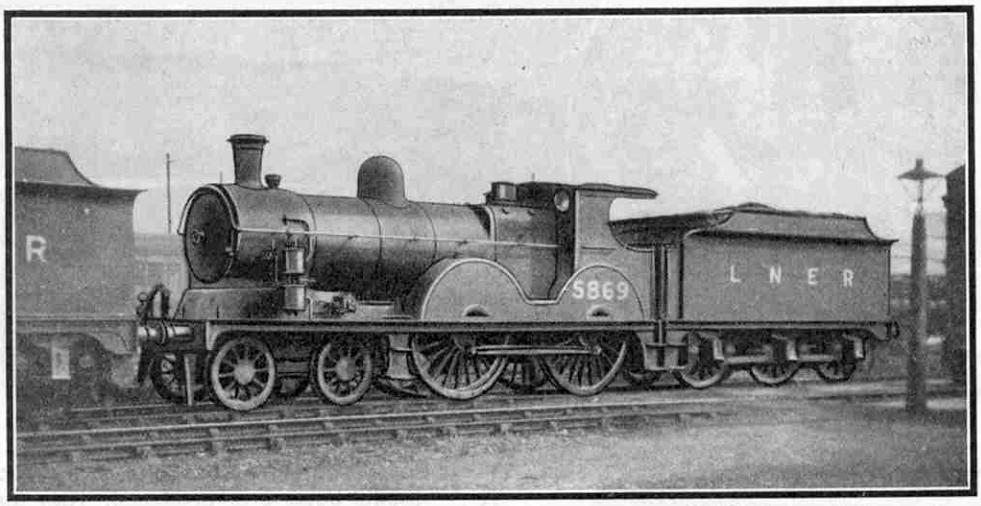
Considering the large size of their driving wheels, the "seven-footers" were surprisingly good hill climbers for their day, and this is shown by records of the performance of Nos. 694–9 during their early years. In 1896 one of these drew a train of 120 tons from Grantham to Sheffield, 56¾ miles, in 61 minutes, in spite of having to slacken to 5 m.p.h. round the sharp curve at Retford and to climb several banks ranging from 1 in 200 to 1 in 150, and even steeper towards Sheffield. On the same run, once the engine had settled down after leaving Sheffield, the rate never fell below 40 m.p.h. all the way up the severe climb of 19¼ miles to the Woodhead summit, and the average gradient is here about 1 in 128. Travelling in the opposite direction, with 100 tons behind the tender, another engine of the same class ascended the steepest part of the Woodhead climb—17¼ miles between Dinting and Woodhead, first at 1 in 100, then at 1 in 117—in only 9 minutes 53 seconds, giving an average speed of almost exactly 45 m.p.h.

These early runs, though made with light loads, were a prelude to the really superior performances that these engines put up with heavier trains on the completed London main line a few years later. The adoption of the Belpaire fire-box had secured for them a better capacity for steaming than was available in most contemporary express 4–4–0 engines of the same size, and it was probably this that gave them such lasting "breath" when hill climbing.

When the Great Central Railway—the former M.S. & L.R.—opened its new extension to London on 9th March, 1899, four of the greatly admired 7 ft. 4–4–0s were lavishly decorated for the occasion.

Corridor coaches and dining cars were then a comparative novelty, and as the inaugural train of five luxurious coaches " vestibuled from end to end " left Marylebone terminus, it was a great sight to see engine No. 861 haul its train slowly away into the distance. The other three engines present for the ceremony were Nos. 268, 269, and 270, which brought visitors' trains from the chief centres of the G.C.R. They all looked very beautiful with their coloured flags, polished paintwork of green, and attractive chimneys, then of the stove-pipe variety.

The G.C.R. at that time was particularly short of locomotives, and for some years the 7 ft. 4–4–0s were kept fully occupied over the terrible grades of the Manchester - London main line. Probably their hardest tasks were the non-stop expresses operating between Leicester and Marylebone, the journey of 103 miles *via* Aylesbury being timed at a speed only a shade under 50 m.p.h.



This photograph shows the usual appearance of the " Pollitts " as running to-day. The Westinghouse brake pump is an exceptional fitting, however, No. 5869 being the only locomotive so fitted working on the Cheshire Lines.

Since these early days the engines have undergone no drastic rebuilding. The splashers have been pierced each with one small aperture over the extremities of the coupling rods, the cab roofs have been extended farther back to secure greater protection for the enginemen, and the boiler mountings, such as the chimney, dome, and so on, have recently been altered to conform with L.N.E.R. practice as applied to G.C. engines ; but the only important change has been the extending of the smoke-boxes and the superheating of all the engines of the series. L.N.E.R. No. 5878 was until recently the only one still running without a superheater, but it has now been brought into line with the other engines of the class with respect to this valuable appliance.

The oldest Parker 4–4–0s of the 1887–92 period that were mentioned at the outset have been more thoroughly rebuilt, and many of them are still at work, mostly on the original M.S. & L.R. section. Not only have they had their cabs, splashers, smoke-boxes and so on altered like the " Pollitts," but their old round-topped fire-boxes have been replaced by those of the Belpaire variety making them externally very difficult to distinguish from the " Pollitts." All these 4-4-0s now bear the black livery standard for subsidiary passenger and all goods locomotives on the L.N.E.R., in place of the deep green with red frames of the former G.C.R. days.

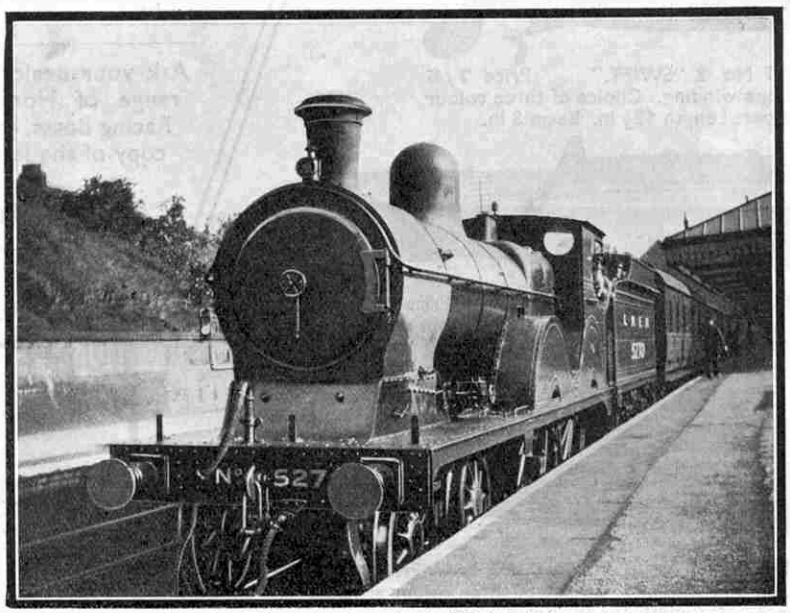
The majority of engines, when they grow old and out of date, gradually descend from their exalted positions and are relegated to less and less important train services, until eventually they end their days puffing up and down some obscure branch line of which few people have even heard. But not so the " Pollitt seven-footers "! They are admittedly no longer to be found on the London main line, but the work they are performing over the Cheshire Lines Committee is more than enough to keep them well before the public eye.

With few exceptions, all the Liverpool-Manchester expresses of the C.L.C. are worked by these engines, and some of the tasks are almost impossibly hard. With the introduction of heavy modern rolling-stock, timekeeping is bound to suffer and, among railway enthusiasts at least, sympathy is all with the engines. They are now some 35 years of age, and when it is realised that on occasions they are called upon to haul loads of over 400 tons on the 45-minute bookings between Liverpool and Manchester, it will be understood that they certainly deserve sympathy. The Liverpool-Harwich " Continental Boat Expresses," with timings of 43 minutes between Liverpool and Manchester, including a stop at Warrington, are further formidable duties involving the normal winter load of seven corridor vehicles.

It should be mentioned that the 34 miles of line *via* Warrington between the two Lancashire cities are laid over sharply undulating country, several of the grades being steeper than the 1 in 150 mark.

While much good work is still being done by the " Pollitts," there is no denying that they are outclassed on the heavier C.L.C. services. On suburban turns, for which they are used extensively on the C.L.C. system, their large driving wheels make them unsuitable. The Great Central 2–4–2 and 4–4–2 tanks have much better powers of acceleration, and for obvious reasons they are more convenient than the comparatively lumbering tender engines on local services.

Further, old locomotives are costly to keep in a state of repair, and they burn a great deal more fuel than the more efficient and economical designs of to-day. With these factors weighing against them, therefore, the Pollitt 4–4–0s are now fast going to the scrap-heap. The last of the pioneer series numbered 694–9, later fitted with 6 ft. 9 in. driving wheels and becoming L.N.E.R. 5694–9, was withdrawn from service in April of last year, some of the six engines of this batch having finished their days on the Cheshire Lines and others on the G.C. main line between Manchester and Sheffield. The famous 7 ft. engines also are diminishing, 15 of them having been scrapped at the time of writing.

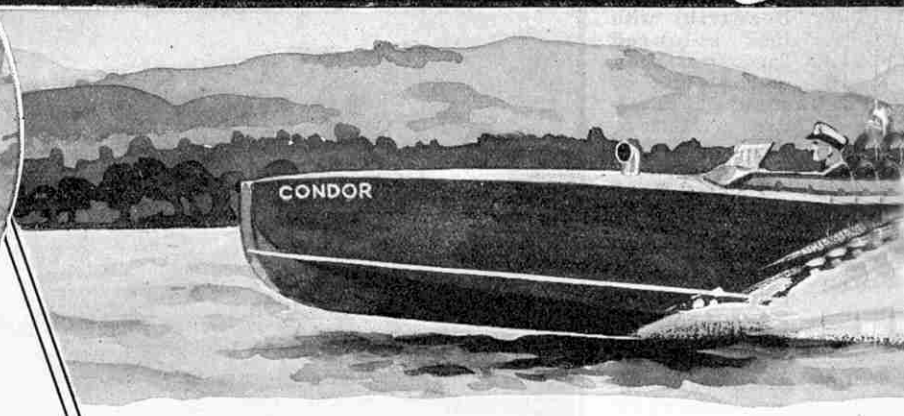


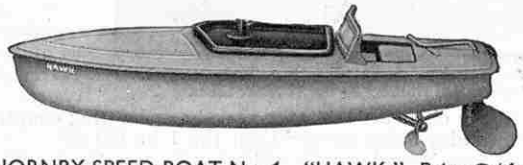
No. 5270 on a stopping train. This engine, formerly No. 270, is notable as being one of those concerned in the running of the special trains in connection with the opening of Marylebone station, the London terminus of the Great Central Railway in 1899.

A common question we hear to-day is : " What engines will serve on the Cheshire Lines to replace the ' seven-footers ' ? " Although many unusual locomotives are now working over the C.L.C. into Liverpool and Southport, it is impossible to say as yet of what class the successors of the " Pollitts " will be. Some say that L.N.E.R. " Shires " would be better employed on the C.L.C. system than on many of their easy duties in the North Eastern area. On the other hand, with the advent of " Sandringhams " on the G.C. main line it may be possible in time to dispense with the services of a few " Directors," " Queen Alexandra " or class " D 9 " 4-4-0s and " Atlantics " on this section, any of which could be used with advantage on the Cheshire Lines.

The problem is a difficult one and all followers of the locomotive will await the solution with interest.

This is Hornby S





HORNBY SPEED BOAT No. 1. "HAWK." Price **2/11**
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HORNBY SPEED BOAT. "MARTIN." Price **3/11**
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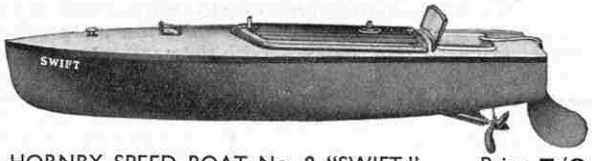
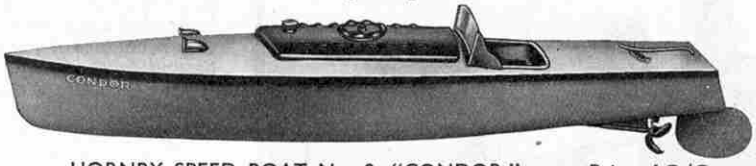


HORNBY SPEED BOAT No. 2 "SWIFT." Price **7/6**
Travels over 300 ft. on one winding. Choice of three colour schemes. Dimensions: Length 12½ in. Beam 3 in.



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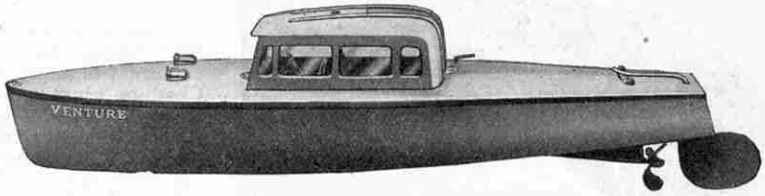

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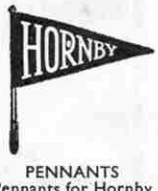

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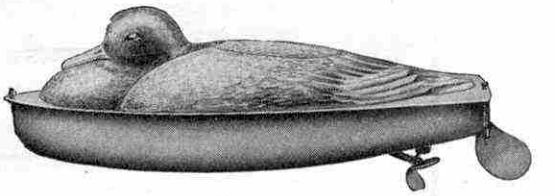

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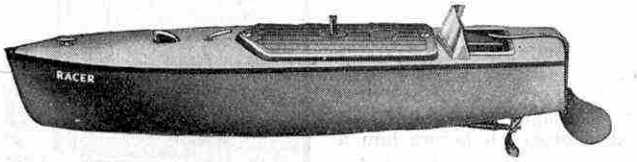
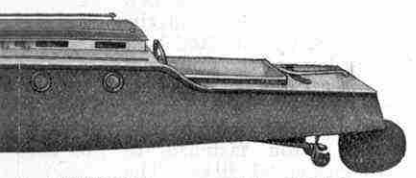


HORNBY RACING BOAT No. 2. "RACER II." Price **8/6**
Travels over 200 ft. at high speed on one winding. Finished in Blue and Cream. Dimensions: Length 12½ in. Beam 3 in.



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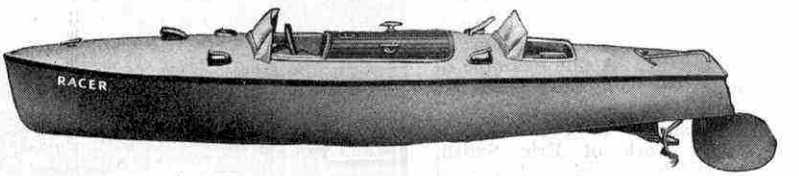

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PEED BOATS

The British Navy in Meccano

Some Fine Models of Modern Warships

MECCANO parts lend themselves in a remarkable manner to the building of non-working models of many different types. In previous articles we have shown some of the possibilities in regard to the construction of models of architectural subjects, aeroplanes, etc., and in this article we shall deal with Meccano as applied to warships.

In this branch of model-building, as in all others, the prototypes should be chosen with due consideration to the number and variety of the parts available. It is little use, for instance, to attempt to build a battleship or a battle cruiser with a small Outfit; but there are plenty of smaller types of warship that can be reproduced effectively with comparatively few parts. The vessels selected for description in this article are typical examples of what can be done with large Outfits, but after careful consideration of the methods of construction employed, any boy with a smaller Outfit should be able to design simplified models that will come within his scope. In a later article we hope to deal with warship models built with small Outfits.

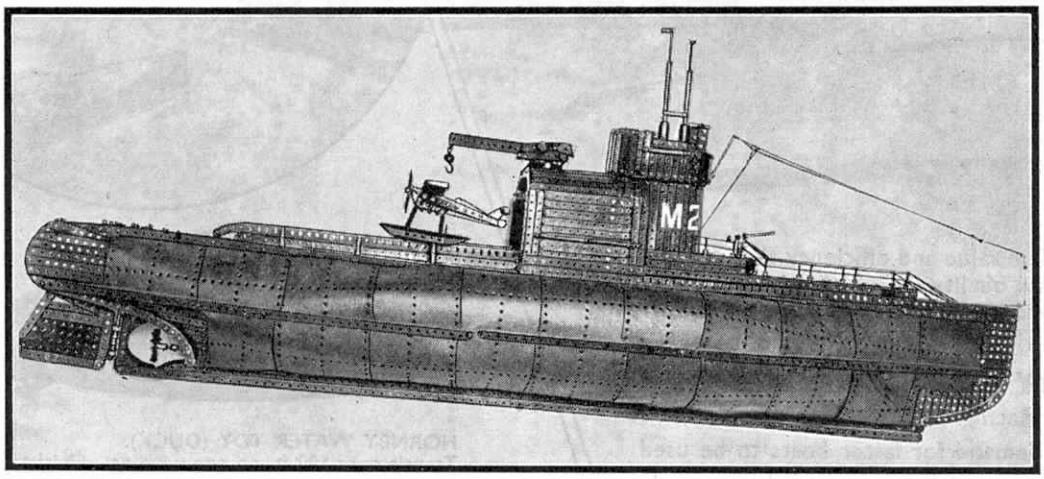


Fig. 1

Pictures of all kinds of naval ships are usually easy to obtain, and illustrations of many of the famous ships of the British Navy have appeared at one time or other in the pages of the *"M.M."* With a good photograph before him a keen model-builder should not find much difficulty in reproducing correctly the proportions and main features of a war vessel.

The chief points to be observed in ship construction are proportion, balance, bold design, and the elimination of unnecessary details. A fine example of a model in which good proportion has been obtained is that of a "Champion" Class cruiser shown in Fig. 4. This model is the work of Eric Smith, Gillingham, and it is a splendid copy of its prototype. Anyone who is familiar with the actual vessel will have no difficulty in recognising the many good points of the model.

The outstanding feature of a fighting vessel is of course its armament, and in modelling the guns, torpedo tubes, mine gear, etc., there is considerable scope for ingenuity in using Meccano parts most effectively. For gun barrels Rods are most generally suitable, but if the model is a very large one, Collars slipped over the Rods can be used to provide a barrel more in keeping with the general scale. For the breech of a small-bore gun a Pinion may be used, while a short Flat Girder makes a good shield for the gun crew. Several different ways of constructing the turrets of big guns are adopted in the various models shown in the accompanying illustrations.

To revert to Smith's model, the hull is 32½" in length and is built up from 12½" Strips, the main deck being 2½" wide and formed from Flat Plates. The centre bridge is reached by two ladders represented by Sprocket Chain. Two Collars are used to form realistic port and starboard searchlights, and these are mounted on the bridge and secured to Angle Brackets by Bolts, which are used in place of the ordinary grub screws. A further searchlight is mounted in the searchlight tower, and in this case is made from a Threaded Boss fixed between the arms of a Small Fork Piece so that it can be swivelled and elevated. On both the fore and after bridges is a miniature range finder made from a 1" Rod passed through a Collar mounted on a long screw. The armament consists of four large guns, two anti-aircraft guns, and a set of triple torpedo tubes. The heavy guns are mounted on large Fork Pieces, and their shields are 1½" Flat Girders secured to the gun barrels by Collars. The two anti-aircraft guns are built on Small Fork Pieces, and are equipped with breeches represented by one half of a Dog Clutch. These guns can be swivelled and can be elevated to an angle of 55°. The torpedo tubes are represented by 2½" Rods passed through Couplings secured pivotally to Bush Wheels as shown in the illustration.

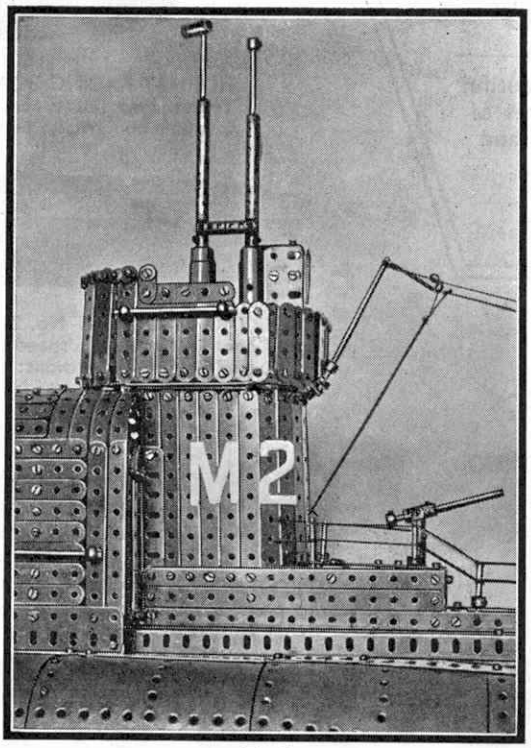


Fig. 2

The foremast is a 2½" Rod capped by a Coupling with a 2" Rod passed through at one of its transverse holes, and the mast is then extended by a 1" Rod held in the longitudinal bore of the Coupling. The crow's nest is a Chimney Adaptor, and the aftermast is a 5" Rod.

A realistic wireless aerial is made with twin strands of cotton fastened to spreaders formed with matchsticks. The raft on the front of the bridge is a Rubber Ring held to an oval shape by pieces of wire, by means of which it is also secured in position on the bridge structure.

Fig. 3 shows an Admiralty "V" Class destroyer of the type built under the War Emergency Programme, 1918. These ships were of 1,300 tons average displacement, length 312 ft., beam 29½ ft., and draught 9 ft. They were equipped with four 4.7" guns, two-pounder pom-poms, and six torpedo tubes mounted in two sets of three. In the model, which was built by G. Ford, Bognor Regis, the sides of the hull are built mainly of 12½" Strips, which are joined together at the bows and spaced apart at the stern by three 2½" Double Angle Strips.

Amidships the sides are kept apart by three $2\frac{1}{2}$" Strips, thus giving the vessel a beam of $2\frac{1}{2}$" compared with a length of $37\frac{1}{2}$". It will be noticed that these measurements are not quite in correct ratio with those of the actual ship. Short Strips are bolted crosswise to the $12\frac{1}{2}$" Strips at various intervals to keep them together. The depth of the hull at the forecastle is $2\frac{1}{2}$" and the rest of the hull is $1\frac{1}{2}$" in depth. The deck consists mainly of Flat Plates and $3\frac{1}{2}" \times 2\frac{1}{2}$" Flanged Plates, the latter being joined to the sides by Angle Girders. This ensures that there is no unsightly space between the deck and the ship's side, and also gives rigidity to the structure.

The stern is slightly rounded by bending the Double Angle Strips from which it is formed. The forward deck house under the bridge superstructure consists of $4\frac{1}{2}$" Strips and Double Angle Strips, and is $1\frac{1}{2}$" wide at the front and $2\frac{1}{2}$" wide at the back. A feature of the actual vessel, and also of the model, is the baffle shield projecting from the roof of the deck house to prevent flames from the upper gun harming the crew of the lower gun. Runners for launching depth charges are mounted in the stern of the vessel, and other details include navigating lights, range-finders, searchlights and wireless aerial. This model also demonstrates the use of Washers to represent aerial insulators. Unfortunately the bridge is rather too high in comparison with the height of the mast and the proportions of the vessel generally.

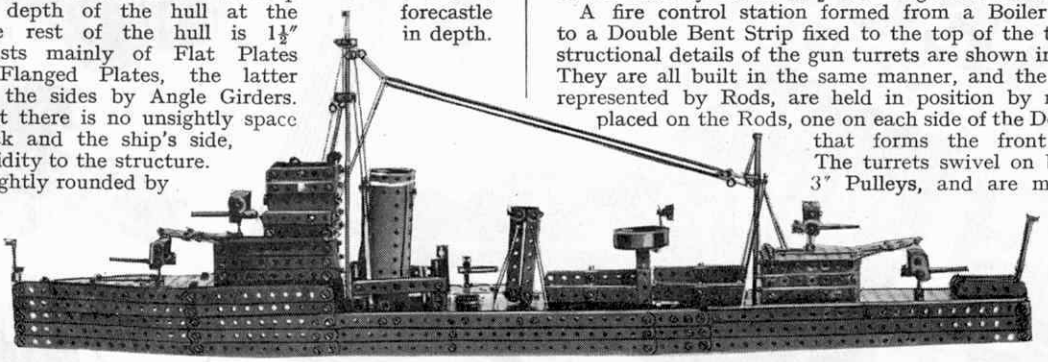


Fig. 3

Even more ambitious than the construction of a dreadnought is the task of building a submarine. This perhaps is a job only suitable for constructors who have plenty of parts and plenty of experience in using them to the best advantage. Excellent results can be obtained, however, as is shown by the splendid model of the ill-fated submarine M2 shown in Fig. 1. This model was built by J. A. Roca of Barcelona, and it embodies some of the finest constructional work that we have yet seen. Owing to its rotundity, the hull of a submarine presents innumerable difficulties to the model-builder, and a great deal of patient work is necessary to construct a really good model. In the example shown here the hull is composed of Boilers opened out and bolted to a skeleton framework of metal rings of various diameters. The rings are made up from Strips, and are spaced apart and connected together by other Strips. The engine room contains an Electric Motor coupled to the propeller shaft, at the end of which a Meccano Fan is fixed to represent the propeller. The construction of the conning tower is shown in the sectional illustration, Fig. 2, and the extremely neat work in this part should be an example to other constructors who decide to try their skill in building a model submarine. The periscopes are Rods over the lower parts of which a number of Collars are slipped in order to give the lower end an increased diameter as in an actual periscope.

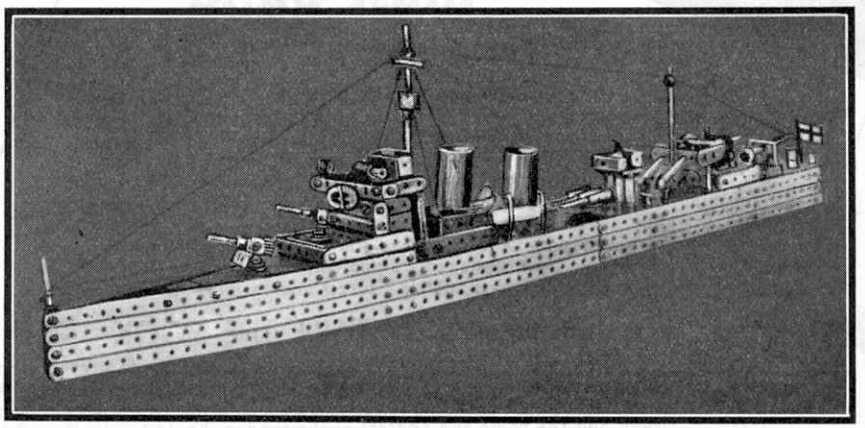


Fig. 4

A very interesting example of a Meccano warship was designed some time ago in our own model-building department. This model represents a battleship of the "*Revenge*" class, and is shown in Fig. 5. The construction of the hull is carried out mainly in $12\frac{1}{2}$" Strips and the decking is made with Flat and Flanged Plates. The rounded stern is formed from a Braced Girder bent round and secured to a Hub Disc. The superstructure is attached to the hull by means of Flat Brackets bolted to the superstructure and also to Angle Girders attached to the hull. The control tower is made up of Angle Girders bolted together to form a box-section girder, and the bridge platforms are Flat Plates edged with short Angle Girders, the Plates being secured to the mast by means of $\frac{1}{2}" \times 1$" Angle Brackets.

A fire control station formed from a Boiler End is secured to a Double Bent Strip fixed to the top of the tower. The constructional details of the gun turrets are shown in the illustration. They are all built in the same manner, and the guns, which are represented by Rods, are held in position by means of Collars placed on the Rods, one on each side of the Double Angle Strip that forms the front of the turret. The turrets swivel on bases made from 3" Pulleys, and are mounted in place by passing a Rod up through the deck and through the boss of the 3" Pulley, then placing the turret over the end of the Rod, and securing it finally by a Collar on the Rod. Setscrews are used to attach to the funnel the Coupling that carries the branch pipe on the ends of which the two sirens are mounted.

A smaller model, which can be built with a No. 5 Outfit, is described under Model No. 5.45 Battle Cruiser, in the Instruction Manual for Outfits Nos. 5–7. In this model the hull consists of three rows of $12\frac{1}{2}$" and $5\frac{1}{2}$" Strips, the upper row being bolted to the flanges of Sector Plates and $5\frac{1}{2}" \times 2\frac{1}{2}$" Flanged Plates, which form the deck. This model is fitted with an aeroplane launching platform. The gun turrets are made from two $1\frac{1}{2}$" Double Angle Strips, to the ends of which two 2" Strips are attached to form a rectangular box, which is then roofed with two 2" Strips. The guns are Rods held in position by Collars and the turrets swivel about $\frac{3}{8}$" Bolts secured to 1" Triangular Plates fastened to the under surface of the turrets and loosely attached to the deck by locknuts.

Boys who have only small Outfits should try their skill at building some of the small naval vessels such as picket boats, steam pinnaces, or motor boats, that are described in the Manuals. There is plenty of fun to be obtained from the construction of such models, and a great assortment of parts is not essential to success.

From the hints and brief descriptions given here it should be possible for any boy to do really good work. When an Electric or Clockwork Motor is available considerable interest can be added to a model ship by fitting an "engine" and propeller. The propeller shaft should be driven from a secondary shaft, and by mounting the model on wheels it can be made to move along the ground. Alternatively some simple form of crank arrangement can be fitted to the hull to provide a rocking effect. In this case the hull should be pivotally mounted near its centre, so that it is free to rock both sideways and endways. Rocking mechanism of this type has been used with good effect in special demonstration models for display in shop windows. Added realism was obtained by the use of canvas painted in blue, green and white, and suitably draped around the model to represent waves. Many readers will no doubt have seen these models at work.

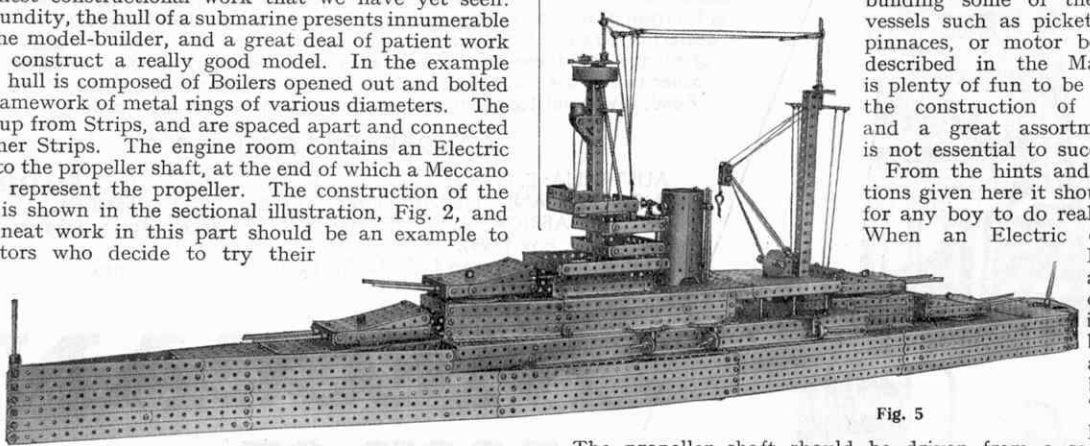
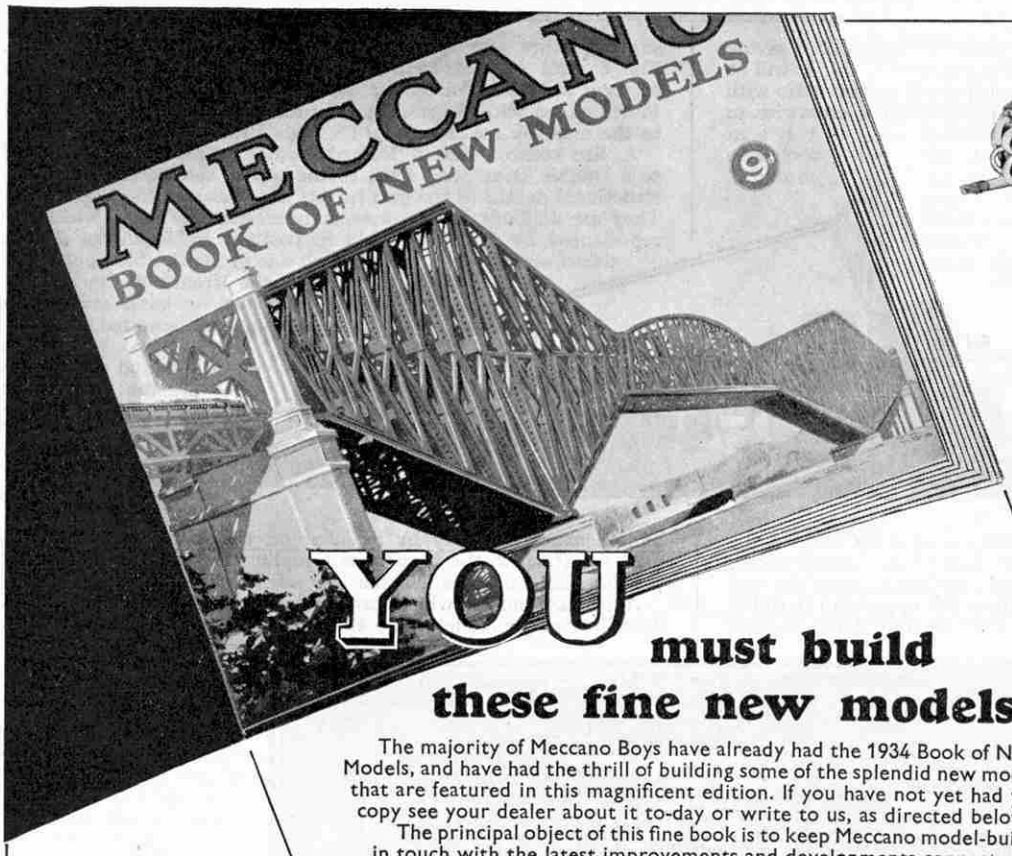
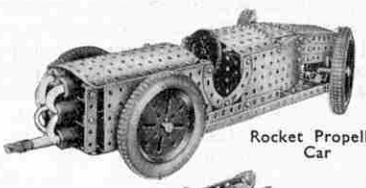
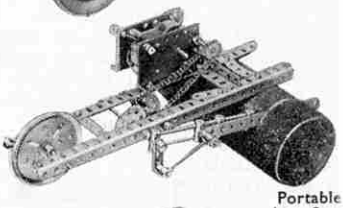


Fig. 5

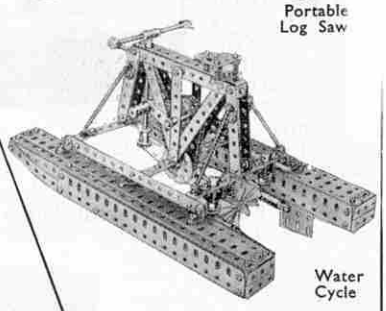




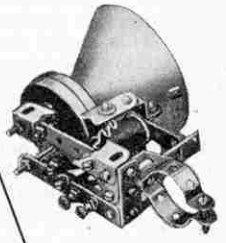
Rocket Propelled Car



Portable Log Saw



Water Cycle



Electric Horn

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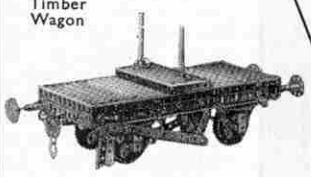
The principal object of this fine book is to keep Meccano model-builders in touch with the latest improvements and developments connected with their hobby. Illustrations and details of the best of the new models and new movements submitted in recent competitions, together with many others that have been designed by our own experts, are included. The models shown are of outstanding interest and variety.



Timber Wagon

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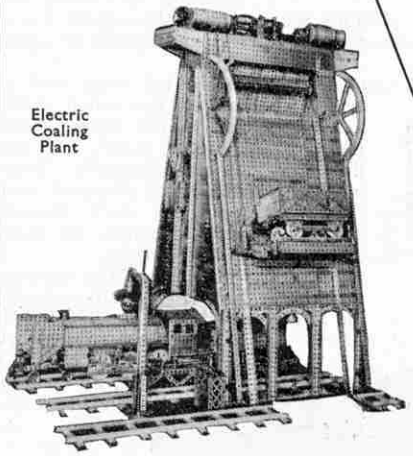

Electric Coaling Plant

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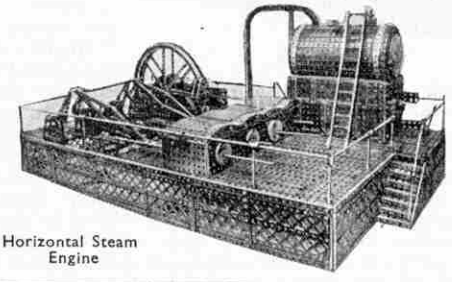
SOUTH AFRICA: Arthur E. Harris, 142, Market Street, Johannesburg (P.O. Box 1199).
CANADA: Meccano Ltd., 34, St. Patrick Street, Toronto.



Horizontal Steam Engine

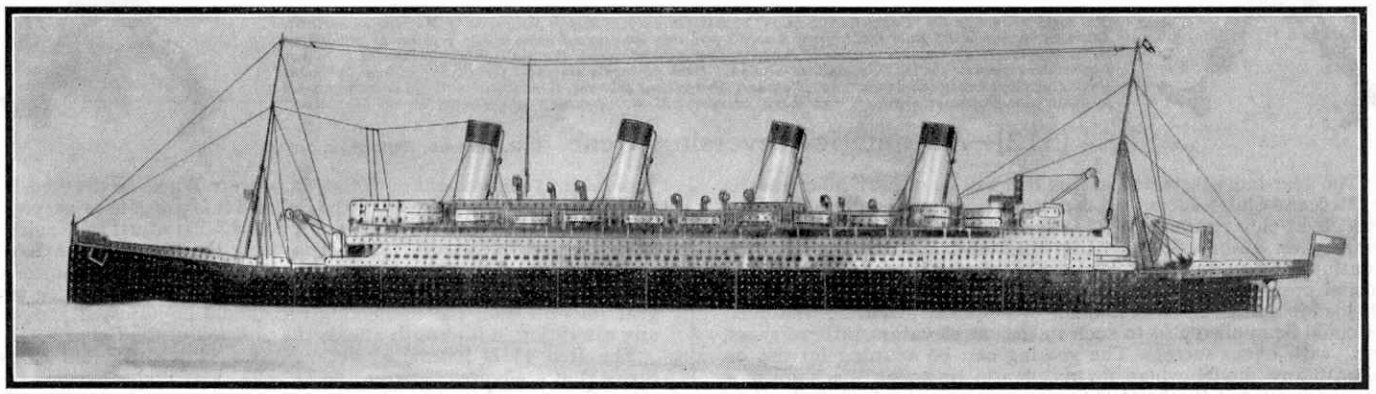
MECCANO BOOK OF NEW MODELS 9D.

MECCANO LTD., BINNS ROAD, LIVERPOOL 13

Model-Building Competition Results

By Frank Hornby

"Winter" Contest (Overseas)



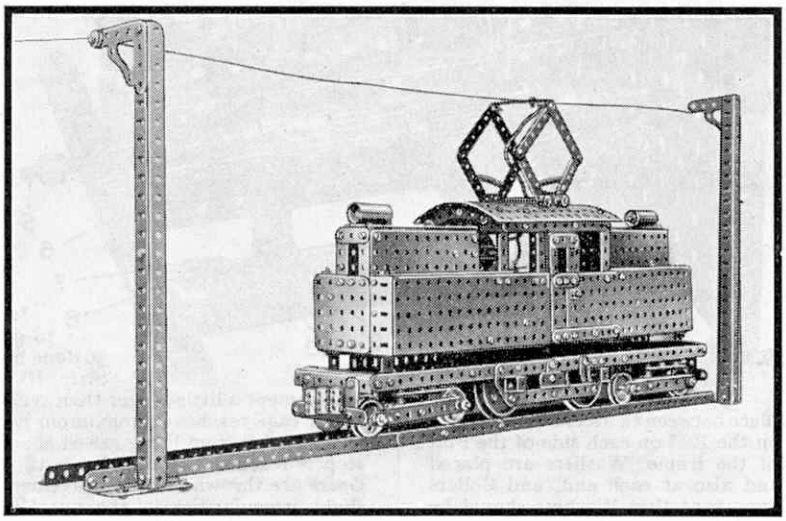
The work submitted in the overseas section of the Winter Contest was, on the whole, good, but many of the models lacked the originality and novelty that is usually the most prominent and pleasing feature of general model-building competitions. The full list of awards is as follows:—

FIRST PRIZE, Meccano or Hornby Goods value £3-3s.: C. Jürgensen, Buenos Aires. SECOND PRIZE, Goods value £2-2s.: U. Rossi, Thiene, Italy. THIRD PRIZE, Goods value £1-1s.: H. Hipkin and N. Stewart, Victoria, B.C. Canada (joint entry).

FIVE PRIZES of Meccano or Hornby Goods value 10/6: A. Wade, Verdun, Canada; A. Ooijen, Nijmegen, Holland; L. Mezzetti, Milano, Italy; I. Rietti, Rheinfelden, Switzerland; A. Schiffman, Bale, Switzerland.

FIVE PRIZES of Meccano or Hornby Goods value 5/-: F. Underdown, Sydney, N.S.W.; A. Wethmar, The Hague, Holland; D. McDowall, Otahuhu, Auckland, S.E.7; E. Osborne, Canterbury, New Zealand; E. de Vidania, Madrid 3, Spain.

"*How to Use Meccano Parts*" Manuals: M. de Wilde, Antwerp, Belgium; R. Latimer, Rangoon, Burma; G. Dodds, Stratford, Canada; T. Sanh, Hong Kong, China; C. Heyden, Hamburg, Germany; S. Alley, Calcutta, India; J. Houlihan, Wellington, New Zealand; L. Holdaway, Blenheim, New Zealand; K. Orams, Blenheim, New Zealand; M. Bartels, Pretoria, S. Africa; G. Cornelius, Durban, S. Africa; B. Hyde, Johannesburg, S. Africa; R. Plewman, Johannesburg, S. Africa; E. Tait, Durban, S. Africa.



A working model of an electric locomotive, by H. Hipkin and N. R. Stewart, Victoria, B.C. The fine ocean liner shown at the top of this page was built by C. Jürgensen, Buenos Aires, and won First Prize in the "Winter" Contest.

A fine model of the White Star liner "*Olympic*" was submitted by C. A. Jürgensen of Buenos Aires, and was awarded First Prize. From the illustration on this page and the following description I think that readers will be able to obtain a fairly good idea of the excellent work that has been done and the skill that has been used in the construction of this model.

There is not much of outstanding interest about the hull, for this is simply a framework of Angle Girders covered with Plates of various sizes, but in the construction of the stern, which has been carefully shaped from Strips and Curved Strips, a striking degree of realism has been obtained. The superstructure is simple but effective, and is carried out chiefly with Strips; while an original use for Windmill Sails has been found in representing the portholes of the cabins, lounges and other public rooms of the ship.

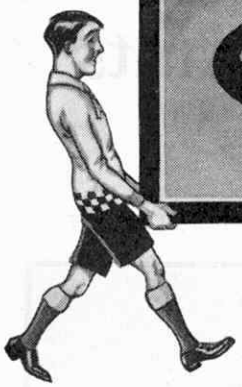
The life-boats, ventilator cowls and other deck equipment are all beautifully constructed and contribute to the fine appearance and interest of the model. The life-boats are each made from two 2½" Strips, and are suspended from davits formed from pieces of strong wire bent into the required shape. Wire has been used to avoid bending the parts, but personally I think a better plan would have been to use Healds, as these are not damaged by bending and, so far as competitions are concerned, a model is much more interesting when made entirely from standard Meccano parts.

The ventilator cowls are made from ¾" Flanged Wheels held by Threaded Rods and Couplings, and other deck and bridge equipment comprises winches and navigating instruments. The funnels, which are always a difficult part to reproduce to scale, are made from thin white cardboard painted in appropriate colours and bent round Meccano Boilers.

Second Prize was awarded to U. Rossi for an ingenious model of a machine for testing the strength of silk thread. Unfortunately it was not possible to illustrate this model. The untested thread is taken from a feed bobbin over a Pulley Wheel, which is drawn upward with each turn of the handle by means of which the machine is driven. After passing over the Pulley the thread is collected on a second bobbin driven by the mechanism of the model. When the Pulley is drawn upward it applies tension to the thread and also unwinds further thread from the feed bobbin. After passing the tension test the thread is wound evenly on to the take-up bobbin by means of a guide arm made from drawn glass and operated by an Eccentric in the driving shaft.

The other prize-winning model illustrated on this page is the joint work of two Canadian boys, H. Hipkin and N. R. Stewart. The model is a good example of scale reproduction and is well built. The chassis is fitted with four fixed driving wheels made from Wheel Flanges with Face Plates bolted to them, and two bogie trucks, which are fully sprung and articulated.

The body of the model is covered with Flat Plates, and houses a Meccano Electric Motor from which the drive is taken to the running wheels through a reduction gear of 18:1. Current for the Motor is taken from an overhead wire by means of a spring pantograph, and the circuit is completed via the rails. A speed regulator for governing the speed of the model, and a switch for controlling the headlights, are situated in the driving cab. Dummy controls to represent those found in the actual locomotive also are fitted.



Suggestions Section "Edited by Spanner"

The ideas printed in the "Suggestions Section" should prove a real help to thousands of Meccano enthusiasts. Often we receive letters from readers who describe how they have solved some knotty problem or evolved an interesting model after studying some of the ideas that have appeared. We shall always be pleased to receive further contributions for the "Suggestions Section." Cash payments are made for all Suggestions published (excluding those mentioned in the "Miscellaneous" Suggestions column). Contributions should be accompanied by clear photographs or drawings and should be addressed to "Spanner," c/o The "Meccano Magazine."

(312)—Automatic Reversing Gear (J. R. Simpson, Nottingham)

The gear-box illustrated in Fig. 312 will be of particular interest to Meccano Club leaders, as it can be applied successfully to working models at club exhibitions. It is specially suitable for models that employ an automatic reversing hoist and are required to work continuously without attention. For instance, by means of it, a model crane may be kept working all day raising and lowering its load in a most efficient manner without any attention whatever. It could be applied also to such models as elevators, pithead gears, etc., with equal success. The gearing can be adapted for use on almost any model where an automatic reversing mechanism is required, even if the hoist is not necessary.

The drive is supplied to the 8″ Axle Rod 1 that carries a Worm and a ½″×¾″ Pinion. The Worm engages a ½″ Pinion on a vertical Rod 2 journalled in 2″ Strips secured in place by means of Angle Brackets. The Rod 2 carries a Worm that meshes with a ½″ Pinion on the Rod carrying the Pinion 3, and another Rod is journalled below this and carries a 57-teeth Gear Wheel 4.

It will be observed that there is a considerable reduction ratio between the Rod 1 and the Gear 4. It is this ratio that governs the time of rotation of the driven shaft in each direction. By increasing the reduction ratio the time of rotation of the driven shaft in forward and reverse directions would be increased accordingly, and by fitting a lower gear reduction the time would be decreased.

The Rod 5 is slidable in its bearings and carries two ½″×½″ Pinions, one of which is in constant mesh with the ½″ Pinion on the Rod 1. A loose Collar 6 on the Rod is retained in place between two fixed Collars. Two Compression Springs are fitted on the Rod on each side of the Flat Plate on the right-hand side of the frame. Washers are placed between the pairs of Springs and also at each end, and Collars retain them in position. It is important that Washers should be fitted between the Springs, otherwise there will be a tendency for the Compression Springs to work one into the other. The purpose of the Springs is to retain the Rod normally in the neutral position with the Pinions out of engagement with their Contrate.

The sliding movement of the Rod is controlled by a lever consisting of a 2″ Strip pivoted at the base of the model and extended by means of a 2″ Slotted Strip. A bolt is passed through the slot in the Strip and fitted with a nut before being screwed into the bore of the Collar 6. The nut is tightened against the Collar to prevent the shank of the bolt gripping the Axle Rod 5. At the lower end of the lever a bolt is inserted in a similar manner into the bore of the Collar 9 that is fixed to a sliding 5″ Rod. The Collar 7 is loose on the Rod, and the 2″ Slotted Strip 10 is pivotally attached to it. This Strip is firmly secured to a 3½″ Strip that is pivoted to the Gear 4. As the Gear rotates the Collar 7 slides between the Collars 8 and 9, and as soon as it strikes either of these Collars it causes the lever to slide the Rod 5 in a corresponding direction. Owing to the arrangement of the lever the Rod 5 slides much quicker than the Collars 8 or 9 and throws one of the ½″ Pinions into engagement with the ¾″ Contrate Wheel on the Rod 11.

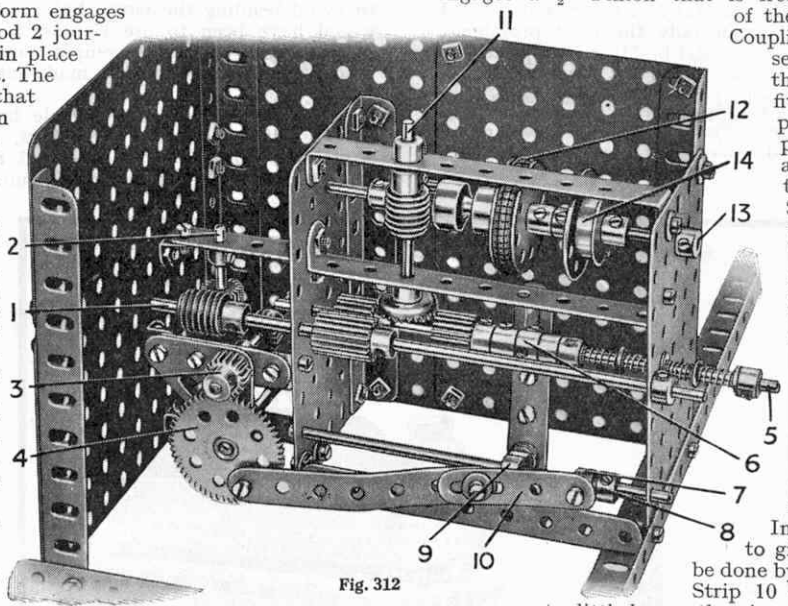


Fig. 312

By adjusting the position of the Collar 8 it is possible to vary the amount of right-hand movement of the Rod 5. To adjust the amount of movement to the left, the bolt securing the Slotted Strip 10 to the connecting link should be slackened off to allow the length of the link to be increased or decreased as required. When setting the gear for operation the connecting rod should be adjusted first, as any alteration in its length affects the position of the Collar 8.

The Rod 11 is journalled between two 4½″×½″ Double Angle Strips that are bolted between the 4½″×2½″ Flat Plates forming the sides of the gear box. The Rod carries a Contrate and a Worm that engages a ½″ Pinion that is free on the Rod 13. The boss of the Pinion is fitted with a Socket Coupling carrying a Bush Wheel. A second Bush Wheel is secured on the Rod, and a 1″ loose Pulley fitted with Dunlop Tyre 12 is placed between the two. A Compression Spring bearing against a Collar on the left-hand side of the Pinion tends to slide the Socket Coupling unit over to the right, so that the free Bush Wheel is kept tightly pressed against the Tyre 12 which, in turn, engages the fixed Bush Wheel. The purpose of this arrangement is to provide a friction drive between the Rods 11 and 13, so that when the latter becomes overloaded, the clutch slips, and no drive is transmitted. The winding drum 14 is made up from a ¾″ Flanged Wheel and Bush Wheel.

In operation the gear should be set to give a slight overwind. This can be done by adjusting the Collar 8 and the Strip 10 so that the Gears remain in engagement a little longer than is actually required. When the load or lift cage reaches its maximum height a stop should be arranged to prevent it from being raised above the limit, and as soon as this stop is reached the slip clutch 12 comes into operation until the Gears are thrown out of engagement. This arrangement allows for slight irregularities in the operation of the reversing gear and ensures that the load is raised to a definite height each time.

The effect of operating without the slip clutch can be quite easily imagined. Supposing for instance that the Pinion for hoisting were to remain in mesh with the Contrate for a very short period longer than the lowering Pinion. The load would be raised a little higher than normal and later would not be lowered to its full extent. On the next operation it would be raised a little higher again and lowered to a level above the previous one. Eventually when the load could go no higher the hoisting cord would be broken or some part of the mechanism would slip.

A good plan is to use a hoisting cord of the exact length required to lower the load to the requisite depth, and arrange the Pinions so that the load is unwound from its drum, which continues rotating and thus winding in the cord again. On reaching the top, the load strikes the stop, and the slip clutch operates until the Pinion disengages with the Contrate. When the second Pinion engages, the direction of rotation of the drum is reversed and the load is lowered and raised again. Various applications for this mechanism will suggest themselves to the enthusiast.

(313)—A Novel Speed Indicator (G. Mitchell, Poynton, Nr. Stockport)

Speed indicators of various types have previously been dealt with in this section, but in each case they have depended upon some form of mechanical movement to show the speed of rotation. The usual type of speed indicator is dependent for its operation on centrifugal force acting on weights that fly outward and are linked up mechanically to a pointer to indicate the speed of rotation. The indicator illustrated in Fig. 313 does not depend upon any mechanical parts for its operation.

The essential feature is a test tube 4 (from a Kemex Outfit) that is filled with oil. The test tube is made to rotate about its axis, and centrifugal force causes the oil to rise up the sides, forming a deep conical meniscus. As the speed increases the cone becomes more pronounced, and as the oil rises up the sides of the tube the centre of the meniscus naturally drops. The level of the bottom of the cone, when read off against a scale, indicates the speed of rotation.

A framework is built up from Plates and Angle Girders, and to show the arrangement of the indicator one of the sides has been removed in the illustration. When this is bolted in position a slot $\frac{1}{2}''$ in width occurs between the two pairs of Flat Girders. A cage for the test tube is formed from four Rods held in Threaded Couplings that are attached to Bush Wheels, and the bottom of the test tube is supported in a Sleeve Piece fitted round a Chimney Adaptor. Before the test tube is fitted in place it should be partially filled with oil—Meccano Oil is quite suitable for this purpose—and a cork inserted as a precautionary measure to prevent the oil from escaping. The upper and lower Bush Wheels carry Axle Rods that are supported in bearings in the frame.

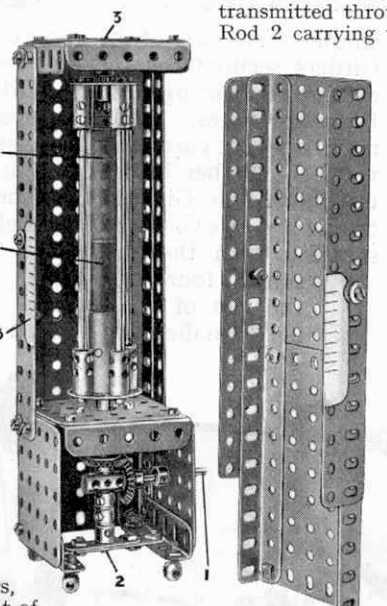


Fig. 313

The Rod 1 takes up the drive that is transmitted through Bevel Gears to the Rod 2 carrying the lower Bush Wheel; the upper Rod 3 is free to rotate in its bearings. The oil can be seen at 5 in the illustration, and when the model is completed a scale 6 should be glued to the Flat Girders as shown. When the test tube is stationary the level of the oil should be indicated on the scale, and the other graduations should be marked in by rotating the test tube at known speeds.

To count the revolutions of a fast rotating Rod it should be geared through a reduction ratio to a Rod that revolves sufficiently slowly to count the number of revolutions made per minute. The figure thus obtained should be multiplied by the gear ratio to find the r.p.m. of the first rod.

This method may be applied to the indicator for calibrating the scale. The device should be driven from an Electric Motor that is provided with a Resistance Controller for regulating the speed, or with a centrifugal governor.

(314)—Swashplate Movement (A. M. Tucker, Topsham)

This interesting movement converts rotary motion into direct to and fro motion, the results being obtained in a somewhat similar manner to those produced by the swashplate mechanism. The most usual mechanism for producing reciprocating motion is the crank and pivoted connecting rod, but a study of the illustration in Fig. 314 will show that in this case the device is quite different. A connecting rod operating from a crank gives a side to side movement besides producing a to and fro thrust; the device illustrated gives a to and fro motion only.

The driving shaft 1 is journalled in two $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips connected together by a Flat Bracket, and spaced from the Plate by one Washer beneath each. The Rod carries a Coupling that is mounted in its centre transverse hole, and the shaft 2 is provided with another Coupling mounted in a similar manner. Bearings for the driven Rod 2 are formed from a $3\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate and a $3\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip, the latter being spaced from the base plate by a Washer.

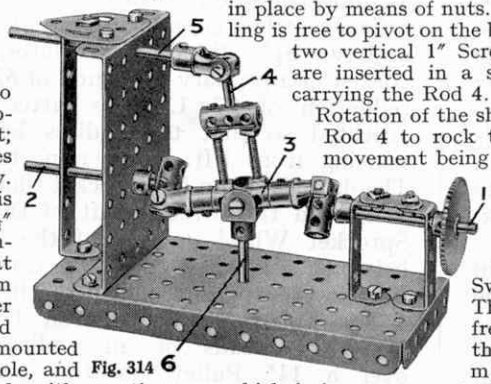


Fig. 314

Small Fork Pieces are attached to the Couplings and connected by a 2″ Axle Rod carrying the Coupling 3. The Rod is free to turn in this Coupling, which is prevented from rotating by a large Fork Piece and Rod 6. The bolts passing through the Fork Piece are inserted in the centre tapped holes of the Coupling and locked in place by means of nuts. Thus the Coupling is free to pivot on the bolts, and carries two vertical 1″ Screwed Rods that are inserted in a second Coupling carrying the Rod 4.

Rotation of the shaft 1 causes the Rod 4 to rock to and fro, side movement being entirely absent. The final sliding Rod 5 is connected to the 1″ Rod 4 by means of a Swivel Bearing. The "spider" is free to slide on the Rod 4, the movement of which is in an arc centering at the large Fork Piece.

To obtain smoothness of operation working parts should move freely, but excessive play should be avoided as this will cause jerkiness. The Coupling 3 should not be allowed any sliding movement.

(315)—Spark Arrester for Clock Contacts

(S. Williams, Leamington)

The make and break contacts used on electric clocks and other mechanisms where an interrupter is required have a tendency to spark excessively if a heavy current is passed through. To prevent sparking and prolong the life of the contacts the ingenious arrangement shown in Fig. 315 has been evolved.

The sliding Rod 1 carries an End Bearing fitted with a Pendulum Connection 2, which is bent as shown and carries a Silver Tipped Contact Screw 3. A second Contact Screw 4 is passed through a hole in a $1'' \times 1''$ Angle Bracket, fitted with an Insulating Bush and Chimney Adaptor, before being provided with an Insulating Washer and Nut to retain the whole in place.

The Chimney Adaptor is filled with oil until the top of the Contact Screw is covered. As the Screw 3 slides over the lower Screw 4, the oil is rubbed off the points and contact is made. As soon as the points break away the oil flows over again, thus forming an insulator.

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.

(M173)—An Unusual Speed Indicator.—An original method of finding the speed of a rotating shaft is suggested by H. H. Rugg (Sherbrooke, Quebec). Mr. Rugg makes use of the knowledge that vibrations of a given frequency produce certain notes, and to find the speed of a shaft he fits to it a 3″ wheel (No. 19a), which has 10 spokes. As this rotates, a reed formed from a piece of stiff card is applied to the spokes of the Wheel, which cause it to vibrate and produce a musical note. The actual note obtained is ascertained by striking the keys of a piano until the corresponding note is found. By this means the frequency of the vibrations can be found out, as each note has a known frequency, which is then divided by the number of spokes of the Wheel to find the number of revolutions per second.

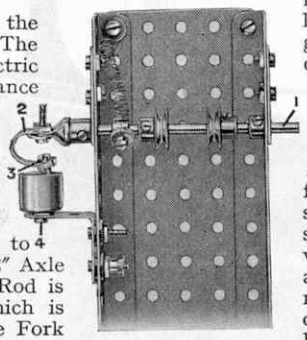


Fig. 315

The usual frequency of middle C on the pianoforte is approximately 256 vibrations per second, and from this figure the frequency of any note on the piano can be found. The approximate comparative frequencies of the notes of the octave are 1, 9/8, 5/4, 4/3, 3/2, 5/3, 15/8 and 2, for the note one octave higher.

This scheme is decidely novel, but the chief objections seem to be the difficulty of identifying the note produced by the reed, and also the limitations of its application to places where a piano is immediately available, and in perfect tune.

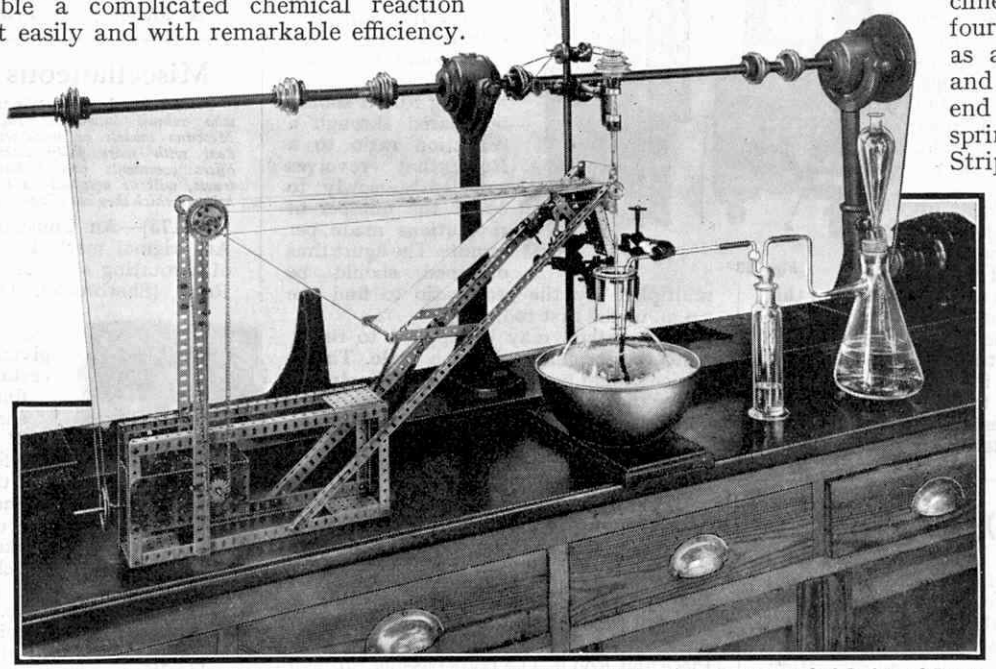
The sound produced by the reed is governed to a certain extent by the material used, and it is advisable to try different substances such as cards of various thicknesses, celluloid, tin, etc., to find which produces a sound most like a pianoforte note.

Meccano Aids Chemical Research

An Interesting Laboratory Mechanism

DURING recent years Meccano has been used more and more frequently by workers in almost every branch of science. On account of its simplicity and its extraordinary adaptability, it forms unique constructional material from which can be rapidly built almost any device called for by the needs of the moment. We have described and illustrated in the "*M.M.*" from time to time many scientific applications of Meccano. The latest instance of this kind to come to our notice occurred recently at the Chemical Research Laboratories of the Pharmaceutical Society of Great Britain, where Meccano was employed in an ingenious manner to enable a complicated chemical reaction to be carried out easily and with remarkable efficiency.

The reaction concerned in this interesting application of Meccano was of a type, familiar to chemists, in which a complex organic substance in the form of a finely-powdered solid is added to a liquid, in this case nitric acid. The powder cannot usually be poured directly into the liquid without producing a rise in temperature that causes waste of material and the production of impurities. In order to avoid these drawbacks a trial was made of an apparatus built of Meccano parts and consisting of a rigid framework supporting an endless moving belt, designed to carry the powdered solid towards the flask in which the reaction is carried out. From the belt the chemical falls continuously and in minute quantities on to a chute that directs it into the flask, where it is stirred mechanically into the mixture.



An ingenious Meccano mechanism in use at the Chemical Research Laboratories of the Pharmaceutical Society of Great Britain. Photograph by courtesy of the Editor of "The Pharmaceutical Journal."

The device works perfectly, no perceptible rise in temperature being caused by the gradual addition of the solid. Larger yields and purer products therefore can be obtained with its aid than when the work is carried out by hand, for then each addition gives rise to local heating. The action also is automatic and those concerned are relieved of the tedious tasks of repeatedly adding small quantities of the solid reagent and of keeping careful watch on the temperature of the mixture.

The construction of this interesting apparatus is very simple. The base of the frame consists of four 12½" Angle Girders secured together in the form of an oblong by means of four 5½" Angle Girders and three 3½" × 2½" Flanged Plates. This base supports the two main members that carry the bearings of the endless belt, the vertical member being constructed from two 12½" and two 5½" Angle Girders, and the inclined member from two 24½" Angle Girders. The belt is a strip of mackintosh sheeting with the ends sewn together. It is passed round four 4½" Rods, two of which are at the top of the vertical member and the third is journalled in Architraves bolted to the inclined member. The fourth Rod functions as a belt tightener, and is carried in the end holes of two spring-loaded 5½" Strips pivoted by locknutted Bolts to the centre of the inclined member.

The chute consists of a Sector Plate lined with rubber. To prevent wastage of the powdered material fed into the flask, a 3½" × 2½" Flanged Plate, also lined with rubber, is fitted as shown in the illustration.

The gear-box is built up from two 5½" × 2½" Flat Plates and two 3½" × 2½" Flanged Plates, and the gear trains consist of a primary reduction of 57 : 1 and a secondary reduction of 27 : 1. This latter gear train may be adjusted so that the endless belt travels at speeds varying from 1 ft. in 20 min. to 1 ft. in two hours. The drive is taken by Sprocket Chain from a ¾" Sprocket Wheel on the driven shaft of the gear-box, to a 1½" Sprocket Wheel on one of the Rods supporting the belt. A secondary drive, by cord, is taken from this Rod to the opposite end of the belt.

The apparatus was driven from an "overhead" shaft by means of an endless cord that passed over a 1½" Pulley on the primary shaft of the gear-box. This shaft also operates the stirrer in the reaction flask.

Much of the information contained in this article is due to the courtesy of the Editor of "*The Pharmaceutical Journal.*"

J.L.L.

Meccano Model-Building Competition

Fine Prizes for New Models

With the approach of autumn and the dark evenings, the majority of Meccano boys recommence model-building with increased enthusiasm. For most of them the summer holidays are over, and they have all kinds of new ideas for Meccano models that they are eager to try out at the first opportunity. In order to encourage boys to exercise their imaginations, and to give an added incentive to their work, we are organising this month the first of the big model-building competitions of the season. In this contest a fine range of prizes is offered for the best models received.

Every competitor has an equal chance, no matter what Outfit he may possess. It is only necessary to think of a new model, and then construct it as neatly as possible. Boys—and girls also—of all ages are eligible, and a competitor may submit more than one model for consideration, provided they are all sent at the same time. No special entry forms are needed, and there are no fees to be paid.

Competitors may use any number of parts in building the models they wish to enter, but it is a mistake to think that the more intricate a model the better its chance of winning a prize. Very often indeed the reverse is the case, and a simple model that is well proportioned and displays sound constructional features secures a prize in preference to a complicated model in the construction of which little regard has been given either to proportion or correct principles.

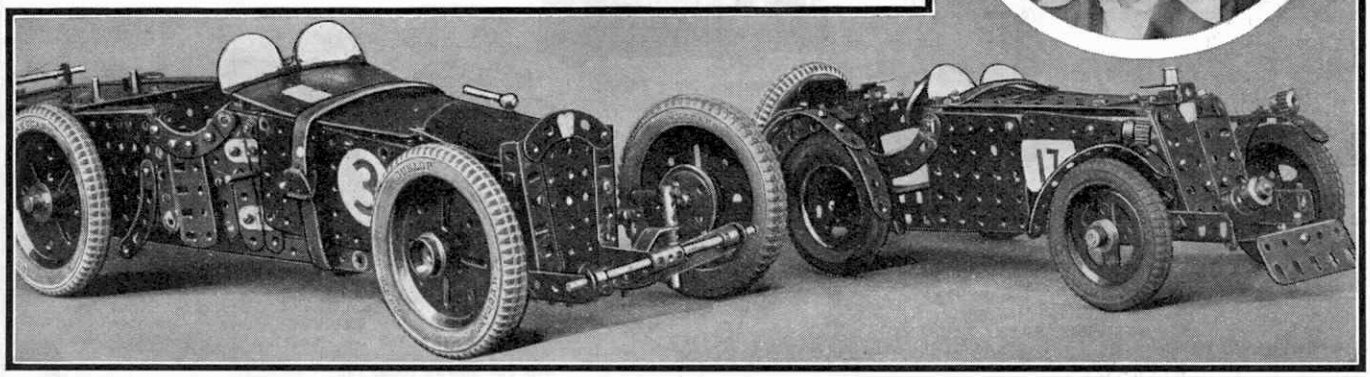
In making the awards the judges will pay special attention to models showing initiative and enterprise, and which are not simply variations of models described in the Meccano Manuals of Instructions.

There are thousands of interesting subjects to choose from, but those competitors who cannot think of a really original model might try to incorporate in their entries new uses for Meccano parts, or concentrate in detail work so that the finished model is as realistic as possible.

Entries will be divided into three Sections as follows:—Section A for readers living in the British Isles and over 14 years of age. Section B for readers living in the British Isles and under 14. Section C for readers of all ages living Overseas.

The prizes in each Section are:—First, Meccano or Hornby Goods value £3-3-0. Second, Goods value £2-2-0. Third, Goods value £1-1-0. Five prizes of goods value 10/6. Five prizes of goods value 5/–. Certificates of Merit will also be awarded in each Section.

The actual model must not be sent; a good photograph or a clear drawing is all that is required. Competitors must take special care to see that their age, name and address appear on the back of each photograph or sheet of paper used, together with the letter A, B, or C, indicating the Section in which they are entering, and the name of the Competition, *i.e.* "September" Model-building Contest. Photographs or drawings need not be the competitor's own work, but it is absolutely necessary that the model itself is constructed without aid from anyone.



Two interesting model motor cars that won a prize in a recent model-building competition. They were built by Willy Todd, Belfast, whose portrait is inset.

Models that include any special mechanical or structural features that are not shown plainly in the photographs or drawings submitted, should be accompanied by a short description that will make everything clear.

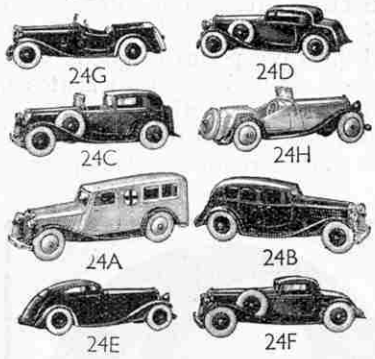
Envelopes containing entries should be addressed to "September Model-building Contest," Meccano Ltd., Binns Road, Liverpool 13.

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

Competitors living in Great Britain and Ireland must forward their entries not later than 31st October, 1934. In order to give Overseas entrants plenty of time in which to build their models we have extended the closing date for Section C to 31st January, 1935.

MECCANO
DINKY TOYS

Meccano Dinky Toys are rapidly establishing themselves as firm favourites with boys and girls. They are in big demand because they are the most realistic and the most attractive models in miniature ever produced. New items are constantly being added to the series to increase the fun and fascination. One of the latest of these is No. 50, comprising a fine selection of Ships of the British Navy. Then there are Aeroplanes, Train Sets, Motor Cars, Motor Vans, Railwaymen, a fine Racing Car and many others. These splendid toys may be purchased either separately or in complete sets, at the prices shown. Ask your dealer to show you the full range.

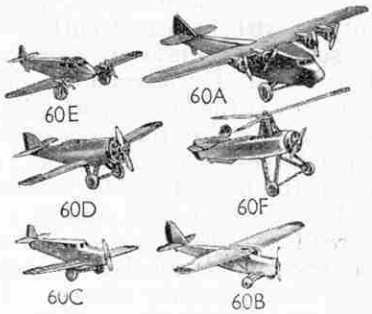


Meccano Dinky Toys No. 24
MOTOR CARS

Fitted with rubber tyres and silver plated radiators.

No. 24a	Ambulance	each 9d.
No. 24b	Limousine	,, 9d.
No. 24c	Town Sedan	,, 1/-
No. 24d	Vogue Saloon	,, 9d.
No. 24e	Super Streamline Saloon	,, 9d.
No. 24f	Sportsman's Coupé	,, 9d.
No. 24g	Sports Tourer (4 seater)	,, 1/-
No. 24h	Sports Tourer (2 seater)	,, 1/-

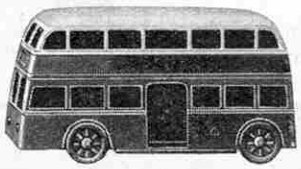
Price of complete set 6/6



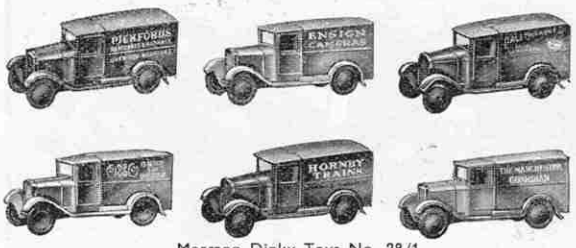
Meccano Dinky Toys No. 60
AEROPLANES

No. 60a	Armstrong Whitworth "Atalanta"	each 9d.
No. 60b	D.H. "Leopard Moth"	,, 6d.
No. 60c	Percival "Gull"	,, 6d.
No. 60d	Low Wing Monoplane	,, 6d.
No. 60e	General "Monospar"	,, 6d.
No. 60f	Cierva "Autogiro"	,, 6d.

Price of complete set 3/-



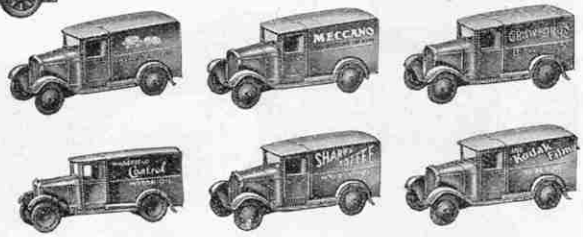
Meccano Dinky Toys
No. 29
MOTOR BUS
Assorted Colours
Price 6d. each



Meccano Dinky Toys No. 28/1
DELIVERY VANS

No. 28a	Hornby Train Van	each 6d.
No. 28b	Pickford's Removals Van	,, 6d.
No. 28c	Manchester Guardian Van	,, 6d.
No. 28d	Oxo Van	,, 6d.
No. 28e	Firestone Tyres Van	,, 6d.
No. 28f	Palethorpe's Sausage Van	,, 6d.

Price of complete set 3/-

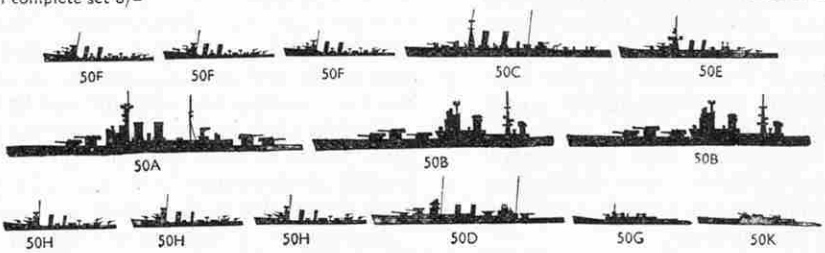


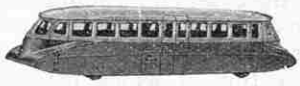
Meccano Dinky Toys No. 28/2
DELIVERY VANS

No. 22d	Meccano Van	each 6d.
No. 28g	Kodak Cameras' Van	,, 6d.
No. 28h	Sharp's Toffee Van	,, 6d.
No. 28k	Marsh and Baxter's Sausage Van	,, 6d.
No. 28l	Crawford's Biscuit Van	,, 6d.
No. 28m	Wakefield's Oil Van	,, 6d.

Price of complete set 3/-

Meccano Dinky Toys
No. 27
TRAM CAR
Assorted Colours
Price 6d. each





Meccano Dinky Toys
No. 26
RAIL AUTOCAR
Assorted Colours
Price 6d. each

Meccano Dinky Toys No. 18
GOODS TRAIN SET

No. 21a	Tank Locomotive	each 9d.
No. 21b	Wagons	,, 4d.

Price of complete set 1/9

Meccano Dinky Toys No. 50
SHIPS OF THE BRITISH NAVY

No. 50a	Battle Cruiser "Hood"	each 9d.
No. 50b	Battleship "Nelson"	,, 6d.
No. 50c	Cruiser "Effingham"	,, 4d.
No. 50d	Cruiser "York"	,, 4d.
No. 50e	Cruiser "Delhi"	,, 4d.
No. 50f	Destroyer, "Broke" class	,, 1d.
No. 50g	Submarine, "X" class	,, 1d.
No. 50h	Destroyer, "Amazon" class	,, 1d.
No. 50k	Submarine, "K" class	,, 1d.

Price of complete set 3/6

Meccano Dinky Toys No. 20
PASSENGER TRAIN SET

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

Price of complete set 2/6

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The Guild's Fifteenth Birthday

This month the Meccano Guild celebrates its 15th birthday. The first announcement of its formation appeared in the 10th number of the "*M.M.*", which was that for September-October, 1919, and it is very gratifying to look back over the 15 years of its existence and to realise how wonderfully it has helped tens of thousands of Meccano boys in all parts of the world.

From its very commencement there was little doubt of the Guild's success. Before it came into existence there had been repeated requests from Meccano boys in all parts of the world for the development of a central organisation to help them to make the most of their hobby, and clubs had been formed in various quarters for the pursuit of model-building and similar activities. This experience failed to indicate the amazing extent of the popularity that the Guild was to attain, however. Thousands of entry forms poured in upon Headquarters immediately after the first announcement, and even when the initial rush was over the pace of recruiting showed little slackening. Since then members have flowed in steadily, every year, bringing new recruits and increasing the enthusiasm of those already associated with the movement, with the result that to-day the actual enrolment is almost 100,000 and the triangular badge has become familiar everywhere.

As soon as the formation of the Guild placed individual Meccano enthusiasts in direct touch with Headquarters, groups of members began to meet together in various localities and entered into friendly rivalry in engineering in miniature. The growth of these organisations has been no less remarkable than that of the Guild itself. Many of them, especially those formed in populous districts or in schools, have developed into large clubs with extensive resources in which widely varied activities are keenly followed by members. Others continue as smaller friendly associations of boys with common interests, who derive as much pleasure from association with their Meccano club as the members of the larger organisations do from more ambitious programmes. All are remarkable for the enthusiasm of their members, and their number and influence are steadily increasing.

Meccano Club Leaders
No. 76. Mr. M. C. Hodder

Mr. M. C. Hodder is Leader of the Exeter M.C., which was affiliated in 1925. He encourages members to undertake the management of the club's affairs, and the value of his wise Leadership is shown by the enthusiasm displayed in all sections of the club and by the high standard of work in ambitious model-building schemes that are prominent in the attractive and varied programme followed by the club.

Value of Membership

The common bond of members of the Guild, whether they are connected with clubs or not, is of course model-building, but that is not all, for the organisation was formed to encourage boys to be clean in thought and habit, and to be determined to learn and make progress. In their efforts to this end, the officials of the Guild have been loyally supported and helped by the Leaders of Meccano clubs, and by older members who have persuaded their friends to join them, with the result that the thousands of Meccano boys and young men have learned to develop their own initiative and resource. Evidence of this continually reaches me from many quarters. Only the other day a keen and experienced Leader wrote to remind me that his club had completed its seventh year, and that already five of his earlier members had distinguished themselves by gaining University degrees, while another had secured his medical diploma, and many were occupying responsible positions in other spheres of life. This record is indeed a proud one, and with many similar instances of successes already achieved by Guild members supplies ample proof of the value of the encouragement and support the Guild provides for its members.

A Birthday Celebration

As yet the Meccano Guild is a youthful organisation. It has already achieved wonderful results, but I am convinced that greater triumphs are in store for it as those who have joined it during its 15 years of existence exert their influence on the generations following them. Its success depends on its members, and if all those who have profited by their association with it will do their best to make its advantages known to their friends, and to enrol them as recruits, it will become an even more powerful organisation for good. I should like every member to mark its 15th birthday by beginning a recruiting campaign, either alone or in association with friends who have already joined it, in order to make 1934–5 the most successful year the Guild has ever experienced. It would be a fitting birthday celebration if every member were to secure at least one recruit during the next few weeks.

Guild and Club Awards

I hope Leaders will bear in mind the importance of encouraging members in recruiting activities and also in general good work on behalf of their clubs. The Recruiting and Merit Medallions have been introduced especially for this purpose. The Recruiting Medallion is intended for Guild members generally, including those who belong to clubs, and is awarded to any member who secures three recruits for the Guild within a period of three months. If during the next three months he is successful in recruiting three more new members, making six in all, he is entitled to have his medallion engraved with his name and the words "*Special Award.*"

The Merit Medallion is awarded by the President for good work on behalf of the Guild and of Meccano clubs. This is chiefly a club award, and Leaders are asked to nominate the recipients, two Merit Medallions being allowed in each club every session. I shall be glad to receive nominations for the summer sessions as soon as possible, and I hope that the award will be kept in mind during the coming winter. Early in the New Year I publish a list of Merit Medallions awarded during the previous twelve months, and I shall look forward on the next occasion to the appearance in this list of the names of many clubs that have not been represented recently.

Proposed Clubs

Attempts are being made to establish Meccano Clubs in the following places, and boys interested in becoming members should communicate with the promoters whose names and addresses are given below:—

RUGBY—N. E. Wheatley, Shawell, Nr. Rugby.

NEW ZEALAND—P. Parr, c/o Govt. Tourist Dept., Queen Street, Auckland.

MECCANO ELEKTRON ELECTRICAL OUTFITS

No. 1 Elektron Outfit Price 8/6

In these days of radio, X-rays, and electric trams and trains, every boy should have a knowledge of electricity. The only way to gain this knowledge is by means of experiments, and the Meccano Elektron Outfits have been produced for this purpose.

These Outfits contain all the materials for carrying out a splendid series of fascinating experiments, commencing with Magnetism and passing on through Frictional Electricity to Current Electricity. In addition many interesting mechanisms can be constructed, including a Reading Lamp, an Electric Bell, a Telegraph, a Shocking Coil that gives real shocks, and Electric Motors.

No. 2 Elektron Outfit Price 25/-

Electricity is the most wonderful force of the age in which we live.

Learn some of its marvels by means of experiments with a Meccano Elektron Outfit.

No. 1 MECCANO ELEKTRON OUTFIT

Magnetism and Static Electricity

The No. 1 Outfit contains two powerful Bar Magnets and a reliable Magnetic Compass, together with everything necessary for the carrying out of a series of fascinating magnetic experiments. In addition there are materials for experiments in frictional or static electricity, and for the construction of an Electric Compass and two forms of Electroscope.
Price **8/6**

No. 2 MECCANO ELEKTRON OUTFIT

Magnetism, Static and Current Electricity

The No. 2 Elektron Outfit contains all that is included in the No. 1 Elektron Outfit, with additional parts that enable a splendid series of experiments in current electricity to be performed. Among these parts are a Horseshoe Magnet, and Coils and Yokes for the construction of Electro-Magnets that can be used in building a real Electric Bell, and a Buzzer for use in an electric telegraph system. A specially-wound coil and other necessary parts are supplied for assembling into a splendid Shocking Coil that will give hours of fun and excitement. Price **25/-**

No. 1A MECCANO ELEKTRON ACCESSORY OUTFIT

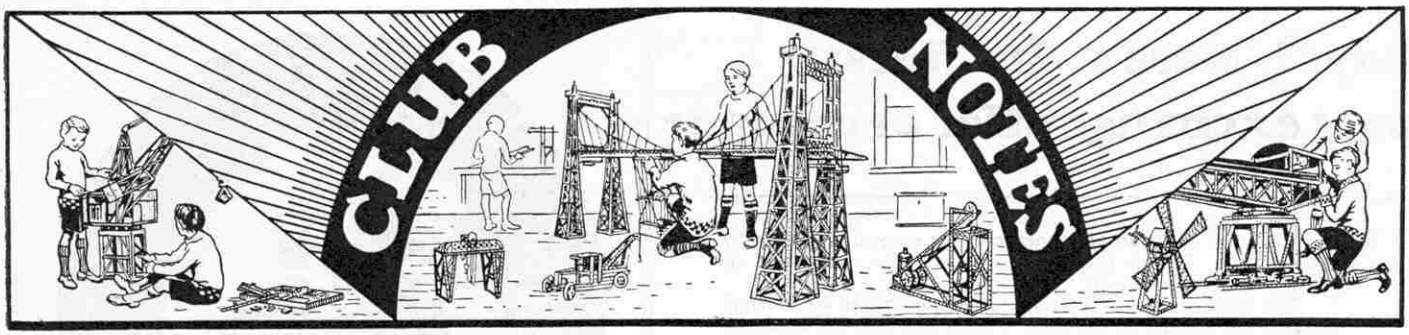
An Accessory Outfit that converts a No. 1 Elektron Outfit into a No. 2 is also available. Price **16/6**

The apparatus and chemicals included in the Meccano Elektron Outfits can be obtained separately. Ask your dealer for the Elektron Folder giving a list of Elektron parts, or write for a copy to the address below.

MECCANO LTD., BINNS ROAD, LIVERPOOL 13

An Elektron Outfit will open up to you a fascinating hobby of endless variety.

Visit your dealer to-day and ask him to show you one of these wonderful Outfits.



Abingdon (Northampton) M.C.—A crowded programme of Model-building Evenings, Games Nights and Socials has been followed with great success under the guidance of Mr. J. Williamson, who has kindly taken over Leadership of the club. A Mystery Play also has been presented by members. A full programme of summer activities was introduced by means of a Picnic and is providing much enjoyment for members. Club roll: 22. *Secretary:* S. Cocking, 4, King Edward Road, Northampton.

New Bradwell M.C.—Two meetings are held weekly and are devoted to Model-building and to Billiards, Table Tennis, Badminton and other games. Interest is being taken in the club's work by the Secretary for Education of the county. A week's camp at Clacton-on-Sea is being planned. Club roll: 50. *Secretary:* R. Bellchambers, 29, King Edward Street, New Bradwell, Bletchley.

John Gulson Senior Boys' School.—A garage has been secured and is being used for special constructional work. The club's magazine has now appeared and a Musical Evening has been held in addition to Cinematograph Displays. A large Hornby Train layout, complete with countryside scenery, has been acquired. A full summer programme is now being followed, including a series of inter-club Cricket Matches. Club roll: 18. *Secretary:* H. Ludgate, 46, Fynford Road, Radord, Coventry.

Holy Trinity (Barnsbury) M.C.—The sessions recently concluded were marked by a large increase in the club roll and the keenness of members has been stimulated by a splendidly varied programme. An outstanding event was the Concert and Prize Giving, undoubtedly the best so far held. The Chair was taken by Rev. T. Darlington, a Patron of the club, and prizes and Merit Medallions were presented by Mrs. Darlington. More than 40 visitors were present on a successful Parents' Night, when all sections of the club were seen at work. Model-building skill is steadily improving, and among the new hobbies introduced is bookbinding. A Service Section has been formed for members of 15 years of age or more, who help as required in club work. Members are now busy making preparations for the club's 15th Annual Exhibition on 18th, 19th and 20th October. Club roll: 72. *Secretary:* J. A. W. Hines, 331, Liverpool Road, Islington, London, N.1.

Bridport Grammar School M.C.—Weekly meetings have been resumed after a short break, much to the satisfaction of members. Good use was made of the club's Library while meetings were not being held. Model-building meetings and Competitions are now being arranged, and the splendid programme has attracted many new members. Club roll: 29. *Secretary:* H. Dommett, West Allington, Bridport, Dorset.

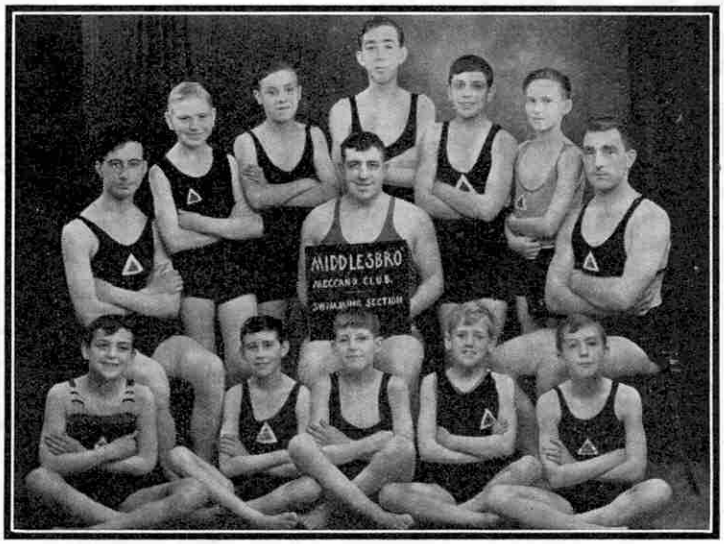
Exeter M.C.—The high standard of model-building skill is being maintained, and at all meetings the club room resembles a busy workshop. Models are always built to orders and specifications and they are dismantled in an equally business-like manner. A model-building record was created in the sessions recently brought to an end, a larger number of well-constructed working models having been built than in any previous year. Club roll: 34. *Secretary:* D. Legg, 25, Chute Street, Exeter.

Gate House (Ingatestone) M.C.—Members were keenly interested in preparations for their Exhibition, at which many attractive working models were on view. A display that merited special attention was arranged by the Fretwork Section, the members of which built a large stage on which marionette performances were given. Club roll: 16. *Secretary:* F. Melville, Gate House School, Ingatestone, Essex.

Swansea Grammar School M.C.—Most of the summer meetings were devoted to Cricket Matches. In addition an interesting visit was paid to the large Power Station under construction near Swansea in connection with the Grid Scheme. The club room is being decorated and provided with better facilities for model-building, the cost being deferred out of the proceeds of the club's Exhibition in April. Club roll: 12. *Secretary:* H. Davies, 21, Kildare Street, Manselton, Swansea.

Bexley Heath Boys' Central School M.C.—The most interesting of recent meetings have taken the form of lectures. A film illustrating the Persian Oil Industry, kindly loaned by the Anglo-Persian Oil Co., was a special attraction. "*The Gear Wheel*," the club's magazine, has been increased in size. Club roll: 30. *Secretary:* D. Choppen, 29, Marlborough Road, Bexley Heath, Kent.

Worcester Y.M.C.A. M.C.—Meccano Nights have been held regularly on Saturdays, other evenings being devoted to games. Cinematograph films have been shown by one of the members, and Lantern Lectures and various Contests have increased the interest of the meetings. Visits arranged for the summer months have included trips to Electricity Works, Power Stations and Flour Mills, and a good programme of Cricket, Cycling and other summer pursuits also has been arranged. Club roll: 17. *Secretary:* R. G. Price, 60, Bath Road, Worcester.



A happy group of members of the Swimming Section of the Middlesbrough M.C. The programmes arranged by the enterprising officials of this club are remarkable for their variety and originality. The Swimming Section has now completed three very successful seasons, during which many members of the club have learned to swim.

Colfe's Grammar School M.C.—Lectures on "*Novel Railways*," "*Fighting Aeroplanes*" and "*Great Engineering Feats*" have been given by members, illustrations being provided in each case by means of the epidiascope. A Whippet Tank Model-building Contest and a Hill Climbing Competition for motor vehicles of any type have provided great interest. A model fitted with creeper track built by one of the members climbed an incline with a gradient of 1 in 2½. Visits have been paid to the Deptford Pumping Station and the R.A.F. Air Display at Hendon, and members were greatly interested in the propellers of the new Cunarder, seen during a visit to the works in which they are being made. Club roll: 18. *Secretary:* H. H. Renyard, 74, Fernbrook Road, Lewisham, London, S.E.13.

St. George's (Edinburgh) M.C.—A new club room in St. Giles Hall has been secured, and during the summer members were busy constructing benches on which to lay the club's Hornby Train track. Cricket Matches and Netball in the club room have provided enjoyable recreation for members, and a series of interesting visits has included inspection of the works of the British Oxygen Co., Turnhouse Aerodrome and the associated workshops and hangars, the L.N.E.R. Haymarket Engine Sheds and Herdman's Flour Mills. Other interesting events have included an excursion across the Firth of Forth and a visit to Edinburgh Police Headquarters. The second issue of the "*Mechor*" has appeared and shows great improvement on its predecessor. Netball is played at each meeting. Club roll: 124. *Secretary:* A. Matheson, 18, Hutchison Terrace, Edinburgh, 11.

St. Nicholas (Sevenoaks) M.C.—The new club house was opened by Mr. W. Sharp, Leader, who pushed open the door with a large key made of Meccano. The house contains three rooms and the club is unique in possessing such magnificent headquarters, free of rent, rates and taxes. Members greatly appreciate the privilege. They have built furniture by painting and enamelling the sides of boxes and placing cushions on top, and are making excellent use of the model-building rooms. A Hornby Train Section has been formed and a permanent layout is being planned. A very successful Exhibition has been held, the attractive display in the club house being open to visitors for nearly a fortnight. Club roll: 14. *Secretary:* J. Kemp, 4, Bosville Road, Sevenoaks.

CANADA

St. Clair Y.M.C.A. (Toronto) M.C.—Interesting models made by members included a Lift and an excellent Tractor fitted with an electric motor. Model-building has been actively pursued at all meetings, and a further attraction has been a Cinematograph Display. Club roll: 21. *Secretary:* G. Bell, 13, Rockvale Avenue, Toronto 10, Canada.

ITALY

Milan M.C.—Members visited the International Fair held in Milan, and afterwards built Meccano models of machines exhibited in the Engineering Section. Lectures have been given on "*Television*" by Sr. C. Vigo, President, and on "*Modern Engineering*" by Sr. C. Santi, discussions following in each case. An excursion to the Valle Sassina was greatly enjoyed, members climbing the "*Culmine de San Pietro*," a peak 5,240 ft. in height. Club roll: 12. *Secretary:* E. Vigo, Corso Genova N, 19, Milano, Italy.

NEW ZEALAND

Christchurch M.C.—Highly successful rambles and Mystery Cycle Runs have been arranged, and a meeting at which members described their experiences on holiday caused great amusement. A lecture on "*Organs*" proved particularly interesting, and other events have included a Cinematograph Display and a visit to Wigram Aerodrome. Club roll: 30. *Secretary:* R. F. Worsley, 50, Opawa Road, Opawa, Christchurch, New Zealand.

Sumner M.C.—Very successful meetings have been held and members are doing excellent work. The Anniversary Exhibition was very successful, more than 250 visitors being present, and a gratifying feature was the help given by members of Christchurch M.C. Mr. C. Sherrard has kindly accepted the position of Leader, and the interesting programme now being followed under his guidance is arousing keen enthusiasm. More members are required and the Secretary will be pleased to hear from all interested in Meccano model-building or in Hornby Trains. Club roll: 14. *Secretary:* I. Baines, 16, Campbell Street, Sumner, Christchurch, New Zealand.

Clubs Not Yet Affiliated

Strathcona (Edmonton) M.C.—The club's first session has been very successful, and keen interest is being taken in preparations for the coming winter. A Membership Drive is being organised, and the secretary would be pleased to give full details of the club to any boys who are interested in its activities. *Secretary:* H. Bowley, 10039–87 Avenue, Edmonton, Alberta, Canada.

Toronto Central Y.M.C.A. M.C.—In a Model-building Contest that proved specially popular members were asked to submit models of engineering structures of the future, and many strange rocket ships and similar models resulted. A Library has been formed and Lantern Lectures on interesting topics have been given. The attractive programme for the future includes the club's first Annual Exhibition, and a Model Dockyard is being prepared for display on this occasion. *Secretary:* W. B. Moore, 141, Albertus Avenue, Toronto 12, Ontario, Canada.

Boys! Here's the finest part exchange offer ever made

Just think of it, an allowance of 50% on your old Hornby Locomotive! This is the most generous offer ever made to Hornby Train enthusiasts.

The complete list of Part Exchange allowances for Hornby Locomotives is given on this page. Please note that the catalogue price of the new Locomotive you purchase *must not be less than double the Part Exchange allowance made for your old Locomotive.*

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 choose a new Locomotive, the cost of which is not less than 12/6.

You decide, say, 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, Binns Road, Liverpool 13.

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.

HORNBY TRAINS

BRITISH AND GUARANTEED

Part Exchange Allowances for Hornby Locomotives

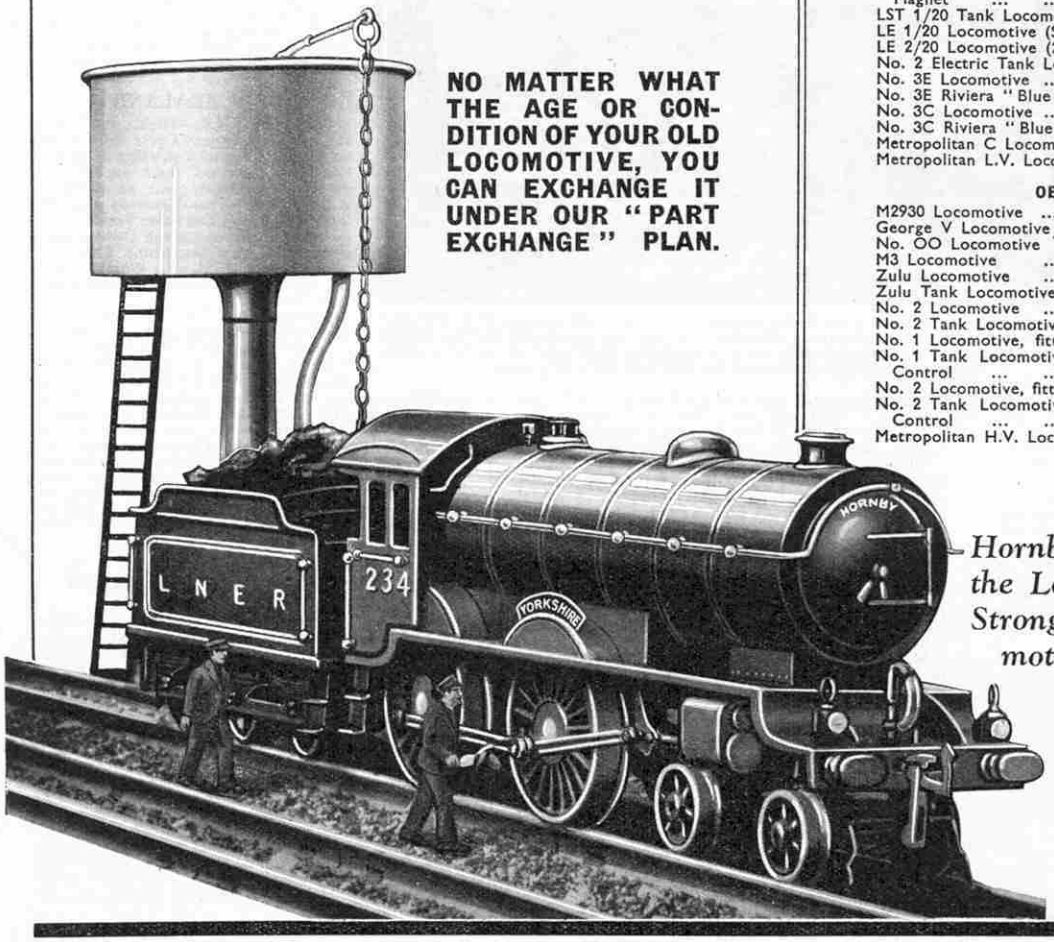
CURRENT TYPES

MO Locomotive	1/4
M1/2 Locomotive	2/3
M3 Tank Locomotive	3/9
No. O Locomotive	5/3
No. 1 Tank Locomotive	6/3
No. 1 Locomotive	6/3
LEC 1 Locomotive (Swiss Type)	7/6
No. 1 Special Locomotive	8/3
No. 1 Special Tank Locomotive	8/3
LST M3/20 Tank Locomotive (20-volt)	11/3
No. 2 Special Locomotive	11/3
No. 2 Special Tank Locomotive	11/3
No. 1 Electric Tank Locomotive, Permanent Magnet	12/6
LST 1/20 Tank Locomotive (20-volt)	12/6
LE 1/20 Locomotive (Swiss Type), 20-volt	13/3
LE 2/20 Locomotive (20-volt)	16/6
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
Metropolitan L.V. Locomotive	20/–

OBSOLETE TYPES

M2930 Locomotive	1/–
George V Locomotive (These models were identical)	3/3
No. OO 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
Metropolitan H.V. Locomotive	20/–

NO MATTER WHAT THE AGE OR CONDITION OF YOUR OLD LOCOMOTIVE, YOU CAN EXCHANGE IT UNDER OUR "PART EXCHANGE" PLAN.



Hornby Locomotives are the Longest Running and Strongest Pulling Locomotives in the World.

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Branch News

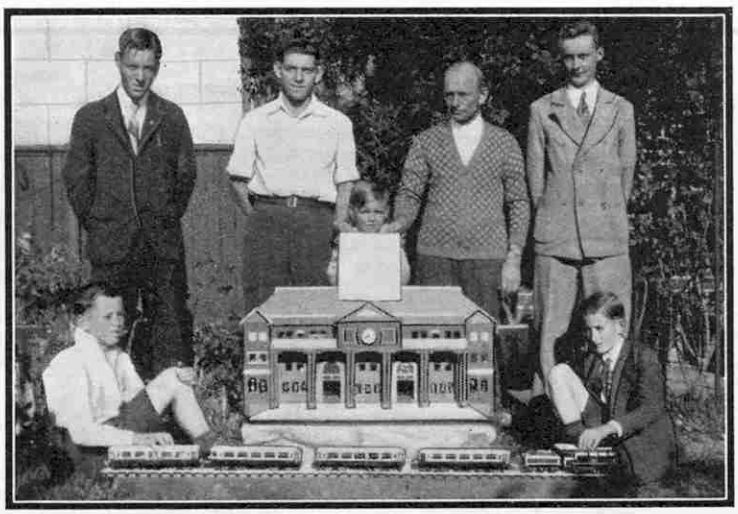
PRIORY (HIGH WYCOMBE).—The Branch track represents the line between King's Cross and York, and a "Midland" section ending at St. Pancras also has been introduced. Special care is taken to keep rolling stock in good condition, both in regard to working and appearance, and interesting meetings have resulted from trials of timetables suggested by members. Secretary: J. T. Cosgrove, 54, Priory Road, High Wycombe, Bucks.

ST. SAVIOUR'S (RAYNES PARK).—The first Exhibition arranged by the Branch was remarkably successful. Two complete Hornby Train layouts were on view, and other attractions included an excellent collection of railway photographs and unusual railway tickets, and Meccano models built by the associated Meccano Club. Interested young visitors keenly enquired for details of the working of the Branch and many new members were enrolled as a result of the excellent display, part of which was illustrated in last month's "*M.M.*" Secretary: A. Williams, 48, Trewince Road, West Wimbledon, S.W.20.

THE BON-ACCORD (ABERDEEN).—At the first meeting of this newly incorporated Branch tests of the speeds and hauling powers of the locomotives available were carried out. An excellent layout was prepared and timetables worked out to give interesting running, control of all points and signals being centralised by means of levers constructed of Meccano parts. The Cycling Club has enjoyed many good runs during the summer. Secretary: J. S. Rowand, 1, Adelphi, Aberdeen.

ST. THOMAS (EXETER).—The running of various services on experimental tracks has been the chief activity so far, the purpose being to devise an extensive layout suitable for all-round operations. A mountain line is included and the trains on one branch are made to serve an aerodrome from which an aeroplane service is organised. When a satisfactory track has been planned, representatives of several famous trains are to be run on it. Secretary: H. A. C. Adams, 24, Holland Road, St. Thomas, Exeter.

WIMBORNE GRAMMAR SCHOOL.—The Chairman and Track Engineer have relaid the Branch track so as to give a double line between two termini. An entirely new three-colour electric signalling system has been installed, and the necessary operations caused unavoidable delay to traffic over the line. The Track Engineer presents a report at each meeting, in order to ensure that the Branch property is kept in the best condition, and criticisms and suggestions for improvements in operations are looked for from members. Timetables and other arrangements for the services on the Branch track have already been arranged, and good times are expected at track meetings to be held during the coming winter sessions. Secretary: F. R. Gillespie, "Holly Lodge," 4, Wimborne Road, Bournemouth.



A few of the members of the Perth (Western Australia) Branch, No. 264. Mr. G. W. Stanbridge, Chairman, is second from the right in the back row, and on his right is J. Stanbridge, secretary. This Branch was affiliated in March of this year and has already built up an excellent track, with four stations and signal boxes connected by telephone. The large station constructed by the secretary and shown in our photograph is incorporated in the layout.

FINCHLEY.—The signalling of the layout has been completed and many minor additions made to the track in order to increase the interest of working. The scope of operations has been greatly enlarged by the extension of the layout into the garden and interest in the work of the Branch is steadily increasing. Secretary: J. Price, 33, Windsor Road, Finchley, London, N.3.

WHITGIFT SCHOOL.—Members took part in the 5th Annual Exhibition of the Whitgift School M.C., with which the Branch is associated, and the layout they designed and operated was exceedingly popular with visitors. An interesting programme of visits was arranged for the summer months and an enjoyable session ended with a business meeting, at which reports from officials were read and prizes won in various competitions were presented. Secretary: H. J. Kirby, 3, Mayfield Road, Sanderstead.

HOLYWELL (OXFORD).—A Lantern Lecture was given by Rev. F. Garrard on "*L.N.E.R. Locomotives*," and this was followed by an excellent track meeting. A visit has been paid to the Oxford Engine Sheds of the G.W.R., where 34 locomotives were inspected. Extensive services have been run on the Branch layout on Track evenings. At one meeting a special feature was made of excursion trains, and at all careful watch is kept on operations in order to improve the standard of working. Secretary: M. Weatherall, 29, Holywell, Oxford.

AUSTRALIA

KEW.—Frequent meetings of the Branch are being held at members' homes, a definite plan of work being arranged on each occasion. A special feature continues to be made of interesting visits. The P. & O. liner "*Strathaird*" has been inspected and members were particularly interested in operations carried on in the Train Control Rooms of the Victorian Railways at Flinders Street and Spencer Street Stations respectively. Secretary: Mr. A. J. McCutcheon, 20, Studley Avenue, Kew E.4, Victoria.

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 apply.

KIMBOLTON—J. A. Whitworth, Kimbolton School, Kimbolton, Hunts.

LONDON, S.W.19—D. Bowler, 129, Dora Road, Wimbledon Park, S.W.9.

LONDON, S.W.12—A. H. St. L. Walker, 68a, Oakmead Road, Balham, S.W.12.

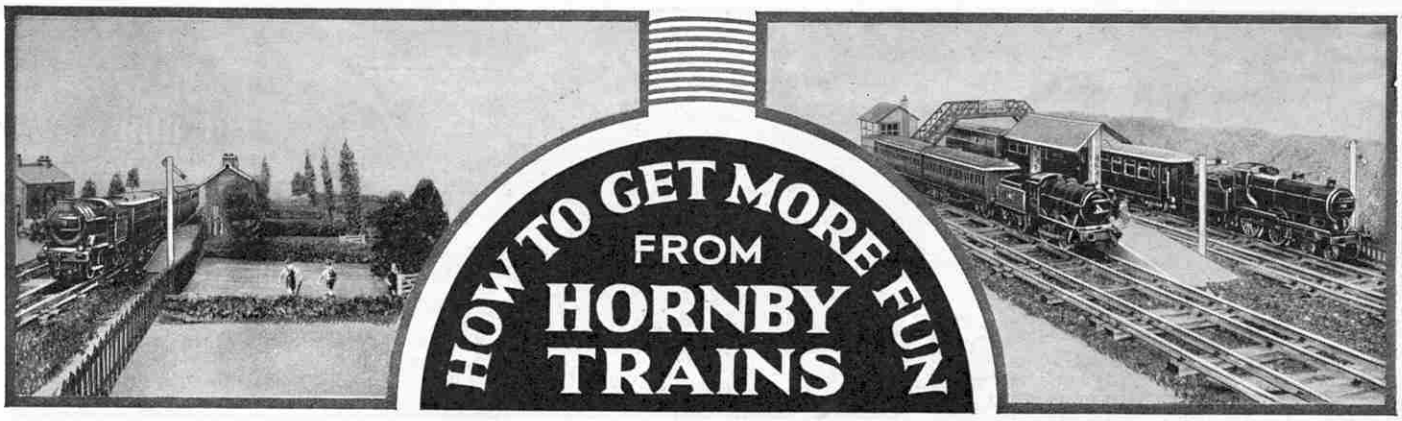
LONDON, E.5—R. Harris, 39, Dunlace Road, Clapton Park, E.5.

PRESTON—J. Scholes, Westdene, Sheep Hill Lane, New Longton, Preston.

ST. HELENS—H. Phillips, 99, Brynn Street, St. Helens, Lancs.

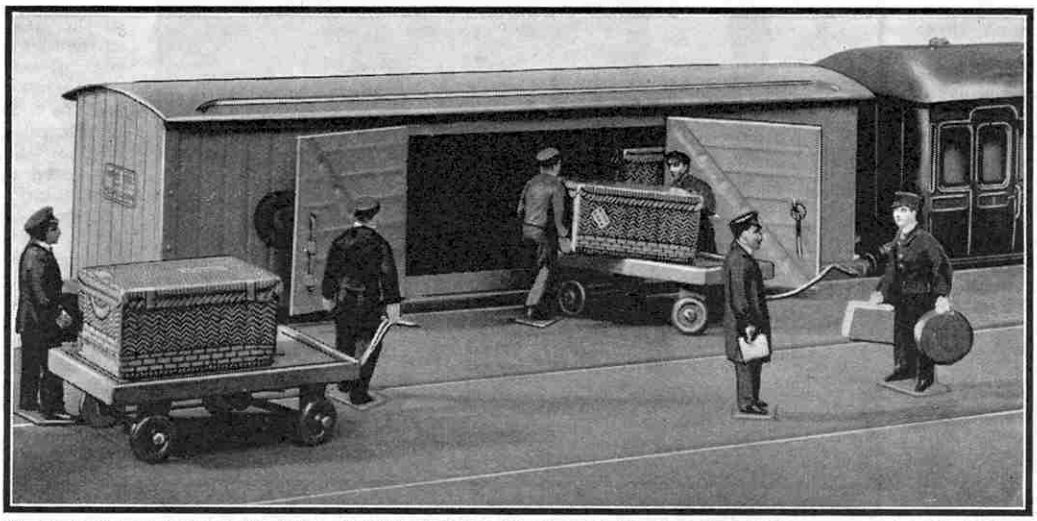
TIMPERLEY—S. Dressler, "Selby," Park Road, Timperley.

TORQUAY—F. Bandey, 50, Warren Road, Torquay.



LXXI.—FREIGHT SERVICES IN MINIATURE

THE fascination of the famous passenger expresses is so great that the railway enthusiast is rather apt to overlook the less attractive freight services. Yet these services are of vital importance, not only to the individual railway company, but also to the nation, for it is the freight trains that provide the bulk of the transportation for the trade of the country. There are several reasons for this apparent neglect, one being that most of the important long-distance freights travel by night and therefore are not seen in the ordinary way. In any case a string of goods wagons of various shapes and sizes hauled by a humble freight locomotive does not look anything like so attractive as a trim express train in all the glory of bright paint and name boards. If we examine the subject of freight working more deeply, however, and consider how suitable freight services can be provided in miniature, we shall find that we have opened up a subject of considerable interest.



This photograph shows the station staff on a Hornby Railway loading up a No. 2 Luggage Van with hampers as contained in Railway Accessories Set No. 1. Traffic of this description is often conveyed by passenger trains.

Freight trains should be run on a Hornby layout if a truly realistic presentation of real railway working is to be attained. The great variety of suitable rolling stock that is available in the Hornby Series certainly encourages the development of freight services and practically all kinds of traffic can be provided for in an appropriate and realistic manner. The most common type of vehicle that is used for all kinds of general traffic is the open wagon and this is well represented in the Hornby range. An important addition in the case of the No. 1 Wagons is that they have a strip of printed tinplate attached along the length of each solebar, thus reproducing the details usually found on real solebars such as bolt heads, strappings, crown plates and the number plate. These wagons may be filled with all kinds of loose loads such as small stones, or even dried peas if the railway is to run on the drawing-room carpet! They may carry miniature baulks of timber representing sleepers or small cartons and boxes such as match boxes and others to represent the cases and crates that are seen in actual practice. Meccano Rods may be used for pipes and tubes and Meccano Loaded Sacks are also useful.

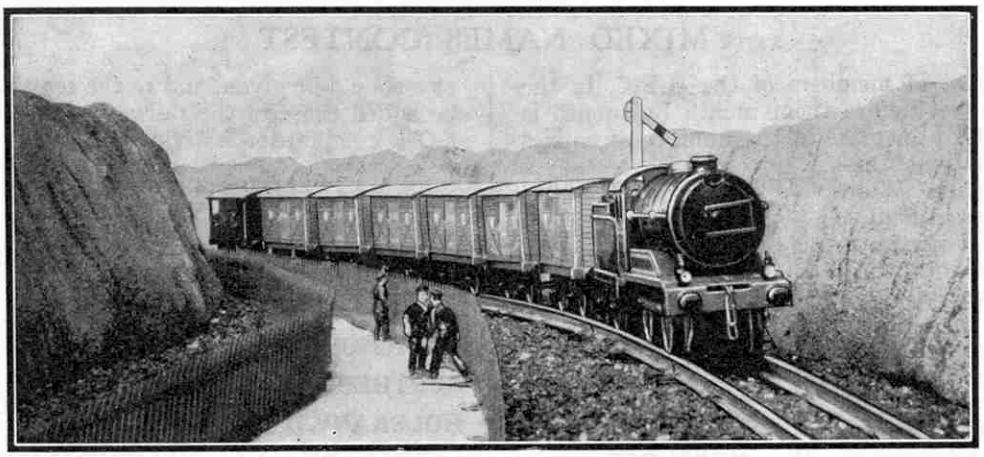
The numerous open wagons belonging to collieries, coal merchants and manufacturing firms, and used exclusively for the carriage of coal, are represented in the Hornby Series by the "Meccano" Coal Wagon. There is no need, however, to load up the wagon with this somewhat dirty substance as it is fitted with an embossed representation of coal.

An interesting variant of the ordinary open Wagon is the Open Wagon "B" which is fitted with a movable rail along the centre of the wagon for supporting a tarpaulin wagon sheet when it is necessary to provide protection from the weather for the load that is to be carried.

Under the general term of covered wagons or vans a great variety of vehicles are included in the Series. There is the ordinary covered wagon or luggage van for general goods and in addition to this there are its various forms developed for particular traffics. Thus there are Biscuit Vans, a Chocolate Van and also a Banana Van, each of these being private owner's and not railway companies' stock. Of the railway-owned vehicles there are Refrigerator Vans for chilled meat, Meat Vans for fresh meat and specially ventilated Fish and Milk Vans. The carriage of livestock which forms an important

branch of freight service is provided for by the No. 1 and No. 2 Cattle Trucks.

The requirements of the timber trade are met by the Timber and Lumber Wagons each of which is available as a No. 1 four-wheeled Wagon or as a No. 2 bogie Wagon. These provide convenient means of carrying tree trunks, planks and poles, and the bogie wagons may also be used for the carriage of rails, steel bars and other lengthy loads.



A fish train passing over a single line section. The train is made up of Hornby Fish Vans and is typical in composition and appearance of the numerous real trains operated for fish traffic.

In these days an interesting feature is the conveyance in bulk by tank wagon of motor spirit, oils and even milk. Therefore the Hornby Series includes several Petrol Tank Wagons, and two Oil Tank Wagons, these being representative of the construction of the tank wagon of average size. There are, however, two further tank wagons which represent the high-capacity tanks now commonly seen, these being the "Colas" Bitumen Tank Wagon and the "United Dairies" vehicle based on the design of the now familiar glass-lined tanks used for milk traffic.

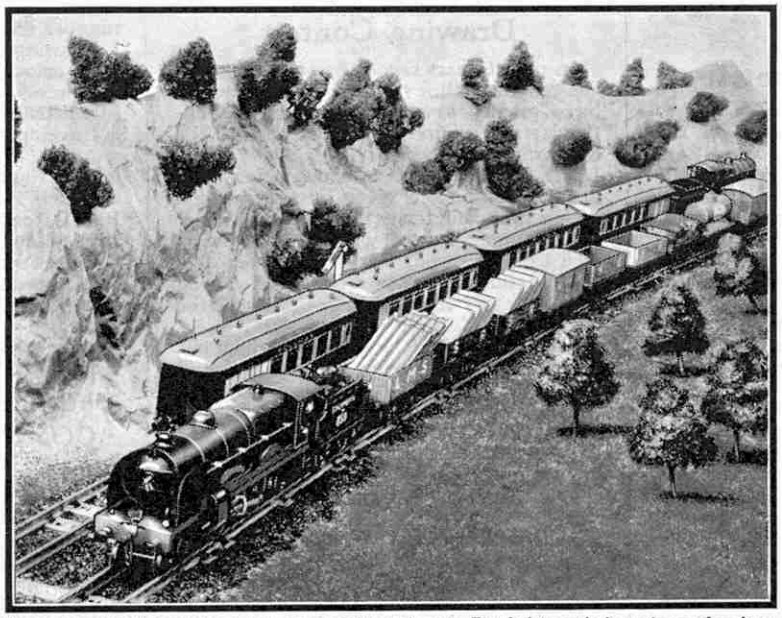
The Cement Wagon is a distinctive type of vehicle that is more common in some districts than in others. It is typical of the appearance of the wagons used for cement, lime and salt traffic where it is essential that the load should be kept dry. Hence the steeply-peaked roof of this wagon which gives it an unusual appearance that is particularly effective in miniature when seen in company with other vehicles. Of wagons not usually seen on ordinary goods trains the Side and Rotary Tipping Wagons also the Hopper Wagon may be mentioned. The first two are usually used by contractors but the Engineering Department of the miniature railway will be able to employ them to advantage and the Hopper Wagon also, in connection with ballasting operations or any process requiring the load to be tipped or dropped.

There are certain French-type vehicles in the Series that are available for use in conjunction with the ordinary English wagons and when used on British type layouts they represent very well the vehicles that are transhipped direct from European to British lines by means of the Harwich Train Ferry, thus giving a through journey with no disturbance of their loads.

The final vehicle of a freight train is the Brake Van and all companies are represented by the two types available. The L.M.S.R. and G.W.R. have many vans with single open ends and those with double open ends are common on the other two systems; so this arrangement is followed in the goods Brake Vans of the Hornby Series.

Of the other vehicles the Crane Truck, Breakdown Van and Crane and Snow Plough are more correctly "service vehicles" rather than typical freight stock, so we need not refer to them in detail.

With such a range of wagons it is not difficult to make up representative freight trains of all kinds. The easiest to arrange are those carrying bulk consignments of a particular load in similar wagons, be it coal, meat, fish, milk, cattle and so on. Coal trains may be made up of wagons representing each group as such wagons are usually subject to the "common-user" arrangement whereby the vehicles are considered common property. In addition there is the Meccano Coal Wagon representing the private owner element which is usually particularly strong in real coal trains.



Passenger and freight trains passing on a miniature layout. The freight train is made up of various kinds of wagons and is representative of the average general freight or mixed goods train of actual practice. It is hauled by a Hornby No. 3 "Lord Nelson" Locomotive.

Meat, fish, milk and cattle trains may be made up with appropriate vans. One of our photographs shows a typical train made up of Hornby Fish Vans. Such trains are common sights in the neighbourhood of ports that are fishing centres and in certain cases the amount of traffic will vary according to the particular season. Fish trains are necessarily worked at express speed owing to the perishable nature of their freight and in order that their destination will be reached in time to catch the market. Speed is also essential in the case of meat and milk trains. Delays must therefore be avoided and this is a point to be remembered in arranging the working schedules of such trains in miniature.

Readers will recollect that special (Continued on page 760)

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, Meccano Limited, Binns Road, Liverpool 13. The name, full address and membership number o each competitor should appear in clear writing on every sheet of paper used.

MIXED NAMES CONTEST

The keen interest of members of the H.R.C. in the railway problems set before them month by month is shown by the steady increase in the number of entries in the Competitions announced on this page. Word building and word-finding problems in which entrants have to exercise both their ingenuity and general railway knowledge are always popular and this month we announce a puzzle of this type.

In the panel in the centre of this page are 16 words of alarming appearance. It seems almost incredible that such extraordinary collections of letters can be arranged to make sense, but actually they hide the names of four locomotives, four British railway stations, four famous trains, and four locomotive parts. Competitors are asked to discover these names, or as many of them as possible, and to write them down in the order in which they appear in the panel. Short descriptions of the functions of the locomotive parts mentioned also should be given, and to the remaining names should be added those of the railway companies concerned.

SHOCTUTENQEFOSE	GARETTLACOSE
TESNOU	RATOLOWE
LEWTHIS	GLICKLINB
RECWE	DAEHSSORC
LPRAEASINS	GERTHEBNOBLIL
RXYSPTAROSBEE	HOLEKARWD
MEXSKOOB	LORTGEARU
CRANELISTNATHA	GOSNICRSSK

The competition is divided into two sections, for Home and Overseas readers respectively, and prizes consisting of Hornby Train material (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded to the senders of the four best solutions received in each section. In the case of a tie for any prize, preference will be given to the entry that is neatest or presented in the most novel or ingenious manner.

Envelopes containing entries must be clearly marked *"H.R.C. September Mixed Names Contest"* in the top left-hand corner and posted to reach Headquarters at Meccano Limited, Binns Road, Liverpool 13, on or before 29th September. The latest date for receiving entries from Overseas competitors is 31st December. Every entry must be clearly marked with the sender's name, full address and his H.R.C. membership number.

Railway Photographic Contest

The month of September may be said to herald the approach of the end of the photographic season, for the days are shorter and the light generally is not too good. This month's photographic contest therefore is the last of the present series. In it we offer prizes for the best photographs of *"Any Railway Subject,"* leaving members free to exercise their own preferences for particular aspects of railway working. As in previous contests the only restriction is that each exposure must have been made by the competitor, but the developing and printing may be the work of a professional.

Entrants may submit as many prints as they desire but no competitor can receive more than one prize. It is important that every print submitted should have on the back the name of the competitor, his full address and his H.R.C. membership number, and the omission of any of these details will result in disqualification.

The contest will be divided as usual into two sections—Home and Overseas—and prizes of Hornby Train material (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded in each section.

Envelopes containing entries should be clearly marked *"H.R.C. September Photo Contest"* and posted to reach Headquarters at Meccano Ltd., Binns Road, Liverpool 13, on or before 29th September. The closing date for the Overseas Section is 31st December. Entries received after the announced closing dates will be disqualified and will not be passed on to the judges.

Drawing Contest

In recent years revolutionary changes in the general outline of the steam locomotive have greatly startled many railway enthusiasts. The first surprise came with the appearance in 1929 of *"No. 10000,"* the L.N.E.R. locomotive to which a very unusual appearance is given by a streamline casing that completely hides the smokebox and chimney except when the engine is seen from the front. The new locomotive was carefully tested in service and proved so satisfactory that it greatly influenced the design of No. 2001, *"Cock o' the North,"* the newest L.N.E.R. locomotive which has the distinction of being the heaviest and most powerful in Great Britain, for its outline shows many similarities to that of its predecessor.

What developments will follow the introduction of these remarkable locomotives? Will the desire for increased speed and greater efficiency make streamlining of a more complete type universal, or will even more startling innovations lead to further alterations in the appearance of steam locomotives?

Every member of the H.R.C. no doubt has his own ideas on these possibilities, and in our Drawing Contest this month we invite them to give expression to their ideas by submitting drawings of the steam locomotive of 50 years hence. To the four competitors in each of the two sections—Home and Overseas who submit the best drawings, Hornby Train material (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded. In case of a tie for any prize the award will be made to the competitor whose entry shows the greatest number of original ideas.

Drawings may be submitted in pencil or in colour as desired, but the prizes will not necessarily be awarded to the entries submitted in colour.

Envelopes containing entries should be marked *"H.R.C. September Drawing Contest"* in the top left hand corner and posted to reach Headquarters at Meccano Ltd., Binns Road, Liverpool 13, on or before 29th September. The closing date for the Overseas section is 31st December.

Competitors who wish their drawings to be returned should enclose a stamped addressed envelope of suitable size. Entries that gain prizes automatically become the property of Meccano Limited.

COMPETITION RESULTS

HOME

June "Name and Number Contest, No. 5."—First: J. F. Aylard (25864), Old Southgate, London, N.14. Second: W. Cross (34990), Northampton. Third: W. S. Arnott (18451), Edinburgh. Fourth: G. H. Preston (12020), West Ealing, London, W.13.

June "Railway Photo Contest."—First: S. Garbutt (30122), Altrincham, Cheshire. Second: V. L. Breeze (2134), Kingston, Lewes, Sussex. Third: R. B. Hayter (21630), Bedford. Fourth: R. Dace-Brown (623), Brixton Hill, London, S.W.2.

June "Drawing Contest."—First: K. Costain (5108), Bolton, Lancs. Second: W. D. Peach (35063), West Cowes, I.O.W. Third: D. Cheverton (31791), South Harrow, Middx. Fourth: H. Dixon (34165), Huntington, York.

OVERSEAS

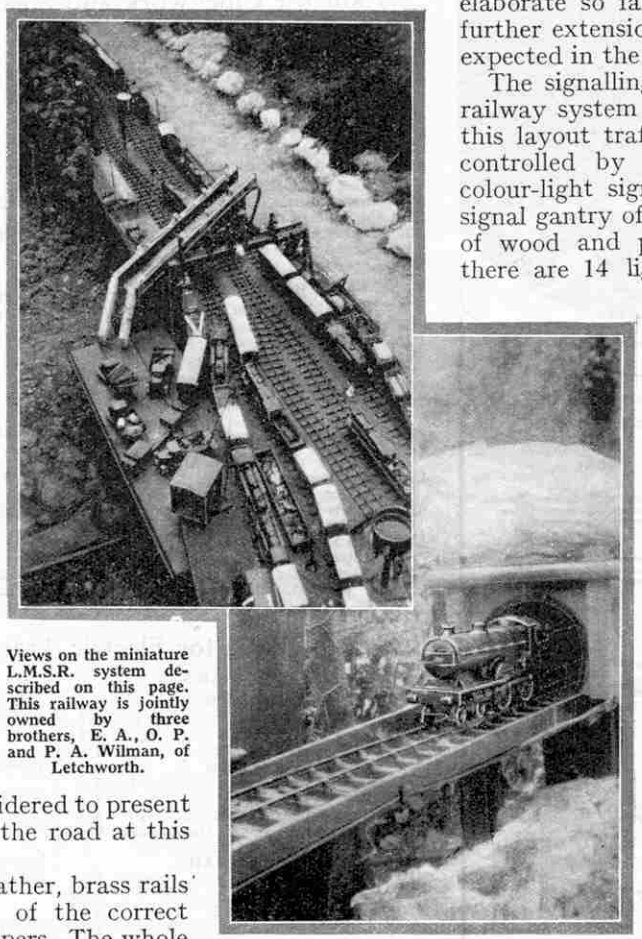
March "Photo Voting Contest."—First: J. A. Rodriguez (3647), Montreal, Canada. Second: J. A. Gnanadurai (33344), Puthur, Trichinopoly. Third: W. J. T. Watson (18065), West Leichhardt, N.S.W., Australia. Fourth: F. Van Bulck (1875), Forest—Brussels, Belgium.

March "Drawing Contest."—First: E. C. Heath (29104), West Pennant Hills, N.S.W., Australia. Second: J. A. Rodriguez (3647), Montreal, Canada. Third: S. D. Kurlawala (28724), Tardeo, Bombay, India. Fourth: P. Galdes (14183), Valletta, Malta.

A Miniature West Coast Route

L.M.S.R. System with Unusual Features

THE majority of miniature railway layouts, on account of being situated indoors, are necessarily of the continuous type. There are of course exceptions, most of them being schemes of various kinds that allow for either continuous or point-to-point working as desired by the operator. The miniature railway system described and illustrated on this page, however, differs from the general run of model layouts, not only in being permanently arranged out of doors, but also in being planned as a non-continuous line from one terminus to another. The line represents the labour of about six years in the design and construction of the track and the stations, and in collecting suitable locomotives and rolling stock to operate the service.



Views on the miniature L.M.S.R. system described on this page. This railway is jointly owned by three brothers, E. A., O. P. and P. A. Wilman, of Letchworth.

The system is the property of and is operated jointly by three brothers, E. A., O. P. and P. A. Wilman, who hold the respective positions of Chief Mechanical Engineer, Chief Traffic Manager and Superintendent of the Line. It represents the L.M.S.R. main line from London to Glasgow, and for the greater part of its length has double track. There is a single line section towards the Glasgow end of the line where a tunnel is encountered that may be considered to present an obstacle to the doubling of the road at this point.

In order to withstand the weather, brass rails are used, supported in chairs of the correct pattern and laid on wooden sleepers. The whole system is raised on a substantial baseboard that is well creosoted in order to preserve it. This track stands up to varying weather conditions in a satisfactory manner, although of course a certain amount of maintenance is necessary in order to keep the rails true to gauge and the track generally in good condition.

The chief station is "Euston," which has six platform faces and also boasts of a working clock. A realistic overbridge spans the tracks outside the station, and alongside this is a signal cabin devoted entirely to the movement of the numerous points in the neighbourhood of the terminus. Leaving "Euston," various lineside buildings are passed, and then an intermediate station of the usual wayside type is reached. This is known as "Leighton Buzzard," and forms a convenient limit for the "Euston" suburban services. After passing "Leighton" the tracks are carried across a footbridge, and some distance after this the up and the down lines resolve themselves into single track. The tunnel already referred to, which is 3 ft. long, is then negotiated, the line opens out again, and "Glasgow," the northern terminus of the railway, is reached. The layout and equipment at this end of the line is less elaborate so far than that at "Euston," but further extensions and developments are to be expected in the near future.

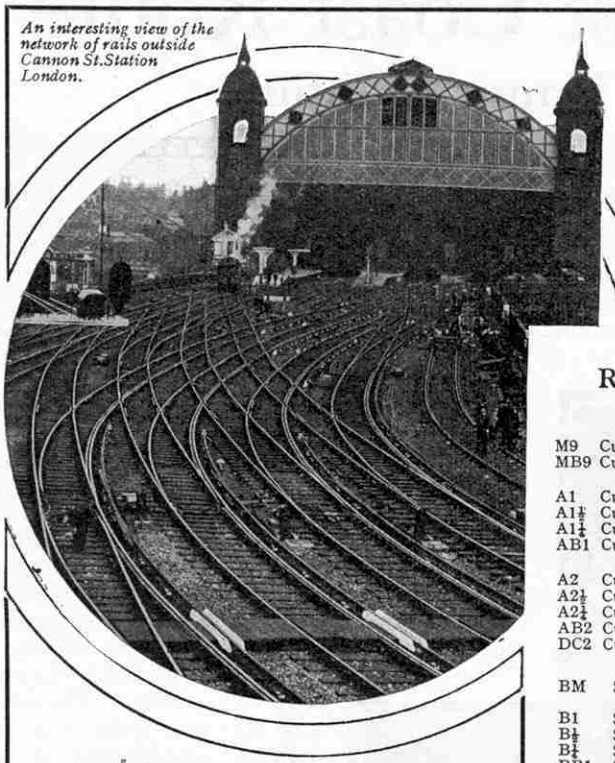
The signalling arrangements of a miniature railway system are always of interest, and on this layout traffic in and out of "Euston" is controlled by an up-to-date installation of colour-light signals. These are mounted on a signal gantry of composite construction, partly of wood and partly of Meccano. Altogether there are 14 lights on this gantry which, as might be expected, looks very effective at night. The lights are operated from a special control switchboard at the side of the line. The other signals on the layout, as far as they have yet been provided, are of the usual semaphore type.

The line is operated to a carefully drawn up timetable that includes most of the famous expresses running on the West Coast Route. A dozen Hornby Coaches of various types are in service, and there are several that have been constructed at home in the "Company's" own works. Goods rolling stock consists of some 30 wagons of Hornby and other kinds. The locomotive stock is exclusively Hornby, and totals nine engines. The crack express locomotive is a Hornby No. 3 *"Royal Scot,"* which has been brought up to date by the addition of smoke deflectors. The other locomotives used for express work are chiefly of the No. 2 Special Standard Compound type. Two of these engines are used together on a miniature mail train that successfully represents the famous *"West Coast Postal"* of actual practice. Another duty undertaken by these engines is to act as pilots on *"The Royal Scot"* express when the load is particularly heavy.

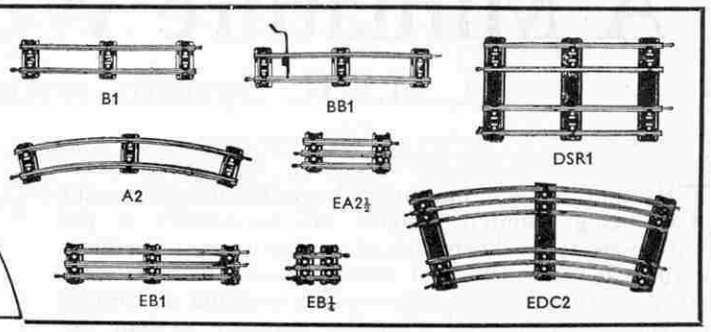
The fast suburban trains between "Euston" and "Leighton" are successfully worked by Hornby No. 2 Special Tank Locomotives.

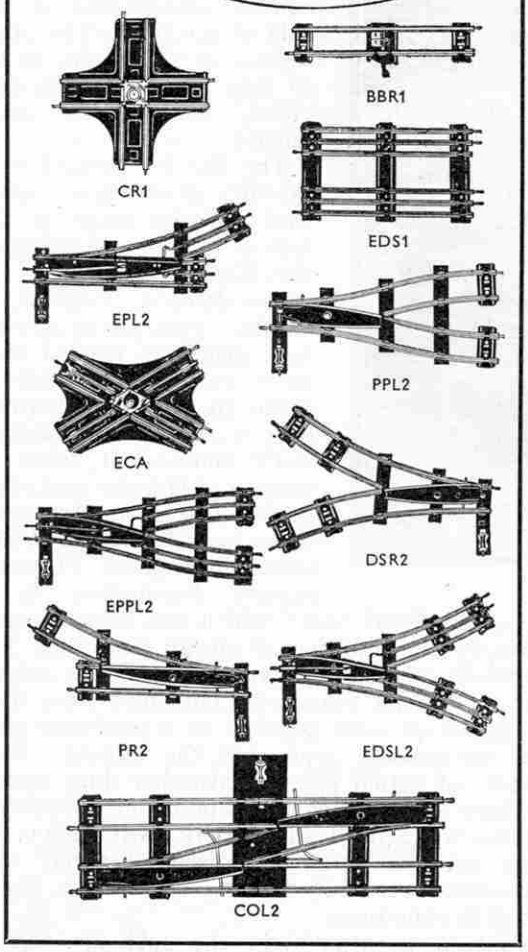
As the layout is situated in the open air, and is therefore subject to all weather conditions, the accessories are of special weather-proof construction.

Hornby Rails, Points and Crossings



An interesting view of the network of rails outside Cannon St. Station London.





Rails for Clockwork and Steam Trains, Gauge 0, 1¼"

CURVED RAILS

9-in. Raduis (for M0 Trains)

M9	Curved rails	per doz. 3/-
MB9	Curved brake rails, ...	each 3½d.

1-ft. Radius

A1	Curved rails	per doz. 4/6
A1½	Curved half rails ...	„ 3/6
A1¼	Curved quarter rails ...	„ 3/-
AB1	Curved brake rails, each	6d.

2-ft. Radius

A2	Curved rails	per doz. 4/6
A2½	Curved half rails ...	„ 3/6
A2¼	Curved quarter rails ...	„ 3/-
AB2	Curved brake rails, each	6d.
DC2	Curved rails, double track,	½ doz. 7/6

STRAIGHT RAILS

BM	Straight rails (for M0 Trains),	per doz. 2/9
B1	Straight rails	„ 4/-
B½	Straight half rails ...	„ 3/-
B¼	Straight quarter rails ...	„ 2/6
BB1	Straight brake rails ...	each 5d.
BBR1	Straight brake and reverse rails,	each 1/6
DS1	Straight rails, double track,	½ doz. 6/6

CROSSINGS

CA1	Acute-angle crossings (for 1-ft. radius tracks),	each 2/-
CA2	Acute-angle crossings (for 2-ft. radius tracks)	„ 1/9
CR1	Right-angle crossings (for 1-ft. radius tracks)	„ 2/-
CR2	Right-angle crossings (for 2-ft. radius tracks)	„ 1/9

POINTS

9-in. Radius (for M0 Trains)

MR9 / ML9	Right-hand points / Left-hand points	... per pair 3/-

For 1-ft. Radius Curves

PR1 / PL1	Right-hand points / Left-hand points	... per pair 4/-

For 2-ft. Radius Curves

PR2 / PL2	Right-hand points / Left-hand points	... per pair 4/-
PSR2 / PSL2	Points on solid base, right-hand ... ... / Points on solid base, left-hand	per pair 8/6

PARALLEL POINTS

PPR2 / PPL2	Parallel points, right-hand / Parallel points, left-hand	per pair 5/-
RCP	Rail Connecting Plates	... ½ doz. 2d.

DOUBLE SYMMETRICAL POINTS

For 1-ft. Radius Curves

DSR1 / DSL1	Double symmetrical points, right-hand / Double symmetrical points, left-hand	... per pair 5/-

For 2-ft. Radius Curves

DSR2 / DSL2	Double symmetrical points, right-hand / Double symmetrical points, left-hand	... per pair 5/-

CROSSOVER POINTS

COR2 / COL2	Crossover points, right-hand / Crossover points, left-hand	per pair 12/-

Rails for Electric Trains, Gauge 0, 1¼"

CURVED RAILS

1-ft. Radius

EA1	Curved Rails ...	... per doz. 6/6
EA1½	Curved half rails	... „ 4/6
EA1¼	Curved quarter rails	... „ 4/-

2-ft. Radius

EA2	Curved rails ...	... per doz. 6/6
EA2½	Curved half rails	... „ 4/6
EA2¼	Curved quarter rails	... „ 4/-
EDC2	Curved rails, double track,	½ doz. 9/-

STRAIGHT RAILS

EB1	Straight rails ...	... per doz. 6/-
EB½	Straight half rails	... „ 4/6
EB¼	Straight quarter rails	... „ 4/-
EDS1	Straight rails, double track,	½ doz. 8/6

POINTS

For 2-ft. Radius Curves

EPR2 / EPL2	Right-hand points / Left-hand points	...per pair 7/6

CROSSINGS

ECA	Acute-angle crossings	... each 4/-
ECR	Right-angle crossings	... „ 4/-

DOUBLE SYMMETRICAL POINTS

For 2-ft. Radius Curves

EDSR2 / EDSL2	Double symmetrical points, right-hand / Double symmetrical points, left-hand	... per pair 8/6

PARALLEL POINTS

EPPR2 / EPPL2	Parallel points, right-hand / Parallel points, left-hand	per pair 8/6

CROSSOVER POINTS

ECOR2 / ECOL2	Crossover points, right-hand / Crossover points, left-hand	per pair 24/-
TCPL6	Terminal Connecting Plates (6-volt)	each 1/6
TCPL20	Treminal Connecting Plates (20-volt)	„ 1/6

Centre Rails for Converting Ordinary Track to Electrical

CURVED CENTRE RAILS

1-ft. Radius

AC1	Curved centre rails	... per doz. 1/-
AC1½	Curved centre half rails	„ 9d.
AC1¼	Curved centre quarter rails	„ 6d.

2-ft. Radius

AC2	Curved centre rails	... per doz. 1/-
AC2½	Curved centre half rails	„ 9d.
AC2¼	Curved centre quarter rails	„ 6d.

STRAIGHT CENTRE RAILS

BC1	Straight centre rails	... per doz. 1/-
BC½	Straight centre half rails	„ 9d.
BC¼	Straight centre quarter rails	„ 6d.

ICR	Insulators for insulating centre rails ...	... per doz. 3d.
CCR	Clips for fixing centre rails	„ 6d.

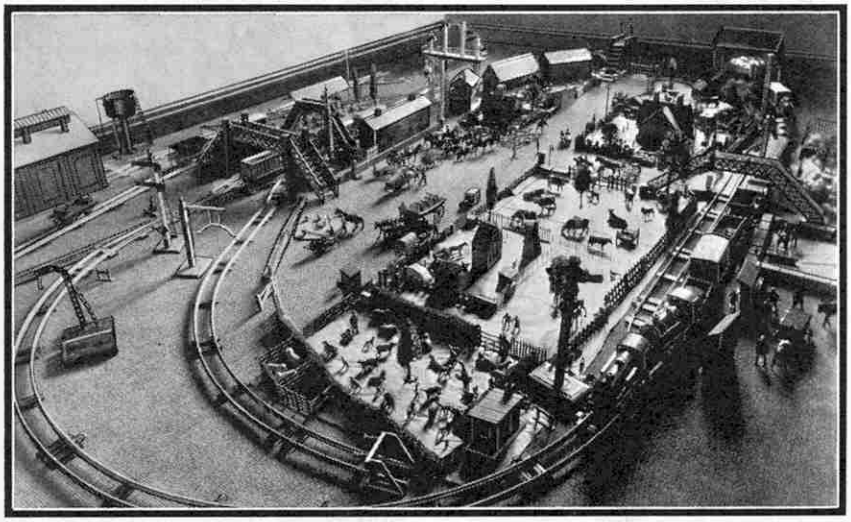
Many interesting illustrations and much useful information regarding Hornby Railway layouts are given in a booklet entitled "How to plan your Hornby Railway." This booklet is obtainable from your dealer, price 3d., or from Meccano Ltd., Binns Road, Liverpool 13, price 4d. post free.

MANUFACTURED BY MECCANO LTD., BINNS ROAD, LIVERPOOL 13

An Interesting Hornby Railway

AN attractive feature of a miniature railway is the variety of effects that it is possible to add to even a small layout, in order to provide it with a suitable setting and thus make it more realistic. The photograph reproduced on this page shows some of the possibilities in this direction, even though the layout of the track itself is comparatively simple. The owner of the line is E. Green of Sidmouth who, although only nine years old, has obtained most realistic effects in the disposition of his miniature railway equipment and the various accessories that are used in conjunction with it.

The main line of the railway system is oval in form, the straight sides of the oval being composed of two tracks which, by means of parallel points, turn into single track before the curved ends of the layout. Various sidings are led off the main line at convenient points, and a Hornby Engine Shed, Turntable and Water Tank make up the equipment of a useful locomotive yard. At one side of the layout an interesting station is arranged, made up of a Hornby No. 2 Railway Station in conjunction with an Island Platform, the two being connected by an M Series Footbridge. In addition there is a No. 3 Lattice Girder Footbridge placed independently of the station.



An interesting photograph of the Hornby Railway of E. Green of Sidmouth. It is remarkable not only for its railway equipment, but also for the completeness of its accessories which add considerably to the realistic effect of the line.

The other straight side of the oval includes a No. 2 Level Crossing, supplemented for foot passengers by a No. 2 Footbridge, the signals mounted on this serving to protect the Crossing itself. A fairly complete installation of signals is provided on the line, and a Signal Cabin is appropriately placed near the station. There is a further Level Crossing and a Meccano Footbridge at one end of the layout, over the single line portion, and close to this is an effective tunnel.

Among other railway accessories may be mentioned a Loading Gauge, M Series Signal Cabin and Halt, a Lamp Standard, Platelayers' Hut, and various Notice Boards. An interesting lineside fitting is a mail bag standard constructed of Meccano parts.

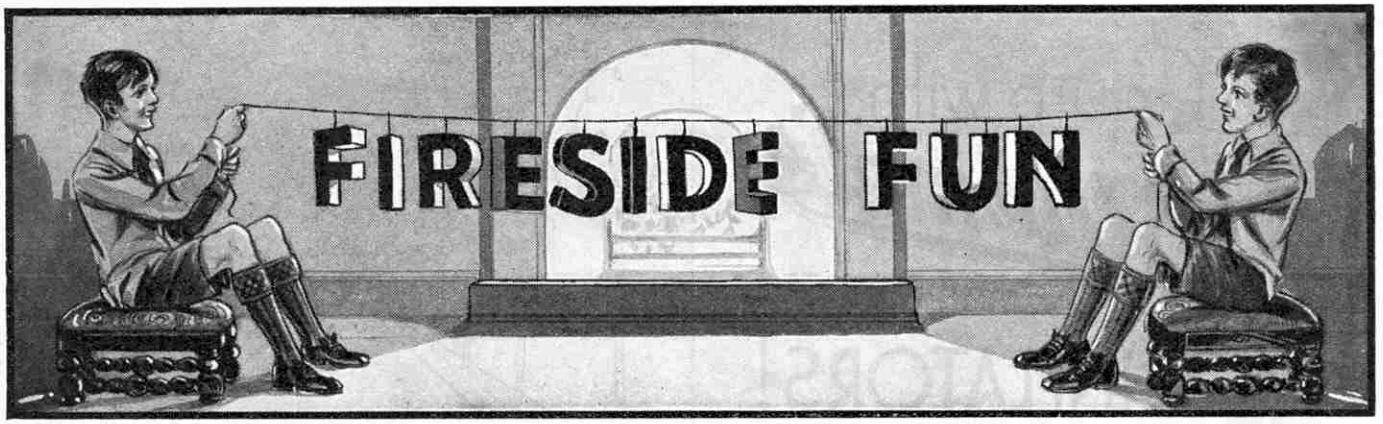
Both passenger and goods trains are operated on this layout, which represents G.W.R. practice as far as possible. The coaching stock consists of No. 1 and M1 Pullman coaches, and in order to supplement the luggage accommodation of the No. 1 Pullman Composite Coach a Guard's Van is often included for the make-up of passenger trains. The goods stock consists of a variety of wagons, including such special examples as a Gunpowder Van and a Side-Tipping Wagon. Petrol Tank Wagons and a Hopper Wagon are found in addition to the usual Open, Timber and Cattle Trucks. A Breakdown Van and Crane is kept ready for emergencies near the locomotive yard.

The engines themselves are all finished in G.W.R. colours, and include a No. 2 G.W.R. Tender Locomotive used for express traffic, a No. 1 G.W.R. Tender Locomotive used chiefly for goods traffic, and a No. 1 Special Tank, which works passenger or goods services as required. The numerous accessories that are used to complete the space enclosed by the main line include some very interesting items. There is a complete miniature hunt, including the pack of hounds and the riders; in the photograph they are seen just moving off from the neighbourhood of the railway station. By the signpost close by, a policeman stands on point duty at the cross roads, and his motor-cycle colleagues are just rounding the bend. From the direction of the double track Level Crossing a horse-drawn rake is passing along the road, evidently returning from the fields. Among other items of traffic there is a large two-horse wagon filled with milk cans, and at the other extreme is a barrow drawn by a diminutive donkey! A Watchmans' Hut and Brazier is also found on the roadside, evidently in anticipation of some road-mending or similar operations.

Numerous miniature buildings add to the realism of the village scene, and near the railway station is a small cottage that has several petrol pumps placed outside to deal with the requirements of passing motor vehicles, of which several examples from the Meccano Dinky Toys series are in use.

Some of the buildings are cardboard models assembled from coloured designs and the remainder are made up of miniature constructional bricks. Of the former there is a small cottage with out-buildings duly fenced round. The various enclosed fields are at present imitated by green paper but it is intended to introduce Hornby Countryside Sections as soon as possible. When this has been carried out the already realistic effect of the surroundings of the railway will be considerably increased.

Of the other structures a notable example is a private residence that is complete with summer house, greenhouse, and many other details, even to a miniature gardener engaged in mowing the lawn!



HOT WORK!

Hiram Hornswoggle had been very impressed by his visit to the city.

"Some of them bank fellers are pretty slick counting notes," he said to a friend one day. "I seen a feller in one o' them banks, and blow me if he didn't have to keep a wet sponge alongside to keep his fingers from getting red hot. He told me so hisself."

* * * *

With a great show of . . . show of . . . determination . . . nation the villain picked up a pistol . . . picked a pistol . . . and showing his teeth shot his enemy . . . enemy . . . in the back . . . determination . . . picked pistol . . . showing . . . shot enemy in . . . teeth . . . the villain . . . showing pistol . . . and picked teeth . . . his back . . . teeth. With deter . . . pistol . . . villain . . . showing teeth in . . . back . . .

"Oh bother, what's the use of trying to read a book in a motor bus?"

* * * *

The officer commented to the sergeant upon the unsoldierly appearance of a recruit: "He looks very slovenly, sergeant."

Sergeant: "Yes, sor."

Officer: "Are you sure he washes?"

Sergeant: "Yes, sor."

Officer: "Absolutely certain he washes?"

Sergeant: "Yes, sor, but he dries a bad colour, sor."

* * * *

"Guess my latest discovery."

"I couldn't, what is it?"

"I've discovered how to tell the number of pieces of macaroni on a plate."

"How?"

"Why, just add up the ends and divide by two."

* * * *

"I tell you I won't have this room," protested the lady from the country to the bell boy. "I am not going to pay my good money for such a small room just because I'm from a small town."

"Step in, madam," interrupted the boy, "this is the lift."

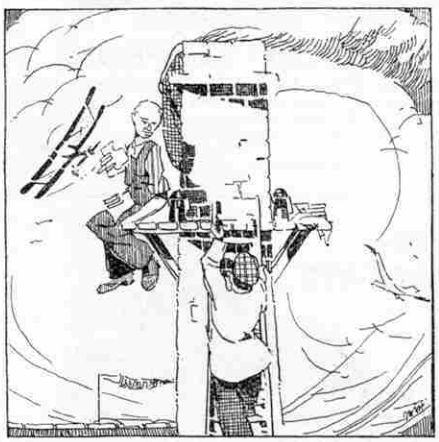
* * * *

"Did you open the window wide?"

"Indeed I did, I pulled the top half all the way down and pushed the bottom half all the way up."

* * * *

THE OPTIMIST



The two steeplejacks had started their lunch at the top of a very tall chimney stack, when one suddenly began to climb down the ladder.

"Where are you going, Bill?" said the other.

"I've dropped my egg," came the reply.

* * * *

An Aberdonian went to a Glasgow football match. On his return a friend asked: "An' did they have a big gate?"

"Big gate, did ye say?" replied the traveller. "It was easily the biggest I've ever climbed over."

HE'D BEEN HAD ONCE

Sergeant: "What's the first thing you do when cleaning your rifle."

Private: "Look at the number."

Sergeant: "Oh, and what's the big idea?"

Private: "To make sure I don't clean someone else's."

* * * *

PUSHING BUSINESS

"Take this, my good woman," said the passer-by as he dropped a coin into the beggar's cup. "You must find it very hard work pushing your invalid husband about in a bathchair all day."

"Thank you, sir. It is hard, but we takes it in turn. I pushes him in the morning and he pushes me in the afternoon."

* * * *

The doctor was summoned to the telephone.

"Come at once," wailed a voice at the other end. "My little boy has swallowed my pencil!"

"I'll come immediately," said the doctor. "What are you doing in the meantime?"

"Using my fountain-pen."

* * * *

"Dear Teacher," wrote Willie's mother, "kindly excuse Willie's absence from school yesterday afternoon; he fell in the mud and soiled his clothes. By doing the same, you will oblige his mother."

* * * *

"So you're a salesman now, eh, Sambo! Do you stand behind the products you sell?"

"No, sah, ah sho' don't."

"Why, Sambo, I'm surprised at you. What are you selling?"

"Well, sah, you see, ah sells mules."

* * * *

They had grown wealthy suddenly and had purchased a farm, complete with hens, cows and pigs. Said a visitor one day: "Do your hens lay eggs?"

"Oh, they can," was the lofty reply, "but in our position they don't have to."

* * * *

"What's Brown doing now?"

"Oh, he's got a job travelling from house to house selling 'No Peddlers Wanted' signs."

* * * *

"He whistles at his work."

"He must be happy."

"No, he's a traffic policeman."

* * * *

"Can you crawl on your hands and knees?"

"Sure I can."

"Well, don't do it. It's babyish."

* * * *

Lawyer: "Your Honour, I would like to ask for more time for my client."

Magistrate: "All right. I was going to give him five years. Now I'll give him ten."

WHEW!

Visitor: "Weren't there two windmills here before?"

Boy: "Yes, but there wasn't enough wind for both, so they took one down."

* * * *

"I beg your pardon, but what is your name?" the hotel clerk asked the guest who had just signed the register.

"Name?" came the indignant reply. "Can't you see it there on the sheet?"

"I can," answered the clerk. "That is what aroused my curiosity."

* * * *

"You sold me a car about two weeks ago."

"Yes, sir. How do you like it?"

"I want you to tell me everything you said about that car all over again. I'm getting a bit discouraged."

* * * *

"Do you know what they do with ferry boats when they're late?

"No—what?"

"Dock 'em."

* * * *

"Say Joe, Are you going in costume to the fancy dress party?"

"Sure, I'm going as a plain clothes detective."

* * * *

Sonny, out shopping with his mother, had been badly misbehaving himself. He wanted everything he saw, until on the way home his mother got exasperated.

"Are you sure you wouldn't like the moon as well," she said.

Sonny looked up at the half moon, "No," he said with disgust, "it's broken."

* * * *

She (at concert) "What's that book the conductor keeps looking at?"

He: "That's the score of the overture."

She: "Oh, really, who's winning?"

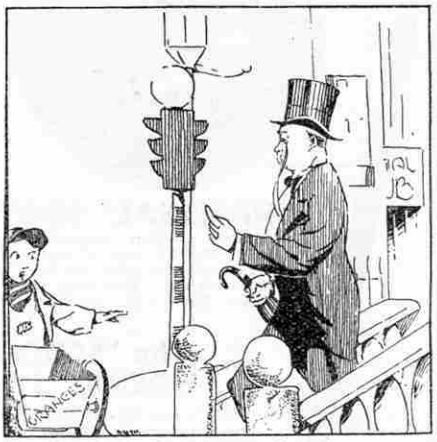
* * * *

Farmer (to friend): "I hear that while ye were in the city ye took up this here golf. How d'ye like it?"

Friend: "Well, it ain't bad. It's a bit harder than hoein' turnips an' a bit easier than diggin' potatoes."

* * * *

THE PESSIMIST



The man in evening dress stood on the pavement outside his club looking for a taxi. Not seeing one he called to a small urchin who was pushing his home-made barrow along the gutter.

"I say, my lad," he said, "just run up to the top of the street and fetch me a taxi."

The boy looked at him. "Not likely," he shouted indignantly. "I knows your sort. As soon as my back's turned you'll nip off with me barrow."

* * * *

"Ah ha! at last I've found you out."

"No, but the next time you come round you will."

Competition Corner

ANOTHER "SLOGANS" CONTEST

The recent Advertising Slogans Competition proved to be one of the most popular that we have featured in recent months, and many attractive and quite ingeniously contrived slogans were submitted.

Having succeeded in arousing our readers' interest in advertising slogans, we are giving them this month another opportunity to turn it to good purpose. On this occasion, however, we are reversing the contest, and instead of asking readers to compose "snappy" slogans for well-known commercial products we give in the centre of this page a list of 30 popular slogans and invite readers to identify them.

1. A meal in a moment	16. More miles per gallon
2. Sticks everything	17. Phil and Phil-up again
3. Makes perfect drives and paths	18. Where the rainbow ends
4. Something to sing about	19. By far the best for the lasting shine
5. King of soaps—Soap of Kings	20. It's cheaper to dye than buy
6. Country health for you	21. Beef is best
7. Always good to meat	22. The suitcase that adjusts itself
8. Extra richness, extra flavour	23. See how it runs
9. Keeps you right on top	24. Here's health!
10. The King of Fish	25. The car you're proud to own
11. Makes delicious puddings	26. It simplifies all soldering
12. A dream of a roll	27. After all you must have QUALITY
13. Gives that superior finish	28. The true tonic food
14. Nature's aid to beauty	29. Better than a mustard plaster
15. Beef in brief	30. See the name on every piece

For the benefit of new readers it may be well to explain that an advertising slogan is a catch-phrase, a short string of easily-remembered words that set forth concisely some point of merit claimed for the goods or service advertised. The name of the product may be embodied, but frequently it is omitted, as in the examples used in this competition.

Some of the slogans given in the accompanying panel are old and on that account may be quickly recognised, but others are quite new and their identification will prove to be a fascinating task. When a competitor has identified all the slogans, or at any rate as many of them as he is able to manage, he should make a neat list of the products they advertise and the names of the advertisers.

Prizes of Meccano Products to the value of 21/–, 15/–, 10/6 and 5/– (to be chosen by the winners from the current catalogues) will be awarded to the senders of the four most accurate solutions in order of merit. In the event of a tie for any or all of the prizes, preference will be given to the neatest or most novelly prepared entries.

Entries should be addressed to "Advertising Slogans, Meccano Magazine, Binns Road, Liverpool 13," and must reach this office not later than 29th September.

A duplicate set of prizes will be reserved for entries from readers living Overseas, that is, outside Great Britain, Ireland and the Channel Islands. Overseas entries must arrive not later than 31st December.

THE 1934 PHOTO CONTESTS

With this month's competition the 1934 series of Photographic Contests comes to an end. We hope, therefore, that all those readers who have not yet taken part will make a point of doing so this month, by sending in the best of their holiday snaps.

The conditions of the competitions are exceedingly easy, for the only restrictions are that the exposure must have been made by the competitor, and that each picture must bear a title. The make of plate, film or camera, the size of the photograph, and whether it has been developed professionally or by the competitor himself is immaterial, except to the extent that preference is given to entries that are solely the work of the competitor when all other points are equal.

This month's competition will be divided into two groups, Home, for those living in Great Britain, Ireland and the Channel Islands; and Overseas, for those living outside those areas. Each group will be divided into two sections, A for those aged 16 and over, B for those under 16; and prizes of Meccano Products or Photographic Materials (to be chosen by the winners) to the value of 21/– and 10/6 will be awarded in each.

In addition to its title, each print must bear on its back the competitor's name, age and address. Unsuccessful entries will be returned if a stamped addressed cover is sent for the purpose. In the ordinary course prize-winning entries are retained, and it is a condition of entry that the Editor shall have the right to reproduce any entry without fee. When non-prize-winning entries are reproduced, suitable acknowledgment will be given, of course.

Entries sent this month must be addressed "September Photo Contest, Meccano Magazine, Binns Road, Liverpool 13," and must arrive not later than 29th September. Overseas closing date, 31st December.

The Overseas Section now having closed, we give below the solution of the April Crossword Puzzle.

■	N	■	R	E	S	I	S	T	E	R	S	■	S	■
C	A	V	E	A	T	■	A	■	S	E	A	L	E	D
■	U	■	P	R	A	C	T	I	C	A	L	■	R	■
A	S	S	E	N	T	■	I	■	O	L	I	V	E	R
P	E	A	N	■	E	R	R	O	R	■	N	I	N	E
P	A	T	T	E	D	■	I	■	T	H	E	B	E	S
E	■	U	■	X	■	■	C	■	■	O	■	R	■	E
L	U	R	K	I	N	G	■	V	A	R	I	A	N	T
L	■	N	■	L	■	■	P	■	■	S	■	T	■	T
A	B	I	D	E	S	■	R	■	A	E	R	I	A	L
N	O	N	E	■	A	L	O	O	F	■	O	O	Z	E
T	R	E	A	D	S	■	T	■	F	O	U	N	T	S
■	R	■	L	O	I	T	E	R	E	R	S	■	E	■
S	O	L	E	M	N	■	G	■	C	L	E	N	C	H
■	W	■	R	E	E	L	E	C	T	E	D	■	S	■

COMPETITION RESULTS

HOME

May Photo Contest.—First Prizes: Section A, D. E. Cooper (Witham); Section B, D. M. Gaunt (Shrewsbury). Second Prizes: Section A, S. Garbutt (Altrincham); Section B, J. Heyman (Highgate, N.6).

July Crossword Puzzle.—An interesting point arose in the judging of this competition, in the form of a curious set of alternatives that was quite unsuspected at the time the puzzle was composed. As the Overseas Section has not yet closed we cannot give the solution now, but those competitors who discovered the alternatives and were at a loss as to which to use, may be reassured by the knowledge that in the judging alternatives that properly interpreted the clues were accepted as correct. The prizewinners' names are as follows: 1. A. K. Brown (Weston-super-Mare); 2. G. Burgess (London, N.12); 3. A. F. Agnew (Dublin); 4. A. W. Turner (Edinburgh). Consolation Prizes: A. C. Horne (Birkenhead); P. Lynam (London, N.6).

July Photo Contest.—First Prizes: Section A, F. H. Culverhouse (Sheffield); Section B, T. G. C. Wood (London, N.W.3). Second Prizes: Section A, W. J. Aitken (Edinburgh); Section B, F. H. Smyth (Exeter).

OVERSEAS

January Stamp Contest.—1. Victor Hillier (Toronto); 2. V. A. Garcia (Trinidad, B.W.I.); 3. E. J. Lloyd (East London, S. Africa); 4. J. Turner (Cambridge, S. Africa).

March Drawing Contest.—First Prizes: Section A, S. Eriksson (Taranaki, N.Z.); Section B, R. J. Dickison (Dunedin, N.Z.). Second Prizes: Section A, I. Hood (Ryde, N.S.W.); Section B, N. Scully (Singapore).

January Drawing Contest.—In the B Section of this competition the judges found it very difficult to place a dividing line between the quality of the first three entries, and in fairness to the competitors it was decided to lump the first and second prizes together and to divide them equally between the three competitors concerned. The prizewinners' names are as shown: Section A: 1. D. E. Yockney (Auckland, N.Z.); 2. J. S. de'Conti Manduca (Malta). Section B, Jt. 1. I. C. Dickison (Dunedin, N.Z.); R. J. Dickison (Dunedin, N.Z.); R. C. M. Young (Athens).

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Send now for my **4-a-penny selections** and full particulars of the new scheme.
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I will send this splendid packet to all Stamp collectors sending 2d. postage only.

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20 STAMPS all different, from the French Colonies, showing natives, leopards, jungle scenes, etc. Handsome Pictures.

SETS (POSTAGE EXTRA)

5	Lebanon	...	2d.	10	Turkey	...	2d.
10	„	...	5d.	20	Sweden	...	2d.
15	„	...	8d.	20	Switzerland	...	2d.
20	„	...	1/-	20	Spain	...	2d.
5	Syria ...	...	2d.	20	Russia	...	2d.
10	„ ...	...	5d.	20	Roumania	...	2d.
15	„ ...	...	8d.	20	Poland	...	2d.
20	„ ...	...	1/-	20	Portugal	...	2d.
4	Iraq ...	...	2d.	10	Norway	...	2d.
8	„ ...	...	5d.	5	Lithuania	...	2d.
12	„ ...	...	9d.	5	Luxemburg	...	2d.
5	Persia ...	...	2d.	5	Jugo-Slavia	...	2d.
10	„ ...	...	4d.	20	Italy ...	...	2d.
15	„ ...	...	6d.	20	Italy Pictorial,		6d.

J. RUSSELL,
23, Shanklin Drive, Westcliff-on-Sea.

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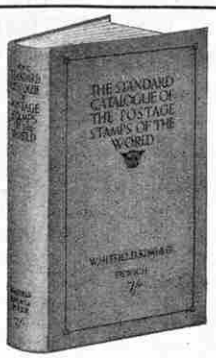

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Stamp Gossip

and Notes on New Issues

The Nyasaland Issue

We illustrate this month the design of the new stamp series issued for the Nyasaland Protectorate. It is certainly one of the most striking British Colonial issues of recent days. The same design is used for

each of the seven stamps in the series. The crouching leopard is symbolic of the territory, and the rising sun suggests the new undeveloped member of the British Commonwealth.

Gibbons' Stamp Monthly makes a rather interesting point concerning the King's portrait. The view apparently is of the right side of His Majesty's face; but actually it is the view of the left side, commonly used on British stamps, reversed for the purpose of the design. As a result the King is shown incorrectly, with his hair parted on the right!

This is, of course, a very minor flaw in a striking issue that merits a place in every stamp album.

Empire Loyalist Stamp

To commemorate the 150th anniversary of the settlement of the United Empire Loyalists in Canada a special 10c. Canadian stamp has been issued. The new stamp is olive green in colour and of particularly large format, and will be available only for a limited period, after which the sale of the current 10c. stamp is to be resumed.

The inscription on the stamp includes the words "1776—United Empire Loyalists —1784," and the year of issue, 1934, appears at the top with a representation of the British Crown and the Union Jack in use in 1784. The centre panel shows a sculptural group of Loyalists consisting of man and wife and two children. Supporting this panel, on each side, are figures of Britannia and a North American Indian.

A 3c. commemorative stamp marking the Jacques Cartier quadri-centenary also has been issued. Cartier was the Frenchman who took possession of Canada for France in 1534, and France also proposes to commemorate his memory by means of a special stamp issue to appear co-incident with the Canadian celebrations.

U.S.A. Holiday Propaganda

With a view to popularising the National Parks, and persuading the people to visit them rather than travel abroad, the United States this year has organised a special "Spend your holidays in the Parks" campaign, and to support this the Postal Authorities have issued a set of postage stamps bearing illustrations of typical scenery in the parks. There are 10 values in the set, ranging from 1c. to 10c. In order that the illustrations may show up as boldly as possible the stamps are rather larger than those normally issued.

It is difficult for anyone who has not visited these parks to imagine their size and grandeur. The largest of them is the Yellowstone National Park, covering an area of 3,348 sq. m., which is featured on the 5c. stamp. This was the first of the national reservations to be set aside by the Government, and is particularly notable for its numerous geysers. It contains more than 4,000 active hot springs.

The Grand Canyon National Park, over 1,000 sq. m. in area, shown on the 2c. stamp, ranges over the grandest section of the famous gorge after which it is named. The Grand Canyon is a natural gorge, from five to 15 miles in width and at points over a mile in depth, cut by the Colorado River into a high plateau in North Arizona.

The Sequoia National Park is situated in middle-eastern California, and covers an area of 604 sq. m. encircling the foot of Mount Whitney (14,496 ft.), the highest mountain in the United States except in Alaska. It is specially noted for its wealth of immense trees, which are made the principal feature of the 8c. stamp.

The 9c. stamp bears an illustration of the Glacier National Park, situated in Montana on the eastern slopes of the Rocky Mountains. Many unique relics of the Ice Age, in the form of glacier-fed lakes and small glaciers, are to be observed in this park.

The remaining stamps will show scenes as follows:—1c., the Yosemite Park in the Sierra Nevada Mountains, with El Capitan (3,000 ft.) as the central feature; 3c., Mount Rainier (14,408 ft.) the highest peak in the State of Washington; 4c., Mesa Verde, in South West Colorado; 6c., the Zion Park, situated on the Rio Virgin in Utah; 7c., Acadia Park, the only one lying in the eastern states; 10c., the Great Smoky Mountains Park, lying partly in North Carolina and partly in Tennessee.

More Football Stamps

Football enthusiasts among our readers will be delighted with the new International Football Championship stamp series recently issued by Italy. The series comprises nine stamps, five (20c. to 5L.) for ordinary postage, and four (50c. to 10L.) for air mail use; and most of the stamps bear illustrations of footballers in action.

The 20c. shows a goalkeeper making a mighty effort to save a shot that seems bound to clear the bar in any event. The 25c., 50c. and 1L.25c. share the same design, showing two players tackling the ball in very determined style; and on the 5L. stamp we are shown a goalkeeper making a clearance under pressure. This is quite the best design, and we have chosen it for reproduction.

The series of air stamps show views of the great Stadium at Rome, where the finals of the competition, won by Italy, were played.

The Italian Colonial issues in the same series are perhaps even more interesting than those of the parent country. There are five stamps (10c. to 10L.) in the general series and five (50c. to 28L.) in the air set. We have selected two of the designs for reproduction. The 10c. design makes a curious spectacle for those of us brought up to the idea of football as solely a winter game. Here a ball is shown smashing into a football net, obviously placed in the midst of tropical sand. The same design is used for the 50c. and 1L.25c. stamps. The second design of this series gives an interesting sidelight on the official attitude towards the game. Here a footballer, presumably waiting to start the game, as the ball is at his feet, is seen giving the Fascist salute.

From the air series we illustrate the 5L. stamp.

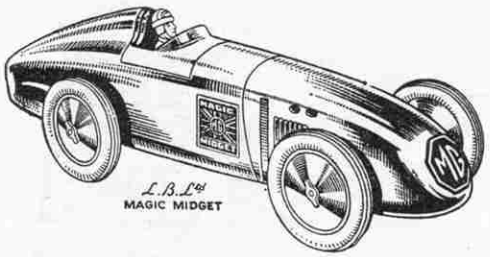
* * *

Ifni, the Spanish settlement in Southern Morocco, is to have a distinctive stamp issue instead of using the stamps of the home country. Pending the issue of the new stamps, the current Spanish stamps will remain in use, but will be overprinted with the name "Ifni."

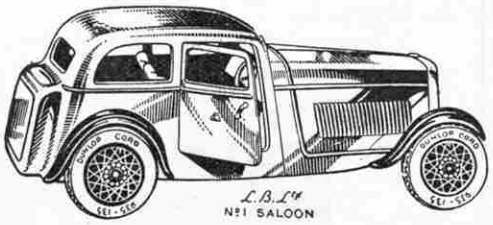
We thank Stanley Gibbons Ltd. for their courtesy in loaning the stamps from which the illustrations on this page have been made.

A SELECTION OF POPULAR 'TRI-ANG' TOYS

EACH OF WHICH IS UNSURPASSED FOR DESIGN, STRENGTH AND FINISH



SEE THIS MARK ON EVERY TOY YOU BUY.



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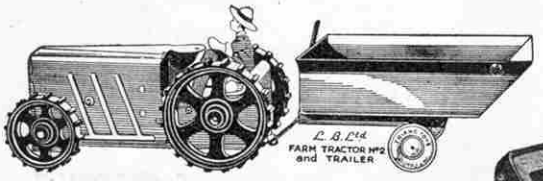

No. 2 Farm Tractor and Trailer

All steel bodied Tractor with powerful motor and heavy rubber wheels. Complete with steel tipping Trailer with solid rubber wheels. Overall Length 18". Price **3/11**

No. 1 Clockwork Saloon

A fine model of a modern Saloon Car. Steel body and realistic wheels. Strong clockwork motor. Length 16". Fitted with electric light 6/11. Price **5/11**

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1935 model with all steel body and side opening door. Magna type radiator and plated tubular bumper. Steel wheels with 1⅛" sponge rubber tyres. Length 35". Price **37/6**

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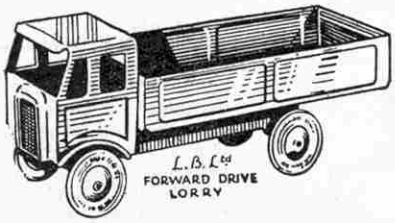
A splendid Doll's Pram. All steel body with design moulded into panels. Best quality fittings include: Chromium plated handles, rims and hubs and rubber duck hood and apron. Price **37/6**



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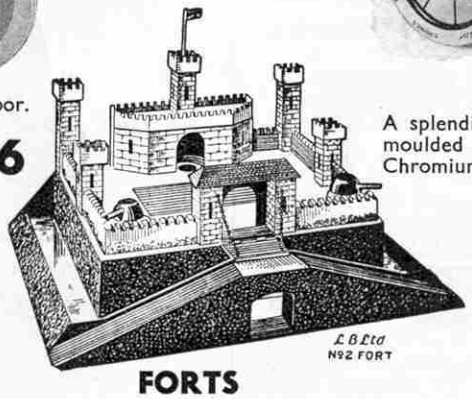

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A splendid series of British-made Forts. Realistic designs, strongly made and nicely finished. Fitted with electric light and model cannon. No. 2 as illustrated, 22 in. long. **8/11**

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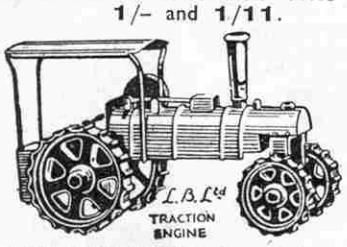
No. 1a	... 16 " "	1 " "	... **6/11**
No. 3	... 18 " "	4 Electric lights	... **12/6**
No. 4	... 28 " "	4 " "	... **19/6**

BREAKDOWN LORRY. With rotating jib and self-locking crank. Steel body and solid rubber wheels. Three sizes. Price **6**d., **1**/– and **1/11**.



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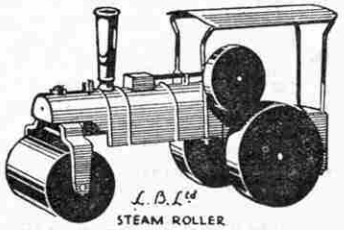

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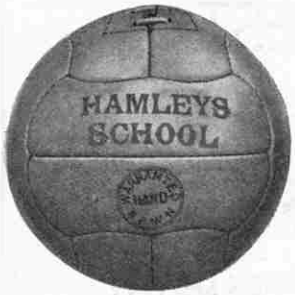

H.3. "THE SCHOOL"

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"THE SCHOOL"

Handsewn case of good quality Hide.

Size 3 ... ... Price **7/6**
Size 4 ... ... Price **8/6**
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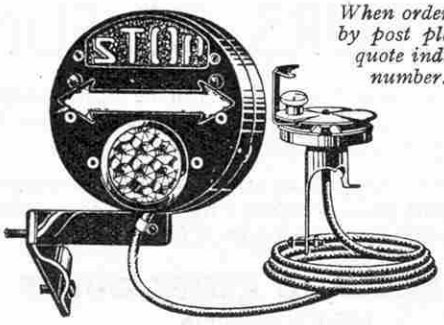

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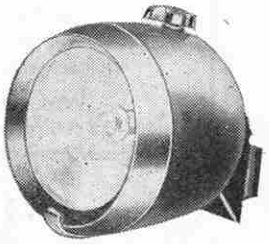
Battery 4½d. extra. Post 6d.



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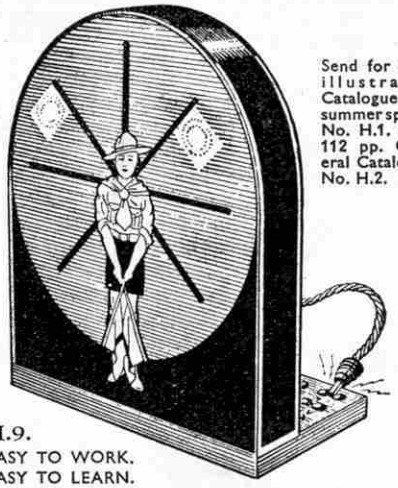

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H.9.

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All the above are supplied complete with leather sheath. (Foreign).

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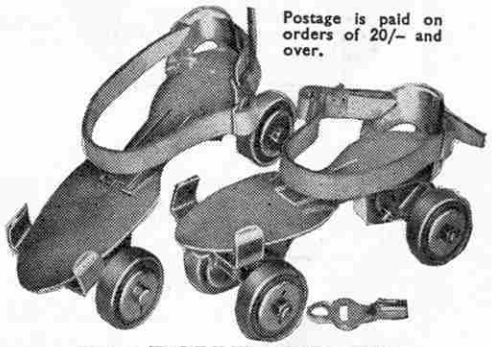

H.10. ROLLER SKATES

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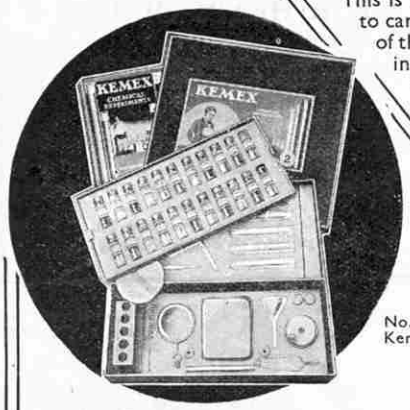
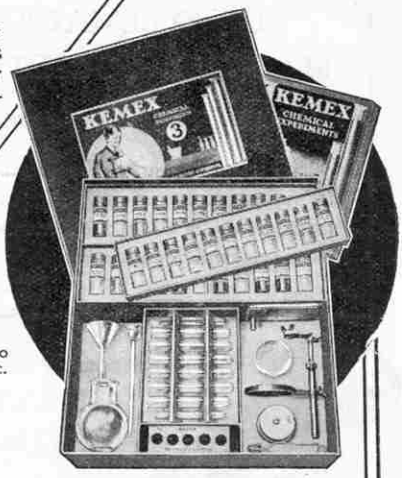


No. 2 Meccano Kemex Outfit.



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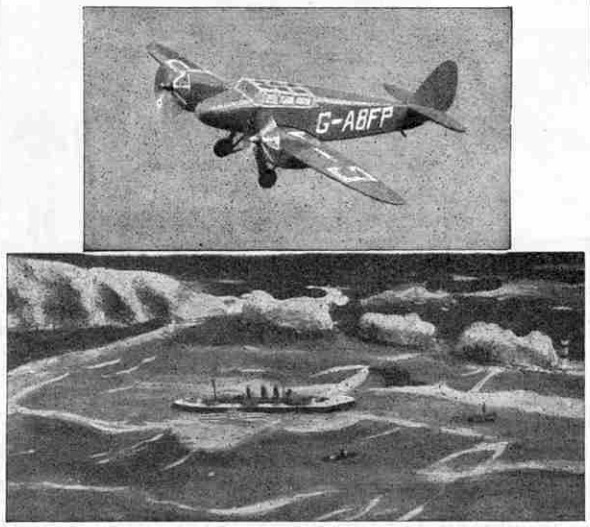

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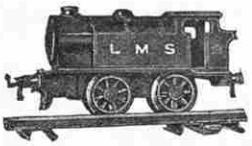
HORNBY TANK LOCOMOTIVES



M3 Tank Locomotive

M3 TANK LOCOMOTIVE. This is the powerful Locomotive (reversing) supplied with the Hornby M3 Tank Goods Set. It is a handsome and extremely reliable model that will give long and excellent service. Available in either red or green. **Price 7/6**

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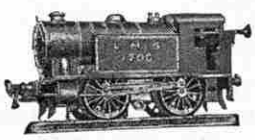
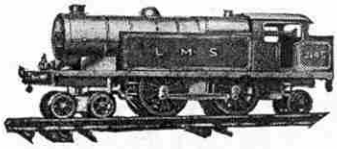
No. 1 TANK LOCOMOTIVE. This strong and durable Locomotive is capable of any amount of hard work. It is fitted with brake mechanism and reversing gear, and is supplied in colours to represent L.M.S.R., L.N.E.R., G.W.R. or S.R. Locomotives. **Price 13/6**



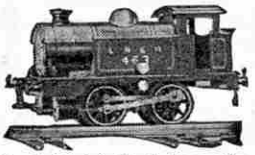
No. 1 Special Tank Locomotive

No. 1 SPECIAL TANK LOCOMOTIVE. This splendid Locomotive which is fitted with brake mechanism and reversing gear, has remarkable power and gives a very long run. It is available in the colours of the L.M.S.R., L.N.E.R., G.W.R. and S.R. **Price 18/–**



No. 2 Special Tank Locomotive

No. 2 SPECIAL TANK LOCOMOTIVE. This Locomotive has great length of run and exceptional pulling power. It is fitted with brake mechanism and reversing gear. In every respect it is a perfect model, beautifully finished in the colours of the L.M.S.R., L.N.E.R., G.W.R. and S.R. **Price 25/–**



No. 1 Electric Tank Locomotive

No. 1 ELECTRIC TANK LOCOMOTIVE. This Locomotive is of the permanent magnet type, and may be run from a 6-volt accumulator. It can be stopped, re-started, reversed and the speed varied by the operation of levers at the side of the track. It is supplied with a terminal connecting plate, speed and reverse control switch and 3 feet of flex, and it is available in the colours of the L.M.S.R., L.N.E.R., G.W.R. and S.R. Locomotives. **Price 32/6**

This Locomotive cannot be run from the mains supply.

MECCANO LTD. - BINNS ROAD - LIVERPOOL 13

There's a RILEY BILLIARD TABLE to suit in size and price...and you can pay as you play

Riley "Home" Billiard Table resting on ordinary table.

8/- DOWN FOR 8/- DOWN you can have a Riley "Home" Billiard Table delivered to your door on 7 days' free trial, carriage paid. All Riley Billiard Tables are perfect replicas in construction of full size tables. Do not confuse them with inferior toy billiard tables. No matter how small or how large your room is, there is a Riley Billiard Table to fit it. Below is a full range of Riley "Home" Billiard Tables with sizes and prices:

4 ft. 4 ins. × 2 ft. 4 ins.	£7 0 0
5 ft. 4 ins. × 2 ft. 10 ins.	£9 0 0
6 ft. 4 ins. × 3 ft. 4 ins.	£11 15 0
7 ft. 4 ins. × 3 ft. 10 ins.	£15 0 0
8 ft. 4 ins. × 4 ft. 4 ins.	£21 10 0

32 FREE Billiard Tables. Send for details.

Dine and play on the same table. The Riley "Combine" makes this simple. Ready for either purpose in a few seconds. In many attractive styles in oak or mahogany. Cash prices from £22 10 0 upwards, or monthly terms. Here is illustrated the Riley "Cabriole" design 6 ft. size, £34 10 0 or monthly terms.

Riley's are the largest makers of full size billiard tables in Great Britain. Also specialists in Re-covering, remodelling, billiard sundries, etc. **Write for Art List.**

or in 20 monthly payments of 8/–, 10/3, 13/3, 17/–, 24/6.

Riley "Combine" Billiard and Dining Table.

E. J. RILEY LTD.

Deal Works, Accrington. And Dept. 6, 147, Aldersgate Street, London, E.C.1.

℗2

International Exhibition of Inventions

Readers of the "*M.M.*" who are interested in invention should not fail to visit the 10th International Exhibition of Inventions organised by the Institute of Patentees, which will be held in the Central Hall, Westminster, London, from 3rd to 13th October. Apart from the interest of the inventions that will be demonstrated, the Exhibition will give an indication of the general trend of invention in all parts of the world. This year's display promises to be even more successful than those of previous years, and the efforts of the Institute to bring new ideas prominently before the public are worthy of the strongest support that can be given.

Stamp Adverts. continued from p. 746

Buddhist Ruin in Java—(*Continued from page 685*)

monument. The task of clearing the great ruins of their covering of volcanic deposit was a much more tedious task and took nearly two years to complete. The administration of the island was taken over by Holland in 1818, and the Dutch Archæological Service in Java subsequently carried out important restoration work at Borobudur. It was a Dutch engineer who discovered in 1886 that in its original plan the monument had a different base from the present one, and excavations disclosed the inscriptions and unfinished reliefs already mentioned.

Borobudur is now one of the show places of Java, and there is an hotel where tourists can stay overnight in order to witness the unique spectacle of sunset and sunrise from the ruins.

How to Get More Fun—(*Continued from page 737*)

attention was given to the operation of fast freight trains on Hornby Layouts in the March "*M.M.*" this year. Modern conditions demand increasing numbers of this kind of train so that express freight working should form an important part in the working programme of a miniature system.

The transportation of livestock must not be neglected and interesting schemes may be worked out in connection with agricultural shows and similar functions for which special traffic arrangements will be necessary. For use on loading docks on a layout the Farmyard Animals of Dinky Toys Set No. 2 are ideal and they may also be loaded into the No. 1 and No. 2 Cattle Trucks by those who are keen on the carrying of actual loads in their wagons.

In addition to such trains used exclusively for the carriage of one particular form of freight, there are those that convey a great variety of general goods. These naturally provide the greatest scope for the use of different types of wagons and different loads. Readers keen on producing appropriate effects should note the composition of trains observed in their own districts or in their local goods or shunting yard. An interesting example of a mixed freight train carrying a miscellaneous collection of goods is shown in the lower illustration on page 737.

In addition to articles carried by freight trains there is a great deal of traffic conveyed by trains that partake more of a passenger character. Trains for parcels traffic are regularly operated and frequently parcel vans are attached to passenger trains. On Hornby layouts the No. 1 and No. 2 Luggage Vans are particularly appropriate for such traffic and good use can be made of the items of miniature luggage contained in Set No. 1 of Railway Accessories for loading them up. The hampers in these sets are especially useful for imitating the large skips that are often used as containers for smaller packages. A consignment of these being loaded into a No. 2 Luggage Van, attached to the rear of a passenger train appears in the illustration on page 736.

Hobbies Handbook for 1935

The 1935 edition of "Hobbies Handbook," the familiar catalogue issued each year by Hobbies Ltd., is even more comprehensive and interesting than its predecessors. In general arrangement it follows similar lines to previous editions, and as usual fretwork occupies the main portion. There are descriptions and illustrations of every type of fretwork apparatus that could be desired, and the purely catalogue section is supplemented by practical advice on how to start this fascinating hobby.

Special articles deal with the making of gramophones, wireless sets, jig-saw puzzles and musical instruments. The numerous illustrated designs cover a wide range of useful and ornamental articles, including bookcases, cabinets for china, photo frames, clock cases, tables and other home-made furniture. The general woodworker and the lathe worker also are catered for, and the tools listed and illustrated cover every requirement. Other attractive items dealt with are model aeroplanes, sailing boats and steam launches, table tennis and miniature bowls.

The "Hobbies Handbook," with three free designs, can be obtained price 6d. from any bookseller, newsagent or Hobbies dealer, or from ironmongers.

Mersey Tunnel—(*Continued from page 687*)

operate automatically when a fire alarm is given. Other illuminated signs are available to order engines to be switched off in the event of a prolonged stoppage, and thus to avoid the risk of increasing unduly the proportion of poisonous gas in the tunnel.

A wonderful system of automatic recorders keeps the control staff fully informed of everything that is happening throughout the tunnel system. The control room is in one of the ventilation buildings and the operator has in front of him instruments recording instantaneously the number of vehicles entering the tunnel, the proportion of carbon monoxide in its atmosphere and the degree of visibility. Other dials tell him which ventilation fans are running, and at what speed, and if the drainage pumps and their motors are doing their duty, and any accident or unusual event occurring in the tunnel itself is brought to his notice by automatic alarms or by telephone messages from the man on patrol.

Photo-electric cells play important parts in the devices that pass this information to the control room. For instance, every vehicle entering the tunnel passes under a beam of light and any car or lorry of more than the permitted height of 17 ft. would intercept the beam and cause a warning bell to ring. Just within the tunnel entrances are other photo-electric cells, placed beneath the roadway, and in the paths of light rays from the roof. As each vehicle passes over one of these cells, it interrupts the light rays and its passage is instantaneously recorded on dials in the control room that automatically take a census of tunnel traffic.

One of the most important recording instruments in the control room shows how much carbon monoxide is present in the tunnel. The proportion of this poisonous gas is kept as low as one part in 20,000, and this is indicated by a red line marked on a chart. Any definite rise would be counteracted immediately by speeding up the flow of air through the tunnel and the operator would be warned of the need for action by the ringing of an electric bell if the proportion of carbon monoxide inside reached one part in 10,000.

This Month's Special Articles

READERS' SALES

Sale. Gauge O Railway. Stamp for list.—"Glenville," Canterbury Road, Sittingbourne, Kent.

Eighty "Hobbies," 7/6. 50 Fretwork Designs, 3/6.—Adams, 5, Nelson Place, Stirling.

Sale. "M.M.'s" January 1926—September 1930. Complete, 10/–.—Mount Hermon, Didsbury, Manchester.

Bumper Bargain! Homers bred from parents hatched in Royal loft, 7/6 each. Sold by necessity. Apply—Box 901.

B.S.A. Air Gun, £2. Electric Motor Boat, 7/6. Scale model Citroen car chassis, 7/6. Bassett-Lowke railway track, £1/10/–. List on application.—44a, Kenilworth Road, Leamington Spa.

"Meccano Magazines." 1925 to 1934 (July), the lot 10/–, volumes sold separately.—Blake, 31, Idmiston Road, Worcester Park, Surrey.

Sale! Cinematograph, 10/–, cost £3. Large quantity Standard Films including Two News Reels. Stamp list. Also Gauge "O" "Duke of York," rebuilt, 10/– or offers.—Vowles, 86, Clifton Road, Rugby.

Wanted. Wade Lathe Chuck, 2 or 2½ in. in diameter.—Reynell, Loxford Road, Caterham.

Sale. 12/6 Bowman dynamo, as new. Take 6/–.—"A," 4, Avignon Road, Brockley.

Harmsworth Self-Educator. Complete, 48 parts, 7,000 pages, hundreds of illustrations, 7/6. Edison Gem phonograph with 100 records, 18/6. ¾ Violin, bow, case, music stand, 12/6. Stereoscope, 36 views, 4/6. Excellent loud speaker, adjustable unit, 5/–. Film camera, as new, 2/6. Hornless gramophone, 15/–. 20 double records, 7/6. Exchange offers entertained.—Smith, Etling Green, Dereham, Norfolk.

Bowman Snipe. As new, 10/– or exchange toys.—Preston, Woodland Cottage, Thwaites Brow, Keighley.

For Sale. Wonder Book of Aircraft. As new. Take 4/– or highest offer.—Ferguson, Seaforth Sanatorium, Conon, Ross-shire.

Meccano Magazines—July, 1932—Aug., 1934 minus one. Offers?—Lane, "School House," Gaywood, King's Lynn.

79 "M.M.'s," 1927—33, 16/–, also Universal Encyclopædia, complete set unbound 15/–. Cost 26/–.—W. Dunn, 10. Hatfield Street, Belfast, Ulster.

Bus, tram, train tickets, sold and exchanged. Belgian, American, etc. Postcard brings list. Fleetwood, 18, Wilfield Road, Ballsbridge, Dublin.

A Morse Transmitting and Receiving System

Readers who are interested in radio telegraphy will find an advertisement in this issue concerning a simple device by means of which it is possible to transmit real Morse signals through their radio sets. No interference is caused to neighbouring receivers, as the low frequency circuit of the radio set only is employed and acts simply as an amplifier for magnifying the Morse signals.

The method of operation with the "Clivex" apparatus is to run a pair of wires from the gramophone "pick-up" terminal of any radio set to the "Clivex" transmitter which may be placed at any distance away from the radio set. One boy sends out the message in the usual manner by means of a Morse key, and his friend receives it clearly and distinctly on the radio set. The "Clivex" apparatus includes the necessary Morse key, transmitter and circuit wire, and should prove very useful to those who wish to practise the Morse code.

MECCANO MAGAZINE

Registered at G.P.O., London, for transmission by Canadian Magazine Post.

EDITORIAL AND ADVERTISING OFFICE:—
LIVERPOOL 13, ENGLAND.
Telegrams: "Meccano, Liverpool."

Publication Date. The "*M.M.*" is published on the 1st of each month and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price 6d. per copy. It will be mailed direct from this office, 4/– for six issues and 8/– for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

Readers' Sales and Wants. Private advertisements (i.e., not trade) are charged 1d. per word, minimum 1/–. Cash with order. Editorial and Advertising matters should not be dealt with on the same sheet of paper.

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 1st 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 1/2 per copy (postage extra), and the subscription rates 8/– for six months and 16/– for 12 months (post free); Canada, where the price is 10c. per copy, and the subscription rates 65c. for six months, and $1.25 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 United Kingdom and Northern Ireland. 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 Limited, Third Floor, Paykel's Buildings, 9, Anzac Avenue (P.O. Box 129), Auckland, C.1.
SOUTH AFRICA: Mr. A. E. Harris (P.O. Box 1199), 142, Market Street, Johannesburg.
INDIA: Karachi: Daryanamal and Bros., Elphinstone Street. Bombay: Bombay Sports Depot, Dhobi Talao. Calcutta: Bombay Sports Depot, 2, Lindsay 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.

This is the giant Fairey Long-range night bomber, a well-known type of low-wing monoplane used for long distance flying.

Buy a Meccano Aeroplane Outfit

and build realistic models of the World's leading aircraft

Every boy should know how aeroplanes are designed and constructed, and should be able to recognise at a glance the different types of machines in order to understand the purposes for which they have been developed.

The Meccano Aeroplane Constructor Outfits enable boys to design and build their own Aeroplanes quite easily, for these Outfits make possible aeroplane construction on sound engineering lines. All the parts are interchangeable on the famous Meccano principle.

The beautifully illustrated Manual of Instructions included in each Outfit shows how to build wonderful models of high and low-wing Monoplanes, Biplanes, Seaplanes and giant amphibian machines. In fact, models of almost every type of aircraft can be made with these splendid Outfits. Ask your dealer to show them to you.

PRICE LIST

STANDARD SERIES

No. 0 AEROPLANE OUTFIT

An interesting range of models can be built with this Outfit, including high and low wing monoplanes. Price **5/-**

No. 01P AEROPLANE HANGAR OUTFIT

This novel Outfit consists of the complete range of No. 0 Aeroplane Outfit parts packed in a No. 01 Aeroplane Hangar. Price **10/-**

Note. The parts in the No. 0 and No. 01P Aeroplane Outfits are not intended for use with any of the other Outfits.

No. 1 AEROPLANE OUTFIT

Magnificent models of high and low wing monoplanes, and interesting model biplanes can be built with this fine Outfit. Price **9/-**

No. 2 AEROPLANE OUTFIT

This Outfit enables a splendid range of models to be built including triple-engined monoplanes and biplanes and a racing seaplane. Price **16/6**

SPECIAL SERIES

No. 1 SPECIAL AEROPLANE OUTFIT

The parts in this Super Aeroplane Outfit will build over 20 realistic models of different types of aircraft. Price **15/-**

No. 2 SPECIAL AEROPLANE OUTFIT

This is the finest Aeroplane Constructor Outfit on the market. It contains a big range of aircraft parts, with which numerous models of practically any type of machine may be built—44 examples are shown in the Manual of Instructions that is included. Price **25/-**

All Meccano Aeroplane Outfits are available in three different colour combinations—Red and Cream, Blue and White and Cream and Green.

Manufactured by
MECCANO LIMITED
Binns Road - Liverpool 13

This fine model of a low-wing monoplane is made with Meccano No. 2 Special Aeroplane Outfit.

No. 0 Meccano Aeroplane Outfit. Price **5/-**

No. 1 Meccano Aeroplane Outfit. Price **9/-**

No. 2 Special Meccano Aeroplane Outfit. Price **25/-**

MECCANO

AEROPLANE CONSTRUCTOR

HORNBY SPEED BOATS

The Best that you can Buy

The 1934 Hornby Speed Boats, Racing Boats and Water Toy are the finest examples of model craftsmanship ever produced. Exceptional performance, graceful lines and beautiful finish are the outstanding characteristics of these splendid boats. They have introduced a new standard of excellence in British toys. Every boy will be proud to possess one of them.
A selection of Hornby Speed Boats and Hornby Racing Boats is illustrated here in full colour. The complete series is illustrated in half tone on pages 720 and 721 of this issue.

HORNBY SPEED BOATS

When other boats are slowing up, the Hornby Speed Boats are still going strong. The special design of the propeller and the unique methods employed in the construction of the hull give each model exceptional speed and length of run. Every line and every feature of the Hornby Speed Boats emphasises their excellent qualities, speed and reliability. Each model is available in three different colour combinations.

HORNBY RACING BOATS

The new Hornby Racing Boats were introduced to meet a widespread demand for faster boats to be used for racing. They are specially constructed to travel at a high speed, and their remarkable performance, perfect design and beautiful appearance have already gained for them a unique popularity amongst boys.

Ask your dealer to show you the 1934 Hornby Speed Boats and Racing Boats

Manufactured by
MECCANO LIMITED
BINNS ROAD
LIVERPOOL 13

HORNBY SPEED BOAT No. 1. "HAWK." Price **2/11**
Travels over 100 ft. on one winding. Dimensions: Length 9¼ in. Beam 3 in

HORNBY SPEED BOAT. "MARTIN." Price **3/11**
Travels over 160 ft. on one winding. Dimensions: Length 8½ in. Beam 2¾ in

HORNBY RACING BOAT No. 2. "RACER II." Price **8/6**
Travels over 200 ft. at high speed on one winding. Finished in Blue and Cream. Dimensions: Length 12½ in. Beam 3 in.

HORNBY SPEED BOAT No. 3. "CURLEW." Price **12/6**
Travels over 500 ft. on one winding. Dimensions: Length 16½ in. Beam 3½ in.

HORNBY RACING BOAT No. 3. "RACER III." Price **14/6**
Travels over 300 ft. at high speed on one winding. Finished in Red and Cream. Dimensions: Length 16½ in. Beam 3½ in.

HORNBY CABIN CRUISER No. 5. "VIKING." Price **16/6**
Travels over 500 ft. on one winding. Dimensions: Length 16½ in. Beam 3½ in.

This is the Hornby Speed Boat Club Badge, which may be purchased from your dealer, price 6d. During Hornby Speed Boat Week it will be supplied free of charge by Meccano dealers to all purchasers of Hornby Speed Boats.

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