VOL. XVI. No. 6. JUNE 1931.

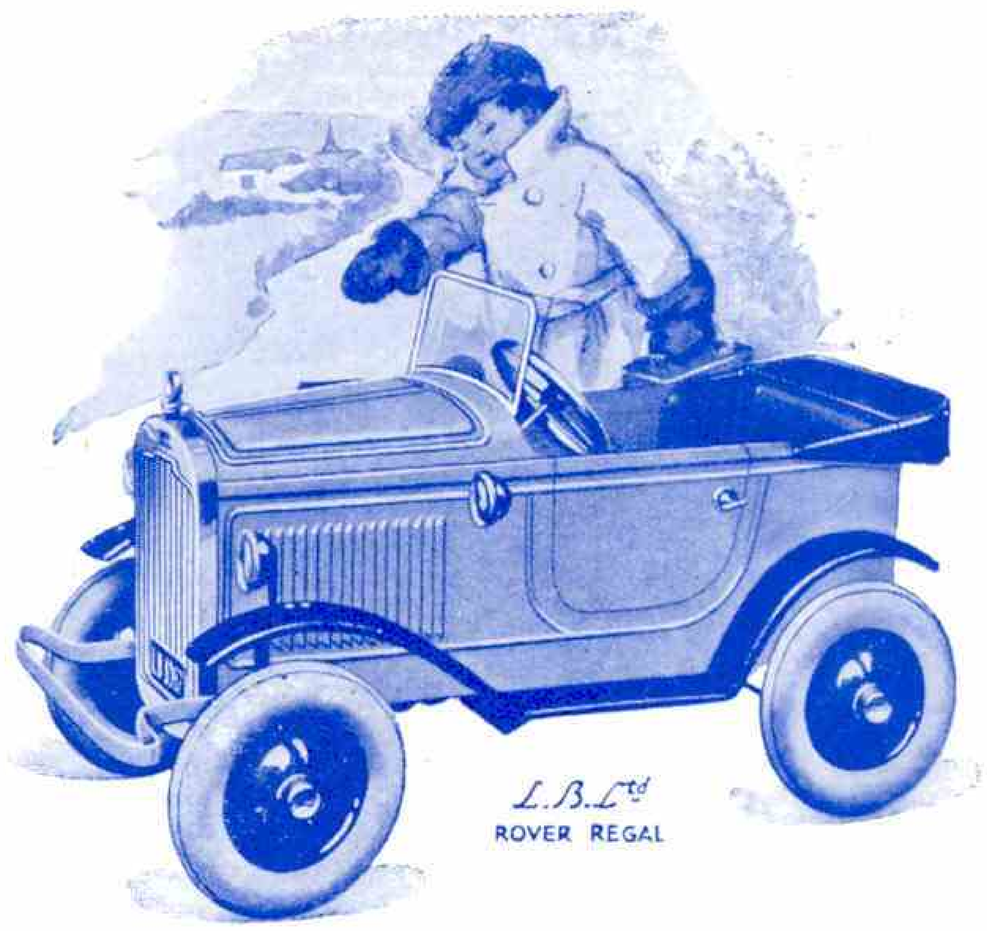
MECCANO MAGAZINE

WONDERS OF UNDERGROUND EXPLORATION: MONSTER STALAGMITES

(See page 450)

6D.

Toy Cars with the real car look!



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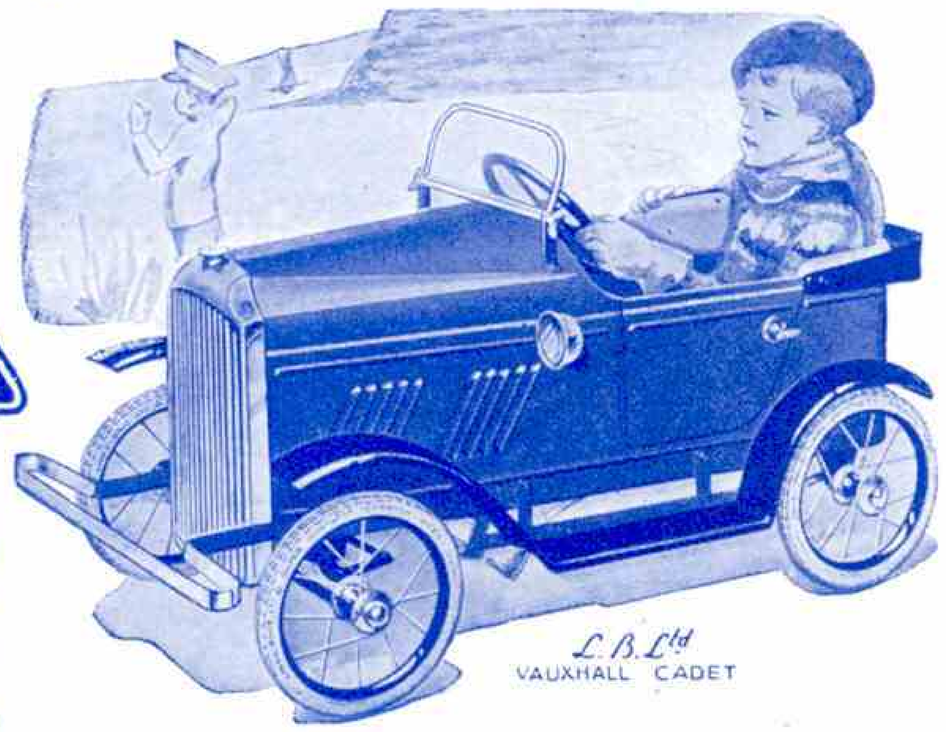

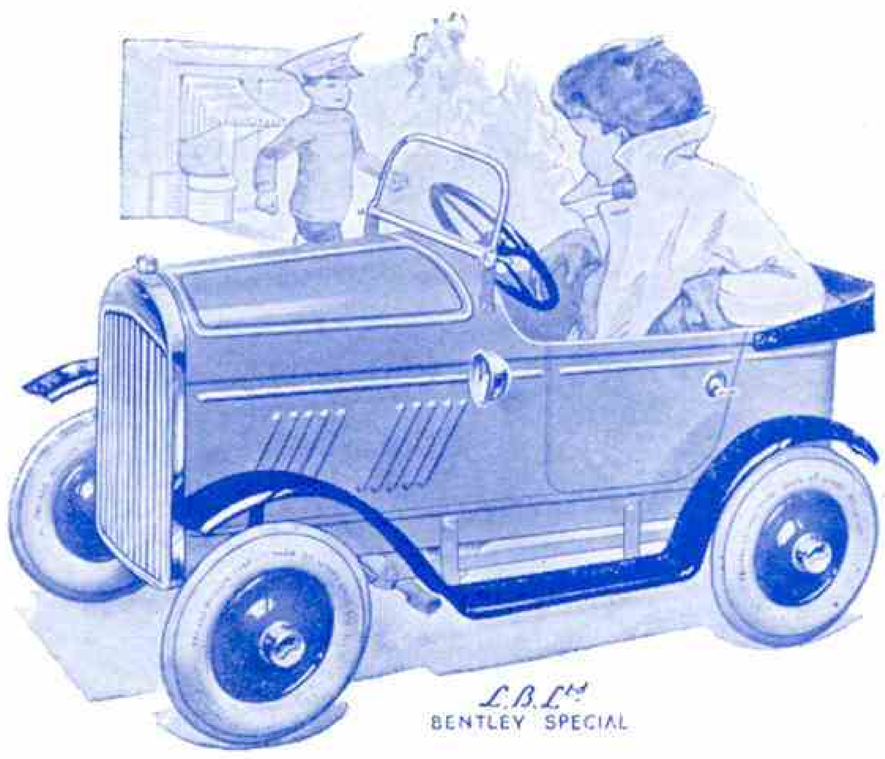

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June, 1931

With the Editor

The "Glorious First of June"

On this day 137 years ago took place the great naval fight known as the battle of the "Glorious First of June," in which a British fleet commanded by Lord Howe defeated the French fleet under Admiral Villaret-Joyeuse.

On 1st February 1793, the French National Convention declared war against England, and in May of the following year Lord Howe's fleet was cruising about off Ushant. The two fleets met on the 28th, and a preliminary engagement took place in which the French ship "*Revolutionnaire*" was attacked by six smaller British vessels, and so crippled that she had to be towed away during the night. One of the British ships, the "*Audacious*," was badly damaged and obliged to return to England. The action was renewed on the following day, without any definite result, although some of the French ships were more or less disabled. Fog now came on, and interfered with further operations until the morning of Sunday, 1st June, when it cleared. Howe hove to for half-an-hour for breakfast, and then bore down on the enemy. Abandoning the orthodox method of attempting to keep an orderly line throughout the battle, He sent his ships headlong into the fray, and the battle resolved itself into a series of desperate ship-to-ship encounters. Howe himself led the way by taking his flagship, the "*Queen Charlotte*," straight for the French admiral's flagship.

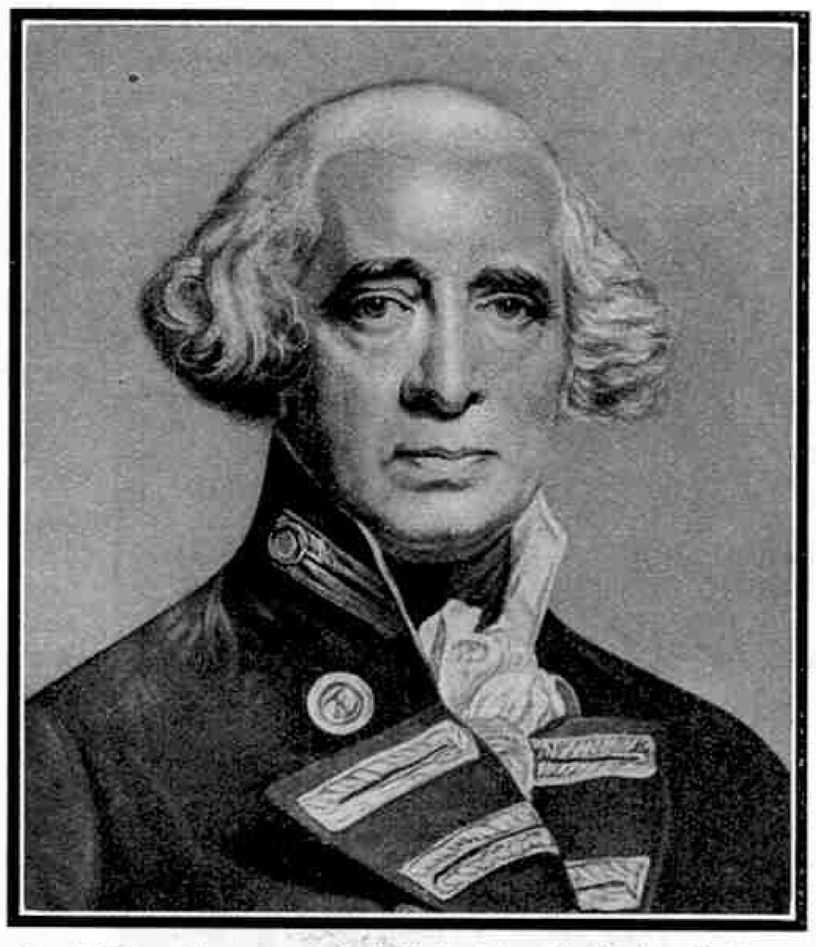
Perhaps the most stirring ship-to-ship fight that followed was that between the British "*Brunswick*" and the French "*Vengeur*." Captain Harvey of the "*Brunswick*" was mortally wounded, and as he was carried below he called: "Remember my last words—the colours of the "*Brunswick*" shall never be struck." The two ships were locked together in a fearful struggle for more than two hours. Then the "*Vengeur*" swung clear, and a broadside from the "*Brunswick*" holed her at the water line and she began to sink. Some 400 of her crew were taken off by British ships, but 200 went down with her. The "*Brunswick*" was so seriously damaged that she could only limp to the nearest home port.

Of the many stories told of this encounter, the following is worth repeating as showing the spirit of the British crew. The figurehead of the "*Brunswick*" was a representation of the then Duke of Brunswick. Soon after the fight opened the carved hat of this figure was shot away. Some of the crew, indignant at this outrage to the Duke, asked Captain Harvey for one of his cocked hats to put on the Duke's head. The captain, greatly amused, gave them a hat, and in the thick of the fight the men climbed out and nailed it in position!

An amusing incident, which is well authenticated, concerns the "*Marlborough*," which did glorious work in the thick of the battle and was so seriously damaged that she had to be towed out of action. A shot from a French ship smashed a coop on the deck of the "*Marlborough*" and released a cock. Immediately it was free, the bird flew up on to the top of the stump that was all that remained of the mainmast, flapped its wings, and crowed vigorously in defiance! The bird was afterwards presented to Lord George Lennox, and lived in honour for many years.

Although the "*Vengeur*" was the only French ship sunk, six were so crippled that they struck their colours. All the remaining French vessels suffered severely, and the fleet made off with all speed. Howe made no attempt to pursue, but rested content with his great victory. He has been blamed for this, but there is little doubt that he was wise, for many of the British ships were in a bad condition, and the men were worn out. The British fleet returned to Spithead on 13th June. King George III went on board the "*Queen Charlotte*" and presented Lord Howe with a sword set with diamonds, said to be worth three thousand guineas, and a golden medal hung on a golden chain.

Next month I hope to tell the life story of this famous admiral.



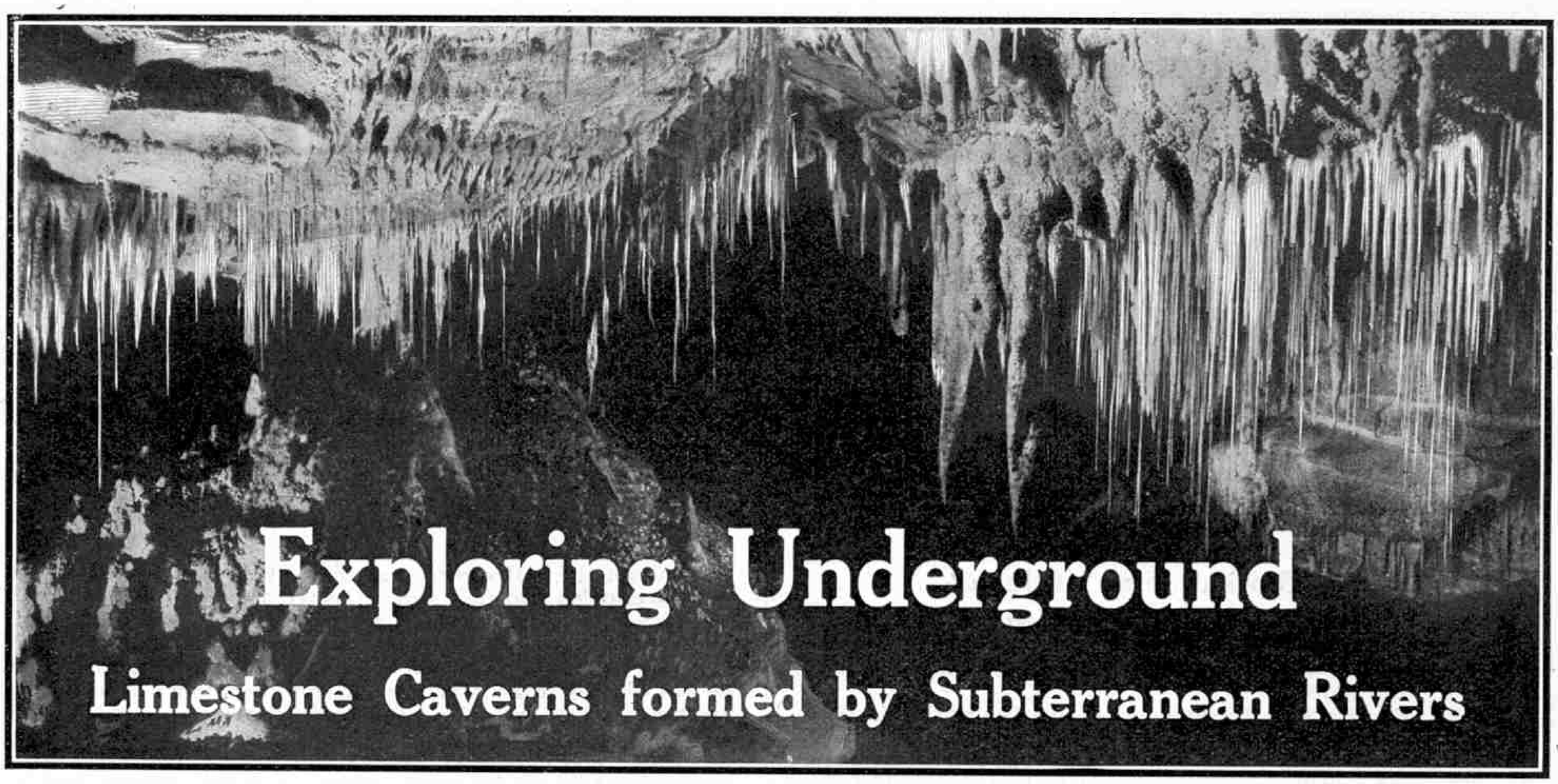
Lord Howe, from a print kindly lent by the Parker Gallery, London.

The "*Shannon*" and the "*Chesapeake*"

Another historic episode occurred on 1st June, 1813, when the British frigate "*Shannon*" fought and captured the American frigate "*Chesapeake*." Great Britain had quarelled with America over the rights of neutral ships in time of war. The American fleet was small, but highly efficient, and included a number of heavily armed frigates. The strength of this fleet was badly underestimated, and the first British ships sent against it were weak and their gunnery was poor. The result was that in the series of single-ship actions that followed the Americans were almost always successful.

The case was different with the "*Shannon*," which in May, 1813, was cruising about outside Boston harbour. This ship, commanded by Captain Philip Broke, was in the highest state of efficiency, especially as regards gunnery. Inside the harbour was the American "*Chesapeake*," commanded by Captain James Lawrence. The ships were about equal in strength, the "*Shannon*" carrying 52 guns and the "*Chesapeake*" 50; but the American vessel had just been re-commissioned with a new and ill-assorted crew. Broke had been greatly worried about the British frigate defeats, and he sent a challenge to Lawrence to come out and fight. Although apparently the challenge was never received, the "*Chesapeake*" came out of harbour on 1st June. The people of Boston were so confident of the result of the fight that she was accompanied by boats crowded with eager sightseers and, it is said, a collection of handcuffs for the British prisoners that were to be taken!

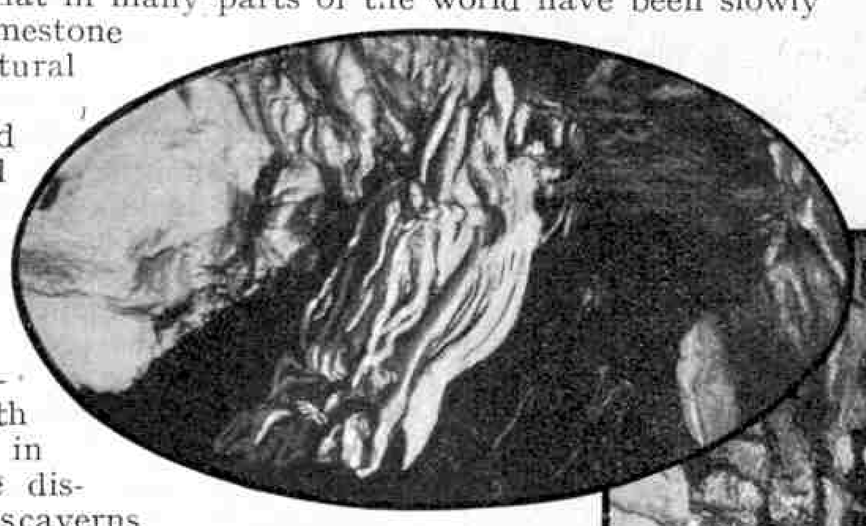
The action began about six o'clock in the evening. Firing was not opened until the ships were less than 100 yards apart, and in 15 minutes all was over. The "*Shannon's*" accurate and deadly fire wrought terrible destruction, and her crew completed the victory by boarding the "*Chesapeake*," headed by Captain Broke, and overpowering all resistance. An unfortunate incident occurred at this point. Lieutenant Watt hauled down the American colours, intending to hoist the British flag above the Stars and Stripes; but in the confusion he placed the American flag uppermost. The gunners of the "*Shannon*," which had drifted apart, took this to mean that the boarding party had been beaten, and recommenced firing, killing Lieutenant Watt and several others. The flags were then hoisted correctly and the fight was over. This victory was received in Great Britain with wild joy, and Broke became a national hero.



Exploring Underground

Limestone Caverns formed by Subterranean Rivers

STORIES of explorations are always full of interest, whether they tell the adventures of those who penetrate into the swampy forest regions of tropical lands, or of the hardy beings who face the dangers of travel over ice and snow, far from any source of supply, in order to solve the mysteries of polar regions. A less familiar kind of exploration that also has its risks, and gives no less interesting results, is carried on underground in the enormous caverns that in many parts of the world have been slowly carved out of limestone rock by natural agencies.



In England caves of this kind are to be found under the mountains of the Pennine Range, near Torquay in South Devon, and in other limestone districts. Numerous caverns of great extent also have been discovered in many parts of the world. For instance, in Kentucky there is an immense system of halls and passages that penetrates many miles into the underworld. This system is rightly known as the Mammoth Cave, for in it there are 256 known avenues, these having a total length of 152 miles. Similarly complicated underground passages have been traversed for amazing distances in New Mexico, South Africa, Australia and New Zealand, and there is scarcely a civilised country in the world where caves of this kind are entirely unknown.

The courage of the pioneers who first explored these underground regions can scarcely be exaggerated. In pitch darkness, except for the light given by almost insignificant flares and lanterns, they penetrated through caverns in which gigantic halls alternated with narrow clefts and low passages through which they could squeeze only with the utmost difficulty. In most cases underground streams and lakes had to be negotiated and the adventurers were almost always in constant danger of encountering violent torrents of ice-cold water, or even of being cut off from the outer world by a sudden rise in the level of a subterranean river.

A remarkable instance of the difficulty of exploring the unknown passages of extensive limestone caves occurred only recently, when the now famous White Scar Caverns of Ingleton were discovered. The first explorer of these was Mr. C. F. B. Long, a Cambridge undergraduate. Mr. Long was a keen geologist and was greatly interested in the well-known pot-holes of the Yorkshire mountain. After a day spent in descending several of these, his attention was attracted by large fissures, or cracks, on the western side of the mountain. Thinking that the cracks might be worth examination, Mr. Long and a companion crept through a small hole, to find themselves in a dark narrow passage. A cool current of air met them and immediately suggested a hope of finding a way into the heart of the Yorkshire mountain.

After traversing a distance of about 75 yards, they came to a broad pool of water. In order to make further progress they had to wade through this, and as the surface of the water was within a few inches of the roof of the cavern, they were compelled to turn on their backs and to keep their mouths near the roof in order to breathe. This portion of their underground journey was carried out in complete darkness.

On the further side of the pool the intrepid explorers relit the candles carried on their heads. Squeezing through a narrow opening, and almost being swept away by a powerful torrent of water, they pushed on and finally were rewarded by reaching a wonderful underground waterfall, up which they climbed into a magnificent grotto, rich in stalactites and stalagmites coloured red, green and white.

Next day a no less arduous and dangerous underground journey was made, and further explorations followed. On one occasion Mr. Long was so numbed by swimming across a lake of intensely cold water that he was carried away down a long gallery and badly bruised and cut by the sharp rocks into which the current swept him. His friends succeeded in rescuing him, only to find that their escape was cut off by a sudden rise in the level of the water. Soaked to the skin they climbed on a ledge, and there they sat for two hours. During that time the water rose until it almost flowed over the narrow shelf of rock on which the hardy explorers had been compelled to take refuge.

In the White Scar Caverns, Ingleton. In the centre Mr. Long, the discoverer of the Caverns, is seen on one of his underground exploring expeditions. On the right is a waterfall near the entrance, and above is the stalagmite formation known as "The Angel."

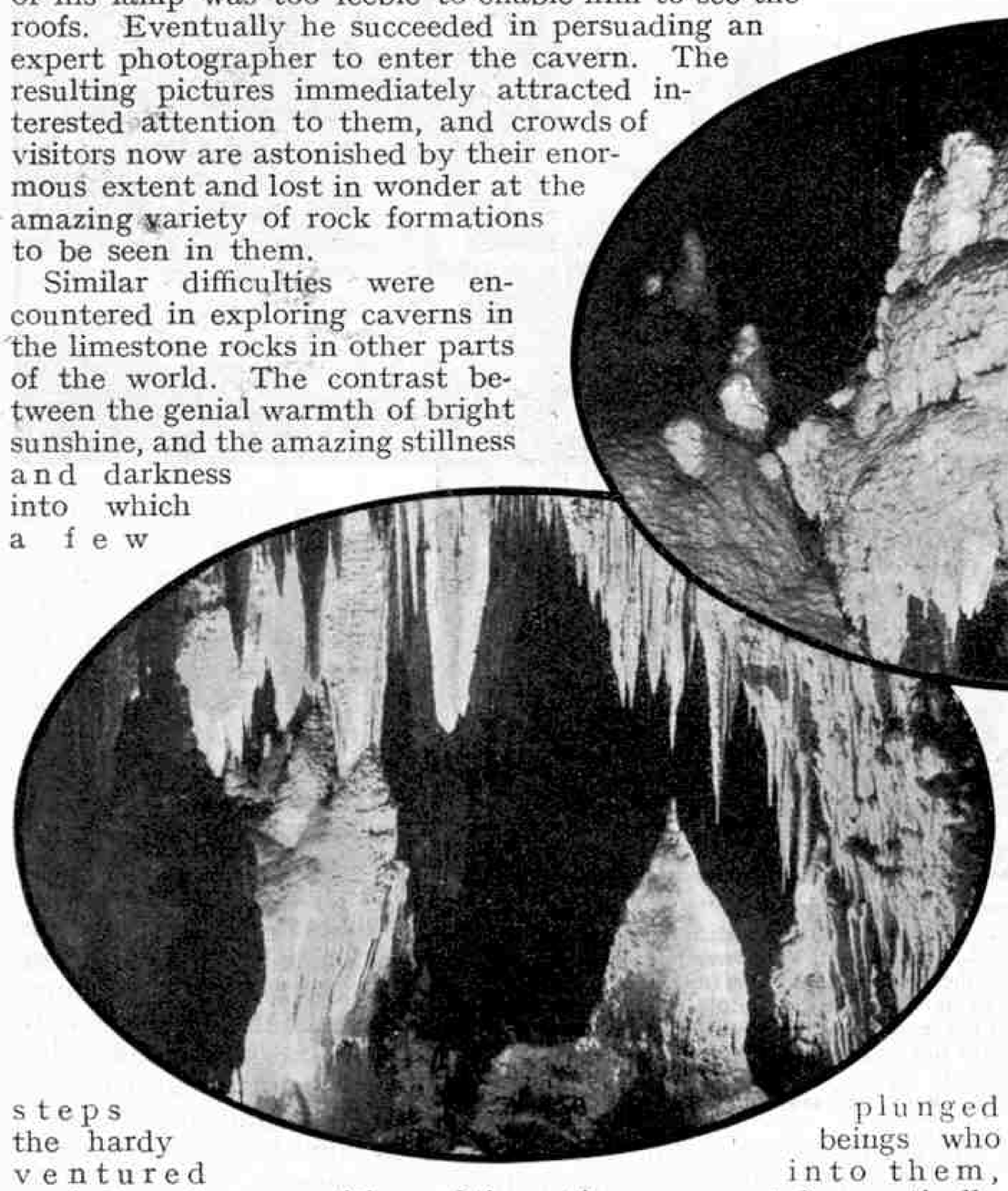
An equally interesting story is told of the discovery of the immense range of caves near Carlsbad in New Mexico. The existence of the caves in the foothills of the mountains in the south east of that State has been known for years to the Indians and to

the cattlemen who had penetrated to that region. In fact, it was impossible to remain ignorant of them, for at a certain time every summer evening myriads of bats flew out of the cave, the great exodus lasting for more than two hours. Early next morning the bats returned, folded their wings and shot downwards, to remain throughout the day in their mysterious hiding place in the depths of the underworld.

No doubt vague guesses of the magnitude of the caves were made from the multitude of bats that hibernated in them during the winter and spent the daylight hours there during summer. But the credit for the real discovery must be given to a man named Jim White, who had been engaged with others in the task of removing immense deposits of guano from the interior. Nobody had then ventured far into the caverns. White became greatly interested in them and spent the spare time of years in a slow and dangerous exploration of their extent. Usually he went alone, carrying with him a compass, a crude miner's lamp and a ladder made of rope and wire. But his most useful allies in this work were balls of twine. These he used in fixing guide strings to enable him to retrace his steps along the intricate winding passages through which he worked his way steadily deeper and deeper into the labyrinth.

In his underground journeys White traversed miles of winding galleries and penetrated into immense chambers where the light of his lamp was too feeble to enable him to see the roofs. Eventually he succeeded in persuading an expert photographer to enter the cavern. The resulting pictures immediately attracted interested attention to them, and crowds of visitors now are astonished by their enormous extent and lost in wonder at the amazing variety of rock formations to be seen in them.

Similar difficulties were encountered in exploring caverns in the limestone rocks in other parts of the world. The contrast between the genial warmth of bright sunshine, and the amazing stillness and darkness into which a few steps the hardy ventured plunged beings who into them, worked on the superstitions of the native races, and in practically all cases it was left to Europeans to make really extensive examinations. For instance, in New Zealand, the imaginative Maori peopled the caverns of Waitomo with spirits, and although they had been known for many years, these caves remained practically unexplored until as recently as 1879. The entrance to the even more remarkable caves of Ruakuri, about a mile and a half away from Waitomo, also was familiar to the Maoris. In former days these caves were the home of the native wild dog. A powerful chief slaughtered the ferocious animals, and partly from fear of the unknown, partly from reverence for this benefactor, no Maori ever ventured to explore the caves, or even to enter them, until they were opened out to visitors.



It is not altogether surprising that natives avoided these underground palaces and passages. To them they must have been terrifying places and the lights they could take with them would be insufficient to dissipate the gloom. If any of them had penetrated into their recesses, they would have found in some instances weird creatures totally different from those they were accustomed to meet in the world of daylight. In the waters of the Mammoth Caves of Kentucky, for instance, are blind fish. More interesting inhabitants are wingless grasshoppers. These also are blind, but their antennae, or feelers, have been developed in a remarkable manner. For centuries the ancestors of these creatures have lived in complete darkness, and in the course of time their organs have become adapted to the weird conditions. Naturally life moves slowly in the absence of light, and it is even believed that some of the curious creatures found in caverns of this type may almost be regarded as living fossils, remnants of the life of thousands of years ago. In the more genial conditions of the outside world they have developed into other forms, and except in the stillness of these caves are now extinct.

Undoubtedly the most wonderful of living creatures found within the many remarkable limestone caves that have already been explored are the glow-worms of Waitomo. Visitors pass through one of the grottoes of these caves in a boat that floats on an underground river. In the beauty of its stalactite and stalagmite formations the grotto itself is equal to others in the same caverns, but it has the added interest that its roof is illumined with millions of glow-worms, the pale light they give revealing the glistening spears of the dripping stalactites with which the roof is adorned. Nowhere else in the world can such a sight be seen, for the insect responsible is only found in New Zealand, and even there it may be regarded as peculiar to the famous glow-worm grotto in the extensive caverns of Waitomo.

To-day the finest of these limestone caverns have become show places. Electric light has been installed in many of them and visitors are conducted by guides on regular tours many miles in length. They are lured by the novelty of underground exploration, but the greatest attraction undoubtedly is the beauty of the natural rock sculpture with which caves in all parts of the world have been so liberally adorned.

The agent responsible for the wonderful carving seen in limestone caverns is water, which has been at work for thousands of years. The fantastic shapes have not been worn out of the rock, but have partly been dissolved away and partly built up, for water is a creator as well as a destroyer. It is capable of dissolving small quantities of limestone and so of eating a way through the rock as it slowly descends through the earth. But the process is chemical and not one of simple solution, for in order to act in this manner the water must contain a small proportion of the gas called carbon dioxide in solution. As it drips from the roofs of the passages and caverns that it has carved out of the limestone, water containing this gas in solution loses it. The effect of this is that the limestone held in solution is released. In every drop falling through the cool air of a cavern a tiny amount of limestone is reformed and this remains on the floor of the cave at the point where the successive drops of water splash upon it.

In course of time the tiny mound of limestone thus formed is built up into a slender column and after ages of slow accumulation, it becomes thicker and more massive. From the roof a similar column strikes downward to meet it, for release of the limestone begins as soon as the water reaches the air. Slowly the stalagmites and the stalactites, as these columns are called, become longer. The process is amazingly deliberate—in many caves the guides point to tiny mounds only a few millimetres in height and remark that they are the work of 75 or 100 years—but after many thousands

The top illustration on this page shows wonderful stalactites in a hall in the Caverns at Carlsbad, New Mexico. In the centre is the limestone "Wedding Cake" in the caves at Ruakuri, New Zealand. Below on the left is a corner of the "Crystal Palace," an enormous underground hall at Aranui, New Zealand.

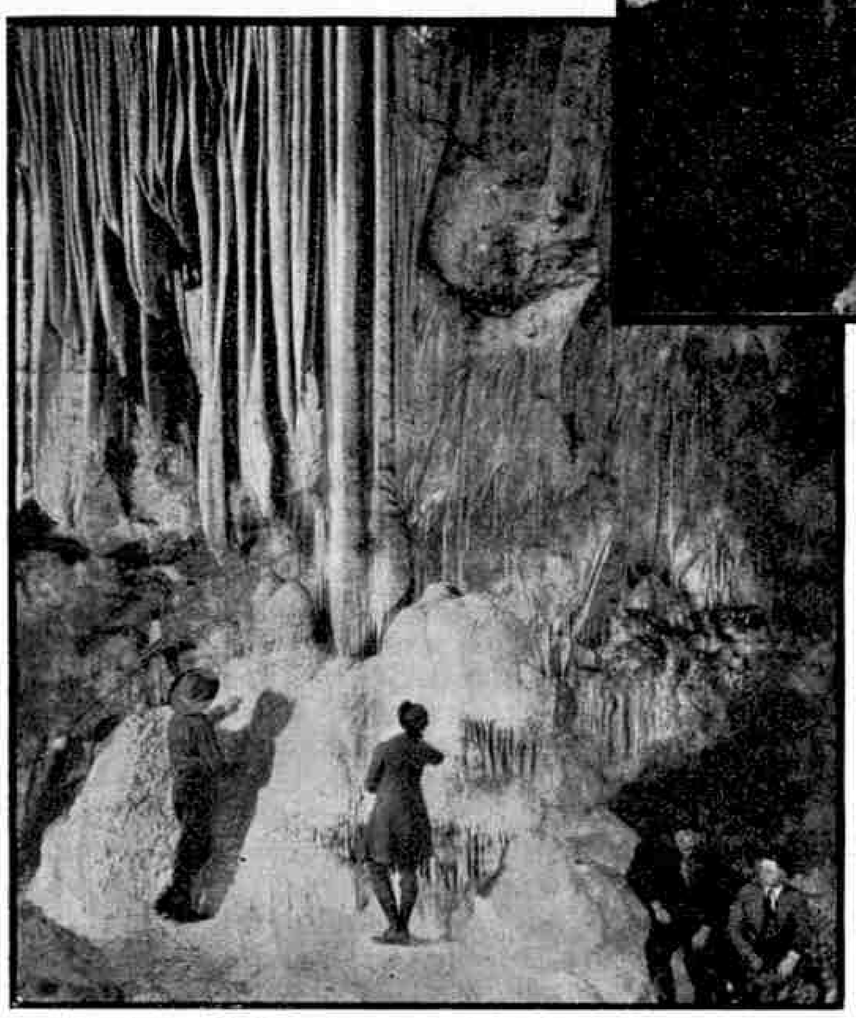
of years they may meet, forming solid pillars that appear to support the roof of the cave in which they have been formed.

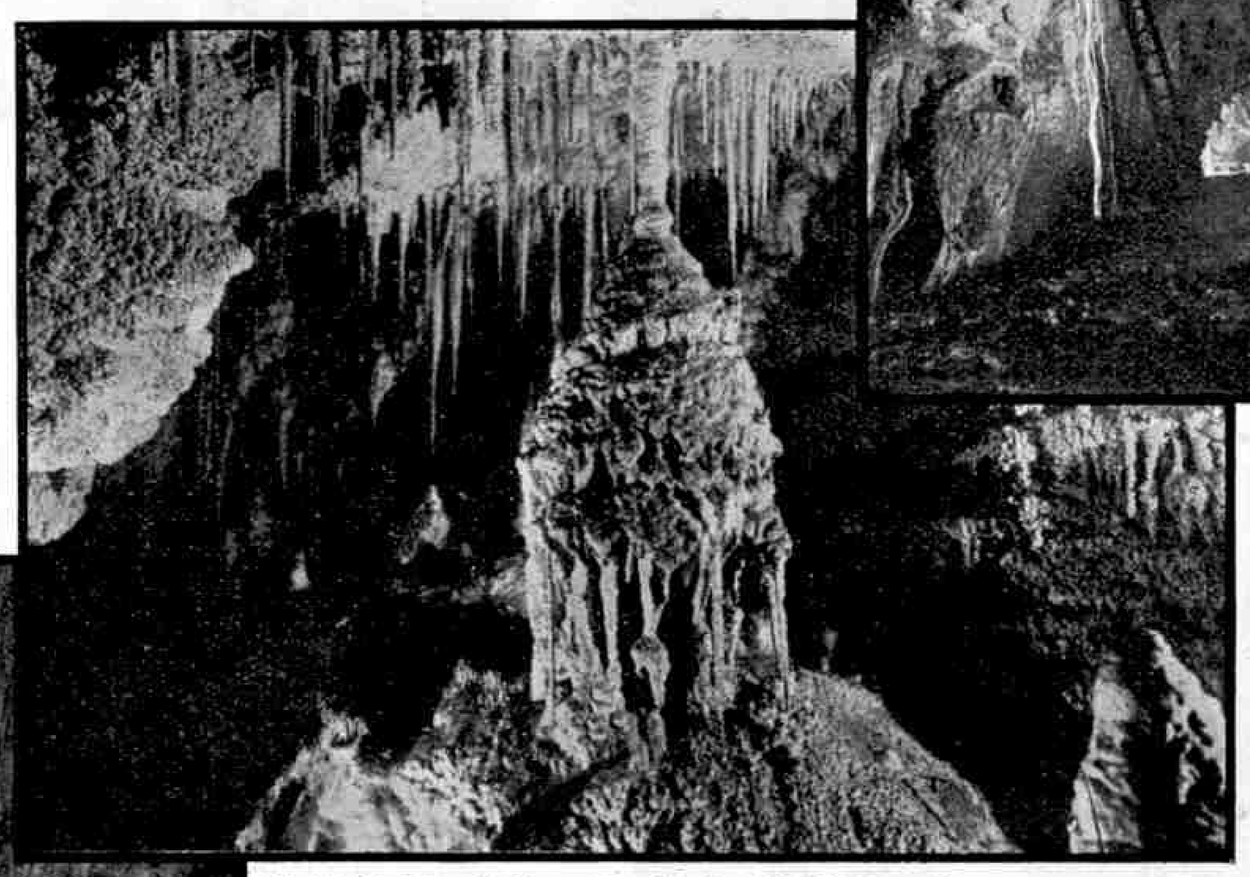
For centuries the stalactites and the stalagmites of many famous caves have slowly been growing, changing their shapes as the directions of the trickles and streams of water have changed. Not all of them are gigantic columns. A few had only become delicate threads or ribbons when the flow of the liquid that shaped them was diverted. But the majority have reached vast proportions. Halls as large as cathedrals have been dissolved out of the rock and in them stalagmite formations of enormous extent have been built up to arouse the awed admiration of thousands of visitors, who pass through the caves and examine them with the aid of the most modern types of lighting.

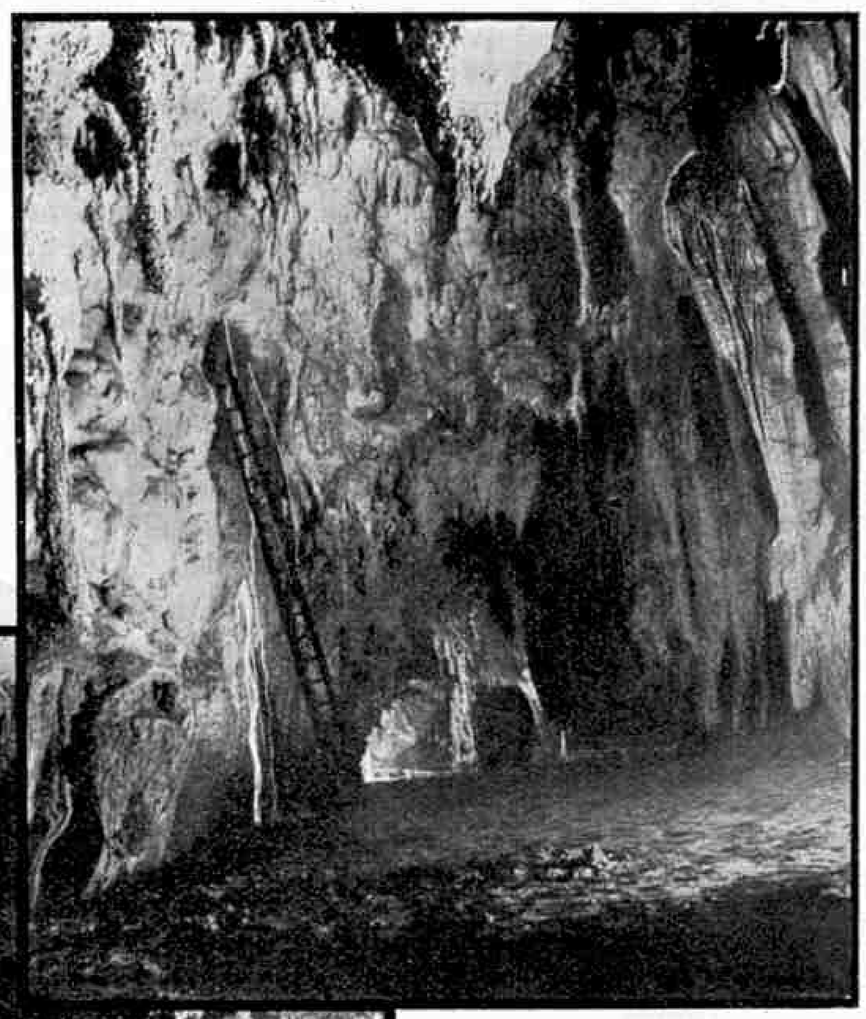
Imagination has run riot while gazing at the fantastic shapes into which the countless stalactites and stalagmites of practically every limestone cave of importance have been carved. For instance, there is no system without its Cathedral. This name usually is given to the finest and largest of the domed chambers and in almost every instance there is in it a towering mass of rock that the water has carved into some semblance of an organ. In the Jenolan caves, a wonderful system in the mountains 136 miles west of Sydney, New South Wales, the cavern that is called the Cathedral is 162 ft. in height. In it there is an enormous mass of gigantic columns that in outward appearance resembles an organ loft and pulpit. In order to add to the illusion, electric lamps have been placed in tiny crevices on the walls of the gigantic chamber, and when lit these have the effect of sunshine entering the windows of an immense cathedral.

The Cathedral Domes of the Mammoth Caves in Kentucky are so far distant from the entrance to the Cave, and the passages through which they are reached are so intricate and winding, that they were lost for 50 years after first being discovered.

A Cathedral complete with an organ may be seen in the Waitomo caves of New Zealand,







(Left) Curtains in limestone in the "Big Room" of the Carlsbad Caverns. (Centre) A fantastic stalagmite in Ruakuri Caves. (Right) "Waitomo Cathedral," an immense chamber with a domed roof in the Caves at Waitomo, New Zealand. It is impossible to form an adequate idea of the enormous length of time that has been required for the formation of these wonderful stalagmites—millions upon millions of years at least must have been necessary.

and there it is quite easy to imagine that nature has anticipated man in constructing columns of the finest orders of architecture. There is also a Cathedral in New Zealand's finest caves—those of Aranui. These were discovered as recently as 1911 by a Maori pig hunter, and are remarkable for the amazing variety of fantastic shapes and forms to be seen in them. The caverns are full of wonderful arches and balconies carved in the limestone, and from these are suspended stalactites of amazing delicacy and beauty. Most of the limestone within the caves is white and crystalline, but in places it shades off to a delicate brown. Everywhere what have been described as shawl and blanket formations are hanging in great profusion and the markings of their coloured edges are almost faultless.

To add to the interest of many caves the limestone often is delicately coloured and in many places is studded with crystals that shine brilliantly immediately the light strikes them. For instance, the wonderful Cango Caves near Oudtshoorn, South Africa, are remarkable both for their wonderful colouring and for the beauty of the crystals embedded in their walls. The colour of the rock is due to the presence of compounds of iron, copper and manganese in the water that has carved out the caverns. Salts of the first-named metal are responsible chiefly for the brown and reddish shades of rock, while green and pink limestones owe their colour to compounds of copper and manganese respectively.

The discovery of the extensive Cango Caves was made in a romantic fashion. In the early eighteenth century a farmer named Van Zyl stumbled across the entrance while searching for a wounded buck that he had followed after shooting it. The game was lost, but instead was found what has become one of the world's great show places.

As in many other caves, electric lights are now employed to reveal the beauties of Van Zyl's Hall, the largest of the caverns, and as soon as these are switched on the visitor sees above him a dome that is as blue as the sky and is crossed with delicate filmy white clouds. In imagination on all sides he sees snow slopes covered with miniature snow ladden trees and castles, and immense columns studded with crystal and flanked by folds of stone moulded in such a manner as to suggest drapery of every kind and texture.

It is interesting to find that these caves must have been known centuries ago. Excavations in them have revealed beneath their earthen floor animal and domestic remains from prehistoric times, while in places the paintings and engravings of the mysterious artistic race that once appears to have inhabited South Africa also may be seen.

In the White Scar Caverns of Ingleton stalagmite formations quite as wonderful as any to be found elsewhere may be seen. These vary from fragile straw stalactites, as they are called, to gigantic columns, and include many attractive ribbon formations and limestone falls. At one place the rock has been moulded into a remarkable statue-like shape, that resembles in appearance the carved figures of angels that are often seen in churches and cathedrals.

The newly-discovered caverns at Carlsbad, New Mexico, are noteworthy for their wonderful stalactites and stalagmites. These range from enormous blocks weighing many tons to tiny specimens of such delicate texture that their colour may be seen on merely holding a lantern behind them. The passages and halls at present explored cover a distance of more than 12 miles and it is certain that beyond these stretch others, possibly even larger, that have not yet been visited. The air throughout is wonderfully fresh and it is believed that there are other entrances in addition to that revealed by the nocturnal flight of the bats that inhabited the caves.

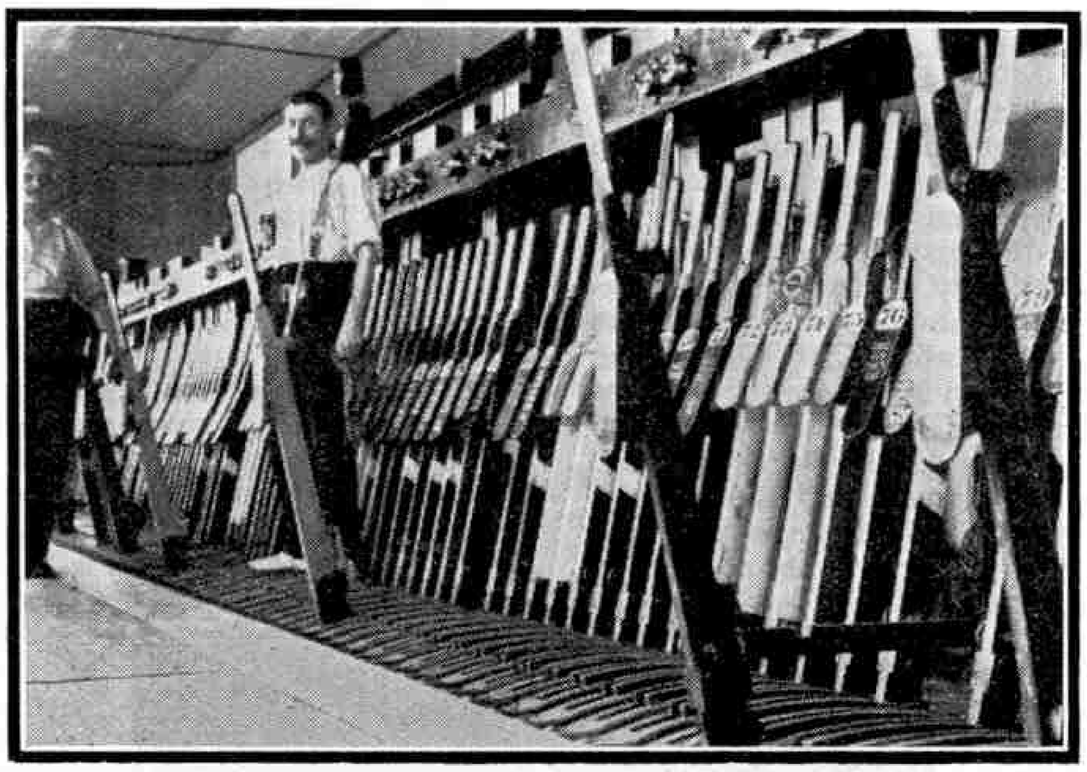
One of the chief glories of the Carlsbad caverns is the enormous hall that has been named the "Big Room." In size this surpasses any hall ever built by man, as well as all other natural chambers that so far have been discovered. It is more (*Continued on page 478*)

The Interior of a Signal-Box

Interlocking Safety Mechanism

ALMOST everybody is familiar with the general appearance of a signal-box with its long row of levers, by means of which the points and signals are operated through the medium of connecting wires and iron rodding. The levers are placed in a frame in which they can be pulled forward or pushed backward. The backward position is the normal one, and when the levers are in this position the signals are at "danger," and the points are set for the main line. Each lever is held in place by a catch that is released by pressing a handle when the lever is moved.

In order to assist the signalman in rapidly picking out individual levers, these are painted in distinctive colours. The arrangement varies to some extent on different lines, but the usual lever colours are green for "distant" signals and red for other signals; black for points or switches; blue for facing point locking bars and bolts, and white for spare levers. In addition to this distinctive colouring the levers carry plates bearing numbers, or alternatively have the numbers painted on their sides. These are known as "releasing" numbers, and they are arranged in the order in which each lever must be pulled before a certain required lever can be operated. These numbers form an important part of the interlocking system.



The interior of a large signal-box, showing the lever frame and the numbered levers. A certain order has to be observed in using the levers and the numbers give the key to this.

Interlocking may be described as arranging the operation of the levers in the signal-box in such a manner that they allow one another's movements in carrying out correct setting of points and signals, but obstruct one another in movements that would bring about wrong settings. In order to guard effectually against mistakes on the part of a signalman, the signals are interlocked so that "distant" signals cannot be lowered until the "home" and "starting" signals have been placed in the "all right" position. In a similar manner, points connected with the running lines must be correctly set before the "home" or "starting" signals can be lowered.

These safety movements are carried out by means of an interlocking frame. In this the movement of a signal or points lever moves a tappet or sliding bar of metal to which it is attached. This in turn moves appropriate "dogs" that engage in notches in the tappets belonging to the particular points and signal levers that the movement of the first lever necessitates should be locked. The signals thus locked remain locked until the first lever is returned to its original position. This method of interlocking also makes it necessary for the levers to be set and returned in the proper order. For example, the points must be set before the signals are lowered; and conversely the signals must be returned to "danger" before the points levers become unlocked.

Each signal-box is provided with a diagram showing the position of all signals and points with which it is concerned, together with the numbers of the operating levers.

The rods and cranks that pass below the signal-box and transmit the movements of the levers to the points and signals. These parts are very strong so as to stand their heavy duties.

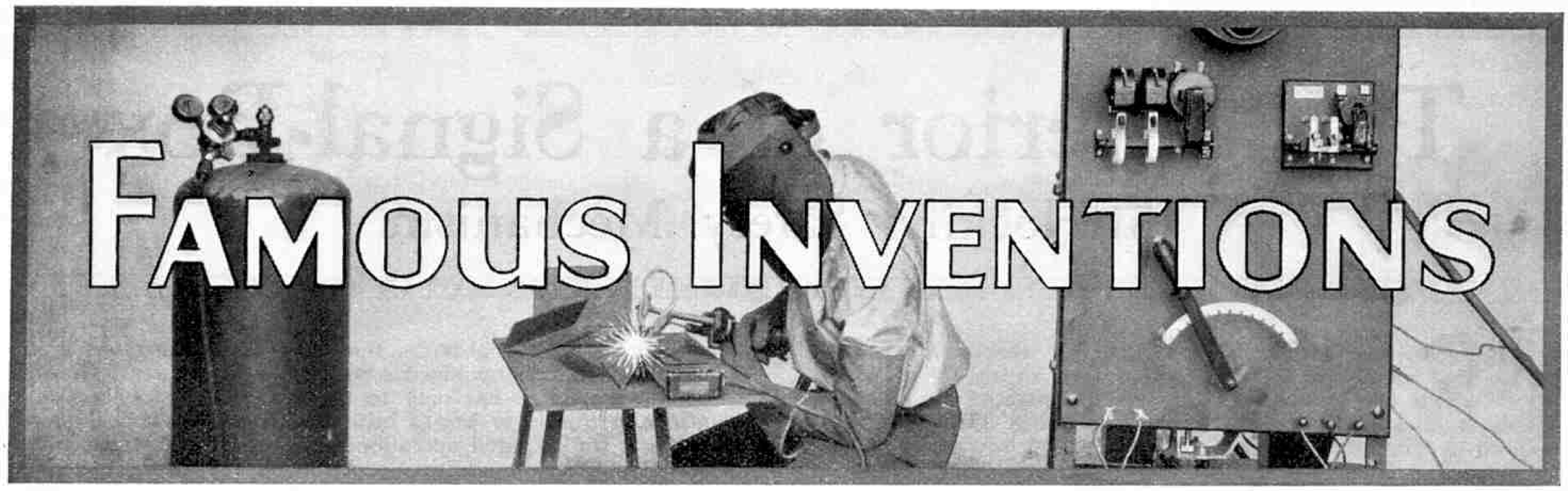
In many large signal-boxes the task of operating the levers is now carried out by electric or pneumatic power. In such cases the signalman has only to move a lever a few inches in length, and this lever brings into action the mechanical power and effects the required operation. Power signalling has many other advantages in addition to relieving the strain upon the signalman's arms. The long stretches of rodding and wire are replaced by electric wire or small tubes, which, as there are no moving parts, can be covered in as desired, or even carried underground. Another advantage is that corners and curves can be negotiated with the greatest ease and without the addition of complications such as arise with rodding.

Every signal-box is connected electrically with the boxes on each side of it, and is provided with telegraph and bell instruments. Trains are worked on what is known as the "block" system. The length of line between the last stop signal of one box—that is the "starting" or the "advanced-starting" signal—and the first stop signal of the next box—that is the "home" signal—is called a "block" section, and only one train at a time is allowed to be on each section. Each box has a tapper bell for each section on each side of it, both for "up" and "down" lines, and communications between signalmen are made chiefly by means of a code of bell signals.

The semaphore type of signal, the idea of which was taken from the semaphore signalling used in the Navy, is now the most popular throughout the world. With various modifications to adapt it to certain special purposes, it is used for all types of signalling. In certain countries, however, disc and other form of signal are still extensively used.

The first semaphore signal is said to have been erected by Sir C. H. Gregory in 1841 at New Cross on the London and Croydon Railway. For a long time the signals were operated by levers fixed to the post itself, which necessitated having men stationed at the foot of the posts, each man having one or two posts under his control. As traffic increased, however, it was found very inconvenient for the signalmen to have to walk to each signal when it became necessary to move the arm. Sir C. H. Gregory followed up his invention of the semaphore signal by producing the first machine for operating several signals and points from one place; and in 1843 he demonstrated the practical value of his invention by working from one frame of levers the signals and points at the Bricklayers' Arms Junction on the Croydon Railway.

The supremacy of the semaphore signal is now threatened by colour-light signals that are easily visible at 1,000 yards in daylight, and at a still greater distance at night. Numerous installations of these have been brought into use during recent years.



XXIII.—GALILEO AND THE REFRACTING TELESCOPE

FEW inventions have meant so much to a particular branch of science as the telescope has meant to Astronomy. With its aid astronomers have learned far more in the past 300 years than in all the ages since Man appeared on the Earth. The ancient astronomers laboured long and diligently, but their progress was inevitably limited by the fact that they possessed no instruments except crude wooden cross-staffs and quadrants. Even the famous Danish astronomer Tycho Brahé (1546-1601), who always dressed in his best robes when observing, in order to show his respect for the heavenly bodies, had only sextants and quadrants to help him in the making of his catalogue of 777 stars and his various observations in regard to comets and the planets. Indeed, when we consider that all the astronomers prior to Galileo were without telescopic aid, it is remarkable that they accomplished as much as they did.

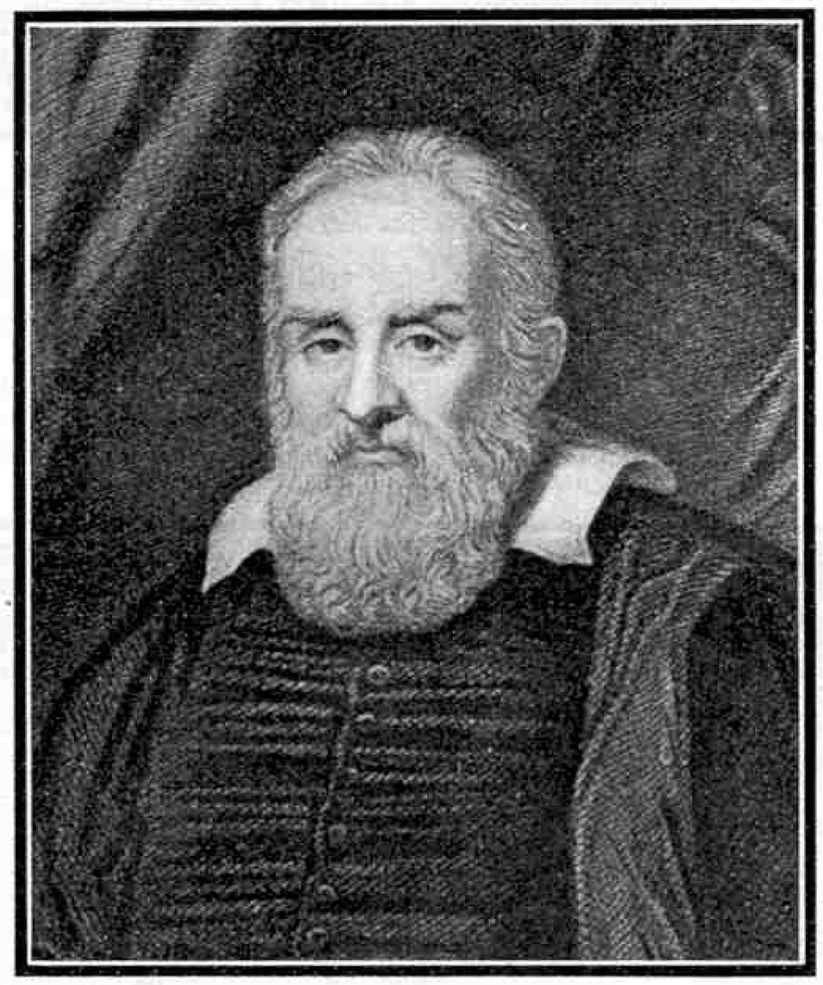
There is some reason for believing that a magnifying instrument of a crude form was known in very early times, for there seems to be some evidence that the Babylonians knew of the four largest satellites of Jupiter, which are invisible without optical aid to even the keenest-sighted person of to-day. If such an early magnifying instrument did exist, knowledge of it appears to have been completely lost.

As was the case with many other inventions, the theory of the telescope was outlined by various writers long before an actual instrument was made. One of the earliest references occurs in a book entitled "*Opus Majus*" written about 1260 by Roger Bacon, a Franciscan friar at Oxford. After describing spectacles, which were then a recent invention, and explaining how they magnify objects, he adds that "greater things than these may be performed by refracted vision . . . And thus from an incredible distance we may read the smallest letters . . . Thus also the sun, moon and stars may be made to descend hither in appearance, and to be visible over the heads of our enemies, and many things of the like sort, which persons unacquainted with such things would refuse to believe."

Three hundred years later an English mathematician and architect named Leonard Digges read Bacon's writings on this subject and became so interested that he began experimenting with various lenses. Digges appears to have been fairly successful, for his son, writing in 1579, records that his father "among other curious practices had a method of discovering by proportional glasses set at due angles all objects pretty far distant that the Sun shone upon which lay in the country round about." It is evident that Digges constructed some form of telescope, but all traces of his instrument have been lost.

The earliest practical telescope of which anything is known was invented in 1608 by a Dutchman named Hans Lipperhey, an optician of Middelburg. There are different stories of how Lipperhey came to invent his telescope. According to one account his apprentice was playing with some spectacle lenses when he happened to hold up two of them, one in front of the other. He casually directed this combination toward the steeple of a neighbouring church, and on looking through the nearer lens he was astonished to find that the weathercock surmounting the steeple appeared to be slightly larger and nearer. The effect startled the boy, and after repeating the experiment to reassure himself, he told his master of the matter. Lipperhey realised the importance of the discovery, and by fitting the lenses in a tube so that he could adjust and preserve their relative distances, he produced his first telescope.

Lipperhey sought to patent his telescope on 2nd October, 1608, and his application was considered by the States Assembly. A committee was appointed to test the instrument, and their report was so favourable that he was commissioned to make three similar instruments with lenses of rock crystal. A condition of the order was that he must not divulge the secret of his invention. He was paid 900 florins for these instruments when they were completed. The States Assembly suggested that Lipperhey should adapt his telescope so that a person could look through it with both eyes. After further experiments he accomplished this, and the altered instrument was approved by the Assembly on 15th December, 1608. Lipperhey was then commissioned to construct two similar instruments "for the use of the Government," and he was paid the same price for these as for the three earlier instruments. The Assembly refused to grant him the exclusive right to make and sell his telescope, however, on the ground that by this time many people had learned of the invention.



Galileo Galilei

Lipperhey later exhibited his original telescope, through which one could only look with one eye, in the window of his shop. As a toy it was regarded with interest by passers-by, and one day it attracted the attention of the Marquis Spinola. After examining the telescope more closely inside the shop he bought it, and later presented it to Prince Maurice of Nassau, who thought that it might prove useful during military operations.

On 17th October, 1608, another Dutchman, James Metius of Alkmaer, applied to the States Assembly for a patent for a telescope that he had invented. In his application Metius stated that he discovered the instrument by chance while engaged in other experiments, and he claimed it to be as efficient as the one that "had recently been offered to the States by a citizen and spectacle maker of Middelburg." Apparently the telescope was not as good as Metius claimed it to be, for the Assembly recommended him to bring it to greater perfection and then repeat his application. No details exist of the telescope, but his original application is preserved in the library of Leyden University.

During the summer of 1609 news reached Venice that a Dutchman had presented to Prince Maurice of Nassau a glass so skilfully devised that by means of it a man two miles away could be seen quite plainly. This information greatly impressed Galileo Galilei, Professor of Mathematics at Padua University, who was then visiting Venice. He gave the matter a great deal of thought, and on his return to Padua he set about constructing a similar instrument.

Galileo was born at Pisa on 15th February, 1564. He was

educated partly at school and partly by his father, and completed his studies with a literary course at the Monastery of Vallambrosa, near Florence. His leisure time was spent in various ways, but from an early age one of his favourite hobbies was designing working toys. His father decided that the boy should become a doctor, and on 15th September 1581, Galileo was sent to Pisa University to commence his medical studies. Medicine did not attract him, however, but he developed a great liking for mathematics and made rapid progress in this subject. In 1589 he became Professor of Mathematics at the University, and three years later he was appointed to a similar post at Padua University. There he found time to indulge his fondness for inventing things. He produced many ingenious devices, including an air thermometer (described on page 842 of the "*M.M.*" for November, 1929), a geometrical compass or sector, and a machine worked by a horse for raising water and distributing it through a series of channels.

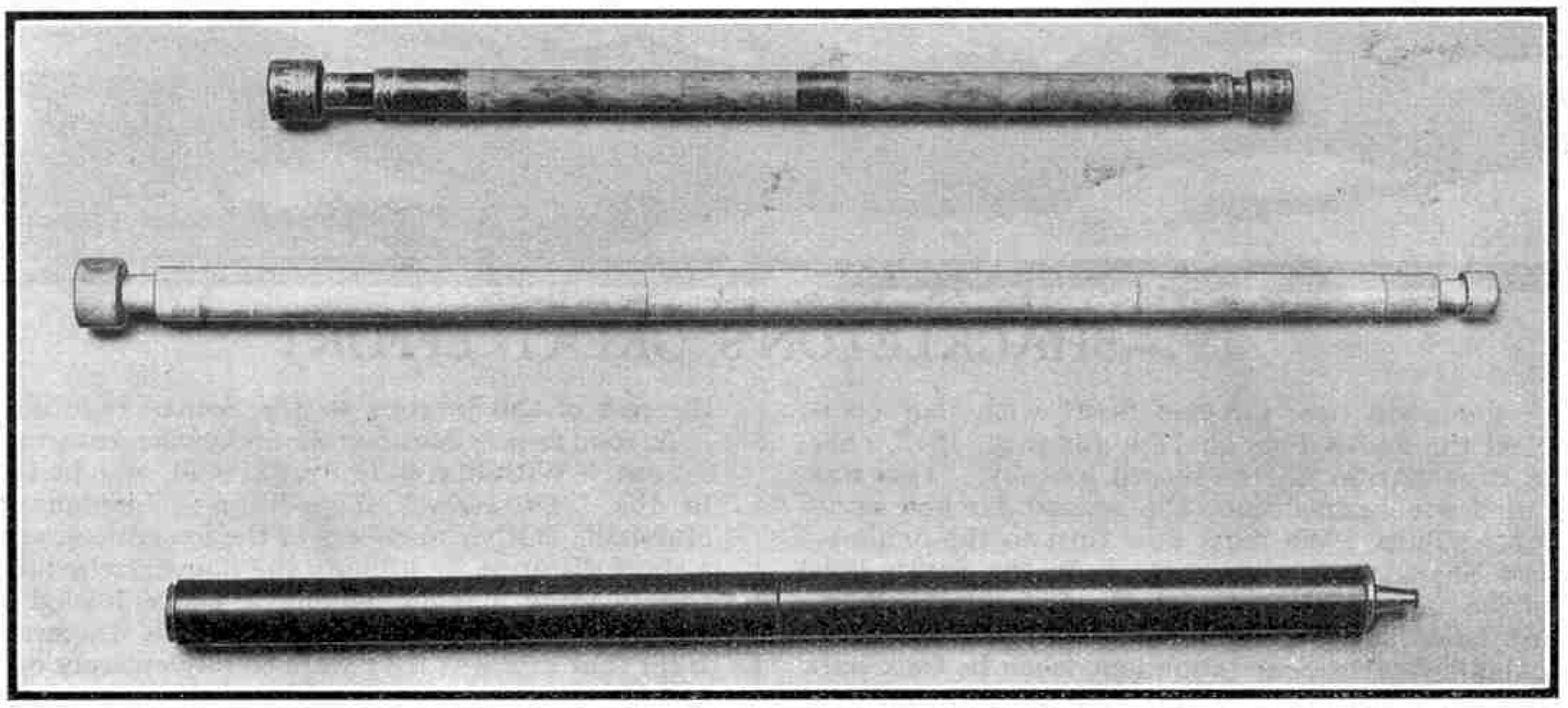
It is unfortunate that nothing is known of Galileo's first telescope beyond the fact that he reported his success to friends in Venice with whom he had discussed the matter. Six days later he was summoned to that city to exhibit his telescope before the chiefs of the Republic. In the meantime he had completed an improved telescope, and there is an interesting account of this in his book "*Sidereus Nuncius*." Galileo says: "I prepared a tube, at first of lead, in the ends of which I fitted two glass lenses, both plane on one side, but on the other side one spherically convex and the other concave. Then bringing my eye to the concave lens I saw objects satisfactorily large and near, for they appeared one-third of the distance off and nine times larger than when they were seen with the natural eye alone." The tube of this telescope was about 26 in. in length and $1\frac{3}{4}$ in. in diameter.

Galileo took this telescope to Venice, where it was shown for the first time in public on 21st August, 1609, from the top of the campanile of St. Marco, the highest church tower in the city. The farthest object that could be clearly seen with the instrument was the campanile of a church $21\frac{3}{4}$ miles distant. The view obtained by means of the telescope greatly astonished those who were privileged to peep through the small instrument. Galileo relates that "many of the nobles and senators, although of a great age, mounted more than once to the top of the tower, in order to see sails and shipping that were so far off that it was two hours before they were seen without my spy-glass, steering full sail, into the harbour; for the effect of my instrument is such that it makes an object 50 miles off appear as large as if it were only five."

Galileo's third telescope was more powerful than the two previous instruments and not only magnified objects more than 60 times but gave better definition.

By means of his telescopes Galileo surveyed the heavens and made many important discoveries. He saw that there were ten times as many stars as he could discern with the naked eye, and thus disproved the common belief at that time that the stars were all at an equal distance from the Earth. The knowledge thus gained made him eager to have still more powerful optical aid, and before long he produced a fourth telescope. With this he carried out observations of the Moon, and declared that this appeared "about 20 times larger and 400 times nearer than when seen by the naked eye." A visit to Florence in 1609 gave Galileo an opportunity to show this instrument to the Grand Duke, who "to his great surprise and delight, was able to see that the Moon was an object similar to the Earth." The lenses of this telescope were adjustable, being held in small tubes that could be moved backward and forward in the main tube of the instrument.

At the beginning of 1610 Galileo completed still another telescope. This new instrument was the most powerful that he ever made, and was capable of showing objects "more than thirty times nearer and almost 1,000 times larger." With this telescope he confirmed his previous observations of the Moon, and made many other astronomical discoveries, including the satellites of Jupiter and a number of fixed stars. During the winter of 1610 he made and ground "at great fatigue and expense" more than 100 object lenses, but of these only ten proved to be sufficiently powerful to reveal the satellites of Jupiter. Galileo continued to grind lenses for his telescopes until his sight began to fail in 1637. Two years later he became completely blind, and his great work as an astronomer was brought to a close. He died on 8th January, 1642.



Replicas of Telescopes made by Galileo and the mathematician Torricelli. This photograph is reproduced by permission of the Director of the Science Museum, South Kensington.

The telescopes of Galileo were what are known as "refracting" telescopes, in which the rays from the object are made to converge by refraction, or bending. The simple Galilean telescope consisted of a tube having at the outer end a large convex lens known as the "object-glass," and at the other end a smaller concave lens known as the "eyepiece." The object-glass acts as a large eye and collects a greater amount of light than could be gathered by a human eye looking at the same object. In passing through this lens the rays are refracted inward so that they converge. Before reaching the eye they are intercepted by the concave lens and refracted outward, so that they become parallel or even slightly divergent. The result is that the apparent size of the object is increased.

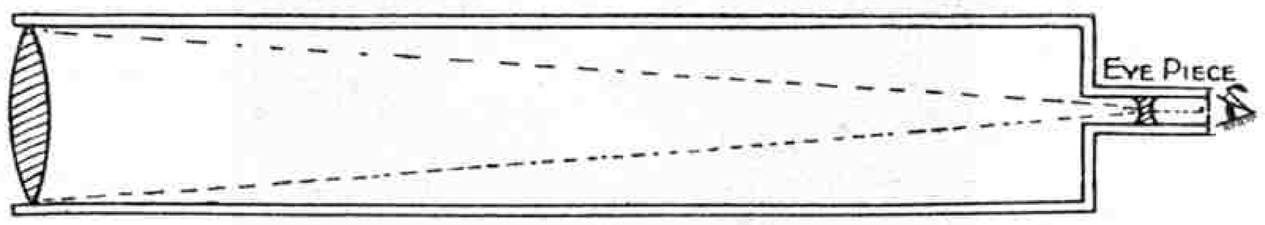
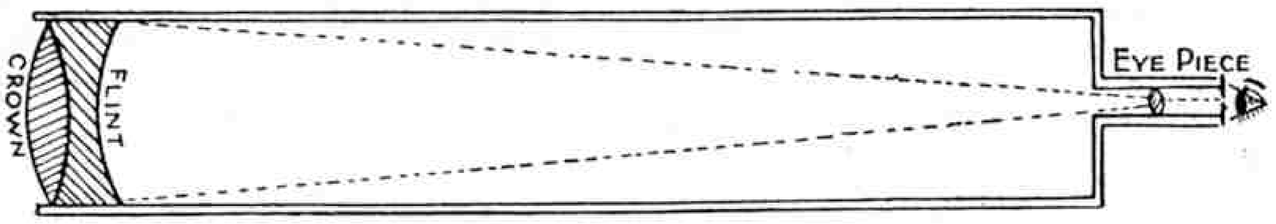


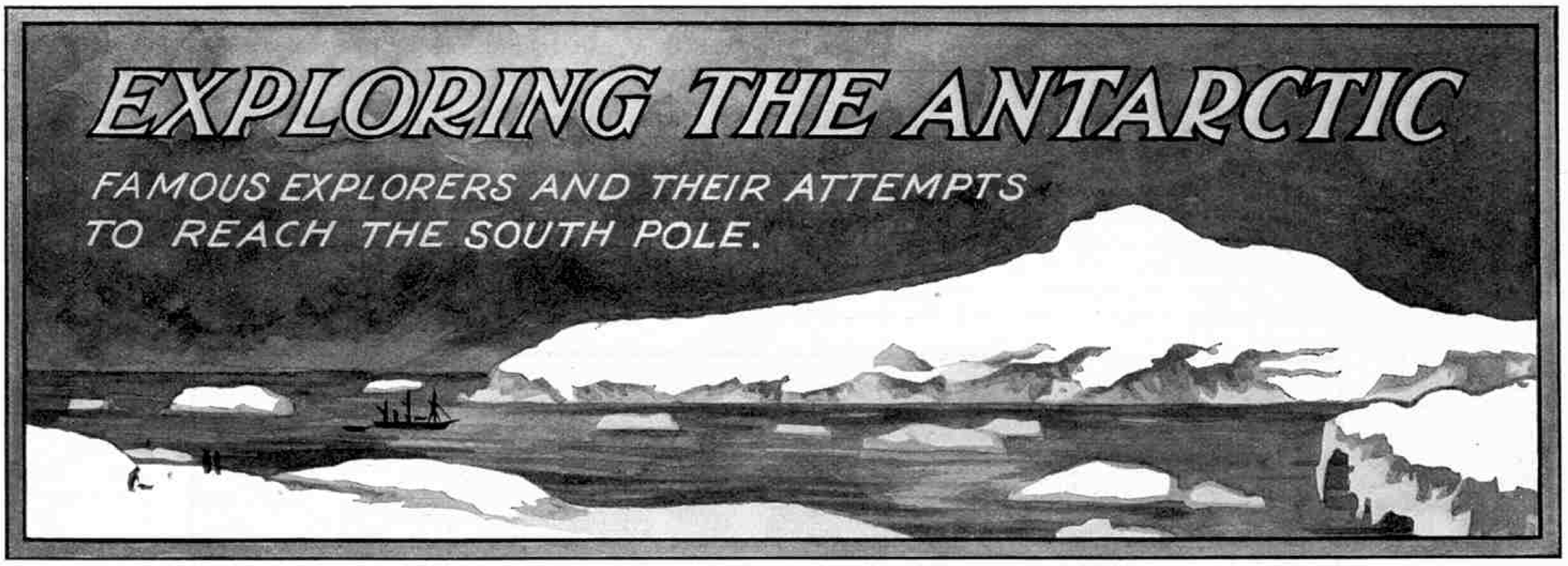
Diagram illustrating the principle of the Refracting Telescope (see below).

During 1611 a German astronomer named Johann Kepler declared that a telescope in which both object-glass and eyepiece were convex lenses would allow a larger field of view than a Galilean telescope, in which the eyepiece was a concave lens. This innovation was not put into practice until many years later, and the first powerful telescope of this type was completed by Christian Huygens. The Kepler form of telescope did not come into general use until the middle of the 17th century.

Makers of refracting telescopes who endeavoured to construct larger instruments encountered two serious drawbacks. They found that the object viewed seemed to be surrounded by the colours of the rainbow, and that the image was distorted owing to the light rays that passed through the margin of the object-glass being brought to a focus before the others. These faults became known respectively as "chromatic aberration" and "spherical aberration." Huygens and other makers of telescopes endeavoured to overcome these defects by constructing telescopes of great length, and Huygens records that he and his brother made object-glasses of 170 ft. and 210 ft. focal length. Some of these unwieldy instruments were mounted on high poles and were moved about by means (*Continued on page 519*)



The principle of the Achromatic Refracting Telescope. These diagrams are reproduced from the Editor's book "The Romance and Reality of Astronomy," by courtesy of the publishers, Thos. Nelson and Sons Ltd.



IV.—SHACKLETON'S GREAT EFFORT

LAST month we described how Captain Scott with four companions reached the South Pole on 17th January, 1912, only to die on the Ross Barrier on the return journey. This was the last episode of Scott's expedition, the second he had commanded in the frozen South. We must now turn to the achievements of Sir Ernest Shackleton, whose attack on the South Pole in 1908 was one of the most brilliant exploits in Antarctic exploration, and only just failed to forestall both Scott and Amundsen.

Sir Ernest Shackleton first became prominent when he took part in Scott's "*Discovery*" Expedition. He owed his selection for that expedition to his knowledge of sailing vessels, but his energy and resource so greatly impressed Scott that he was chosen as one of the leader's companions in the march southward that established a new Polar record.

During that journey Shackleton suffered severely from scurvy, and he was in such an exhausted state on reaching the headquarters of the expedition that it was necessary to invalid him home. In spite of this experience his enthusiasm for Antarctic exploration grew, and he bent all his energies to the task of securing sufficient financial backing to enable him to lead an expedition of his own. In this he was eventually successful and in the "*Nimrod*," an old whaling vessel, he entered the Ross Sea in January, 1908. His intention was to establish a base in King Edward VII Land, which had been discovered by Scott a few years earlier; or near it on the Barrier. Unfortunately his plans to reach King Edward VII Land were frustrated by heavy ice pack. Changes on the Barrier also seemed to show that it would not provide a safe winter home, for enormous masses of ice had broken away from its edge since last seen by Antarctic explorers, and Shackleton had no wish to be carried northward on an iceberg formed in this manner. The only plan that remained was to winter on Ross Island, on which Scott had established his headquarters in 1902; and the members of the expedition were therefore landed on Cape Royds, on the west coast of the Island. There they erected a hut that was to be their home throughout the coming Antarctic winter, and the necessary stores and equipment were quickly unloaded in order that the "*Nimrod*" might return to New Zealand before the sea froze over.

Shackleton had entered the Antarctic with the intention of making a very determined effort to reach the South Pole. Most of his preparations were made with this end in view, and he had given special thought to the sledging equipment necessary for traversing the wilderness of ice and snow over which he must pass. His experience with Scott had shown him that dogs were not too reliable on the Barrier, and in their place he brought a number of hardy ponies from Manchuria. These animals were accustomed to snow and ice, and he anticipated that they would do good work in hauling the sledges so far southward that he and the members of the little party that he intended to take would be able to accomplish the rest of the journey to the South Pole and back themselves.

As soon as possible after the end of the Antarctic winter Shackleton set out. With him were Frank Wild, who had also been with Scott in the "*Discovery*" Expedition; Lieutenant Adams and Dr. Marshall. Other members of the expedition accompanied them for a short distance, and finally the four marched out into the unknown, each leading a pony hauling a sledge loaded with provisions, on 7th November. They had started a desperate undertaking, for from that moment they were to rely entirely on their own capabilities for success in their journey of about 1,400 miles over treacherous surfaces and in the face of death by starvation or exposure.

Sir Ernest Shackleton, O.B.E.

Shackleton set a course almost due south, and thus kept well away from the mountains on the right that had been discovered by Scott and his companions five years earlier. The weather was bad and pulling the sledges in the soft snow was heavy work for the ponies. As they pressed farther and farther south the animals became weaker, and it became necessary to kill three of them in order to put an end to their sufferings. Even when dead the animals were still of service to the expedition, however, for their meat provided the explorers with a change from sledging rations and helped to ward off scurvy, the dread of Arctic and Antarctic explorers.

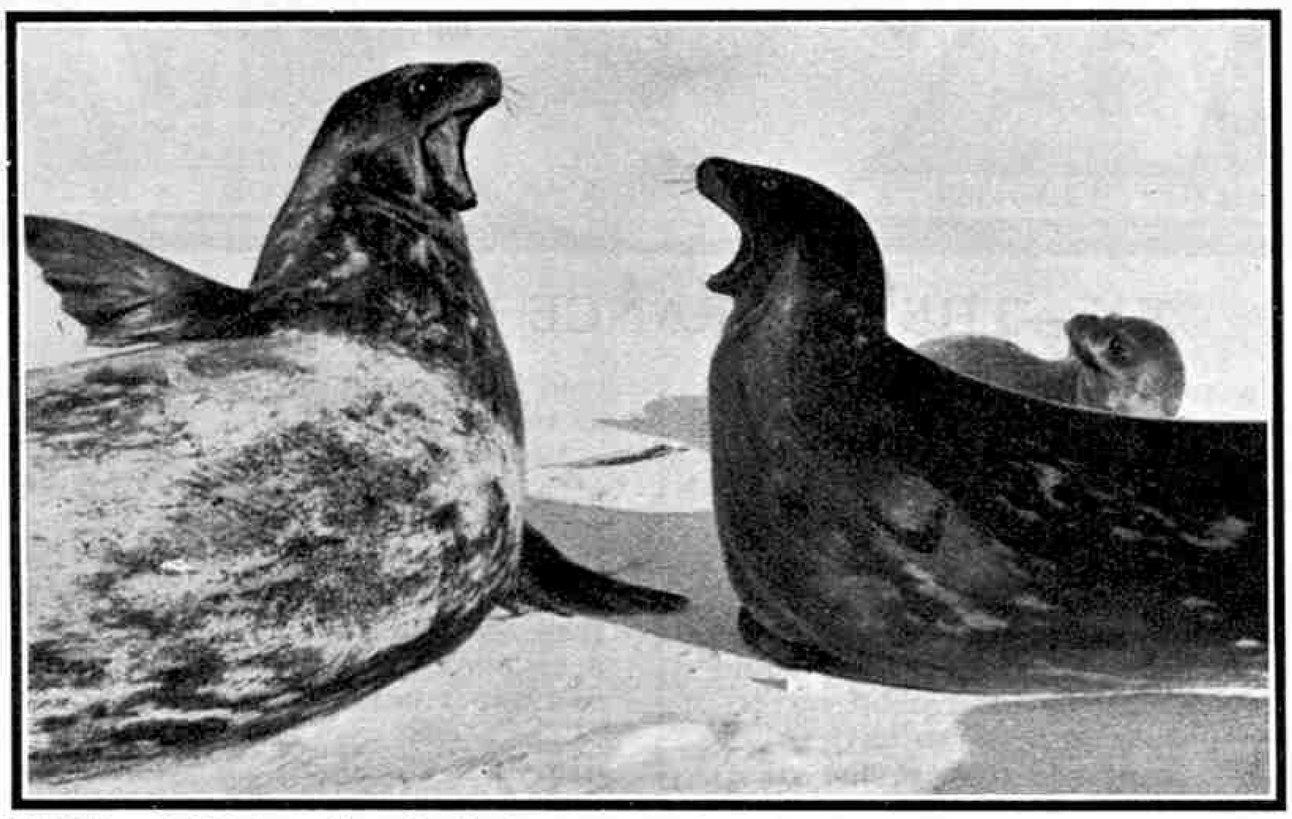
On 28th November the four men achieved a new Antarctic record, for they passed beyond the latitude reached by Scott in 1902. New land lay ahead of them, and every day splendid mountains never previously seen by human eyes came within their view. Then they began to experience trouble with the disturbed state of the Barrier surface, and eventually they were brought to a standstill by a gigantic chasm, 80 ft. in width, that compelled them to make a wide detour. The range of mountains they had seen for days now lay directly in their path, and it became evident that their way to the Pole lay across them. They climbed one, about 4,000 ft. in height, in order to trace out a possible route through the mountains, and from its summit were overjoyed to see an enormous glacier that seemed to offer an easy path southward.

Without hesitation the four men resumed their march up the great white way that led Poleward, to which they gave the name Beardmore Glacier. Shackleton, Marshall and Adams hauled one sledge, while the solitary pony left to them pulled the second under Wild's leadership. They had not proceeded very far up the glacier when the man-hauling party heard a loud and agonised shout from Wild, who was a little in the rear. Hastening back to his assistance they found him precariously perched on the edge of a gigantic crevasse, holding on for dear life to the sledge, which threatened every moment to fall into the unknown depths below the ice and to drag him with it. The sledge with its precious load of provisions was quickly pulled into safety, but there was no trace of the pony, which had disappeared in the black depths of the crevasse. This had been a very narrow escape for Wild, and

indeed for the entire party, for if they had lost the provisions on the sledge they would scarcely have been able to make their way homeward, and certainly would have had to abandon all hope of reaching the Pole.

From this point onward every ounce of food and equipment had to be pulled by the four men themselves. They forced their way upward, slowly approaching the head of the gigantic glacier they had discovered. Time after time they thought they had reached the plateau from which it descended, only again to find ahead of them ice falls up which it was necessary to climb, dragging after them their tremendous load. But they doggedly pressed on in spite of mishaps. Falls were frequent, and each of them disappeared on various occasions through the thin crusts of snow that covered yawning crevasses. Fortunately their harness was strongly made and reliable, and saved them from the fate that had overtaken their last pony.

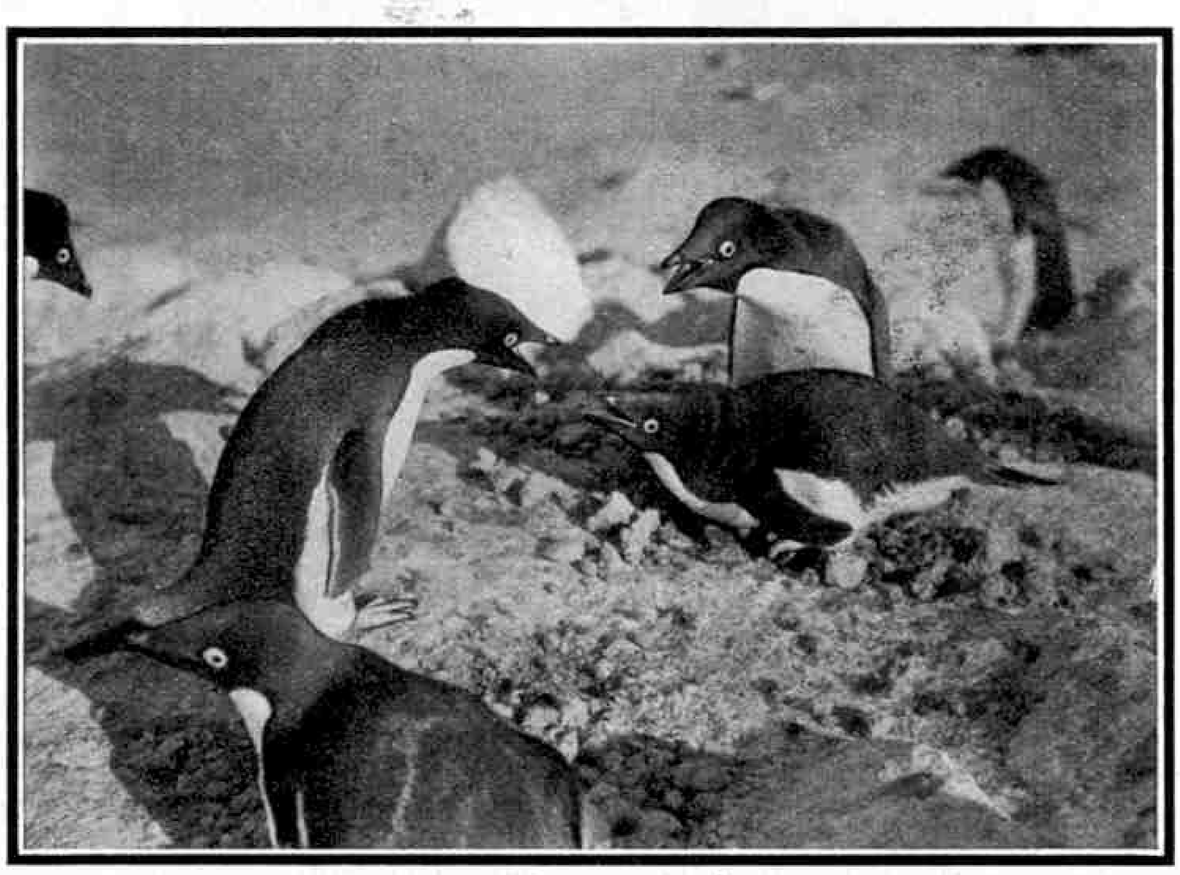
When the party reached the plateau, conditions under foot were much better, but they were now at a height of nearly 10,000 ft. above sea level, and the temperature was as low as 40-50°F. below freezing point. Their clothing was worn thin and their footgear was almost falling to pieces, with the result that they suffered terribly from the cold. Breathing in the thin atmosphere was difficult, and their hard work under these trying conditions brought on terrible headaches. To add to their discomfort they were half starved.



Weddell seals fighting. These inoffensive creatures abound in the Antarctic. They are agile and graceful in the water, but ungainly and awkward when on land.

All these hardships were endured in the hope that the scanty store of food they had with them would enable them to reach the Pole. As they marched southward, however, covering almost incredible distances every day, they began to fear that their resources were scarcely sufficient. Christmas Day was celebrated by an exceptionally long march of 13 hours and by a wonderful feed that included a tiny plum pudding. It was then that their fear of failure became most acute, but they were not yet beaten. They formed the desperate resolve to make each week's supply of food last ten days in future. They were then living on a few biscuits a day, and pemmican boiled up with maize that had been intended for food for the ponies. The maize was half raw and brought on acute indigestion. Considering the circumstances, it is remarkable to read the cheery entry that Shackleton made in his diary at this time :—" It is a fine open air life and we are getting south."

" Getting South " was always in the leader's mind, and his companions backed him up nobly. But even their iron determination was beaten when a fierce blizzard compelled them to spend two days in idleness in their tents, shivering with cold and dreaming of the food they so greatly needed.



A violent quarrel between Adelie penguins. The two photographs on this page are reproduced by permission from " The Great White South " by Herbert G. Ponting, F.R.G.S. (Duckworth & Co., London. 7/6).

At last the party recognised that they had shot their bolt. At 4 o'clock in the morning of 9th January, 1908, they left their camp, and half ran and half walked a further distance of 11 miles southward. There they set up a Union Jack given them by Queen Alexandra, and buried a metal cylinder containing a record of their achievement. They had reached a latitude of 88°23′5. This was 420 miles nearer the Pole than any previous explorer had reached, and only 113 miles separated them from their goal. With a feeling of disappointment, tempered by the knowledge that they had done their utmost, they gazed longingly southward through their field glasses. Nothing was visible but a continuation of the bleak plateau covered with ice and snow over which they had advanced since reaching the head of the Beardmore Glacier.

Returning to camp Shackleton and his companions quickly packed up and began the homeward march. Day after day they continued the dreary journey northward, full of aches and pains, and tantalised by dreams of abundance of food. Shackleton has recorded that their conversation during the day almost entirely ran on food. As soon as the day's march had fairly begun, one of them would say : " What's for breakfast to-day, boys ? " They had already breakfasted on a pannikin of tough horsemeat, and a biscuit and a half, but each in turn would then give free rein to his imagination in describing the amazing fare that awaited them at the end of their journey !

The imaginary dishes they invented were astonishing in their richness and quantity, the most remarkable being a wonderful roll of mincemeat, bacon and rich pastry, suggested by Wild. Shackleton's best contribution to these imaginary feasts was a gigantic pasty filled with the contents of at least ten sardine tins. He writes that he proposed this with considerable pride, for their talks on food were taken very seriously and on returning home they really intended to carry out a long programme of intermittent sleeping and feeding that should only be interrupted for regular substantial meals !

In the meantime the reality was far different from their dreams. At no time during their homeward run had they food on their sledge for more than a few days, and failure to find one of the numerous depots they had left behind on their southward march would almost certainly have meant starvation. " Our food lies ahead and Death stalks us from behind," wrote Shackleton in his diary. While descending the Beardmore Glacier death nearly overtook them, for after terrible struggles in a maze of dangerous crevasses, they reached the depot at the foot of the Glacier after being practically without food for two days. They were all heavily bruised from continual falls, and so weak that they only continued pulling day after day through force of habit. On several occasions one or other of them simply dropped from exhaustion at the end of the day's march.

At last they left the Glacier and commenced the last stage of their homeward journey. The Barrier surface was almost familiar ground, and they were full of confidence. But new troubles arose. Each in turn became seriously ill with dysentery caused by tainted pony meat picked up at one of the Barrier depots, and for several days they made painfully slow progress.

Their hopes eventually centred on a depot that Shackleton had ordered to be laid down for them. Failure to find it meant the end, for the supplies they carried were practically finished. They scanned the Barrier surface eagerly as they drew near the spot where they expected to see it. At last a strange flash attracted their notice ; they pressed forward to investigate, and to their intense relief and joy they found that it came from the depot. Joyce, the man who had made preparations for their return, had placed a biscuit tin in such a position on top of the pile of cases that it reflected the sunlight. A feast of good things now awaited them, and the four hungry and weary men were able to indulge in a meal as substantial, if not as varied, as the meals they had dreamed about !

Their troubles were not yet at an end, (*Continued on page 519*)

XX.—THE INSURANCE PROFESSION

THIS month we deal with a profession that affects every section of the community very closely. To-day practically everybody takes the precaution of protecting any valuable property he may possess, by paying agreed sums to an insurer, usually an insurance company, who in return is willing to take the risk of being called upon to make good any loss that may be incurred. In addition, life insurance business has grown to very large proportions. As a result the insurance profession has become one of very great importance, and it offers boys and young men good opportunities for carving out successful careers.

The earliest form of insurance business appears to have arisen in connection with losses at sea. Insurance against fire dates from a later period, and apparently it developed in its modern form after the Great Fire of London in 1666. In recent times the scope of insurance has been very greatly extended, and to-day it is possible to insure against risk of loss from almost any cause. Fire and marine insurance are still predominant, but many subdivisions of the chief branches of this business have sprung into existence, and insurance generally tends to become more complicated and world-wide in character.

There are two distinct branches of insurance, one being described correctly by this name, while the other is known as assurance. Assurance is a form of life insurance under which a sum of money is paid to the representatives of the insured person on his death, or to himself when he reaches a certain age. The amount of the periodical payments or premiums that are required to secure this benefit are based upon the average death rate, the actual sum paid depending on the age at which the assurance was effected. It will be seen that this money is certain to be paid, unless the policy or agreement is allowed to lapse.

Insurance is chiefly concerned with losses at sea, or from fire, burglary and accident. Property of all kinds may be insured, or protected against loss, and the premiums are calculated as a proportion of the value insured, this proportion depending on the risk. It is by no means certain that losses of this kind will occur, and actually in the majority of cases no claim is made by those who have taken out a policy. It is this fact that constitutes the difference between assurance and insurance.

The probability of being required to make good any losses that may occur among its clients in any one branch is carefully averaged out by an insurance company in order to ensure that it may profit from its willingness to take the risk. Losses are repaid from the premiums of clients who do not have cause to make any claims.

The total funds of British assurance companies exceed £600,000,000. The annual premiums paid to fire insurance companies amount to £12,000,000, and every year £15,000,000 is paid in the form of premiums to the accident insurance companies in this country.

Insurance offers scope for a wide variety of talents. A boy with a good mathematical training may find employment as an actuary, whose work consists of compiling and interpreting statistics relating to insurance work. Another who possesses selling ability and powers of organisation will find an outlet for these in obtaining new business for his company; and the possessor of commercial ability and sound business instincts will find opportunities in practically all branches of insurance.

Those who wish to make the best of a career in this sphere should have an all-round education, and the profession offers good opportunities to those who have obtained training at a good public or secondary school. The usual age at which to take up a junior clerkship, the natural beginning for a career in insurance, is from 17 to 19, and preference is given to those who show a satisfactory school record. It may be taken as necessary that a Matriculation Certificate, or its equivalent, should be obtained before leaving school.

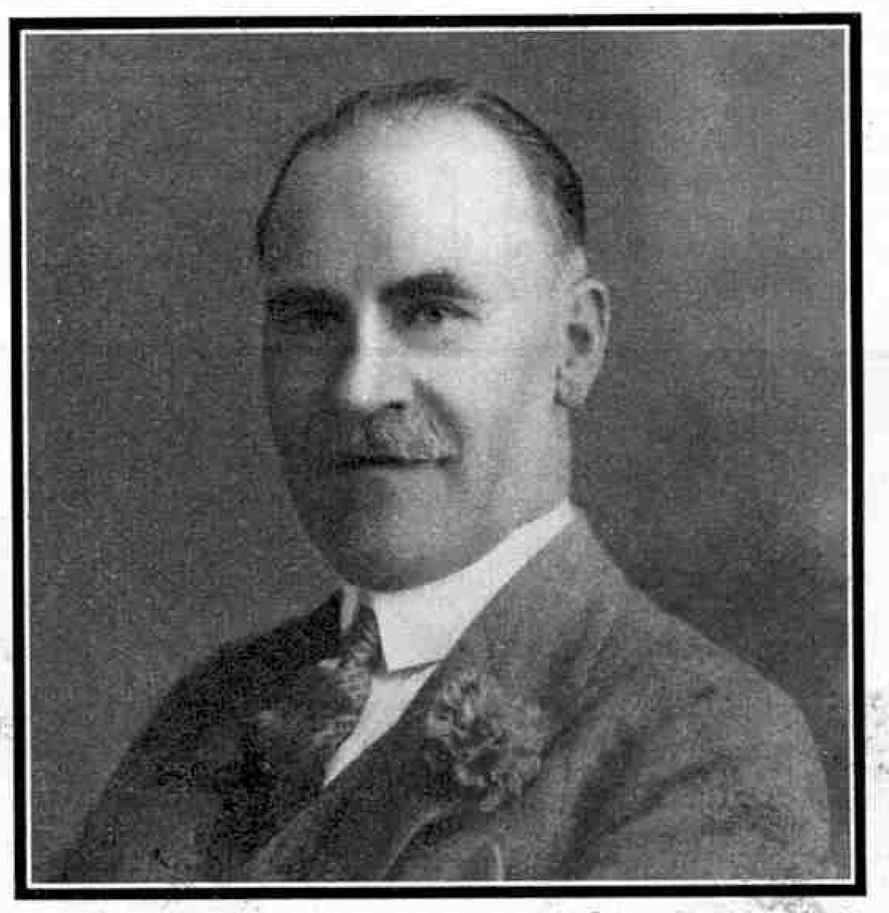
The salaries paid during the first few years in the offices of an insurance company or a firm connected with insurance are usually low. A boy who has entered a good office will find ample rewards in later years, however, for as he progresses and becomes capable of undertaking more responsible work, his salary rises in proportion. The prospects are undoubtedly good for a boy who is enthusiastic and industrious, and has a natural aptitude for the business.

The early years of work in an insurance office are devoted to learning as much as possible about the business generally, and particularly to acquiring practical experience. A considerable amount of specialised knowledge is required in dealing with insurance matters, and when the time comes for advancement, it is necessary to make a choice of one branch of the work. The selection will depend largely on the inclinations of the boy himself. Generally speaking, the fire and accident departments offer the best opportunities, and the higher posts are usually filled by men who have a sound knowledge of one of these branches.

The greater number of the large composite insurance companies generally employ two distinct staffs, one for work in the office and the other for outside duties. All insurance companies make use of agents to obtain business for them. Some of these agents are professional men, such as solicitors and accountants, who are likely to be useful to the company.

An inspectorship in an outside department is an excellent avenue to promotion. The holder of such a position deals with those who act as agents, and it is his duty to see that his company's position is well maintained. An application for a post of this kind may be made by a young man who has spent some years in the office of

An Insurance Authority



Sir Ernest Bain, K.B.E., LL.D., J.P., is Governing Director of A. W. Bain & Son, Incorporated Insurance Brokers, and is a leading authority on insurance. During the War he controlled the Insurance Department of the Ministry of Food, and was knighted in 1921 in recognition of his services.

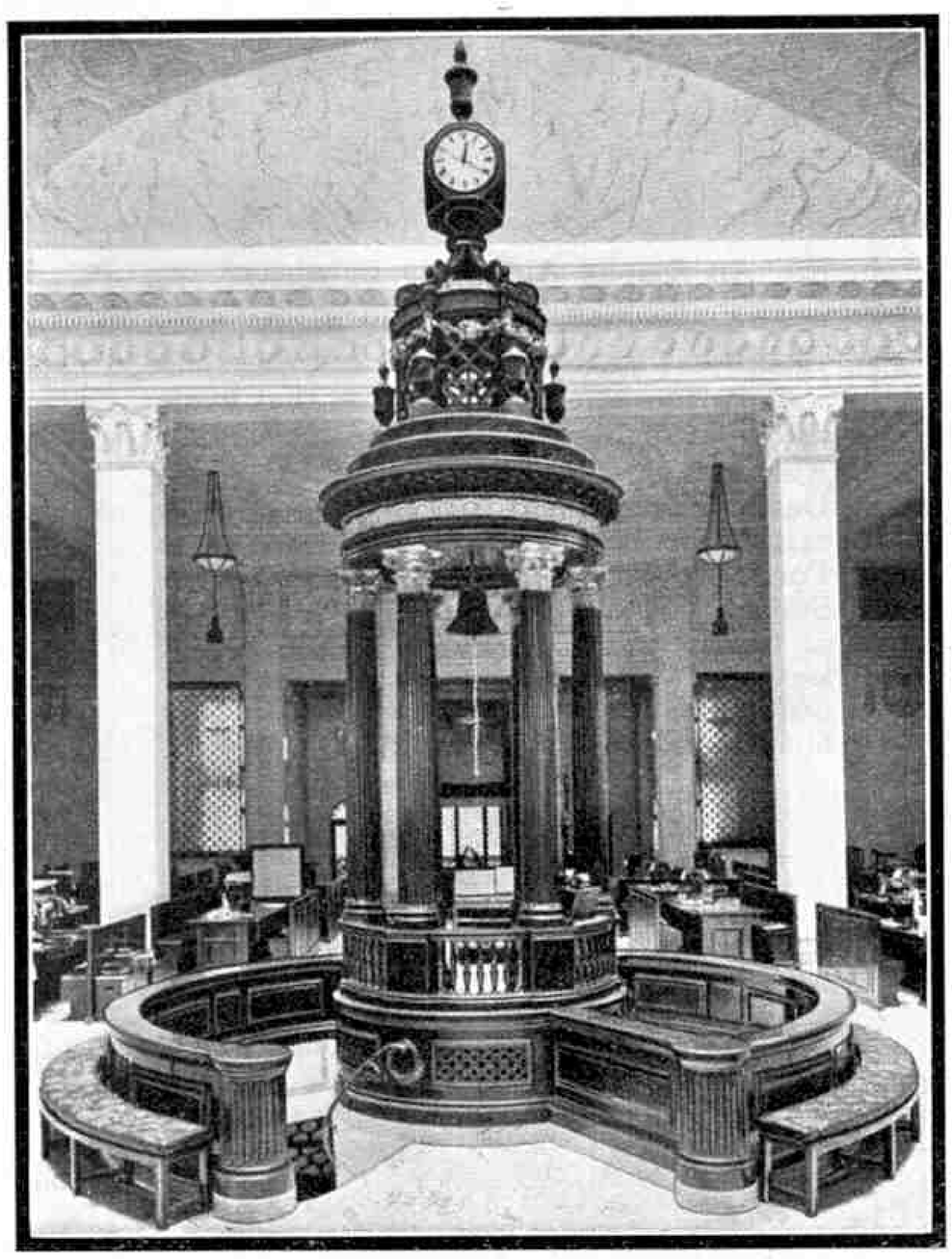
Sir Ernest is greatly interested in educational matters, and is Chairman of the Finance Committee of the University of Leeds.

an insurance company and is thoroughly familiar with the necessary routine work. If his application is granted, he will receive a fixed salary and commission on the business that passes through his hands. The fixed remuneration is not very high, £150 a year being a reasonable figure for a young man; but one who is moderately successful may earn in addition a commission of between £200 and £300 a year.

An important branch of insurance work deals with the calculation of probabilities in life insurance and with similar problems. The men who specialise in this work are known as actuaries. The statistics that they prepare are used in fixing premiums and in deciding the general conditions under which insurance policies are issued. Thus actuaries occupy very important positions, and thoroughly competent men command high salaries. The head of the actuarial department of a large insurance company may receive as much as £5,000 a year, and well-qualified assistants may expect £400 to £800 a year, or even more.

The usual method of becoming an actuary is to secure a junior clerkship in the life department of an insurance company, and a salary of from £60 to £80 a year may be expected during the first few years. The next step is to qualify by examination for membership of the Institute of Actuaries. Mathematics naturally figures prominently in such examinations, and only those who possess ability in this subject should think of adopting this side of the insurance profession. When full membership, or Fellowship as it is called, has been obtained, the qualified actuary may set up in practice for himself; but it is more usual to take up a position on the actuarial staff of an insurance company.

In view of the highly-specialised character of the work, it is advisable for those who wish to reach the highest posts in the actuarial profession to attend a University after leaving school, and to obtain an honours degree in mathematics. The next step is to secure an appointment as an actuarial clerk in order to acquire the necessary practical experience; and at this stage the examinations of the Institute of Actuaries may be taken. A young man who becomes a Fellow of the Institute by following this course is well equipped to occupy successively the posts of Assistant Actuary and Chief Actuary to an insurance company.



The "Caller's" Rostrum at Lloyd's. In it is suspended the famous "Lutine" Bell, which was saved from the "Lutine," a vessel wrecked in 1799. The bell is rung when an announcement of the loss of a ship is to be made.

Those who wish to succeed in the insurance world should become members of the Chartered Insurance Institute. There are two classes of members, Associates and Fellows, and admission to each class follows an examination. The test that qualifies for Associateship is held in four branches dealing with fire, life, accident and marine insurance respectively, and is divided into two parts. The Fellowship examination is open only to Associates, and deals with the general principles of insurance. Membership of the Institute is not absolutely necessary, but success in passing its examinations is one of the best means to promotion, and it is gradually being recognised that the leading posts are secured by its members.

Work that is directly connected with insurance is carried on by loss assessors, who estimate the amount that should be paid by an insurance company in respect of claims made on them. The work was originally confined to the fire insurance branch, but with the great increase that has taken place in recent years in the number of burglary, theft and motor car insurance policies taken out, the scope of the profession has been considerably widened. To-day insurance covers so wide a field that there are abundant opportunities for experts in many branches of industry, who may make excellent careers for themselves as assessors of damage due to fire or other causes, and also for keen, alert men who are capable of investigating the claims made on insurance companies. For instance a well-qualified motor engineer may specialise in assessing damage to cars due to collisions and other accidents.

The usual manner in which work of this kind is taken up is by obtaining a situation as a clerk or articled pupil with someone already engaged in the profession, but valuers, engineers, and other specialists or capable young men who have had experience in the claims department of an insurance company also may do well as independent loss assessors.

Another interesting branch of insurance work is carried on by the insurance broker, who acts as intermediary between insurance companies or underwriters on the one hand, and those who wish to effect insurances on the other. A broker must have an expert knowledge of insurance in practically all its branches in order that he may be in a position to advise clients of the best means of carrying out their wishes as well as to place their business in the most advantageous quarter.

The advantages offered by the insurance broker have given increasing importance to his work. In addition to guiding his clients in placing their insurances, he also aids them when it is necessary to make claims. Settling a claim is seldom a simple business and the expert knowledge of the broker undoubtedly saves his clients a considerable amount of worry by dealing with the many complicated questions that may arise.

A boy who wishes to become an insurance broker should obtain a situation with a well-established firm of brokers. In addition to gaining experience of the work in this manner he should endeavour to secure membership of the Corporation of Insurance Brokers, which may be regarded as essential for success. Two grades are recognised. These are Associateship and Fellowship, and they can only be obtained by passing examinations held by the Corporation.

There are excellent openings in various special branches of insurance. Of these the most interesting is probably marine insurance, which is chiefly effected through the famous London Corporation known as Lloyd's. This historic institution derives its name from that of Edward Lloyd, who owned a coffee house in London towards the end of the 17th century. This house became the principal resort of those interested in marine insurance. Shipowners were accustomed to meet there underwriters, as the men are called who are prepared to accept the risk of loss of vessels or cargo in consideration of the payment of a premium. Eventually the coffee house was abandoned for a room in the Royal Exchange, and owing to the great expansion in the amount of business transacted, Lloyd's also began to publish shipping news and to collect information of all kinds that would be of value to underwriters.

The Corporation itself does not issue, or assume any liability under policies, all the underwriting business being transacted by individual members. Underwriters at Lloyd's must have a wide knowledge of ships, seamen and cargoes, in order that they may be able to estimate quickly the risk of loss in any proposed transaction. Their responsibilities are very great, but those who are successful earn very large incomes. A system of working in syndicates spreads the risk over a number of underwriters, whose combined resources are capable of standing the strain of the heavy payments that may result from a series of wrecks or other misfortunes.

The first step towards becoming an underwriter is to obtain a really sound education, and in this emphasis should be placed on mathematics. A boy who is well qualified in this respect should seek a position as clerk to an underwriting member of Lloyd's. If successful in securing a post of this kind he will spend several years in the acquirement of experience of the class of work he has chosen, during which time he will receive only a small salary. A post as deputy-underwriter should then follow, work of this kind being carried on for a small salary or commission.

After spending about five years as deputy underwriter, election to Lloyd's as a full underwriter may be sought. Every application must be supported by at least six members, and a sum of from £5,000 upwards must be deposited as security, the exact amount being determined by the ruling committee of Lloyd's. In addition there is an entrance fee of £500 and an annual subscription of £300. When the necessary formalities have been completed, the applicant becomes a full member.

New Form of Aerodrome Beacon

The illustration on this page shows a new form of aerodrome beacon that has been introduced by the International General Electric Company. The beacon has been erected at the Cleveland Municipal Airport. It incorporates several new lighting principles and should be of great assistance to night flyers, for its rays are visible at long range and penetrate fog better than beams of ordinary white light are capable of doing.

The beacon provides a rotating fan of light that easily reaches the pilot at whatever angle he approaches the landing ground. One half of the light is white and the other half red, and therefore the airman sees alternate red and white flashes, and is able to distinguish the aerodrome from other brightly lighted areas.

Of the various light units composing the beacon, four are drum-shaped and project high intensity beams, two of which are red and two white. These units are the four lower ones shown in our illustration, and they are identical in design with those used in beacons that mark air routes, as described on page 602 of the "*M.M.*" for August, 1930. The remaining units of the beacon project less intense beams at higher angles.

Aerodromes may readily be distinguished by installing at them beacons of this type having different sequences of coloured flashes. Thus they may become as useful to airmen as lighthouses are to seamen.

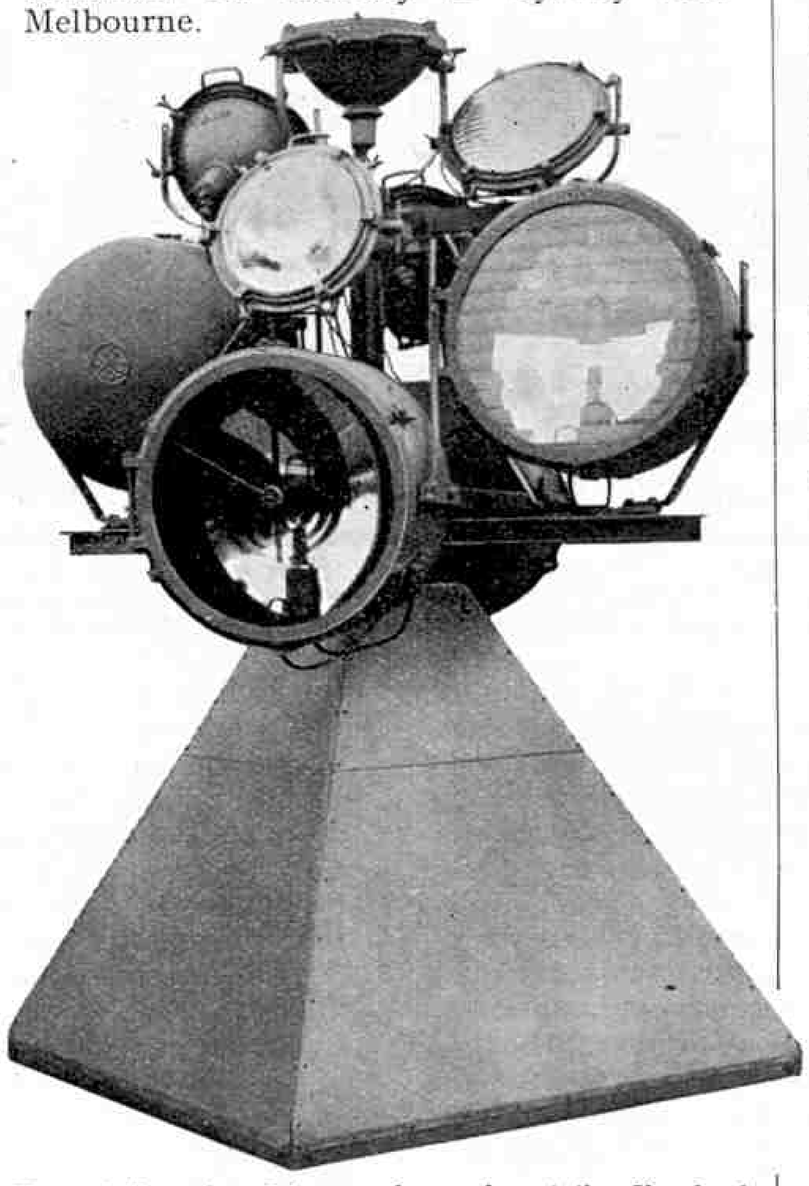
Air Trophies for Air Commodore Kingsford-Smith

The Britannia Trophy of the Royal Aero Club has been awarded for 1930 to Air Commodore C. H. Kingsford-Smith. The Trophy is held by the airman who makes what is thought to be the most remarkable flight of the year, and in this instance was awarded in respect of the famous Australian's flights from Ireland to Newfoundland and from England to Australia. Readers will remember that the first of these flights was made in the Fokker monoplane, "*Southern Cross*," and the second in the Avro "Avian," "*Southern Cross Junior*."

Air Commodore Kingsford-Smith also has been awarded the Segrave Memorial Trophy for 1930 in recognition of the same flights. This is awarded annually by a special committee to the British subject who, in the opinion of the members, gives the most outstanding demonstration of the possibilities of transport by land, air or water.

An Empire Air Route Extension

Two experimental air mail flights were carried out between England and Australia a short time ago. The machine that made the first flight unfortunately crashed at Kupang, on the island of Timor in the Dutch East Indies, and the mails were carried on the remaining 500 miles to Port Darwin by Air Commodore Kingsford-Smith. From Port Darwin an aeroplane of the "Qantas" Company took up the service, the mails being flown across the continent for delivery in Sydney and Melbourne.



The rotating airport beacon in service at the Cleveland Municipal Airport, Ohio, and described on this page. Our photograph is reproduced by courtesy of the International General Electric Company.

The scheduled time for the journey of 11,194 miles was 15 days, which represents a saving of nearly a fortnight on the time required by the fastest surface transport. The route naturally follows the one used by the Indian Air Mail Service as far as Delhi, the journey after this being made by way of Calcutta, Rangoon, Singapore and the Dutch East Indies. It is proposed that a regular weekly air mail service should eventually be set up between England and Australia.

French Airmen Make Aviation Records

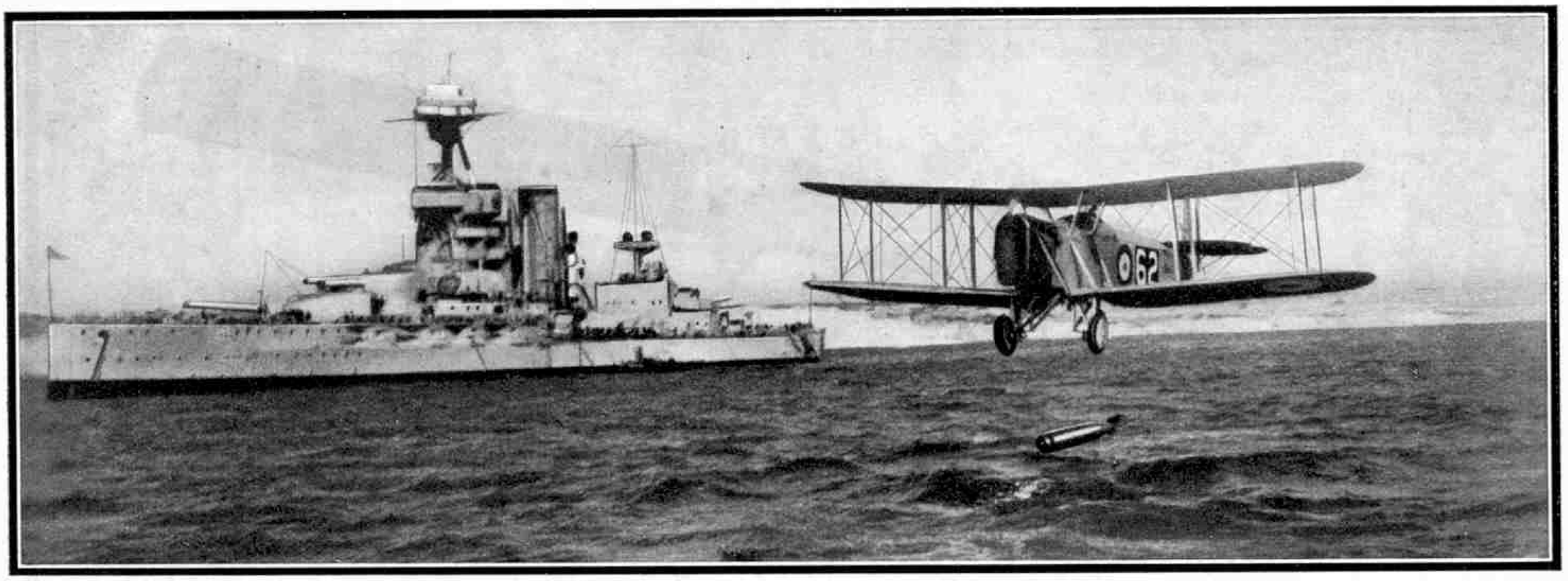
Seven new international records were set up simultaneously a short time ago by two French airmen, Joseph le Brix and Marcel Doret, in a Dewoitine D.33 low-wing monoplane fitted with a Hispano-Suiza 650 h.p. water-cooled direct drive engine. The records were for duration of flight and distance flown for machines carrying various loads, the aeroplane remaining in flight for 32 hours 17 minutes. During this time 4,662 km. or 2,872 miles were covered. The actual records were duration and distance for machines carrying a load of 500 kg., or 1,102 lb.; 1,000 kg., or 2,205 lb.; and 2,000 kg., or 4,410 lb. A speed record for machines carrying a load of 2,000 kg. also was established, the speed over 2,000 km., or 1,243 miles, being 151.36 km. per hour, or 94 m.p.h.

On its record-breaking flight the machine carried 1,063 gallons of petrol, 55 gallons of oil and a load of 4,762 lb., in addition to the two pilots. The all-up weight was 8,965 kg., or about 9 tons. The aeroplane took off after a run of 4,225 ft. in 68 seconds.

Parachute Jump of Nearly Three Miles

Two remarkable records were made recently with Irvin parachutes. The first was a low jump from a height of only 85 ft. In this the daring parachutist was only 10 ft. from the ground when his fall was checked. This effort followed two successful jumps from a height of 150 ft., these being equal to the lowest heights from which a successful jump had previously been made.

The second of the two new records was a long-delayed jump in which the parachute fell 15,265 ft. before the canopy was opened. The airman fell freely for about 1½ mins. but the shock when the parachute came into action was not excessive. This is not altogether unexpected, for it is well known that in his rush earthward a falling human being reaches his greatest speed at the end of a drop of about 1,000 ft., the resistance of the air preventing any further increase. The speed attained is about 119 m.p.h. The experiment was useful, however, for it showed that an airman may remain sufficiently alert to open his parachute after falling thousands of feet. This should finally dispose of the idea once held that a fall through space produces unconsciousness. The successful low jump demonstrates that, if there is no other chance of escape, a parachute descent from this height can be made with a fair prospect of landing safely.



The Blackburn "Dart" torpedoplane in action. The torpedo it has just discharged may be seen above the surface of the water. We are indebted to the courtesy of the Blackburn Aeroplane and Motor Co. Ltd. for permission to reproduce this photograph.

The Pobjoy "R" Aero Engine

In the "*Air News*" pages of our issue for January 1929, a brief description was given of a light aeroplane engine designed by Mr. D. R. Pobjoy. An improved form of this engine, known as the Pobjoy "R" type, is now in regular production at Hooton Park Aerodrome, Cheshire, the headquarters of the Liverpool Aero Club, and is illustrated on this page. The new engine is of the seven-cylinder, air-cooled radial type and develops 75 h.p. Its bore and stroke are 77 mm. and 87 mm. respectively, and it has the low petrol consumption of 5.34 gallons per hour. The engine is very small for the power developed, its diameter being 25½ in., and its weight, including airscrew hub, starter, and full dual ignition, only 130 lb.

The most unusual feature of the Pobjoy "R" engine is that the airscrew shaft is not in line with the crankshaft, but is above it, the two being connected through simple helical reduction gear. Thus when the engine is running at 2,760 r.p.m. the airscrew runs at a normal speed of 1,400 r.p.m. and a large slow-running propeller may be used. This has the effect of reducing noise, and a specially arranged exhaust system has been installed for the same purpose.

The new engine is fitted in the Comper "Swift" single-seater light aeroplane also constructed at Hooton Park Aerodrome. When fitted with this engine the "Swift" has a very fine performance and is considerably quieter for the occupants than are most modern aeroplanes.

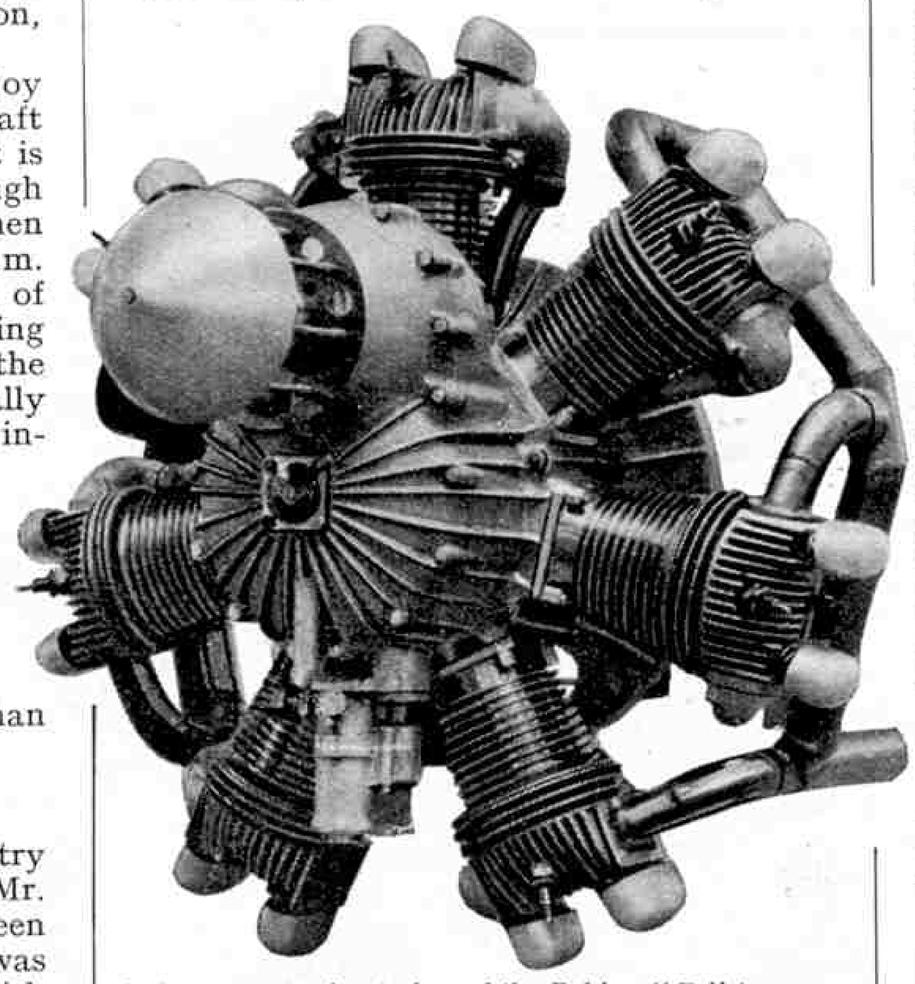
England to Australia in 10 Days

An excellent flight between this country and Australia has been made by Mr. C. W. A. Scott. Mr. Scott, who has seen service with the R.A.F. and also was employed for some time as a pilot with "Qantas," the Australian Air Line Company, made the flight of 10,500 miles in 9 days, 4 hours, 11 minutes. This is 16 hours 48 minutes better than the time taken by Air Commodore Kingsford-Smith and more than five days less than the time taken by Squadron Leader B. Hinkler only three years ago. Mr. Scott made the flight in a "Gipsy Moth." The first stage of his journey was from Lympne to Belgrade, a distance of 1,100 miles, and this was covered in one day.

Speeding Up British Air Services

Accelerated air services from London are features of the summer time schedules of the Imperial Airways that are now in operation. A saving of 15 mins. has been made on the 225-mile aerial journey between Croydon and Le Bourget, while flights to Berlin, Zurich, Prague and Marlo, in Sweden, may now be made in a single day. Business centres on the Rhine and throughout Central and Southern Germany, are within a few hours' journey of London, and Imperial Airways machines from London establish at Cologne connections with a network of air routes to all parts of Central and Southern Europe.

The England-India service also has been speeded up. This has been made possible



A three-quarter front view of the Pobjoy "R" type aero engine, reproduced by courtesy of Pobjoy Airmotors Ltd.

as a result of new agreements with Italy and Greece, but the introduction of faster flying boats on the Mediterranean section has played a part in the change. Passengers and mails travel via Switzerland, Italy and Greece. The journey between London and Karachi is completed in 5 days, 2 hours, 35 mins., and the air mail from London to Central Africa is scheduled to reach Kenya Colony in only a few hours over six days.

The Junkers Diesel Aircraft Engine

Research work on aero engines of the Diesel type is now being carried out in various parts of the world. In this country, Rolls-Royce Ltd. are at work on two engines of this kind, both of which are standard Rolls-Royce engines adapted for use with heavy oil. So far the greatest advances have been made in America. The Packard Diesel engine has been flown in many types of machines. A detailed article on the Packard engine appeared in the "*M.M.*" for October, 1930.

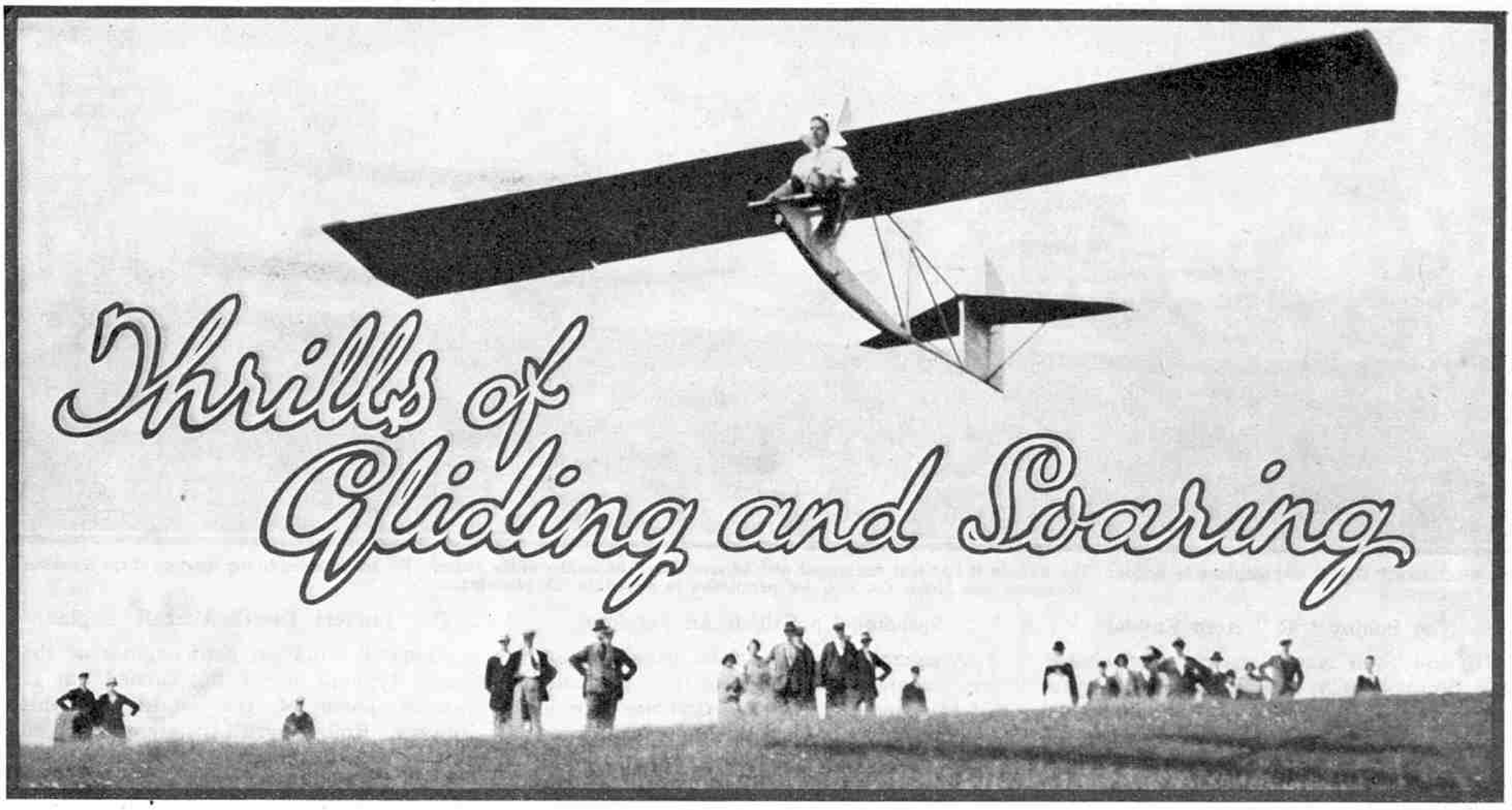
The only other Diesel aero engine to have attained any degree of practical success has been constructed by the Junkers firm in Germany. The first model of the Junkers Diesel engine was completed more than two years ago, the first flight in which it was employed being carried out on 3rd February, 1929. Since then the engine has been subjected to extensive tests, both on the bench and in aircraft, and the latest type, known as the "Jumo 4," has been fitted in a Junkers F.24 low-wing monoplane and put into service on German air routes.

The new engine is of the vertical opposed type, the cylinders being in a vertical plane. Two pistons are carried in each cylinder, and they work in opposition to each other. The engine operates on the two-stroke principle and weighs 800 kg., or 1,760 lb., and develops a maximum of 720 b.h.p. When working with the throttle two-thirds advanced the petrol consumption is approximately .348 lb. per h.p.

World's Longest Glider Flight

Since the article on Gliding and Soaring that appears on page 462 of the issue was completed, a German pilot has set up a new world's distance record for gliders by covering a distance of 165 miles. This flight, which exceeds the old record by more than 70 miles, was commenced at Münich, where Groennoff, the holder of the new record, was towed in his glider behind an ordinary aeroplane until a height of 4,000 ft. was reached. He then cast off and remained in flight until darkness fell, when a landing was made at Kaaden in Czechoslovakia.

The flight was made in a sailplane of the Fafnir type, which has a wing span of 66 ft. It has a gliding angle of 1 in 25, which means that the machine sinks one foot for every 25 ft. travelled forward.



TOWARDS the close of 1929 an Austrian aviator, Lieut. Dinort, remained in the air in a glider for 14 hr. 44 min., setting up a duration record for gliding flight that has not yet been beaten. This feat seems to have focussed world-wide interest upon the sport of gliding, for immediately it experienced a revival of popularity throughout the world. This wave of enthusiasm was particularly noticeable in England where, since 1922, when the sport experienced a brief period of popularity, all general interest in it had ceased. After Lieut. Dinort set up his record, however, a number of British enthusiasts reintroduced the sport to this country, and now there are nearly 100 clubs either in existence or in process of formation. The sport is not yet so far advanced here as it is in Germany where, in addition to numerous clubs there are six training schools, the most famous being that at Wasserkuppe.

Gliding is often thought of as a new sport, although in reality gliders were the forerunners of the modern aeroplane. Most of the early pioneers of aviation were keen students of gliding, for there was no means of mechanical propulsion available, and this was the only way in which they could emulate the soaring flight of birds, which no doubt first filled Man with the ambition to fly. Records show that as far back as 1809 attempts were made to build gliders. In that year a machine was constructed by Sir George Cayley, a wealthy Englishman. The machine that he made was not a success, and neither were the many others constructed by various designers after Cayley's experiments. Numbers of these machines actually did succeed in remaining in the air for short periods, but they usually ended by crashing and either killing or injuring their pilots.

The upper photograph shows Mr. Lowe-Wylde, of the Kent Gliding Club, flying the primary machine constructed by members. Mr. Lowe-Wylde holds the first gliding licence granted in England. The lower photograph shows a "Prüfling" intermediate type glider in flight.

One of the most famous of the early pioneers was Otto Lilienthal, who is often referred to as the "Father of Aviation." Much of Lilienthal's study of flying was made on gliders, and he carried out many hundreds of successful flights, his record distance being 1,200 ft. He was killed in 1896 when a glider he was flying crashed to the ground and he was flung out of his seat.

After Lilienthal's death the next important figure in the history of gliding was Percy Pilcher, who devised an ingenious solution of the greatest difficulty experienced by early enthusiasts, namely, that of making their gliders leave the ground. Lilienthal had overcome this difficulty by constructing an artificial hill, from the top of which he launched his glider. Another method, first used by a Belgian named Vincent de Groof, was to carry the glider up into the air below a balloon, and to release the machine at a suitable height above the ground. De Groof's glider had movable wings, and he made several successful flights in it after being launched in this manner. On one occasion, however, the mechanism of the wings failed to operate, and the flight ended in a crash in which the pilot was killed.

The method adopted by Pilcher was by far the safest that had been invented up to that time, for he towed his glider behind a horse! When the machine had risen into the air the tow rope was cast off, and the pilot proceeded to glide to earth. It is interesting to note that a similar method of launching gilders, but with the place of the galloping horse taken by a motor car, is used by many clubs to-day, particularly in America.

Pilcher's work was contemporary with that of the American Chanute, who was followed by Orville and Wilbur Wright. The prolonged and extensive experimental glider work carried out by these famous brothers, enabled them to design and construct the first successful power-driven heavier-than-air machine.

The success achieved by the Wright brothers resulted in gliding being studied in all parts of the world, particularly in Germany. As already mentioned, the sport became popular in England in 1922, and a gliding meeting was held at Newhaven in that year. Several records that still stand were set up at this meeting, but public enthusiasm was never really aroused, and interest soon died away. In 1930 Robert Kronfeld, the famous German glider pilot, paid a

visit to this country at the request of a number of enthusiasts, and it was due largely to the wonderful flights that he made in sailplanes that the sport became definitely re-established here.

Gliding appears to be the ideal pastime for the air-minded youth of to-day. Flying generally is a sport that has a fascination for thousands of young men in this country. Unfortunately the cost of taking it up is exceedingly high as compared with the cost of most other sports, the training for an "A" licence alone usually costing at least £25. On account of this it is only a favoured few who are able to enjoy the exhilaration of actual flying. Gliding has made it possible for non-flying enthusiasts to gratify their desires, for it provides a sport that combines all the excitement of flying with the great advantage of small cost.

The biggest actual outlay before gliding may be taken up is the cost of the glider itself. This may be anything between £50 and £120, but anyone possessing the necessary skill and experience could buy the parts and build a glider for about £20. Usually a number of young men band together to form a club and purchase with their subscriptions a machine, or the parts to build one. In starting a club in this manner it is advisable, and in fact really necessary, to secure the services of someone with practical experience of gliders; or failing that of an aeroplane pilot.

When a student joins an already established club the first thing that will be required of him is to assist in catapulting other pilots into the air. This operation is carried out by a number of men who pull on an elastic rope fastened loosely to the front of the glider by means of a ring. When the pilot is ready to commence his flight he gives the word for his machine to be released, and he is then shot up into the air.

Gliders are controlled in an exactly similar manner to aeroplanes, except that there is no engine that can be brought into play when the wind fails, and the glider commences to sink. The gliders are divided into three main classes, primary and intermediate types, and sailplanes. A student receives his preliminary training on a glider of the primary type, of which the "Zögling" is probably the best known. This training consists of being towed over more or less level ground, so that the machine only rises a few feet. After experience has been gained in this manner the student is allowed to make his first real flight.

It is not often that the first flight is the great success that the beginner intended to make it! The shock of being catapulted into the air frequently causes the pilot to forget all that he has been told, and in order to remain up he pulls the "stick" back, the nose rises, and the machine loses flying speed and stalls. Crashes are seldom serious, however. So far there has been only one fatal gliding accident in this country, and this, it is important to note, occurred during the use of an entirely experimental type of machine.

Some British clubs have now introduced the practice of towing the glider behind a motor car, the tow rope being cast off when sufficient height has been attained. This method of launching makes it possible for gliding to be carried out over quite flat country, but unless operations are in charge of a fully-qualified instructor, there is a certain amount of danger in the process.

When a gliding student has shown himself capable of controlling a glider of the primary type he graduates to the intermediate machine, which usually resembles an ordinary aeroplane more closely than does the primary glider. The "Prüfling" is the most common intermediate type glider, although it is now being replaced by the "Falke" in many clubs. Machines of this type are considerably more difficult to handle than the ordinary beginners' machine. They are also much more efficient, however, and in them it is possible to make considerably longer flights.

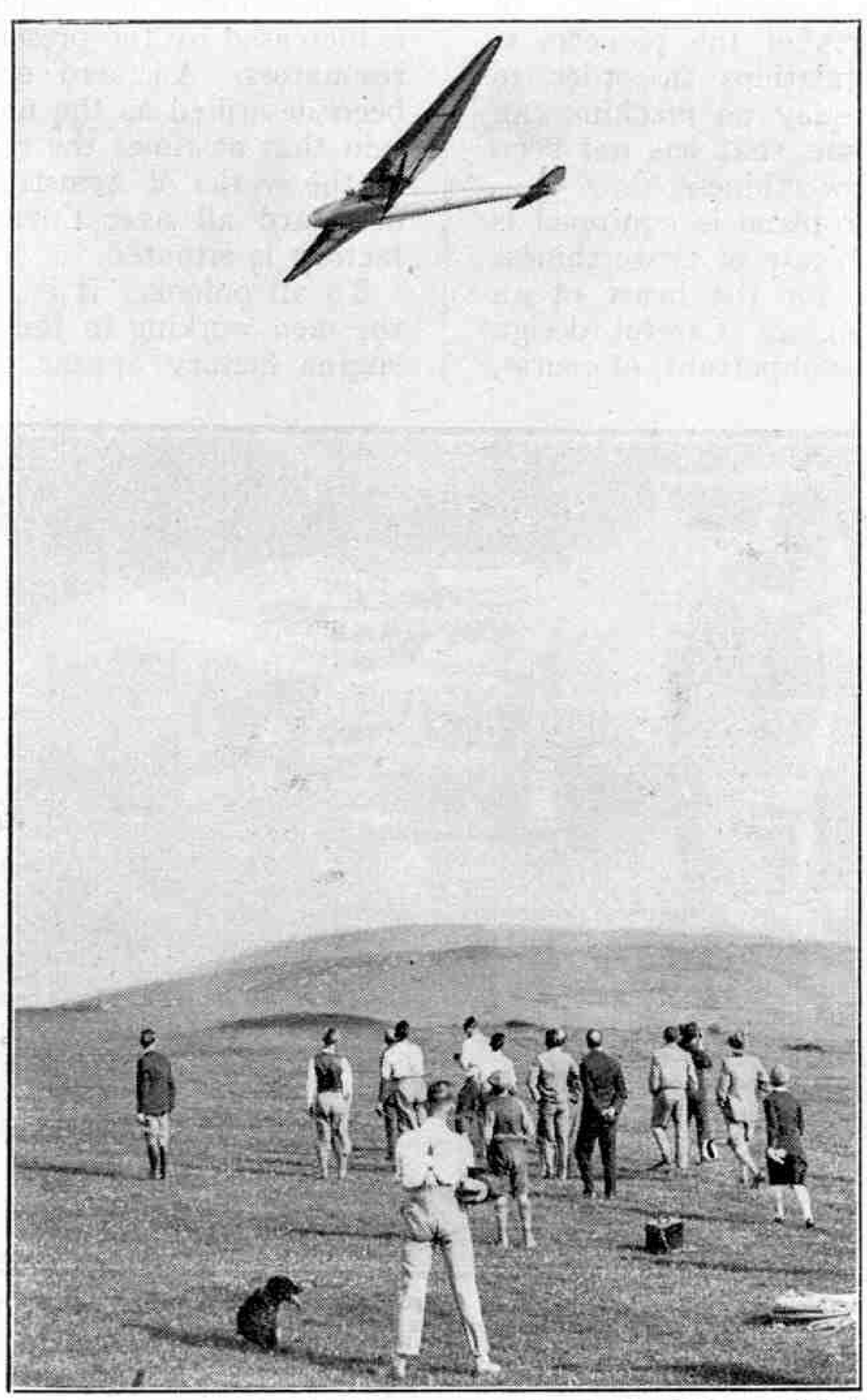
By the time the student is able to fly an intermediate glider with some degree of success, he is ready to attempt to fly a sailplane. A sailplane is a type of glider that has an extremely high efficiency, and is suitable for use on cross-country flights, and flights of long duration. The sailplanes owned by most schools and clubs are of the "Professor" type. Some idea of the efficiency of these machines may be gained from the fact that Kronfeld, during one of his exhibitions given at Itford Hill, near Lewes, made a flight from this hill to a point near Portsmouth. The flight was made in a straight line between the two places, which are over 70 miles apart, and it occupied about three hours.

Glider pilots are licensed in a similar manner to pilots of power-driven aeroplanes. There are three certificates for which they can apply. The first of these is known as Certificate A, candidates for which are required to make a flight of at least 30 seconds' duration, followed by a normal landing. The second or B Certificate is given to pilots who are already in possession of the first certificate, and have in addition made two further flights each lasting for 45 sec. Candidates must also pass a test on application for the licence, and this consists of remaining in the air for one minute, and making two S-shaped turns during the flight. The third or C Certificate is given only to fully qualified glider pilots. To obtain this a flight of not less than five minutes must be made at an altitude greater than that of the pilot from which the flight was commenced.

Although much enjoyment and many thrills are to be obtained during the early training of a glider pilot, it is only after he has secured the "C" licence and is able to fly a sailplane that he is in a position to realise the practically unlimited pleasure afforded by the sport. When sufficient experience has been gained long cross-country flights may be made by taking advantage of air currents caused by the nature of the country, or by using the currents that exist beneath cumulous clouds.

So far we have mentioned only the sporting aspect of gliding, but it has also other important features. A glider pilot gains an extensive and very valuable knowledge of the technical principles of flight, which would stand him in good stead if ever he wished to become an aeroplane pilot. He also gains a considerable knowledge of meteorological conditions, and in particular of the air currents which, when they are sufficiently understood, will make long glider flights a matter of every-day routine. When this comes to pass gliding may be turned to commercial use. Already two-seater gliders have been built, and it is possible that larger ones to carry more passengers will be constructed before long. A glider does not use either petrol or oil, and consequently this form of transport would be quite cheap. Another possibility is that gliders may be utilised commercially by towing them behind aeroplanes, as barges are towed behind tugs. A flight across America in a towed glider has already been carried out, and further experiments in this direction are awaited with interest.

Readers who wish to take up the sport of gliding will be well advised to join established clubs, and not to build gliders for themselves until they have gained some experience of glider operation and repair work. There are numerous gliding clubs scattered about the country, the greatest number being in the South, where conditions, both of prevailing winds and the nature of the country, are more favourable. Any reader who decides to join a club may obtain the address of the secretary of the nearest one by writing to the Editor of the *"M.M."*



The famous pilot Robert Kronfeld soaring in the "Wien" sailplane at Itford. We are indebted to the courtesy of the Editor of "The Aeroplane" for permission to reproduce this illustration and the lower one on the previous page.

Aero Engine Testing

Air Speeds of 197 m.p.h. in Wind Tunnel

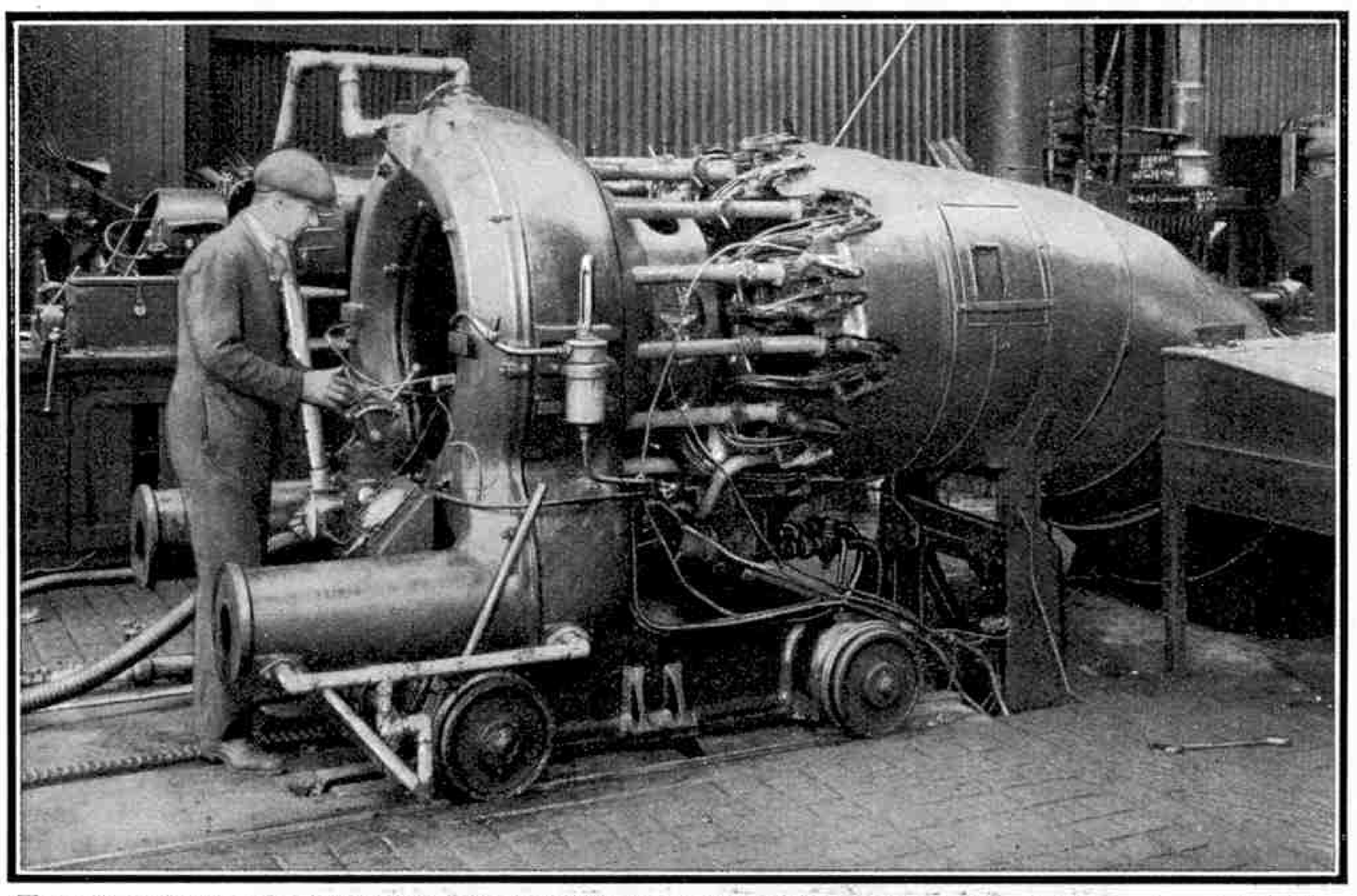
IN the early days of aviation there were no restrictions on the construction and design of aeroplanes and aero engines. With the astonishing growth of aviation that followed the efforts of the pioneers it became necessary to make regulations in order to ensure safety in the air, and to-day no machine can be flown, except near an aerodrome, that has not been given an official certificate of airworthiness.

The engine with which an aeroplane is equipped is carefully examined before a certificate of airworthiness is given. This is only natural, for the heart of an aeroplane undoubtedly is its engine. Careful design of the machines themselves is very important, of course, for aircraft that are not built on correct lines may lack stability, or may be slow and cumbrous, but it may almost be said that the first essential in flying is a reliable and efficient power unit.

The failure of an engine while the aeroplane to which it is fitted is in the air may have disastrous consequences, not only for the pilot and passengers of such a machine but also for people on the ground. For this reason manufacturers take care to subject their products to careful tests in order to make sure that they are capable of developing the power that is necessary, or for which they have been designed. In all aero engine works special departments have been developed in which testing is carried on, and costly plant has been installed for the purpose of making accurate measurements. So great is the importance attached to these tests that they can only be carried on in accordance with regulations laid down by the British Air Ministry, and in addition to power output the consumption of fuel and lubricating oil must be measured during official tests.

A visitor to a factory in which aeroplane engines are built is warned by a dull roar when he is approaching the engine testing shop. As he progresses towards this department, the noise gradually increases, and when he actually enters the shop it becomes almost unendurable. The roar from an engine bolted to a heavy test plate is far louder than that from the same engine in use in an aeroplane, and the effect of the noise is increased by the presence of solid objects that act as resonators. An aero engine testing department has been described as the noisiest place on earth and it is said that at times the roar of the engines being tested at the works of Armstrong Siddeley Motors Ltd. may be heard all over Coventry, the town in which the factory is situated.

To an onlooker it is usually a surprise to find that the men working in the testing department of an aero engine factory appear quite indifferent to the noise. Enquiry reveals the fact that they use ear plugs. These are so designed that conversation may be carried on in ordinary tones, although the roar of the engines is reduced to endurable proportions. Any worker who dispensed with his ear plugs would be deafened and eventually would lose his hearing.



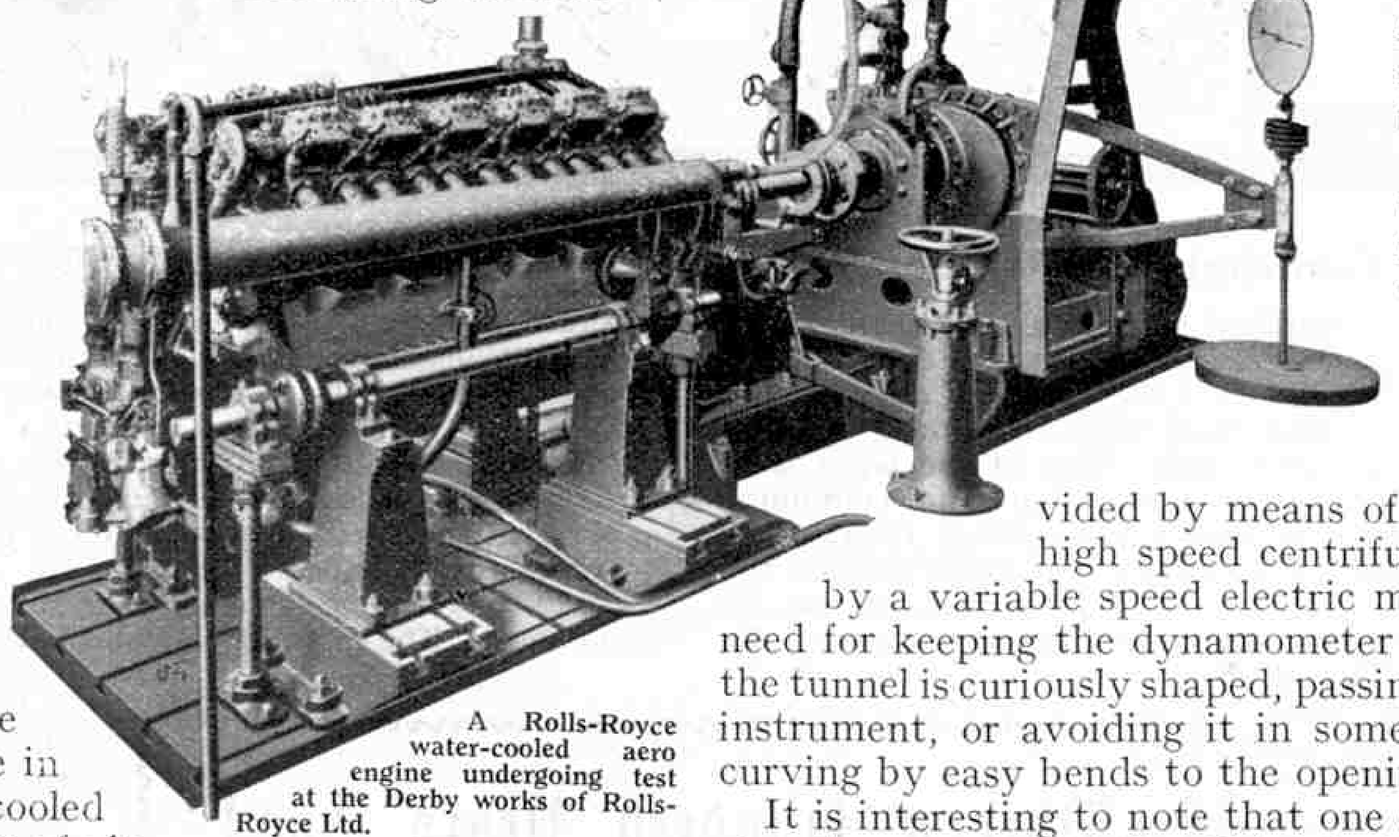
The aero engine testing plant in service at the works of Armstrong Siddeley Motors Ltd., to whom we are indebted for permission to reproduce this photograph.

The plant on which an aero engine is tested consists of two parts. At one end of it there is a supporting body on which the engine is clamped. The rest of the plant is enclosed in a casing. This is the dynamometer, which actually measures the power developed. Several forms of dynamometer may be used for aero engine testing, but the one that is usually employed is the Froude hydraulic dynamometer, an illustration of which accompanies this article. In this, the engine that is being tested is directly coupled to the shaft of the dynamometer upon which is keyed a rotor that revolves inside the casing, which is filled with water. The liquid opposes the movement of the rotor and the amount of resistance it offers may be regulated by means of sluice gates.

The casing itself is mounted upon ball bearing trunnions in such a manner that the forces resisting rotations of the shaft, whether they arise from the friction of the water or by ordinary friction at bearings, tend to turn it. The twisting effect is transmitted to a weighing device connected to the casing by an arm.

Thus it may readily be measured and from it the power developed by the engine on test is found.

The Froude hydraulic dynamometer is built in standard sizes for testing a wide range of aircraft engines. The load placed upon these engines may be adjusted by means of a handwheel in order to make the instrument as sensitive as possible. On certain installations changes in power output as low as 1 b.h.p. may be detected in a 500 h.p. engine to which a minor tuning adjustment has been made. It is interesting to note that a similar hydraulic dynamometer is employed for testing larger internal combustion engines, such as high-powered Diesel engines used for driving ocean-going vessels.



A Rolls-Royce water-cooled aero engine undergoing test at the Derby works of Rolls-Royce Ltd.

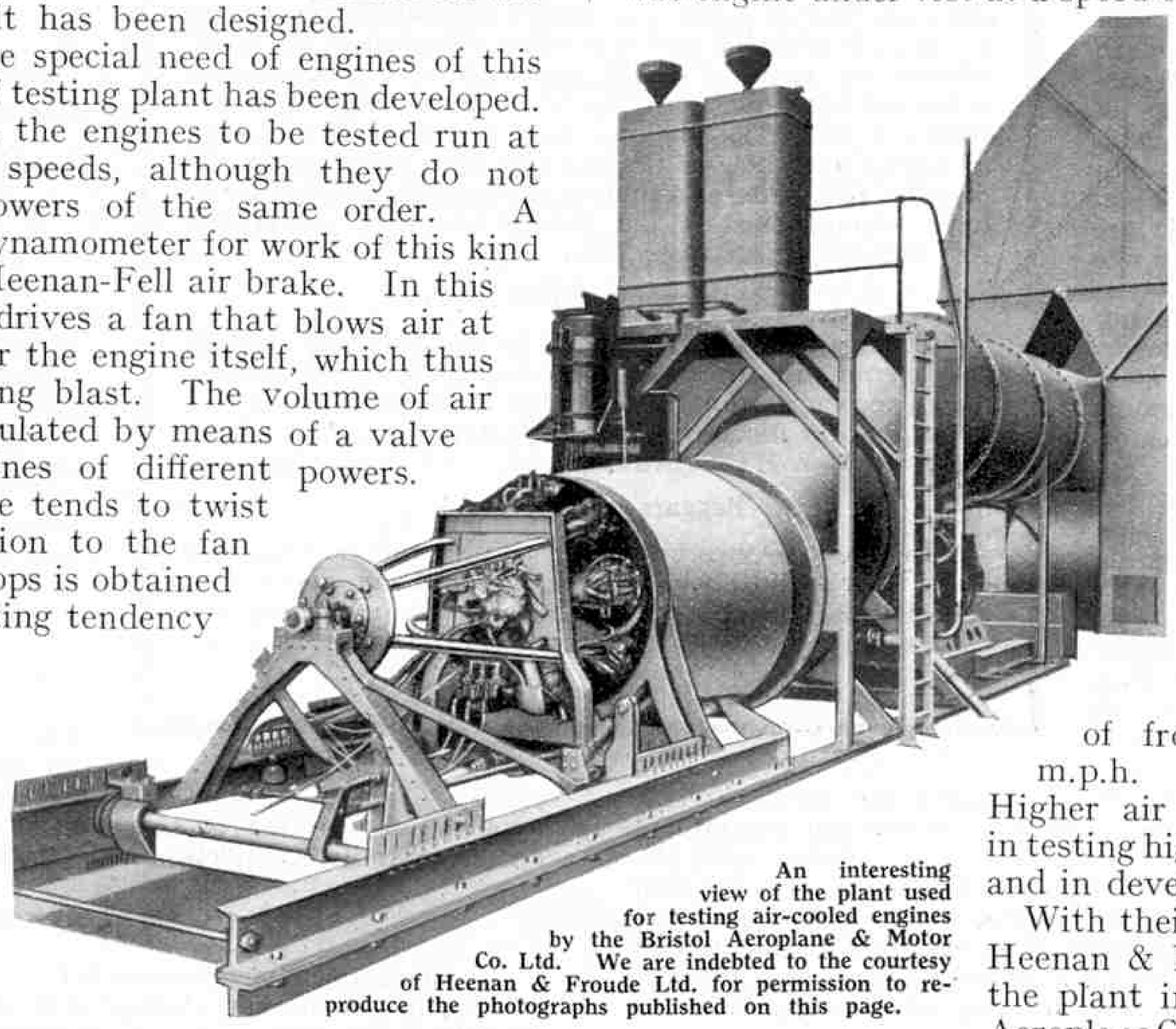
The testing plant we have described is satisfactory for water-cooled engines, but when aero engines of the air-cooled type are to be tested, special arrangements for cooling them have to be made. In an aeroplane in actual flight an air-cooled engine works in a stream of air. An air stream of the same speed must be supplied to it when on the test bed, therefore, for otherwise the trial would not show how it would behave in the service conditions for which it has been designed.

In order to meet the special need of engines of this kind, a different type of testing plant has been developed. In many testing shops the engines to be tested run at practically the same speeds, although they do not necessarily develop powers of the same order. A satisfactory form of dynamometer for work of this kind is that known as the Heenan-Fell air brake. In this the engine under test drives a fan that blows air at high velocity back over the engine itself, which thus provides its own cooling blast. The volume of air discharged may be regulated by means of a valve in order to suit engines of different powers. In this case the engine tends to twist in the opposite direction to the fan and the power it develops is obtained by measuring the twisting tendency of the crankcase.

When the air-cooled engines to be tested differ widely in type, size and power, a more flexible plant becomes necessary and the air-stream required is then provided by means of a wind tunnel. A plant of this kind is used at the works of the Bristol Aeroplane Company, and is illustrated on this page. In it an engine to be tested is mounted on a cradle that is supported at the front on rollers and at the back on a pivot bearing. Thus the carriage can rotate to a limited extent, its movement being restrained by means of springs. The cradle may be racked toward, or away from, the open mouth of the tunnel in order that access to the engine is unobstructed and adjustments may easily be made to it. After being mounted upon the cradle the engine is fitted with an adaptor that enables the propeller shaft to be connected through a flexible shaft to a dynamometer of the Froude hydraulic type. When running in these conditions the entire power of the engine is absorbed and accurately measured by the instrument.

During the test the engine is placed in the mouth of the wind tunnel, which is built of heavy steel plate, the necessary air-stream being provided by means of a specially designed high speed centrifugal air pump driven by a variable speed electric motor. Owing to the need for keeping the dynamometer out of the airstream the tunnel is curiously shaped, passing over the measuring instrument, or avoiding it in some other manner, and curving by easy bends to the opening facing the engine.

It is interesting to note that one of the variable speed electric motors at the Bristol Aeroplane Company's works is capable of an output of 300 b.h.p., and the air pump driven by it produces an airstream that passes the engine under test at a speed of more than 130 m.p.h. In an adjacent testing shop there is a second wind tunnel fitted with a variable speed motor of 515 b.h.p. The wind speed produced in this tunnel is well in excess of 180 m.p.h. and during official tests an air speed of 197 m.p.h. was obtained.



An interesting view of the plant used for testing air-cooled engines by the Bristol Aeroplane & Motor Co. Ltd. We are indebted to the courtesy of Heenan & Froude Ltd. for permission to reproduce the photographs published on this page.

The high wind speeds mentioned are not usually employed for engine testing, for in normal conditions a wind speed of from 70 m.p.h. to 90 m.p.h. only is required. Higher air speeds are only used in testing high performance engines and in development work.

With their wind tunnels Messrs. Heenan & Froude, the makers of the plant installed at the Bristol Aeroplane Company's works, supply a complete range of accessories to enable every necessary measurement to be made speedily and accurately. These include thermometers with which to find the temperature of cooling water, air speed indicators, and tachometers that are employed in checking the number of engine revolutions per minute. The use of these instruments ensures that under test the engines shall run in correct conditions.

Of General Interest

Measuring the Temperature of the Stars

The heat of a candle one hundred miles away may be detected by means of an improved thermocouple, or electrical thermometer, now in use at the Mount Wilson Observatory, California. It consists of two tiny wires that have been fused into intimate contact with each other at their ends. One of the wires is of bismuth and the other of an alloy of the same metal containing 5 per cent. of tin. When one junction is heated to a higher temperature than the other, a minute current flows through the circuit formed by the two wires, and measurement of this by means of a sensitive galvanometer enables the temperature of the source of heat to be found. Thin metal plates are fused over the junction. These are blackened to enable them to absorb heat radiation efficiently and the instrument is placed in a vacuum in order to prevent loss of heat by conduction.

The Mount Wilson thermocouple is extremely small, for its weight is about one tenth of a milligram, or one thousandth of that of a drop of water. This weight includes that of the receiver and connecting wires, the parts upon which the rays of heat are concentrated weighing only one third of the total.

The thermocouple is intended chiefly for use in measuring the temperatures of stars and for this purpose it is mounted upon the 100-in. reflector, the largest telescope in the world, that is installed in the observatory at Mount Wilson. It is capable of measuring the heat radiated from a star of the 13th magnitude. This is an incredibly small quantity, for the faintest star that may be seen without the aid of a telescope is 631 times brighter than one of this magnitude. The quantity of heat radiated by such a star may be gauged from the fact that one of the 6th magnitude, which can scarcely be seen by the naked eye, radiates upon the whole of West Riding of Yorkshire only as much heat as the Sun supplies to a square inch of the earth's surface. The electrical current produced in the thermocouple by this minute quantity of heat is about one twenty-billionth of an ampere, and the rise in temperature at the junction of the tiny wires is less than one three-millionth of a degree Centigrade.

Harvesting Natural Ice

Although factories in the United States produce more than 40,000,000 tons of ice a year, large quantities of the natural product are still obtained from ponds, lakes and rivers in New England and in other northern states where the winter temperature falls below freezing point for a sufficient length of time. Formerly the ice was laboriously sawn into blocks of uniform size. Later its surface was grooved by tools drawn by horses and the pieces were broken away by blows from an axe or a crowbar. To-day the ice is harvested at extraordinary speed with the aid of a circular saw driven by a petrol engine. The operator merely walks alongside the machine in order to guide it and the whirling disc cuts slots of such a depth that moderate blows break the ice up into blocks of uniform shape and size.

Ice has always played a great part in American life. Before the days of mechanical refrigeration, blocks obtained from conveniently situated lakes were regularly stored in underground ice-chambers, where it was packed in pine sawdust. There it remained unmelted, and was available for use during the greater part of the following summer. The practice is still followed in many parts of the United States.

It is interesting to recall that American ice has travelled to many parts of the world. In the early days of last century it was exported to the West Indies in enormous quantities, and several cargoes of ice from lakes near Boston, Massachusetts, actually crossed the Equator twice on their way to Calcutta and other eastern ports where it was greatly in demand.

Over a Hundred Years Ago!

A Circular Tour

On Monday last a man calling himself Richard Sutton started in the Marsh to unwind 100 yards of line from a stick six inches in circumference, and which he was to accomplish with the end of the line attached to his body, continually running round the stick and progressively enlarging his circle until the whole was unwound in the twelve hours. The distance he would have run had he unwound the whole of the line has been calculated to be 68 miles 436 yards, and there is reason to believe he would have accomplished it but for interruption."—"HANTS ADVERTISER," 4th October, 1824.

Southampton Looks Ahead

"From a prospectus which is in circulation it appears that a company is forming for the purpose of establishing docks and depots for the reception of merchandise in this town, and for its conveyance to London by means of rail roads . . ."—"HANTS ADVERTISER," 17th January, 1825.

Beggars on Horseback

"In Buenos Ayres horses are so plentiful that beggars make their rounds, asking alms, on horseback, and do not consider that position as diminishing in any degree the claims to sympathy."—"LIVERPOOL COURIER," 20th July, 1825.

Road Surfaces of Cotton

A new and surprising use for cotton that has been discovered in the Southern States of the U.S.A. is road making. It is claimed that cotton fabric suitably treated gives a durable rainproof surface, and roads made with it may be kept in condition at little expense.

A roadway that is to be transformed into one of the new type is first broken up and traffic is allowed to pass over it in order to make it hard and compact. It is then swept clean of loose material and a coating of light tar is applied. The cotton fabric is spread on the tar while this is sufficiently "tacky" to hold it in position and hot asphalt is then applied. A covering of coarse sand and fine gravel, or finely crushed granite, completes the surface.

Coal to be Burned in Mine

An American engineer has made the revolutionary suggestion that coal should be burned underground instead of being laboriously brought to the surface before being consumed. His proposal is that it should be distilled in the mine and that the gas formed should be pumped to the surface through pipes. There it may be employed in the generation of electricity or may be distributed for use in the ordinary manner.

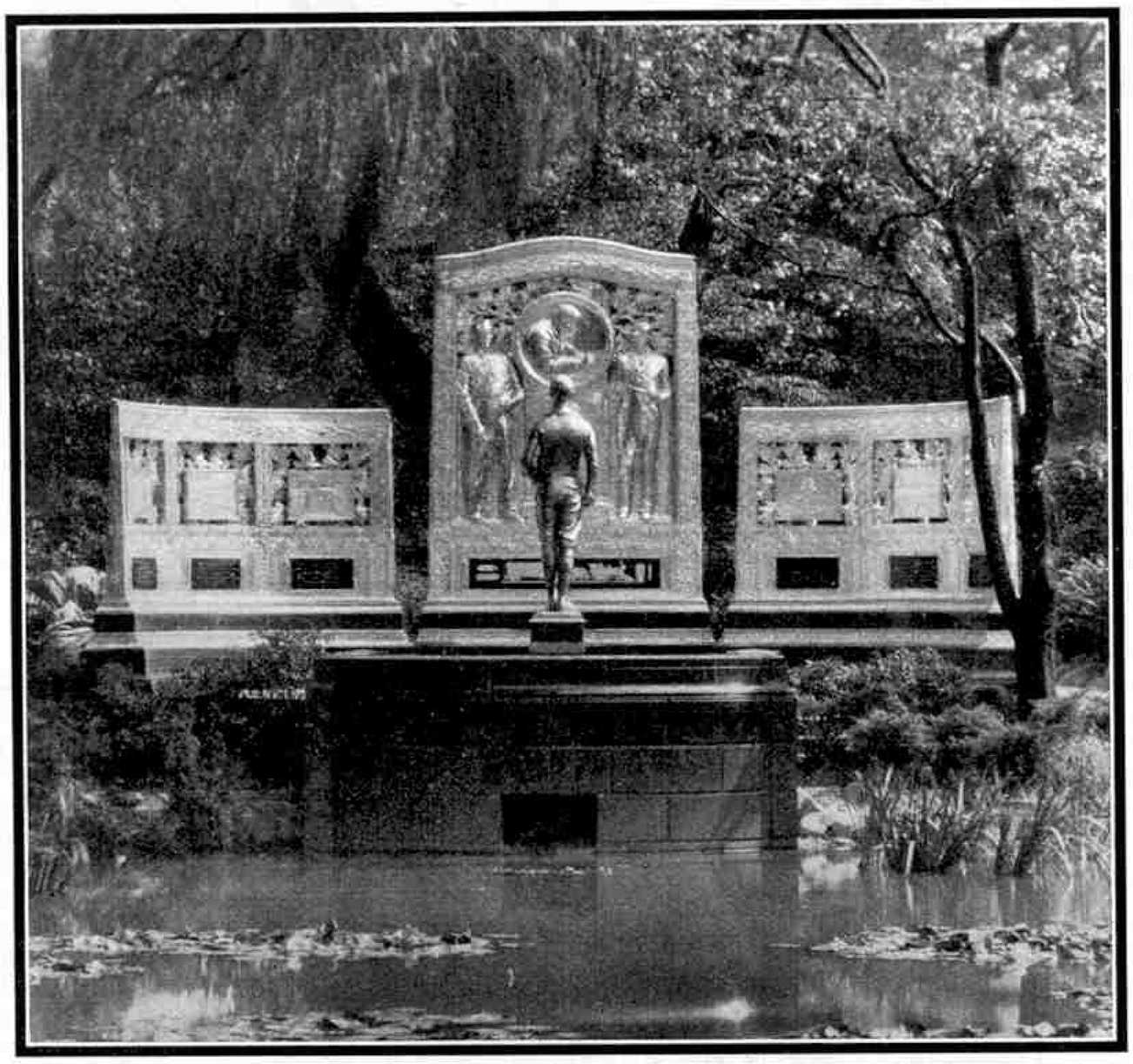
By controlling the temperature at which the coal is distilled, a gas rich in oil could be obtained, and by suitable treatment this could be made to yield fuel suitable for use in motor car engines. Full details of the exact methods to be employed have not yet been revealed but it is expected that work of an experimental character will shortly be commenced.

Unique Memorial to a Great Inventor

The illustration on this page shows an interesting Memorial to George Westinghouse, the famous inventor, that has been erected in Schenley Park, Pittsburgh, U.S.A. It will be seen that this consists of three panels. The one in the centre is 20 ft. in height and its principal feature is a bas-relief portrait of Westinghouse himself, who is shown in a characteristic attitude bending over his drawing board. On one side of the portrait is the figure of an engineer, and on the other that of a skilled mechanic. These figures are intended to emphasise the fact that the creative genius of Westinghouse, which he expressed in his designs, only became practical through the co-operation of those who worked with him. At the foot of the central panel is pictured the first locomotive to use the Westinghouse air brake, the most important and widely known of his inventions.

The central panel is flanked by others that commemorate six of the most outstanding engineering achievements of the great inventor. The three plaques on the left wing illustrate railroad electrification ; the steam turbine, which was introduced into America by Westinghouse ; and the hydro-electric plant at Niagara Falls, for the construction of which the Westinghouse Company was responsible. The chief event commemorated on the right wing of the memorial is the introduction of the Westinghouse Air Brake. The others are the lighting of the Chicago World's Fair, a pioneer effort in the use of electric lighting on a large scale, and the introduction of modern railroad signalling, in which the Westinghouse Company has played a very important part.

One of the most interesting features of the memorial is a figure representing an American youth that faces the three panels from a short distance. This is 10 ft. in height and is intended to symbolise the inspiration that may be derived by youth from a study of the achievements of the great inventor.



The wonderful memorial shown in our illustration and described on this page has been erected at Pittsburgh, U.S.A., to George Westinghouse, the famous inventor of the air brake. The photograph is reproduced by courtesy of the Westinghouse Electrical Company.

The story of the invention of the air brake, and of later developments for which Westinghouse was responsible, was told in the "*M.M.*" for September 1927. His achievements in this respect represent only a small part of the activities of the great inventor, who was very largely responsible for the wonderful growth of the electrical industry during the second half of the 19th Century. Westinghouse took out no fewer than 400 patents, an average of one in every six weeks, and these covered almost every conceivable field in which electricity could be usefully applied. He died on 12th March, 1914, at the age of 68 years.

Zonolite—The New Sound Insulator

An interesting new mineral, to which the name of vermiculite has been given, has been found in Montana, U.S.A. The discovery was made by a prospector who explored an old mine shaft in the hope of finding molybdenum and vanadium. The flame of his candle accidentally came into contact with part of the wall of the shaft and caused a remarkable change in colour. Being curious to find the reason for this, the prospector extracted samples of the material in order to make further experiments. These showed that the mineral he had discovered was capable of many useful applications and its extraction on a large scale was begun.

Vermiculite is laminated and resembles crude mica in form but not in colour, for the new mineral is green. In order to prepare it for use it is strongly heated in a kiln, when it breaks up into a gold-coloured powder with a lustrous appearance. To this the name zonolite has been given. It is light in weight, and is capable of withstanding high temperatures, but its most useful feature is its power of damping sound waves. This makes the new material of great value as a sound insulator.

One interesting use to which zonolite has already been put is the construction of silencers for motor cars. The form of silencer that has been developed consists of a cylindrical sleeve, lined with zonolite, through which the exhaust pipe passes. Perforations allow the sound waves formed by the explosions in the cylinders to pass into the sleeve, where they are absorbed by the zonolite. Baffle plates are unnecessary in silencers employing the new material and thus the engine is not throttled down to any appreciable extent by back pressure.

Zonolite is also being used as a sound insulator in theatres and halls. For this purpose it is made into a plaster, composed of three parts of zonolite and one part of wood pulp, which is applied directly to the walls. The plaster is dull gold in colour and lends itself to artistic treatment.

Cathode Rays to Test Gems

It is about four years since Dr. Coolidge developed in the research laboratories of the International General Electric Company a very large tube for the production of cathode rays. The streams of electrons or negatively-charged particles constituting these rays is produced by an electric discharge in a vacuum tube, and in that used by Dr. Coolidge a pressure of 350,000 volts is employed. A nickel foil window is provided through which the rays pass into the air, where they are available for practical purposes.

The chief commercial application of the cathode rays yet made is in testing gems. For example, synthetic sapphires may readily be distinguished from the natural stones by exposing them for a few seconds to the rays in a dark room. All glow during this exposure. Immediately the rays are cut off the glow of the natural stones ceases, however, and any artificial ones that may be present are detected at once by the sparkling colours they continue to show.

It is interesting, and also a little surprising, to find that more than a million-and-a-half synthetic sapphires are used every year by the General Electric Company. The stone is not so hard as the diamond, but it is quite suitable for the bearings of meters and other delicate electrical instruments.

City Without Chimneys

As long ago as 1925 a central heating plant was built in Winnipeg from which steam was supplied to a number of consumers in the centre of the city. More than 200 buildings are now heated by means of the steam, which reaches them through underground pipes in the same manner as supplies of water or gas. The service is to be extended to the houses in a large residential area. House and property owners making use of the steam find that there is an overall saving of from 12 per cent. to 40 per cent. in their heating costs.

Lignite coal mined in Canada is the fuel used at the central station, which is under municipal control, and great care is taken to prevent the emission of smoke. The result is that Winnipeg is much cleaner than formerly, and a greater improvement is expected when the system is extended further, for it is believed that eventually Winnipeg will become a city without chimneys.

An even more interesting large-scale heating project is planned for Reikjavik, the capital of Iceland, where boiling water from a geyser is to be employed to heat the radiators of several large buildings. Electrically-driven pumps will drive 390 gallons of hot water to the city every minute through seamless steel piping of small diameter. Loss of heat will be prevented by embedding the pipes in layers of cork and concrete and wrapping them in jute and felt paper.

Giant Vertical Waterwheel Generator

The illustration on this page shows a 4 in. cavity being drilled in the hub of a huge "spider." The spider is part of a 23,000 k.v.a. vertical waterwheel generator, six of which are now under construction for service in a new power station that is to be erected at a point about 100 miles west of St. Louis, U.S.A. The station is intended to furnish light and power to the whole of the St. Louis district.

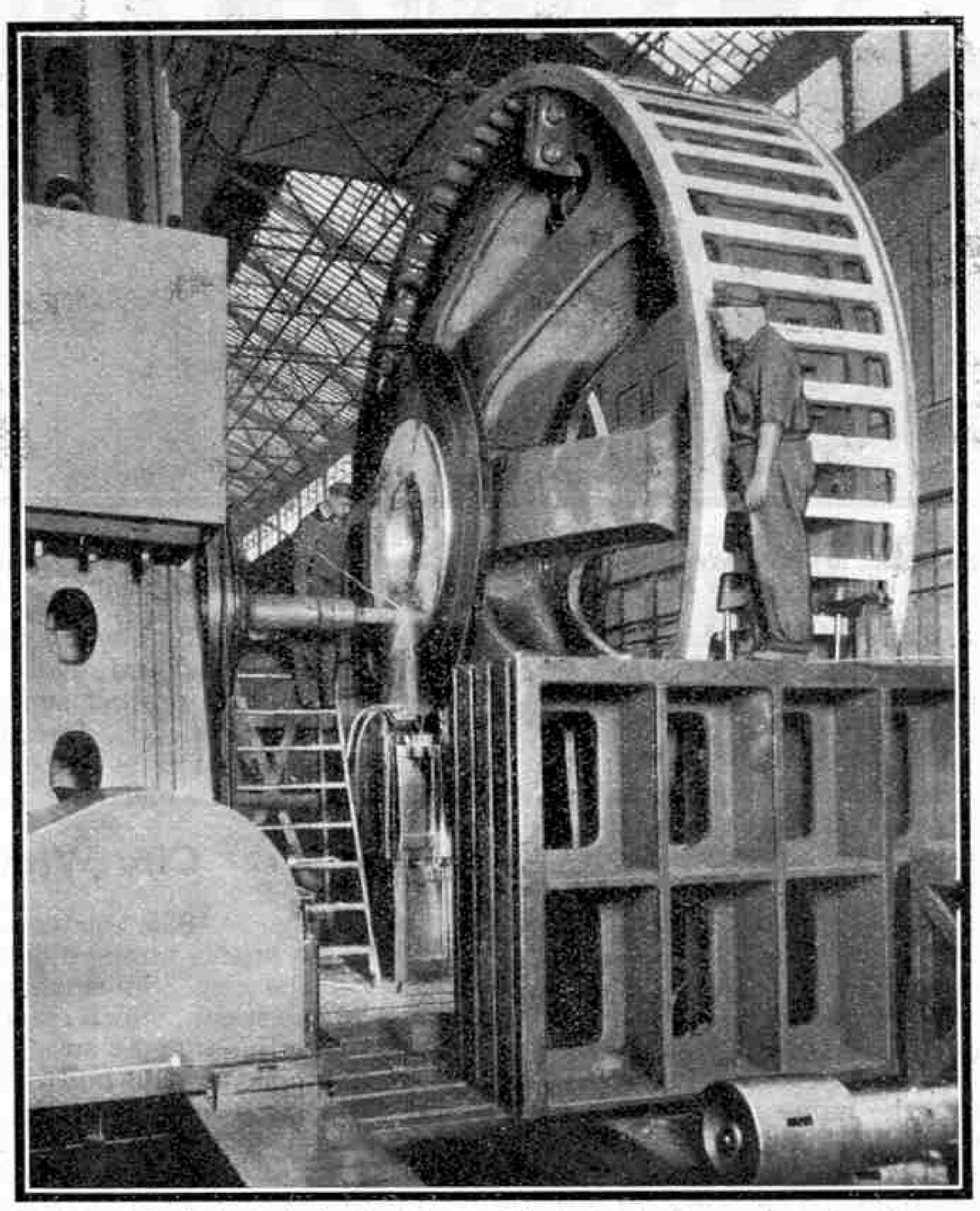
The spider is 4 ft. in thickness and 20 ft. in diameter, and it has a weight of 90,000 lb., or a little more than 40 tons. The 4 in. cavity that is being drilled is one of several that will later be tapped, after which 4 in. bolts will be inserted to assist in handling during the various operations in the shop. The construction of the entire generator will occupy about nine months.

An interesting feature of the spider is that the arms droop downward from the hub. This is clearly shown in our photograph. The resemblance of the arms to the spokes of an umbrella has led to the use of the name "umbrella type" generator for machines of this type.

Famous Battle Cruiser to be Broken Up

H.M.S. "*Tiger*," the famous battle-cruiser that was the last capital ship in the Royal Navy to burn coal, has now been withdrawn from service and is to be sold for breaking-up purposes. The vessel has been in service since 1914, having been launched in the previous year. During the War she took part in the action off the Dogger Bank early in 1915, and also in the Battle of Jutland in July, 1916.

The vessel had a displacement of 28,500 tons. She was equipped with eight 13.5 in. guns, twelve guns of the 6 in. type and a number of smaller ones, in addition to four submerged broadside torpedo tubes. She was fitted with four screws and was engined with direct drive turbines making possible a maximum speed of 29 knots. The original cost of constructing the cruiser was approximately £2,087,500, and she has been refitted on two occasions, the first time being during 1920 and the second in 1922-1923. She is being broken up in accordance with the London Treaty.



Boring a hole in the hub of a "spider" of the waterwheel generator referred to on this page. We are indebted to the courtesy of the Westinghouse Electric Company for permission to reproduce this photograph.

112-Ton Ingot Mould

A huge ingot mould that weighed 112 tons was recently made at the Sheffield works of the Brightside Foundry & Engineering Co. Ltd. Five traction engines were required to haul the mould to the Vickers Works of the English Steel Corporation Ltd., for whom it was made, and it was moved on a special carrier on to which it was lifted by means of a 150-ton crane. It is intended for service in the production of hollow forgings required for making heavy rotors, the construction of vessels in which high-pressure chemical operations are to be carried out and for other similar purposes.

* * * *

Sir William Arrol & Co. Ltd. are now constructing 13 cranes for a foreign railway company. Two of these, of the overhead electric travelling type, are capable of dealing with loads of 35 tons.

Europe's Largest Power Station

A power generating plant that is now being constructed at Vitry, one of the suburbs of Paris, will eventually be the largest in Europe. At first its output will be 100,000 k.w., but in the five years following the opening this will gradually be increased to 750,000 k.w.

The new station is being built by the Paris-Orleans Railway Company. It will be linked with a hydro-electric generating plant on the River Coindre, the largest tributary of the River Dordogne, and will thus compensate for any falling off in the supply from this source that may be caused by lack of water or other natural causes.

New Dock on Merseyside

A large new dock recently was opened near Port Sunlight, on the south bank of the River Mersey. It has been constructed for Lever Brothers Limited, the soap manufacturers. The area of the dock is about 37 acres, of which 18 acres are suitable for use by deep water vessels. A stream flowing into the dock has been converted into a canal and on this barges will travel continuously between the dock and the wharves of the works. Formerly the stream could only be used at high water.

The entrance to the Bromborough Dock, as the new structure is called, is 70 ft. in width and 165 ft. in length. The dock has 2,975 ft. of berthage and is fitted with five quays, one of which is only suitable for use by barges. Of the remaining four quays, one has been designed for loading and unloading oil. This is fitted with a tank that has a capacity of 25,000 tons, and may safely be used at any state of the tide by vessels with a draught of 27 ft.

The dock was under construction for over six years, and during this time between 400 and 500 men have been employed. The spoil excavated from the site amounted to about 1,100,000 c. yds., this including 448,000 c. yds. of rock.

* * * *

A plate, claimed to be the largest and heaviest ever rolled, was made recently in America. It is 195 in. in width, 360$\frac{3}{4}$ in. in length and 2$\frac{3}{8}$ in. in thickness. It weighs nearly 22 tons, and was reduced from an ingot weighing over 41 tons.

Ship Cut Into Three Pieces

An interesting reconstruction that involved cutting the vessel into three pieces was carried out a short time ago on the oil tank steamship "*Saranac*." This vessel, which has been in service since 1918, has a length of 544 ft., a beam of 66 ft. and a deadweight carrying capacity of about 17,000 tons. A new central section was required and this has been constructed separately and fitted in position.

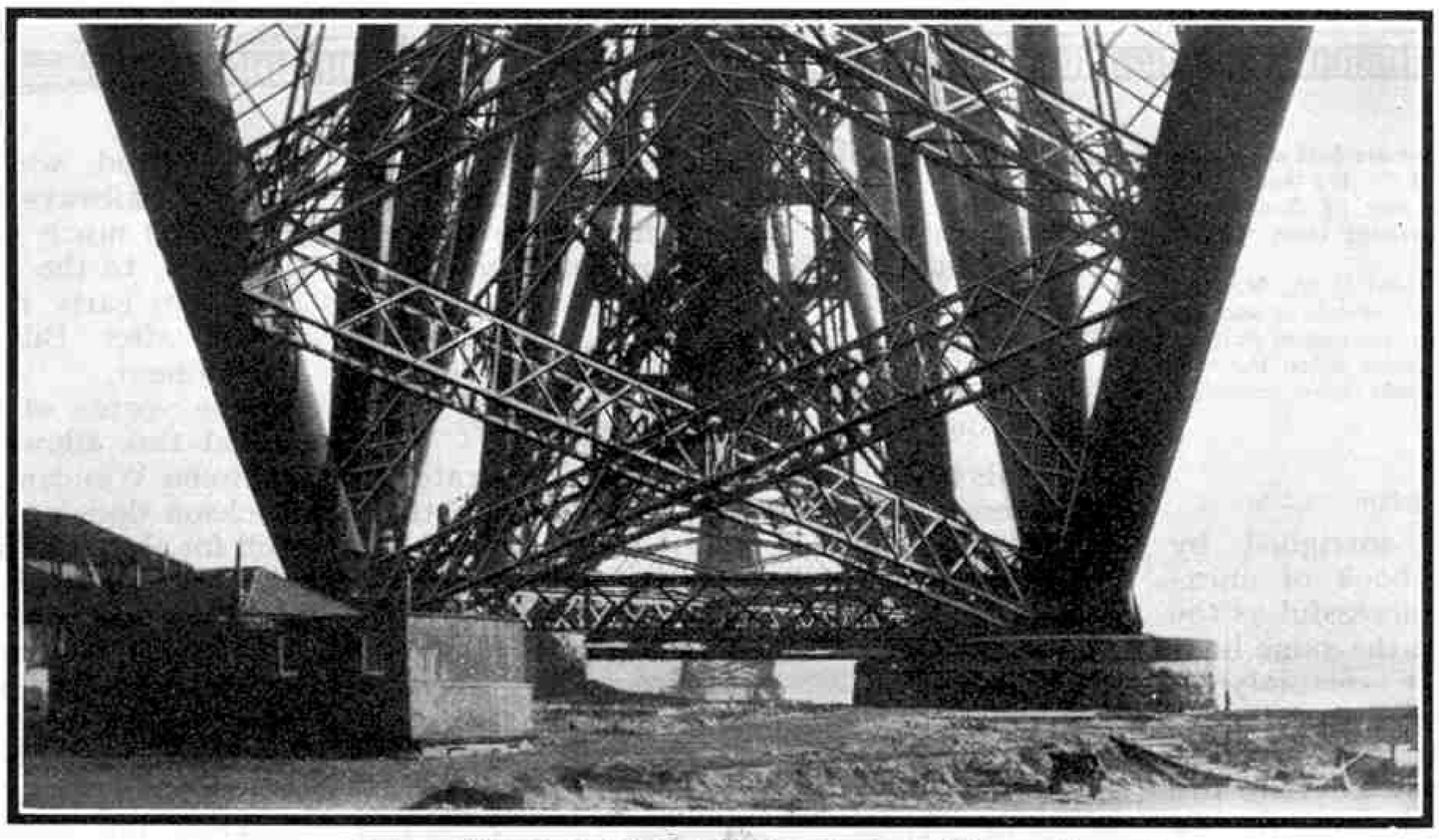
The vessel was first put into dry dock, where it was cut into three portions. Water was then gradually admitted to the dock, when the fore and middle portions, weighing 800 tons and about 4,000 tons respectively, rose with the water and were towed out. The new central portion had been launched previously and was now floated into the dock and allowed to settle into its correct position as the water was pumped out. It was then secured to the aft end and ballasted so that it would remain stationary as the water was let into the dock once again.

The next step was to restore the old fore end. This was readily towed into the dock and secured in position in a similar manner to that employed in fitting the central section. This final operation occupied only about one month and the whole of the work was carried out according to a pre-arranged programme.

The "*Saranac*" is the second oil-tanker to be treated in this way, the other vessel being the "*Cadillac*," a sister ship. The cost of rejuvenating the vessel in this way is said to be only about half that of the construction of a new ship of equal size.

Canadian Hydro-Electric Scheme

A project for the development of hydro-electric energy from the Saskatchewan River is now receiving the attention of Canadian engineers. The power station would be erected four miles from the mouth of the Dauphin River, a stream that flows from Lake Manitoba to Lake Winnipeg. Between the two lakes there is a drop of 100 ft., and a plentiful supply of water would be assured by the construction of a system of dams and canals to direct the flow of the Saskatchewan River from its present direct route to Lake Winnipeg into an indirect one passing through Lakes Winnipegosis and Manitoba. These lakes therefore would be converted into enormous storage reservoirs behind the proposed station. The power that would be developed if the scheme were adopted is 400,000 h.p., a great addition to the electrical resources of Manitoba.



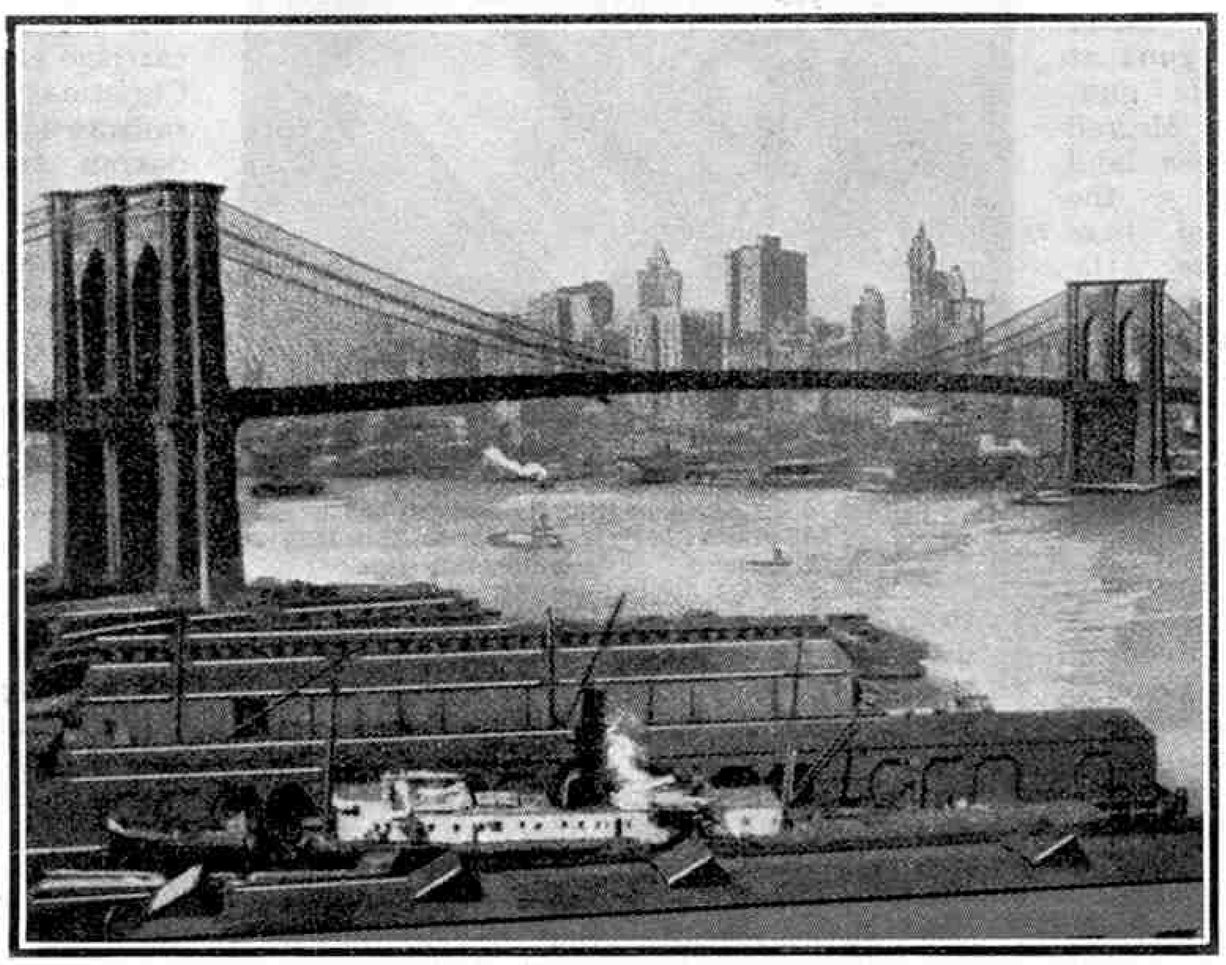
An unusual view of the Forth Bridge, showing the foot of the north cantilever.

New Turbo-electric Liner Launched

A new turbo-electric liner intended for the Australian service of the Peninsular and Oriental Steam Navigation Company was launched a short time ago at the Barrow-in-Furness works of Vickers-Armstrong Ltd. The new liner is named the "*Strathnaver*," and is one of two similar vessels that are being built for the Company. It is 664 ft. in overall length and has a beam of 80 ft. and a draught of 29 ft., the deadweight being about 10,500 tons.

The vessel is fitted with four Yarrow boilers, each of which evaporates 70,000 lb. of water per hour. The working pressure of the steam is 400 lb. per sq. in., and it is superheated to a temperature of 725° F.

The propelling machinery has a designed output of 28,000 s.h.p., and it is expected that this will give the vessel a maximum speed of 22 knots. The equipment includes two 10,700 k.w. 300 v. three-phase alternators, working at 3,000 r.p.m., and two synchronous propulsion motors, each of which has an output of 14,000 s.h.p.



The Brooklyn Bridge spanning the East River between Manhattan and Brooklyn, New York. This photograph is reproduced from the Editor's book, "Engineering for Boys," by permission of the publishers, T. C. & E. C. Jack Ltd.

An Interesting Waterless Gasholder

An interesting new waterless gasholder has been constructed by Sulzer Bros. of Winterthur, Switzerland. In this the outer casing is of the usual cylindrical shape, but remains fixed, the gas being confined in its lower portion by means of a disc that moves up and down like a piston. The disc is guided by two rows of rollers and leakage is prevented by means of a flexible metal sealing ring that is pressed against the sides by means of a number of levers. The lower edge of the ring is immersed in a sealing trough filled with oil, and escapes of gas due to wear may be stopped by adjusting the weights on the levers. It is interesting to note that the rollers guiding the piston are made of wood instead of metal in order to avoid risk of sparking. The desired gas pressure is obtained by loading the disc with concrete slabs.

The gasholder is 128 ft. in height, 78 ft. in diameter and has a capacity of 530,000 c. ft. It is closed at the top by a rigid, metallic roof, in the centre of which a ventilating device is fitted. The bottom is flat and rests directly on the foundations, the total weight supported being about 330 tons.

Mine Hoist Lifts Loads of 17 Tons

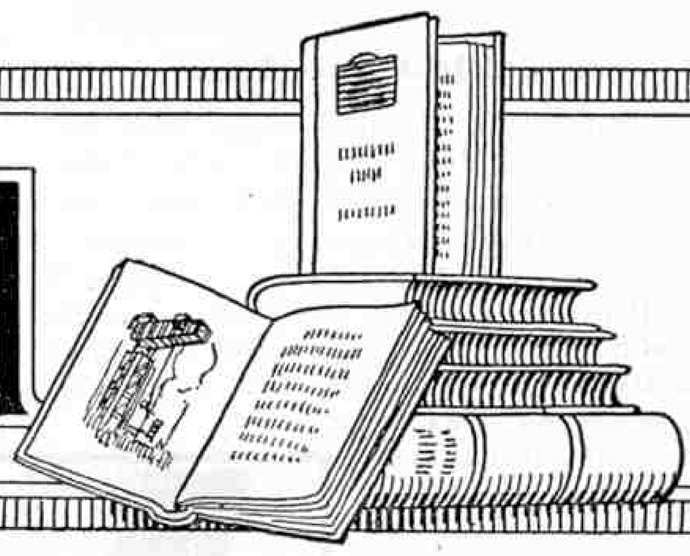
An elevator in service at the Frood Mine of the International Nickel Company in Ontario is the largest single motor hoist in service in the Western Hemisphere. It is equipped with a 17-ton bucket and operates at a speed of 3,000 ft. per minute, or about three times that of the fastest passenger elevator. This speed is attained in 15 seconds when starting from rest, and automatic slow-down gear is fitted for use when stopping. The elevator is capable of bringing up daily 10,500 tons from the 1,200 ft. level, 7,000 tons from the 2,200 ft. level or 3,500 tons from the 3,800 ft. level.

The single driving motor with which the elevator is equipped is rated at 3,200 h.p., 600 volts, and 79 r.p.m. The motor generator set included in the plant has an 11-ft. flywheel weighing 40 tons. This set is of imposing size. It is made up of four machines—a variable speed induction motor, two direct current generators and an exciter—having a total length of 41 ft. The output is 2,500 k.w. at 750 r.p.m.

* * * *

It is suggested that the proposed Forth road bridge should be constructed at Rosyth and not at Queensferry, as the cost of construction there would be £2,750,000, a saving of £3,250,000.

Books to Read



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

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

"Enigmas"

By F. R. Gould. (Philip Allan. 12/6)

As nearly everyone is intrigued by anything mysterious, this book of unexplained facts should be as successful as the earlier book "Oddities" on the same lines by the same author. It certainly is equally interesting, for Lieutenant Commander Gould has collected a further series of enigmatical happenings that are as fascinating and as mysterious as we could wish.

There is, for example, the enigma of the wonderful "voice" of Memnon, the great statue that stands about a mile from the western bank of the Nile among the ruins of Thebes. Long ago, those who stood near this statue at sunrise heard a strident sound, like the breaking of a harp string. The sound was heard at rare intervals over a period of 200 years, but no satisfactory explanation has been given for it. Then there is the enigma of the strange sounds that occur in many parts of the world, called "Barisal Guns" which are not guns at all although the sounds resemble gun-firing; there are the claims of Morrell to the discovery of that mysterious land named "New South Greenland"; the enigma of the conversion of base metals into gold by the alchemists; the problem of the canals of Mars; and the question of the identity of the island where Christopher Columbus made his famous landfall.

One of the chapters deals with the strange cases of men who have lived to be very old. Perhaps the most famous of these remarkable men is "Old Parr," who died in London in 1635 and was buried in Westminster Abbey. His gravestone records that he had lived in the reigns of ten monarchs from Edward IV to Charles I, inclusive. He was reputed to have been born in 1483 and would therefore have been 152 years of age when he died, but there is some doubt about it, and it is this doubt that causes the case to be classed as an enigma.

What are we to make of the mysterious ringing of the bells at a house called Great Bealings in Suffolk? The bells were often rung simultaneously and with extraordinary violence at various times, without any human being going near them and whilst an actual watch was being kept on them. These disturbances continued for 54 days, and in spite of investigations by the owner of the house—a Fellow of the Royal Society—the cause could not be discovered. It is claimed that it was physically impossible to ring the bells as they were rung—and as they undoubtedly did ring we have here a first-class mystery that remains unsolved to this day.

British Railways: The Romance of their Achievement

By G. Gibbard Jackson. (Sampson Low. 6/- net)

This book, which is copiously illustrated, traverses much of the ground that the author has already covered in some of his earlier books, but some of the chapters expand what he has written previously. The task that the author has set himself is to describe the growth of the British railway system, and whilst the scheme of the book is excellent and its chapters contain much of interest it is to be regretted that it contains numerous errors and careless statements that greatly detract from its worth. The first sentence of the first chapter makes the amazing statement that "We owe the Romans many things, but not always is it realised that they originated our railways." In support of this extraordinary assertion, Mr. Jackson says that "when Cæsar brought his legions to Britain he encountered stern opposition, and, to ensure that his troops should act quickly, he planned and built some magnificent roads. These were his railways." Thus the Romans originated our railways!

Thomas Parr: "the olde, old, very olde man . . . who was borne in 1483 in the raigne of King Edward 4th and is now living . . . age 152 yeares . . . He dyed November 15th 1635!" From "Enigmas" reviewed on this page.

Mr. Jackson's reasoning is often inconsequent and he confuses things that differ—and, indeed, when he attempts to write of early railways and of locomotive history he shows much confusion. He refers, for instance, to the fierce opposition that was made to early railways and affirms that "Bill after Bill was thrown out" by Parliament. "One little Bill swam out of the vortex of the rejected," he writes, "and this allowed a railway to be built between Wandsworth and Croydon." Mr. Jackson does not seem to realise that the Bill for this (the Surrey Iron Railway) was the first public Railway Act to be passed by Parliament and was obtained in 1801, and that, although Parliament did later reject many railway Bills, at that time there was no "vortex of the rejected" from which this "Little Bill" could "swim out."

Then our author is decidedly foggy about Trevithick's locomotives. He tells us that after building his first steam road-carriage, Trevithick went on to build the steam locomotive "*Catch-me-who-can*," which he brought to London and ran on a small elliptical railway, almost on the site of the great terminus at Euston; and that, following on this experiment, he built a small steam locomotive that worked on a Welsh colliery tramroad. Whilst we could wish to know more than we do about Trevithick's locomotives, several facts are established—it is definite that his first steam road-carriage ran a trial trip at Camborne on Christmas Eve, 1801; that his first railway locomotive worked on the Penydarran tramroad in South Wales in February, 1804; and that "*Catch-me-who-can*" ran in London in 1808—which historical facts are not the same as Mr. Jackson's loose statement.

Coming to George Stephenson, Mr. Jackson "makes history" to suit his convenience quite regardless of facts. We learn with surprise that Stephenson's "first locomotives were little better or stronger than Trevithick's successful engine of 1804. But in the "*Blucher*," built in 1814, he took a distinct step forward." We wish Mr. Jackson would tell us more about these "first locomotives," which exist only in his imagination, for they certainly are not known to any locomotive historian! The simple fact is that no locomotive was built by Stephenson before the one in 1814.

Although Mr. Jackson tells us that "most locomotive histories begin with the '*Rocket*,'" we can only say that none of ours do, although we have many on our shelves!

We cannot help smiling at some of the gems of information we are given—as for example when we are told that "water troughs are usually laid on the more level sections!" Let Mr. Jackson lay a trough anywhere except on a level section and he will soon see what happens to the water! Another instance of careless writing is in this description of the Railway Race of

1895 :—" It was often the case that on the West Coast the load did not exceed 75 tons, consisting of two or three coaches." As a matter of fact, it was *on the final run only* that as small a load as three coaches, weighing 75 tons, was taken. Nor is it correct to say that " for a few weeks the fun was fast and furious," for although there certainly was a preliminary period during which interesting accelerations took place, the actual " race " was run on three nights only.

Mr. Jackson is also wide of the mark when he says that " the coming of the 'Atlantic' to British metals was mainly due to the races to Scotland in 1888 and 1895, particularly the latter year." The first " Atlantic " locomotive appeared in 1898 on the G.N.R., some two years after the West Coast and East Coast routes had reached an agreement that prevented further racing. It was the necessity for increased steaming capacity in order to deal economically with increasing loads, rather than increases of speed, that brought the " Atlantic " into being, for the 4–4–2 wheel arrangement allows of greater development of the boiler and firebox than is possible with the 4–4–0.

There are many more inaccuracies that we might cite but we really have not the space—nor the inclination—to point them out. Sufficient has been said to show that whilst readers undoubtedly will find " romance " in this volume, they must accept much of its history and many of its facts with extreme caution.

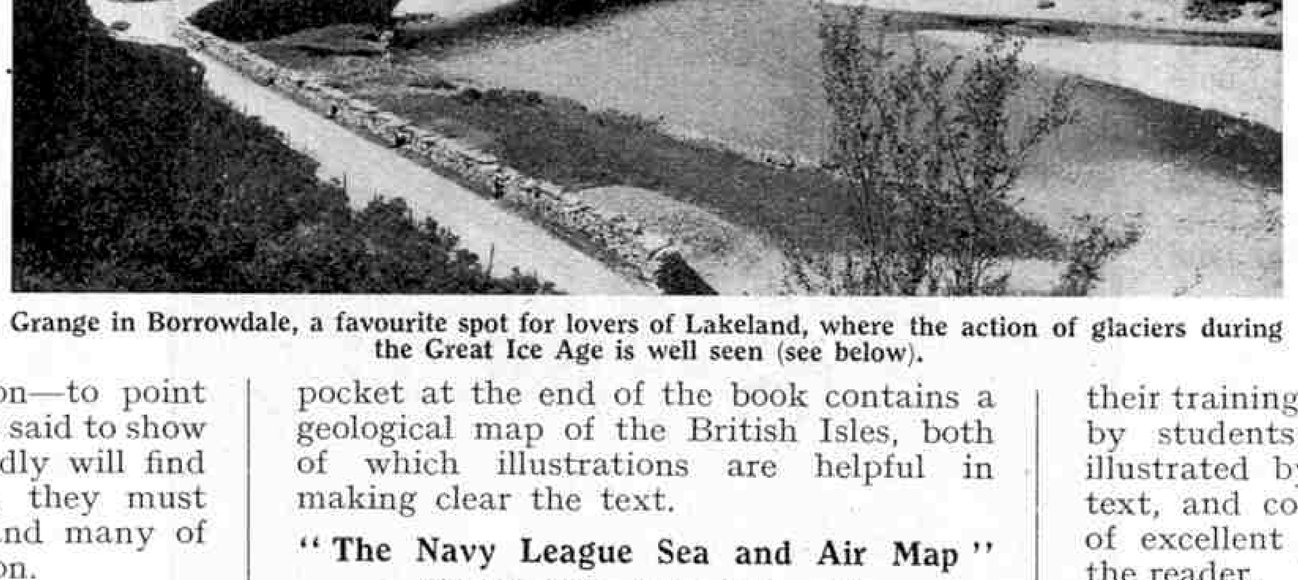
" Rediscovering England "

By C. A. Simpson
(Ernest Benn. 21/–)

This most interesting book tells us chiefly about the influence of geology and geography on the life and work of the people. There are successive chapters showing how the rocks of the country have affected the lives of those who live in South-east England ; in Hampshire and the lower Thames ; in the Midlands ; and in Northern England. These are followed by chapters showing how geographical considerations control sites of villages and even the shapes of parishes, influencing the lives of the people who live in them by helping to determine the style in which their houses are built, the industries that are established, and the crops that are cultivated.

The book is neither a text book nor a guide book, but is one that will be found an invaluable help to anyone who wishes to " see England first," and to see it with an understanding eye. Motorists, cyclists, and walkers should read this book before setting out to " explore," and more particularly if their expeditions are concerned with those parts of the country with which Miss Simpson deals at greater length. And in this connection it should be mentioned that, in gathering material for this book, the authoress made her own journeys in the way in which most of us travel—sometimes on bicycle ; sometimes by motor-bus to some selected spot and then by walking ; or by train for the longer journeys.

The rocks and soils of the Oxford district are shown in a coloured frontispiece and a pocket at the end of the book contains a geological map of the British Isles, both of which illustrations are helpful in making clear the text.



Grange in Borrowdale, a favourite spot for lovers of Lakeland, where the action of glaciers during the Great Ice Age is well seen (see below).

" The Navy League Sea and Air Map "

(George Philip & Son Ltd. 5/6)

The development of aerial transport during the past year or two has been so rapid and extensive that air maps tend to become obsolete almost as soon as they are drawn up. *"The Navy League Sea and Air Map"* is an admirable attempt to produce a map that is not only up to date, but even ahead of the times. Every air route of importance, either in operation or projected, is clearly shown. British and foreign air routes are indicated in different colours, and all the junctions and other places of importance along air routes are named. Particularly valuable features of the map are the diagrams of British and foreign air records—height, speed, distance and duration—from 1906 onward, and an aircraft identification chart in colour, showing the colours and markings of the aircraft of all countries in the world. In addition every regularly traversed sea route is shown, the width of the marking indicating the relative trade importance ; and the interdependence of sea and air routes is seen at a glance.

The map measures 47 in. by 37 in. It is printed on stout paper, and is folded and inserted in a stiff cover.

" Intermediate Mechanics "

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

This is the second volume of a work dealing with the mechanics required for the intermediate stages of University degree courses. The first volume dealt only with dynamics, and was reviewed on page 217 of our issue of March of this year. The present volume is devoted to statics and hydrostatics, and is planned on similar lines to the earlier volume. Although it is unsuitable for beginners, it will be found very useful by those who have reached a later stage of their training for an engineering career, and by students for a degree. It is well illustrated by means of diagrams in the text, and contains a remarkable number of excellent examples to be worked by the reader. Within the limits of an intermediate text-book the volume and its earlier companion form a complete survey of this interesting and useful branch of science.

Arlington Row, Bibury, showing limestone slabs often used for the roofs of cottages in the Cotswolds. (From " Rediscovering England " reviewed on this page).

Interesting New Books

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

" The Paris Gun "
by H. W. Miller. (Harrap. 10/6)

" Ginevra : A Romance "
by V. Watson. (Dent. 7/6)

" Mechanism of Nature "
by E. N. da C. Andrade.
(Bell. 6/–)

" Essays of a Locomotive Man "
by E. A. Phillipson.
(Loco. Publishing Co. Ltd. 3/6)

" Britain's New Profession " *by* J. A. Dunnage.
(Industrial Transport Publications Ltd. 3/6)

" The Journal of a Jackaroo "
by Frank Hives. (Lane. 10/6)

" The Quest of the Diamond Cave "
by J. G. Rowe. (Sharp. 3/6)

" The Wonder Book of Inventions "
(Ward, Lock. 6/–)

" Pilot's 'A' Licence "
by John F. Leeming. (Pitman. 3/–)

" Hildebrand "
by John Thorburn. (Country Life. 10/6)

" Blenden Hall "
by J. G. Lockhart. (Philip Allan. 10/6)

" Dreamers of Empire "
by Abdulla & Pakenham. (Harrap. 7/6)

A Bridge Five-and-a-Half Miles in Length

Spanning the James River, U.S.A.

THE tremendous increase in fast road traffic during recent years has led to great activity in road construction. Developments have been particularly rapid in the United States, where it has been found necessary to spend enormous sums on the construction of new highways. Cities many miles apart, which hitherto could only be reached by very devious routes, often of doubtful quality, have been brought into direct communication with each other by means of roads specially designed to carry fast and heavy motor traffic.

The construction of a modern highway is a costly business even where the route is straightforward; and the cost is enormously increased if the route involves the negotiation of a railway, the construction of a tunnel, or the bridging of a river. A striking example of American highway engineering is afforded by the construction of the 16-mile Virginian highway described in this article. The route to be followed necessitated the bridging of the James River at a point where it is 4½ miles in width, and also the bridging of two smaller streams.

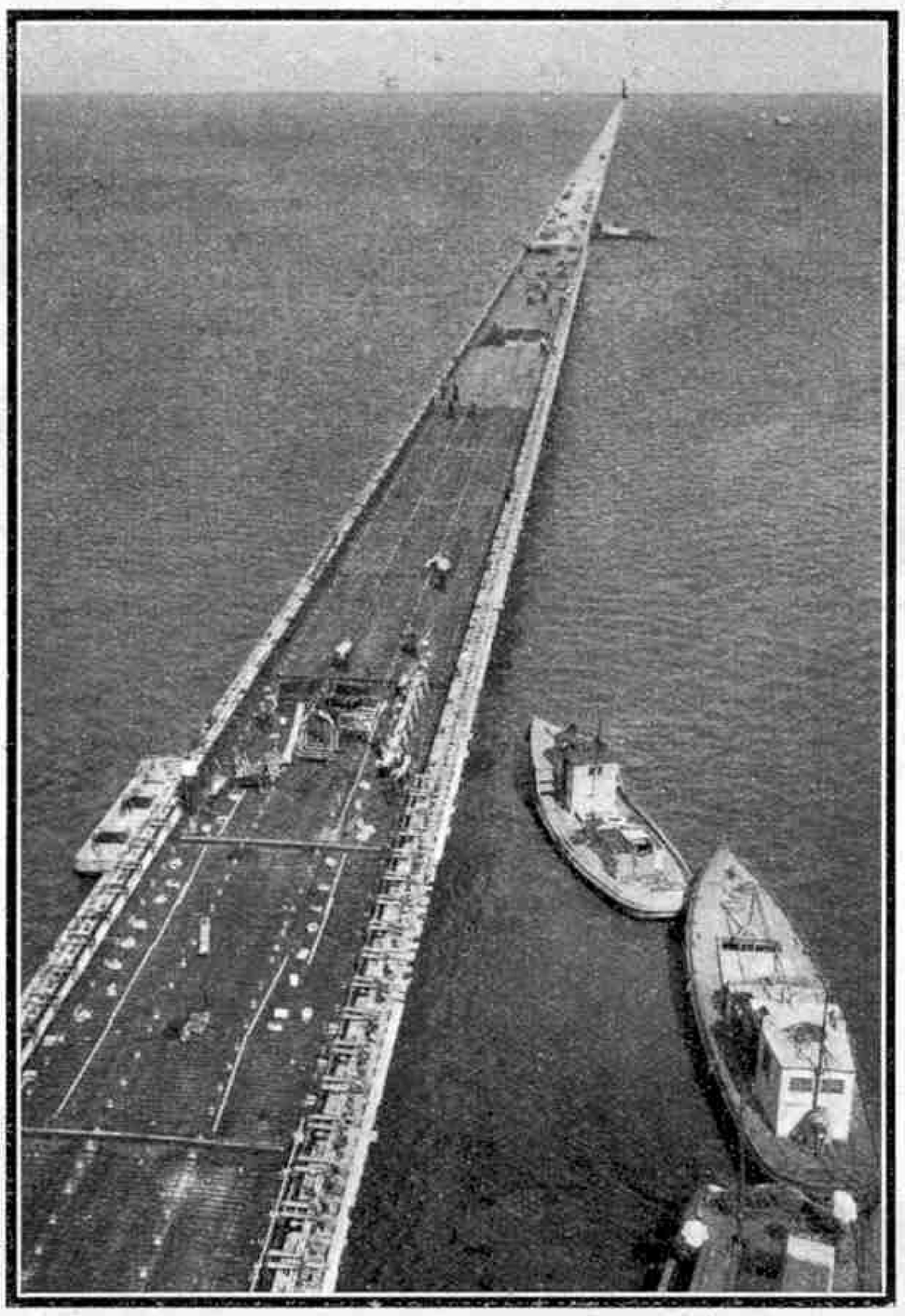
Before the work was carried out a journey from Richmond, Virginia, to Norfolk and the south was a tedious affair involving extensive ferry trips, or long detours inland with consequent loss of time. The new road has done away with this serious inconvenience by establishing a through route, and has supplied a very important link in the Atlantic coastal highway system.

The new highway traverses the tidewater area between Newport News, the famous shipbuilding centre, and Portsmouth, Virginia, and is one of the largest undertakings of the kind ever carried out in the United States. As already stated, the project includes three bridges, which are linked together by lengths of wide concrete roadway. The largest of these bridges crosses the James River a little to the south of Newport News, and is 23,771 ft. in length. From the southern end of the bridge a concrete road 7½ miles in length continues the highway to the second bridge. This structure, which has been named the Crittenden Bridge, spans a short estuary known as Chuckatuck Creek, and is the shortest of the three bridges, being only 2,500 ft. in length. Another concrete road, 1½ miles in length, links up this bridge with the 3,750-ft. bridge that spans the Nansemond River.

The scheme was commenced in September 1927, and in spite of the vast amount of work that had to be done such excellent progress was made that the highway was completed and opened for traffic in November of the following year. This record performance was in large measure due to the fact that the three bridges were of similar design and enabled repetitive construction methods to be adopted.

Concrete was used for the roads and also to a record extent in the building of the bridges, no less than 2,900 concrete piles being driven into the river beds to support the bridge superstructures. The greater portion of each bridge is made up of a series of short spans each consisting of a concrete deck slab, 44 ft. in length, 23 ft. 6 in. in width and 9 in. in thickness, supported by four 2 ft. 6 in. " I " beam stringers resting upon specially formed caps surmounting the concrete piles. The James River Bridge contains 447 of these short spans, the Crittenden Bridge 54, and the Nansemond Bridge 82.

When the sites for the bridges had been chosen, soundings and tests were carried out in each river. In the case of the James River the investigations disclosed that at some bygone period the deep-water channel had been situated considerably farther south than it is to-day, and also had been of much greater depth. Even so, the hard bottom of the existing channel proved to be at such a depth that the piles for this portion of the bridge had to be made 115 ft. in length. The lengths of the piles required for the respective bridges were ascertained from test piles driven at short intervals along the bridge sites.



A striking photograph of the James River Bridge taken during construction of the concrete highway. What appears to be a lighthouse in the far distance is actually the lift span seen in the photograph on the opposite page, and is only three-quarters of the distance across. For this and the accompanying photograph we are indebted to the courtesy of the " Scientific American."

The piles used in building the bridges were made at a pile-casting yard established at Newport News, about six miles from the bridge site. The sand and gravel for the concrete were unloaded by means of a stiff-leg derrick from shallow flat-bottomed boats called " scows," in the boat harbour, and were charged into hoppers that conveyed the material to an overhead storage bin of 400 cu. yd. capacity. From this bin the material was conveyed to one or both of two 1-cu. yd. capacity concrete mixers. Cement was transferred from a storage house at the yard to the mixing plant by means of a belt conveyor. The materials fed into the machine were compounded for at least two minutes in order to ensure a thoroughly strong and impervious mixture.

On completion of mixing the concrete was poured into small trucks termed " buggies," which travelled along a narrow gauge track to the casting platforms, where the material was discharged into moulds or " pile forms." The casting platforms were ranged alongside one another, the largest accommodating 60 pile forms each 115 ft. in length by 2 ft. square, and the next 40 forms each 70 ft. in length by 2 ft. square. A third platform was utilised for 18 in. piles and carried thirty-two 70-ft. forms and eight 75-ft. forms. The concrete was allowed seven days in which to set and dry. At the end of that time portions of the moulds were removed and a gantry crane lifted the piles from their beds by means of " T " bolts screwed into threaded plates embedded in the concrete. A steady output of 100 piles per week was maintained at the yard, and all piles had to be stored for a minimum period of 30 days before they could be put into service.

Specimen cylinders were made of the concrete used at each mixing, and these were broken when seven, 14 and 28 days old. In this manner the contractors obtained an exact knowledge of the strength of the concrete used for each part of the work.

At the site of each bridge a channel 180 ft. in width was dredged where required to ensure a minimum depth of 6 ft. 6 in. at low water. This work was carried out by means of a 14-in. suction dredger, and more than 350,000 cu. yd. of earth was removed. Most of the material was pumped ashore, and that discharged at the south end of the James River site was pumped inland for nearly a mile and used in building up the roadway above swamp level.

Floating pile-driving plants were utilised to sink the piles in

position, the bulk of the work being accomplished by means of a huge apparatus known as a " four-lead floating driver." While this plant was being towed by a tug from New Orleans to Newport News for use in the James River, a terrific storm was encountered off the Florida coast and the pile-driver broke away from the tug. Later it was recaptured by a Coastguard cutter and on inspection was found to be little the worse for the adventure.

The piles were loaded on to scows at the Newport News yard and conveyed to the bridge site, where they were hoisted into a vertical position on the pile-driver by means of a 35-ton derrick that surmounted the floating plant. This derrick lifted the piles one by one with the aid of an adjustable sling. The floating plant could accommodate four piles ranged vertically and in line, and all four positions, or " leads," were filled before driving operations were commenced. Two 7,500 lb. single-acting steam hammers were then brought into operation simultaneously, and drove two of the four piles. These hammers had a drop of 3 ft. 6 in. and drove the piles downward one inch for every three or four blows.

The speed with which the piles went " home " varied according to the nature of the river bed ; some driving very easily on account of mud pockets, while others sank very slowly owing to hard sand. Piles that descended readily were tested to ascertain what risk there was of further settlement taking place. This test consisted of balancing a 100-ton water tank on top of the pile by means of a heavy structural steel framework. Water was then pumped into the tank until this was full, the engineers meanwhile noting carefully any settlement of the pile that took place. When the piles had been driven down to a firm foundation any portion in excess of that required above water was cut off by means of pneumatic chisels and hammers operated from a floating compressor plant. The first pile was driven on 2nd January, 1928, and the last on 17th August of the same year.

The piles were levelled according to the requirements of the bridge engineers, and were then " capped " by surmounting them with a horizontal timber mould into which concrete was poured from one of two floating concrete plants. Each plant was carried on a single barge, and included a stiff-leg derrick mounted at the rear of the barge, by means of which sand and gravel were unloaded from scows and transferred to overhead hoppers, The cement, in bags, was conveyed by barge from the supply yard to the floating plant, and there unloaded on to a belt conveyor. The mixing plant was operated by a 30 h.p. gas engine, and the concrete was discharged into a bucket that conveyed it up a 65 ft. wooden tower and tipped it into a hopper. The material then descended by gravity through chutes suspended by blocks and tackle from the top of the tower. Each chute terminated in a short sectional spout through which the concrete was poured into the moulds.

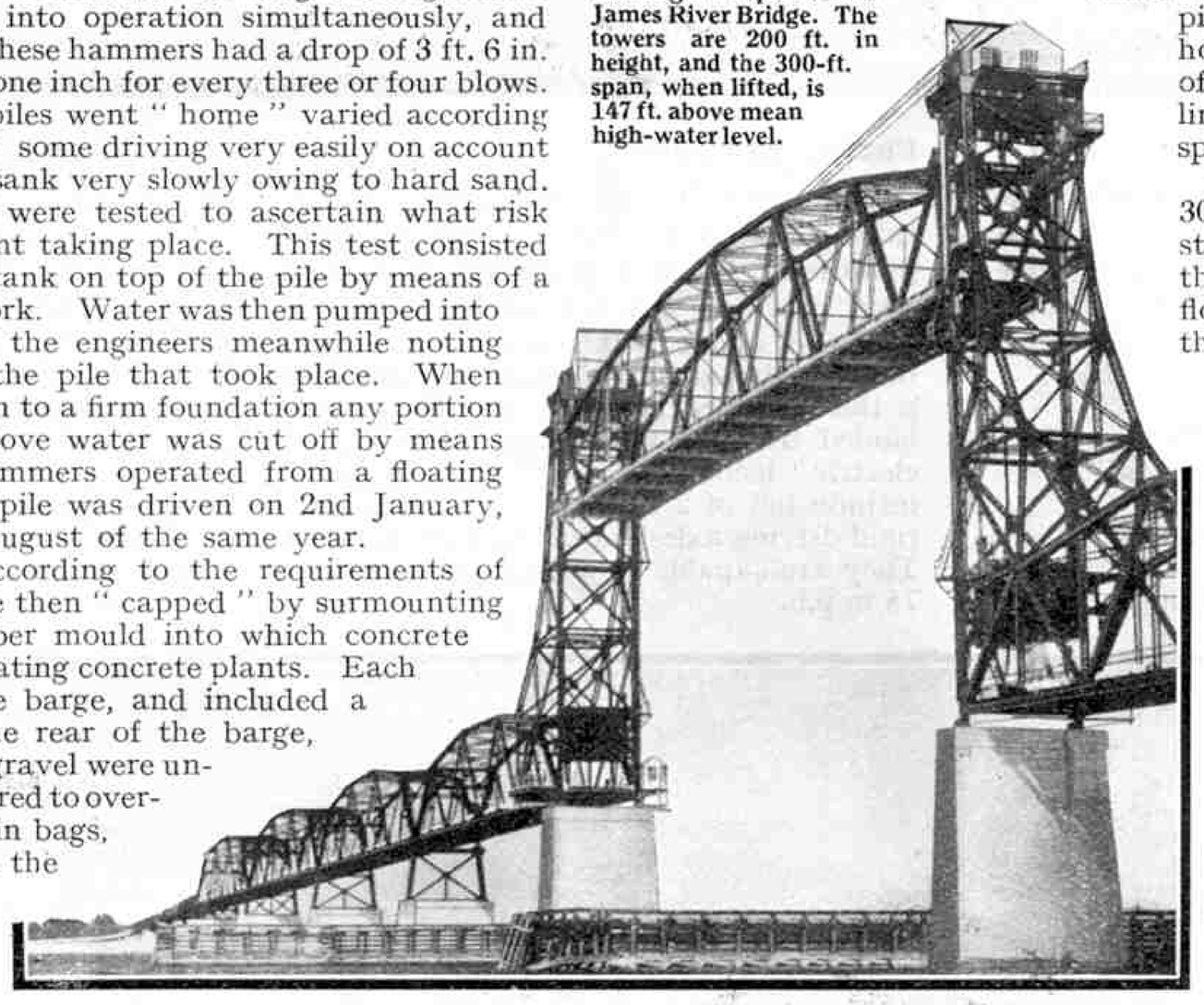
The steel " I " beams and the moulds for the concrete deck were next placed in position, and soon the concrete floating plants were again fully employed.

In addition to the 447 short concrete spans, the James River Bridge contains seventeen 90-ft. through plate-girder spans, eight 210-ft. truss spans, and a 300-ft. vertical lift truss span that is the outstanding feature of the bridge. The short concrete spans that make up the greater portion of the bridge are only a few feet above high-water level ; but about two-thirds of the way across, from the north, the bridge level is raised to a height of 57 ft. above the water—the level of the lift span when closed. This elevation takes place over the deep water channel of the river and is effected on each side of the lift span by a group of four girder spans and four truss spans, the highest of the latter connecting with the lift span. When raised to its full height this span is 147 ft. above the water, and therefore is high enough to allow the largest vessels to pass beneath it.

Another but slighter elevation of the bridge takes place about mid-stream, where two groups of four girder spans raise the bridge level at a gradient of 2.35 per cent. to a central span 28 ft. above the water. This elevation provides mast room for small vessels to pass under the bridge.

The concrete piers beneath the various girder spans were built up of two groups of six 2-ft. square concrete piles, each group being capped by a large pedestal of the same material and surmounted by a stout column supporting the girders. The 90-ft. plate-girders were conveyed from the contractor's yard to the bridge site by barge and were lifted into position by floating derricks.

The two piers of each truss span each consist of two bell caissons, resting upon a foundation of 40 timber piles at approximately 36 ft. below water level. The steel shells for the caissons were assembled on shore and shipped complete to the bridge site. While the work of fabrication was in progress ashore, the river area to be covered by the caissons was dredged to a depth of 10 ft. below the river bottom, and timber piles were driven downward through steel tubes. These tubes facilitated straight driving and prevented a descending pile from being deflected from its course when hard sand pockets were encountered. Immediately a caisson had been sunk in position a diver descended to inspect the bottom and to see that the huge structure had settled correctly upon its pile foundation. Concrete was then poured into the caisson to a depth of 20 ft., after which all water was pumped out and more concrete added until the caisson was full. The two caissons of each pier are connected by a wall 2½ ft. in thickness. They are 23 ft. in diameter at the base, and above water level taper to a diameter of 8 ft.



The huge lift span of the James River Bridge. The towers are 200 ft. in height, and the 300-ft. span, when lifted, is 147 ft. above mean high-water level.

The truss spans were assembled on timber falsework carried upon wood pile foundations and were hoisted into position by means of floating derricks and travelling cranes on the adjoining spans.

The two piers supporting the 300-ft. lift span were constructed in open cofferdams that were erected ashore and floated to the pier sites. When the cofferdams had been adequately braced to resist external pressure they were sunk in position and pile-driving operations commenced. In each cofferdam 200 untreated timber piles, 65 ft. in length, were driven through steel tubes, and afterward sealed together at their tops by concrete poured from an adjacent concrete mixing plant. The seal of each pier was made 52 ft. by 28 ft. by 15 ft. in depth. The cofferdams were then pumped dry and the lift span piers built up by surmounting each sealed group of piles with two tall square concrete towers, connected by a concrete wall 3 ft. in thickness, the whole being well reinforced. The concrete piers were built up to a height of 79 ft. above the massive base blocks. The pier superstructures were then erected, floating derricks and travelling cranes being utilised as in the erection of the girder and truss spans.

The vertical lift span is operated by direct drive, 16 cables being attached at each end and carried over sheaves at the tops of each tower and attached to counterweights. These counterweights are huge steel tanks loaded with concrete, and each is 234 tons in weight. The cables are attached to the movable span through mechanical equalisers that ensure the weight of the span being uniformly distributed to each of the cables. The operating machinery is located in the tower tops and consists chiefly of two 40 h.p. motors in each tower. One motor in each tower is sufficient to operate the bridge, and the second, apart from acting as an electric brake, is held in reserve.

The operation of the lift span is controlled from an operator's cabin at the base of the north tower. This cabin contains a switchboard and an indicating device that enables the operator to keep the two ends of the span in a horizontal position as the bridge is raised and lowered. The span requires 1½ minutes to make the complete upward or downward trip. Safety gates and warning lights are provided on the roadway of the bridge, at each side of the lift span, for the protection of traffic when the bridge is opened.

The concrete bridges erected across the Chuckatuck Creek and Nansemond River were each provided with a bascule span so that traffic along these waterways would not be hindered. The spans are of the double-leaf rolling type, each leaf being operated by a 20 h.p. electric motor. Hand-operated lifting mechanism is also provided for emergency purposes.

The construction of the two overland lengths of concrete road to link up the three bridges did not present any serious difficulties except at the south end of the James River Bridge, where the route selected lay directly across a swamp lying almost at tidal level. The bottom of this marshy land proved to be so soft that it was excavated along the route of the road and, as previously mentioned, a considerable quantity of sand was pumped in from the river to provide a firm foundation for the roadway.

The cost of the new highway, including the three bridges, was approximately £1,400,000.

RAILWAY NEWS

G.W.R. Locomotive News

The first five of the new batch of 4–6–0 engines of the "Hall" class have been completed at Swindon. They are numbered and named as follows:—5901, *"Hazel Hall"*; 5902, *"Howick Hall"*; 5903, *"Keele Hall"*; 5904, *"Kelham Hall"*; and 5905, *"Knowsley Hall."*

The name plates of No. 4985 have been corrected from *"Allersley Hall"* to *"Allesley Hall."*

The ten new 2–6–2 tank engines, which were reported in the March *"M.M."* as building, are now being put into traffic. They are numbered 6100–9. Like the engines of the recent "51" series, they have driving wheels 5 ft. 8 in. in diameter and outside cylinders of 18 in. diameter and 30 in. stroke.

The following 0–6–0 goods tank engines have been received from outside builders:—Nos. 8700–23, from Beyer, Peacock & Co. Ltd.; Nos. 8731–6, from W. G. Bagnall Ltd.; and Nos. 7770–4, from The North British Locomotive Co.

Engine No. 2935, *"Caynham Court,"* a 4-6-0 of the two-cylinder series, has now been fitted with Lentz poppet-valves and is being tested in service.

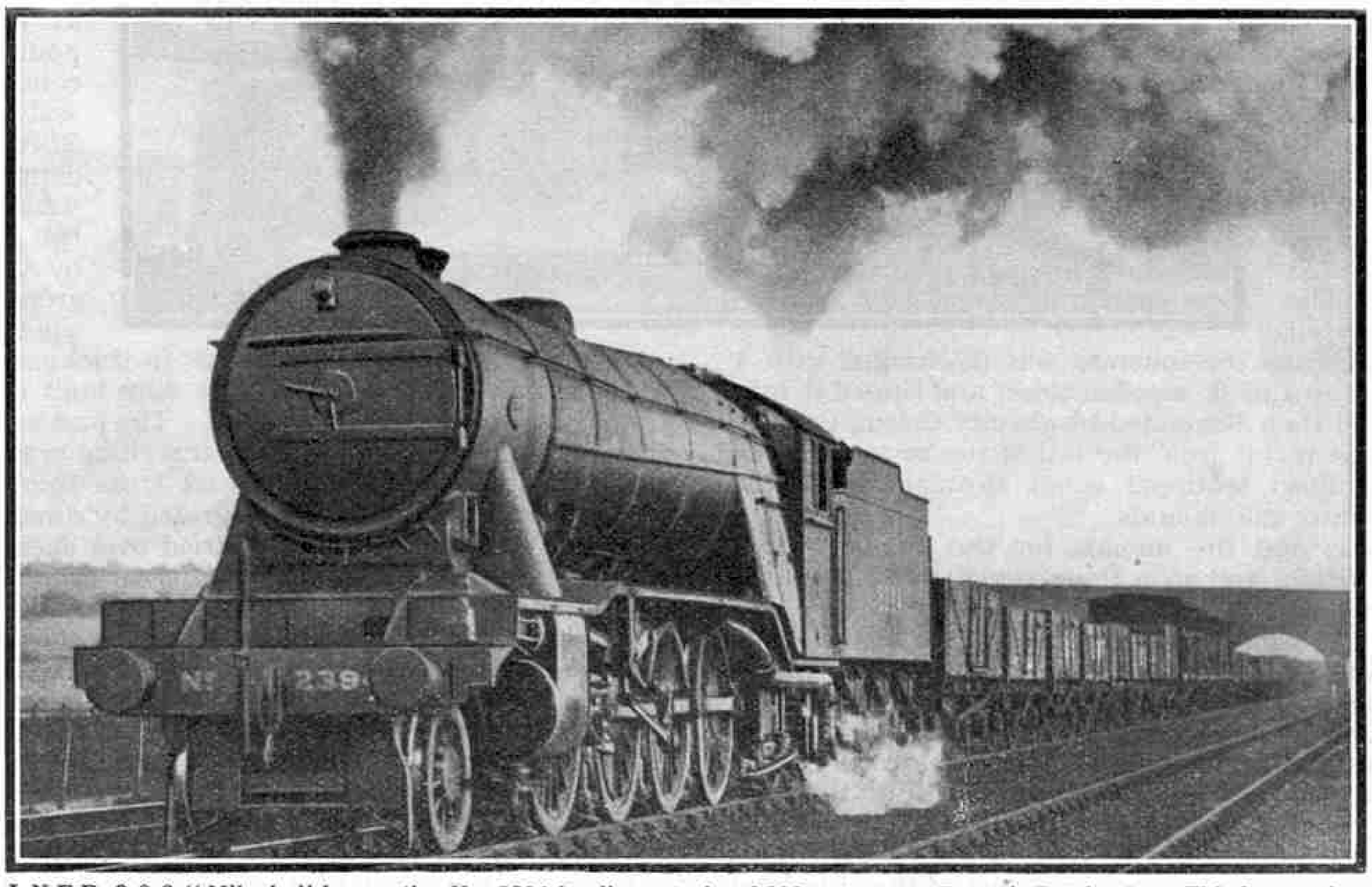
Excellent Running by "Schools" Locomotive

Further 2–6–0 engines of the new "U1" class, which was described and illustrated in last month's *"M.M."*, have been built at Eastleigh and are numbered A896 to 899.

Engine No. 909, *"St. Paul's,"* of the 4–4–0 "Schools" class, was tested recently with a train weighing 360 tons on the heavily graded Portsmouth direct line. Although the rail surface was unfavourable owing to a slight drizzle, excellent running was made, even up the Haslemere and Buriton banks, and time was in hand at Havant. Up the stiff Haslemere bank, with its 3½ miles at 1 in 80, a speed of over 20 m.p.h. was maintained.

Electric Expresses on the Midi Railway

The extensive electrification scheme that is being carried out on the Midi (Southern) Railway of France is making good progress. Of a total route mileage of 2,660 about 800 miles have already been equipped for electric working and a third of the traffic on this line is now hauled by electric traction. The express electric locomotives of the Company include ten of 2,100 h.p. each, with three rigid driving axles and a bogie at each end. They are capable of a maximum speed of 75 m.p.h.



L.N.E.R. 2-8-2 "Mikado" locomotive No. 2394 hauling a train of 102 wagons on Potter's Bar bank. This locomotive and L.N.E.R. No. 2393 are the only examples of this wheel arrangement on standard gauge line in Great Britain. They have similar boilers to those of the Gresley "Pacifics." (Photograph by Railway Photographs, Liverpool).

One of the accelerated electric expresses on the Midi can now claim to be the fastest train on the continent of Europe. It runs from Dax to Bordeaux, 91.7 miles in 87 mins., start to stop, giving an average speed of 63.2 m.p.h.

It is interesting to recall that more than twenty years ago the Midi ran a steam drawn express from Bordeaux to Dax at 62 m.p.h., but after a serious accident to the Sud Express considerable decelerations were made.

A Long Rope

A heavy wire rope was recently conveyed by a London and North Eastern Railway goods train from Gateshead to Whitehaven Colliery. This rope weighs 38 tons, is 7½ miles in length, 1⅛ in. in thickness and is composed of 42 strands.

Garratt Locomotives on L.M.S.R.

Crewe works have turned out further standard 0–8–0 freight engines. These are numbered 9615–19. All of the engines of this new series are now working on the L. & Y. section.

Two more 0–8–0 engines—Nos. 9128 and 9130—which were in "G" class have been provided with new boilers, having Belpaire fireboxes and superheaters, and so have passed into "G1" class.

As all the thirty new Garratt freight locomotives are now in service, they have become very familiar objects on the old "Midland" line between Cricklewood (Brent Sidings) and Toton, near Trent, for which section they were specially built. Nos. 4967 to 4986 are stationed at Toton, and Nos. 4987 to 4999 are at Wellingborough. They are engaged for the most part in hauling coal trains and other heavy goods trains for which two engines were formerly required. It is of interest to recall that during the Great War several Midland "single" express engines were stationed at Toton for piloting work on goods trains. It was not at all a dignified task for those graceful engines, and the contrast between them and the huge modern "Garratts" that are now working where they once did is a very striking reminder of the progress of locomotive design.

More Containers on L.N.E.R.

The L.N.E.R. announce that 300 small covered and 250 large open containers are to be built to supplement those already in use on their goods services. The present L.N.E.R. stock consists of 710 containers of four types. Traffic in containers has steadily increased since their introduction owing to the fact that this means of transport avoids the necessity of packing and enables door to door conveyance to be given. Containers have also found favour on the Continent and are largely used for traffic via the Harwich routes.

Electrification of British Railways

In September, 1929, the Government appointed a Committee to investigate and report on the question of the electrification of the railway systems of Great Britain. The report of the Committee has been published recently and recommends the electrification of the entire railway system of Great Britain. The cost of the scheme would be close upon £400,000,000, but the Committee is of opinion that the financial returns would justify even that huge expenditure.

The report calls attention to the many advantages of electrification. It is pointed out that as compared with steam electric services would be speedier, cleaner, more frequent and more comfortable. There also would be great saving on locomotive costs for wages, repairs and fuel. The work of conversion would be spread over 15 or 20 years, and would provide employment for 60,000 men.

The report is being keenly discussed. It is generally recognised that for areas where the traffic is dense, electrification is undoubtedly desirable. Many authorities feel that steam traction is still the most suitable and economical on lines where the traffic is not heavy, and point out that improvements are continually being made in the steam locomotive.

The "*Bournemouth Belle*"

Among the expresses that will be put on by the Southern Railway this summer will be a new Pullman train between Waterloo and Bournemouth. This will be known as the "*Bournemouth Belle.*"

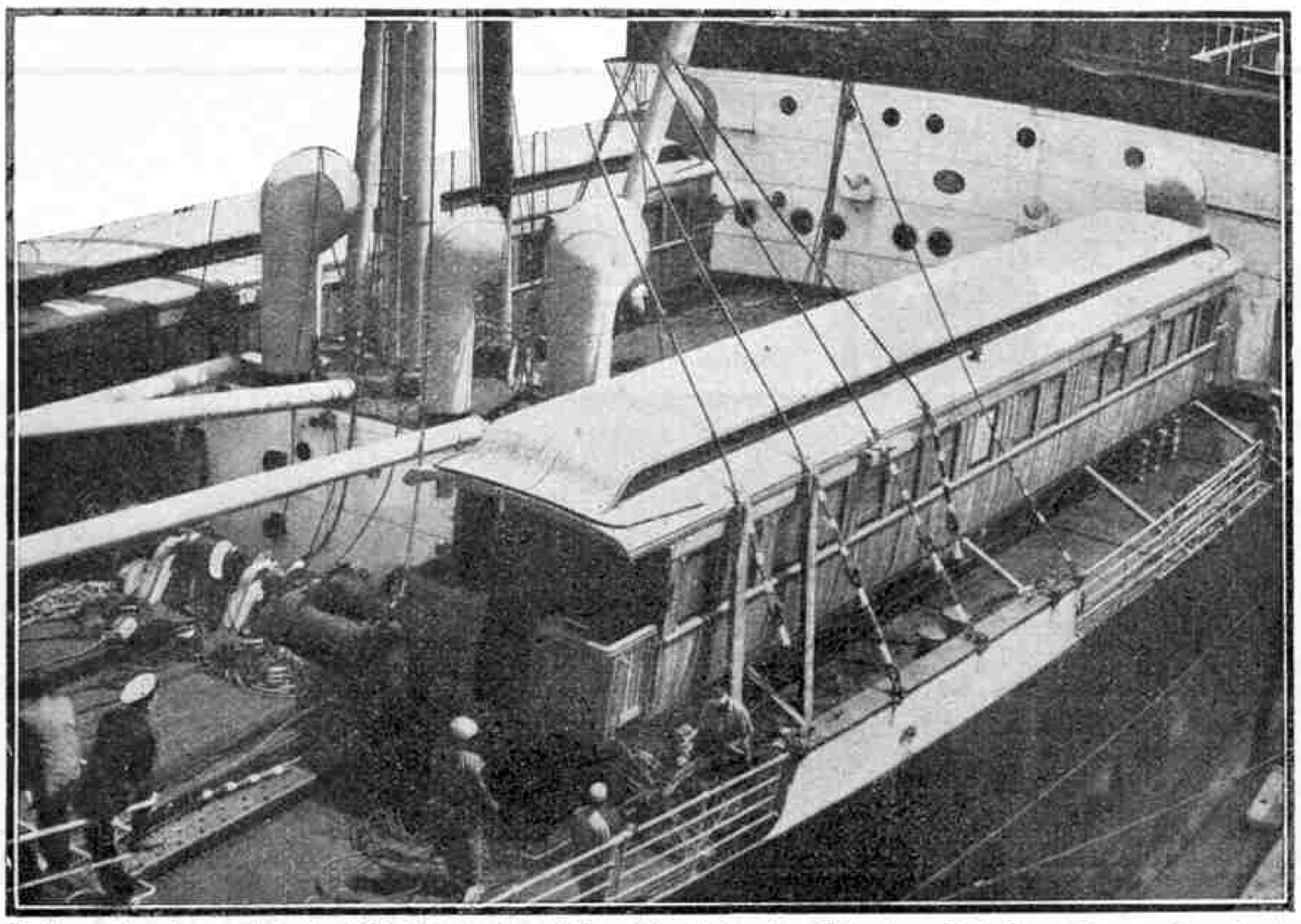
Longer Rails on the L.N.E.R.

Orders for 40,000 tons of steel rails have just been placed by the L.N.E.R. with a number of British firms. The new rails will contain a higher percentage of manganese than those at present in use and it is hoped that better wearing results will be obtained.

By way of experiment, a mile of the main line immediately south of Thirsk is to be laid with new rails, each 90 ft. in length. This is 30 ft. longer than the standard rail which was adopted a few years ago. It is expected that the use of the longer rail will make for smoother running. These special rails will be of the British standard weight of 95 lbs. to the yard. Experiments with very long rails are also being made on the Continent.

High-Capacity Goods Vans

In pursuance of the Great Western Railway Company's policy of providing large wagons wherever the use of such vehicles is justified, it has been decided to construct 100 20-ton vans for the transport of general merchandise. Forty of these vans have been placed in service, and the remainder are now being built.



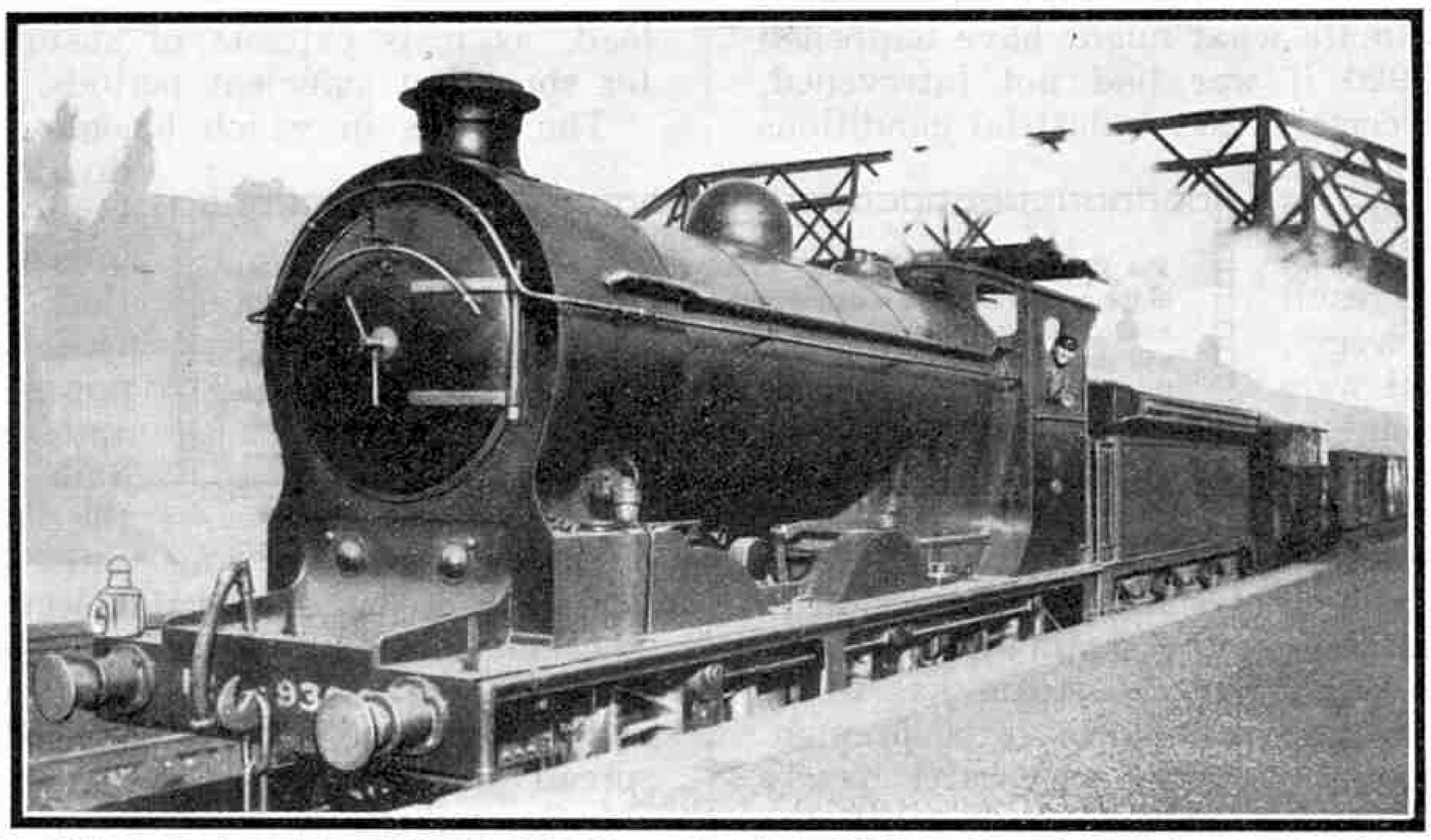
Railway Coaches arriving at Durban in the "Clan Mackinlay." They travelled from Liverpool as deck cargo. Our photograph is reproduced by courtesy of the "South African Railways Magazine."

The new vehicles are vacuum-fitted, and are known as "Mink G." They have a cubic capacity of 1,732 c. ft., and their length over buffers is 33 ft. Their inside width and depth are both 7 ft. 7½ in., and they have a wheel base of 19 ft. 6 in.

New "Sandringhams" on L.N.E.R.

The latest engines of the 4–6–0 "Sandringham" class to be turned out from Darlington works are:—No. 2827, "*Aske Hall*"; and No. 2828, "*Harewood House.*"

Some new 2–6–0 engines of the "K3" class are being built by Messrs. Armstrong, Whitworth & Co. Ltd., and three—numbered 1100, 1101 and 1102—have already been delivered.



[An 0-6-0 goods locomotive of the North British section of the L.N.E.R. These large and powerful engines are provided with superheaters and do valuable work on the difficult routes of the old N.B.R. This photograph was taken by our reader, C. McLean, of Ayr.

Locomotive Water Supplies

Some interesting facts in regard to locomotive water supplies were recently given by Mr. Whitelaw, the chairman of the L.N.E.R. He stated that the life of a locomotive boiler in Scotland is about twice as long as the life of a boiler in England on account of the good water supply. The problem of the provision of suitable water supplies is one that is being considered by the officers of his Company. It is believed that important savings can be secured by the adequate provision of water softening plants. The fullest efficiency of the locomotives cannot be attained as long as unsatisfactory water has to be used.

British Locomotive Returns

At the beginning of the present year a total of 22,519 steam locomotives were in service on the four great British railways. Of these, 13,640 were tender engines and 8,879 were tank engines. Although more than 500 new locomotives were added during 1930, over 1,000 were withdrawn for scrapping, and the total shows a decrease of 571 as compared with the previous year.

Speeding up in Italy

Under the new rule in Italy, the State Railways have made marked progress and are being operated with greatly increased efficiency. An extensive scheme of electrification is being carried out.

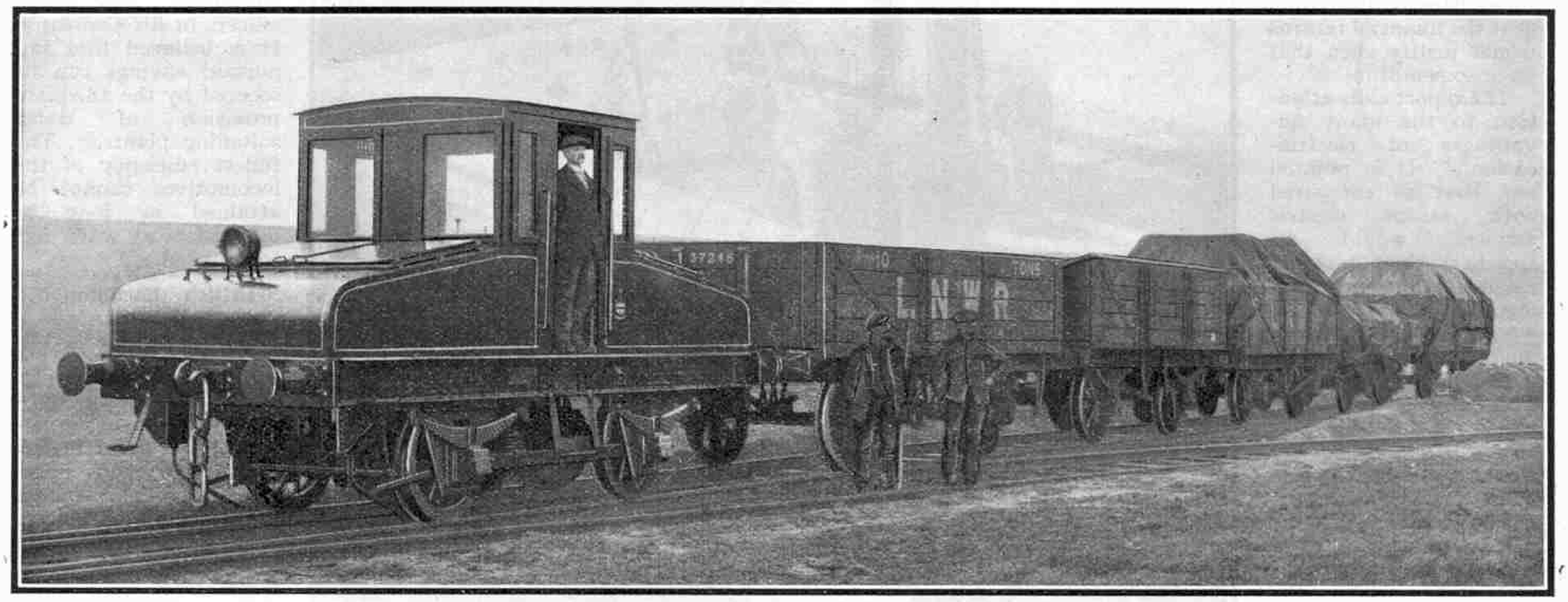
The new time-tables for the present summer reveal some remarkable accelerations. The fastest timing is from Milan to Venice, a distance of 164¾ miles, for which 168 minutes are allowed, giving an average speed of 58.8 m.p.h. In the reverse direction, three minutes more are allowed. On a trial run, a "Pacific" locomotive, hauling a train of 300 tons, covered the distance in 155 minutes, thus averaging almost 64 m.p.h. The new schedule shows a reduction of no less than 81 minutes on the previous fastest timing between Milan and Venice.

L.M.S.R. Locomotive Works

In the interests of economy and efficiency, the L.M.S.R. are concentrating on new construction and repairs at their largest and most up-to-date works. The shops at Barrow are being closed, and it is understood that the works at Horwich will not be used for new locomotive building after the present year.

Industrial Electric Locomotives

Advantages over Steam Propulsion



The illustration on this page shows a battery-driven electric locomotive of the central cab type engaged in shunting operations. For a given weight an electric locomotive will haul 25 per cent. more than a steam locomotive; will complete a journey in 75 per cent. of the time, and needs only half the engine crew. For the illustrations to this article we are indebted to the courtesy of the English Electric Company Limited, London.

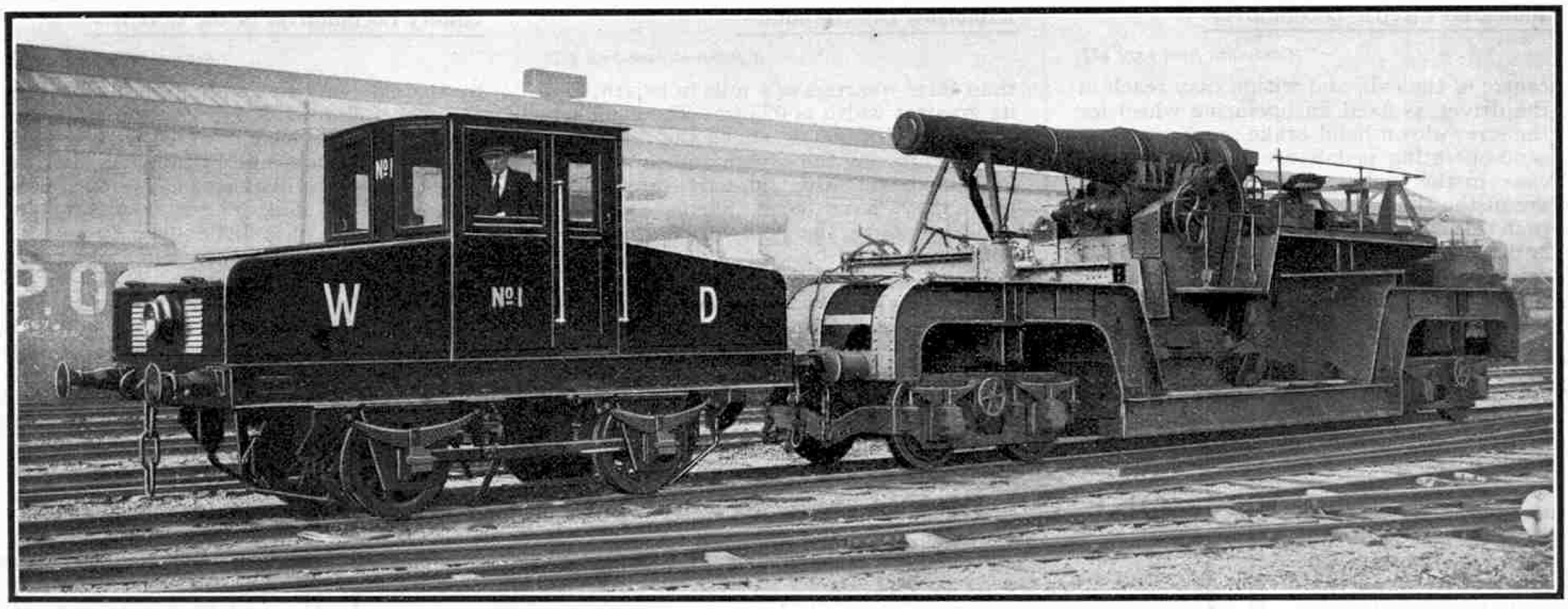
IT is only within comparatively recent years that the question of substituting electric locomotives for steam locomotives in industrial work has received the attention that it deserves. It has long been recognised that the small steam locomotive is wasteful and inefficient for industrial purposes, or in shunting yards; but in most cases this has been regarded as unavoidable. Generally speaking, the introduction of electric traction prior to 1914 was confined to tramways and passenger-carrying railway stock, and the electric locomotive for industrial work had obtained only slight recognition. It is impossible to estimate what might have happened between 1914 and 1920 if war had not intervened, but it is at any rate certain that industrial conditions have now changed in almost every respect. The cost of production has increased very greatly, largely as the result of dear coal and high wages. When labour and coal were cheap, a certain amount of waste was not relatively important; but this is not the case to-day.

In most works one source of waste is to be found in the handling of material with steam locomotives. Before the engine goes into service, steam has to be raised, which involves the attendance of a fireman. Then the bunkers have to be filled and water has to be taken on board. During service hours, when the locomotive is not usefully occupied the consumption of fuel and water still goes on; and after service the fires have to be drawn and the ashes cleared away. In addition to this daily waste the steam locomotive must be withdrawn from service at intervals for boiler washing and for a variety of small repairs; while at longer periods it must have its boiler thoroughly cleaned and retubed.

It is claimed that the electric locomotive eliminates a great deal of this waste. It is ready for use when required, it costs nothing during idle periods, and at the end of the day it is simply placed in the shed and left there. The drive is through rotational machinery, and the driving parts do not have to withstand the impulsive forces to which the steam locomotive is subject. Repairs are thus much less frequent, and are quickly carried out. A steam locomotive must be engined for the heaviest load that is likely to be hauled, but an electric locomotive can be motored for the normal load, as it is capable of sustaining heavy overloads for short but sufficient periods.

The works in which locomotives are used may be divided broadly into two kinds—those that require intermittent service and those that demand continuous service. In the first class are power stations, gas works, and factories with a moderate bulk output, or those where the daily production is transported only three or four times daily to the main line. For work of this nature the electric locomotive is ideal. The efficiency of a steam locomotive under these conditions is very low, because although only two or three hours' work per day are required, these hours may be spread over the whole working day. In the second class are colliery yards, steel works, and large commercial undertakings and construction works generally. In such cases as these, where several locomotives may be employed, considerable economy can be effected by the use of electric locomotives. For a given weight an electric locomotive will haul 25 per cent. more load than a steam locomotive; will complete a journey in 75 per cent. of the time, and needs only half the engine crew.

In addition there are cases where special conditions



Electric locomotives are particularly suitable for use in works where the sparks from a steam locomotive would be dangerous. The above photograph shows a battery-driven electric locomotive in use at an ordnance depôt.

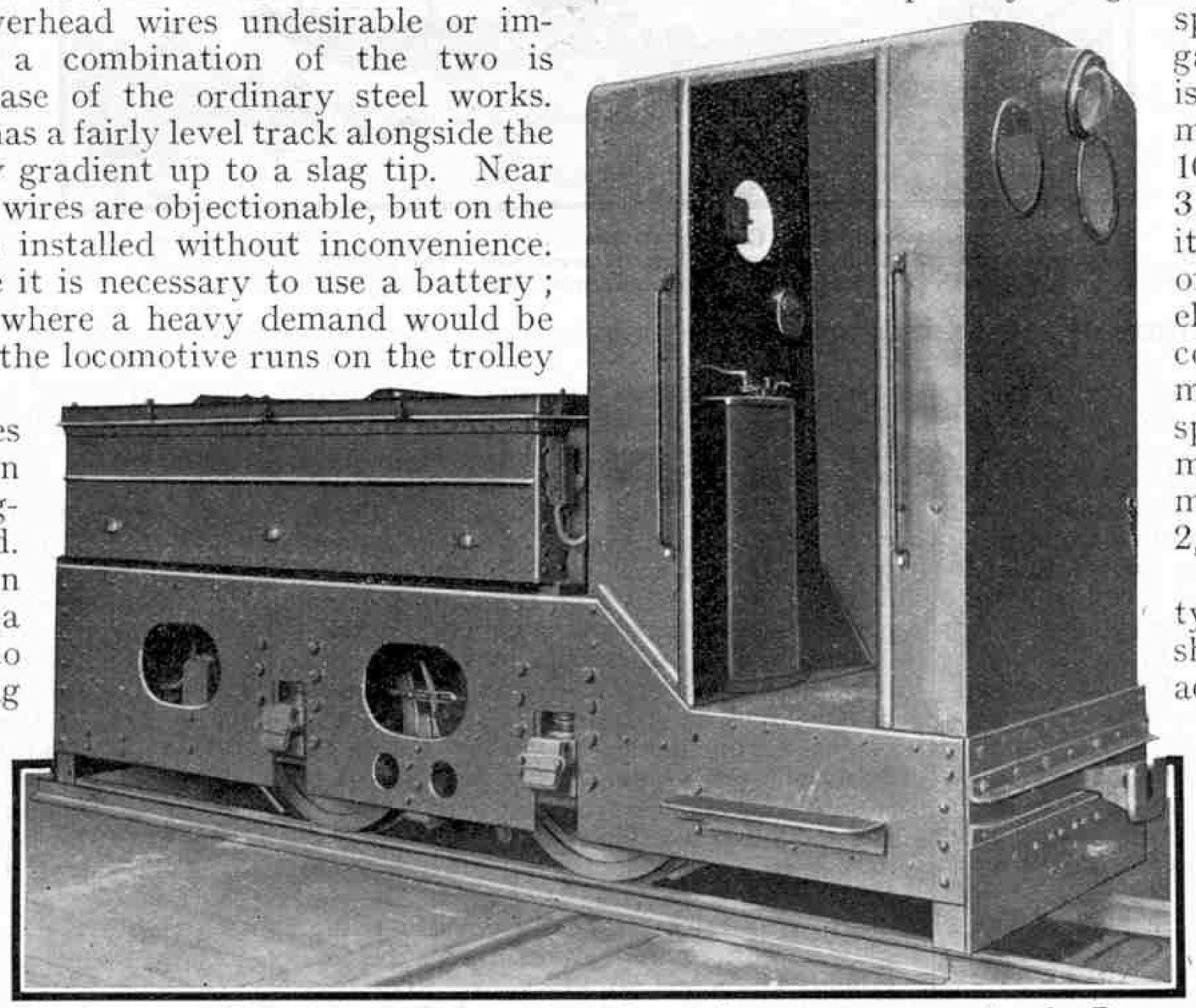
exist, such as wood yards, docks and paper mills, where cleanliness and safety from fire is of great importance.

In the first class a battery locomotive may be used; while generally speaking a trolley locomotive is recommended for the second class, unless circumstances make the installation of overhead wires undesirable or impossible. Sometimes a combination of the two is effective, as in the case of the ordinary steel works. A steel works usually has a fairly level track alongside the furnaces, and a heavy gradient up to a slag tip. Near the furnaces overhead wires are objectionable, but on the gradient they can be installed without inconvenience. On the level therefore it is necessary to use a battery; but up the gradient, where a heavy demand would be made on the battery, the locomotive runs on the trolley wires.

An interesting series of locomotives has been developed by the English Electric Co. Ltd. The lower illustration on this page shows a locomotive arranged to work on gauges ranging from 2 ft. to 3 ft. 6 in. It has a wheelbase of 3 ft. 11 in. and is capable of negotiating curves of 20 ft. radius. The frame is built up of steel plate, braced with stretcher plates and angle iron, to which the cast steel horn guides are attached; and the weight of the frame is taken on the axle boxes by helical springs. The cab affords head protection to the driver, and is open at the sides.

The wheels are 32 in. in diameter, so that it is possible to use standard traction type motors, driving direct on to the axles through spur gearing. The two motors range from 12 h.p. to 35 h.p. each, according to gauge, voltage and speed required. The maximum tractive effort at the tread of the wheels is 4,000 lb. and the normal speed from 6 to 10 m.p.h., according to requirements. The total weight is approximately 7 tons. This locomotive can be equipped either with a removable battery compartment, or with a bow trolley mounted on a trolley standard to suit varying heights of wire.

A smaller locomotive similar in general construction is adaptable to suit all gauges from 1 ft. 6 in. to 2 ft. 6 in., and has been specially designed for work in confined spaces. On the 1 ft. 6 in. gauge the overall width is 3 ft. 6 in. The locomotive is fitted with 16 in. wheels and has a 3 ft. wheelbase, so that it can negotiate curves of 14 ft. radius. The electrical equipment consists of two 11 h.p. motors, giving a normal speed of from 5 to 6 m.p.h. and the maximum tractive effort is 2,000 lb.



Another type of electric locomotive, designed for service on narrow gauge track. Power is obtained from a battery housed in the removable compartment mounted in front of the cab.

Another interesting type of locomotive is shown in two of the accompanying illustrations. This is adaptable for all gauges from one metre to 5 ft. 6 in. It is of the central cab type with sloping end covers, the ends being made to contain the batteries when these are used. The general dimensions, according to the gauge for which the locomotive is designed, are length over buffers, up to 21 ft.; overall width, up to 8 ft. 9 in.; minimum height over cab, 9 ft.; wheelbase, 6 ft. to 8 ft. With a 6 ft. wheelbase the locomotive can operate on a curve of 30 ft. radius. The frame is built up of rolled steel channel iron, strongly braced and riveted together; and it can be arranged for any type of buffer or combination of buffers.

The arrangement in the interior of the cab is simple. By means of the standard controller the driver can operate the locomotive in either direction without changing his position. In the (*Continued on page 478*)

Industrial Electric Locomotives—

(*Continued from page 477*)

centre of the cab, and within easy reach of the driver, is fixed an operating wheel for the screw-down hand brake ; and gong and sand-operating pedals are set in the floor close to the brake. The doors of the cab are of the sliding type, and one window in each side can be let down. The locomotive is driven by two traction motors through spur gearing on to the axles. According to the nature of the work required, and the voltage available, it can be fitted with motors varying from 15 h.p. to 90 h.p. each ; and the total weight can be varied from 11 to 22 tons. With the most powerful equipment the locomotive will give a normal tractive effort of 5,000 lb. and for short periods 8,500 lb. at the tread of the wheels. With the wide range of standard traction motors available normal speeds of from 4 to 25 m.p.h. can be arranged to suit requirements.

In the smaller types of locomotive the battery containers are removable, so that the entire battery can be taken out for charging, and replaced if necessary by a fully charged spare one. The change occupies only a few minutes. According to the dimensions and the special circumstances, the battery containers are made either to roll off the locomotive on to a platform, in which case the container is fitted with four wheels ; or to be lifted off, for which purpose the container is supplied with suitable lifting lugs. Special care has been taken in the design of these containers to ensure ample ventilation, and at the same time to keep them perfectly weatherproof. The interior of the container is coated with an acid—or alkali-resisting compound, and drain holes are provided to allow any spilled liquid to escape. In the larger types of battery locomotive the batteries are not made removable as a whole, on account of their great weight. The cells are mounted in trays firmly secured in the battery compartment ; and the covers of these compartments are hinged on rollers that can be opened easily.

For operation on a trolley system the locomotive is fitted with a standard current collector.

All locomotives are supplied with a powerful screw hand brake, easily operated from the driving position, and applying brake blocks to each wheel. In addition, all locomotives equipped with two motors can be braked electrically through the driving controller, which is provided with a suitable number of notches for smooth and efficient braking. With locomotives of 18 tons or over, or where there are heavy gradients, it is usual to supplement this braking equipment by a standard air brake.

The locomotives are fitted at each end with a headlight of bulkhead pattern. Suitable lighting is arranged also in all driving cabs, and each locomotive is provided with an inspection lamp, complete with flexible cable and plug.

Exploring Underground—

(*Continued from page 452*)

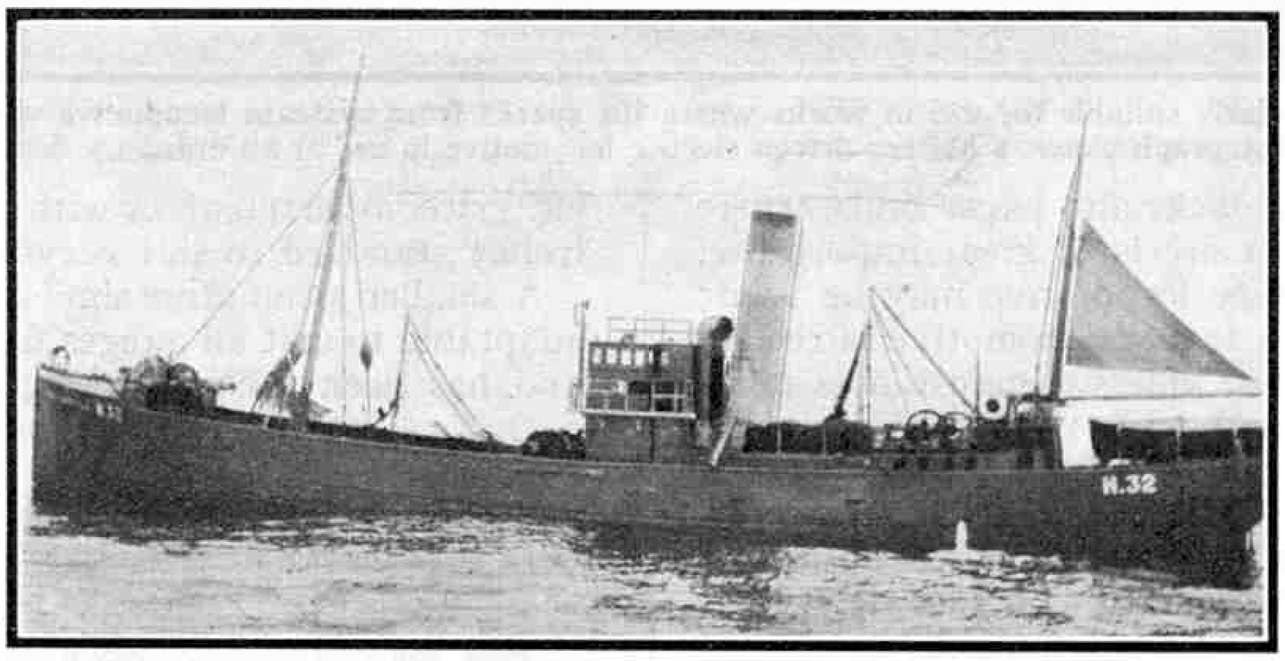
than three-quarters of a mile in length, and its greatest width is 625 ft. The ceiling is at a height of 300 ft. above the floor, and visitors crossing the cavern appear so small in comparison with its vast proportions that they have been likened to ants crawling across the floor of a large warehouse.

In colour and shape the rock formations of the " Big Room " are superb. The ceiling has long been hidden by the slow growth of millions of stalactites of all sizes. From the ground enormous numbers of stalagmites rise to meet them. Many of these are of monster proportions, as may be realised from the two shown on our cover. At intervals may be seen the basins of springs, some of which are empty, while others are filled with clear cold water. Their colours vary from a glistening white to shell pink, tea rose and brick red, while in the artificial light by which it is seen the water of the pools appears to be turquoise blue in tint.

Although at present limestone caves are only show places it is possible that in course of time they may be put to practical use in a rather unexpected manner. The air in many of them is remarkably pure and free from dust, while its temperature is uniform and agreeable. This fact so greatly impressed an engineer who lives above a famous cave system at Luray, in the State of Virginia, that he constructed a shaft from one of the enormous underground chambers to his house. Up this shaft the cool air of the cavern is driven by a large fan. In winter it is passed over steam coils before entering the house, but in summer this is unnecessary. Heating engineers have taken a hint from the use made of the Luray Caverns, and the future may see a development of ventilation systems employing air that has been cooled and purified underground.

For the illustrations of the White Scar Caverns that accompany this article we are indebted to the courtesy of G. H. Swift, Esq., K.C. We are also indebted to the High Commissioner for New Zealand for the illustrations of caverns in that country, and to the Atchison, Topeka and Santa Fe Railway for those of the caverns at Carlsbad.

ONE OF BRITAIN'S FOOD PROVIDERS



The Hull steam trawler "Lord Gainford." This vessel is employed in fishing in the waters surrounding Iceland, about 1,000 miles from its home port. The photograph was taken by our reader H. L. Yeoman, Hull, who made an interesting voyage to Iceland in her.

County Locomotives of the G.W.R.—

(*Continued from page 481*)

by the old route to Paddington, a distance of 193¾ miles in 3 hr. 24 min. 22 sec. Three signal checks were experienced between Swindon and Paddington, but in spite of them the distance of 77¼ miles was covered in 76 min. 56 sec., equal to an average speed of a little over 60 m.p.h. Another run timed by the same observer, Mr. C. Rous-Marten, on the " up " *" Cornish Riviera Limited "* showed the engine, *" County of Wilts "* to be capable of averaging 58.8 m.p.h. with a load of 190 tons from Exeter to Paddington. The average speed from Westbury was exactly 60 m.p.h., thus showing that very even running had been made. On another occasion *" County of Warwick,"* with a load of some 300 tons, lost only 10 seconds between Bristol and Exeter, in spite of difficulties caused by an extremely strong side gale. The minimum speed up Wellington Bank, with its grade of 1 in 90, 1 in 81, and 1 in 80, was 30.2 m.p.h.

Within more recent years other splendid performances have been recorded behind these engines. For instance, *" County of Bedford "* was provided, instead of the usual 4–6–0, to work an " up " express from Birmingham, with stops at Leamington and Banbury. With a load of 315 tons 79 m.p.h. was attained down Hatton Bank ; and Leamington, 23.3 miles, was reached in 23 min. 55 sec. or a little over " even time." The booked allowance was 26 min. The 19.8 miles to Banbury, allowed 24 min., occupied 27 min. 10 sec. on account of a signal check. Then, with the 67.5 miles to Paddington, scheduled to be covered in 70 min., at a rate of almost 58 m.p.h., more fine work was done. Up to Ardley Tunnel 50 m.p.h. was maintained on a gradient of 1 in 200, and on descending the Bicester Bank 82 m.p.h. was topped. Down Saunderton Bank 71½ m.p.h. was reached after a minimum speed of 46½ m.p.h. on the 1 in 167 grade after Princes Risborough.

Following the usual slack to 35 m.p.h. to High Wycombe 56½ m.p.h. was reached on the level ; and on the subsequent 1 in 225 gradient speed fell to 52½ m.p.h. At Denham, 79 was reached, and at Greenford, 72½, the gradient here being 1 in 264 down. Delays spoiled the finish of the run, so that the arrival at Paddington was 8½ min. behind time. Actually 73 min. 45 sec. were taken for the 67.5 miles from Banbury in spite of the 70 min. allowed. This was surely a great effort on the part of a 4–4–0 locomotive weighing 58 tons 16 cwt., hauling a train of such weight over this difficult route.

The " Counties " clearly possess remarkable powers of acceleration, and this may be due no doubt to the increased leverage afforded by the long piston stroke. Whatever objections may be offered to it, this feature appears to have been remarkably successful on these engines, and on other G.W.R. locomotives similarly provided.

Charcoal Burning

A Peep at an Ancient Industry

By W. Coles Finch

CHARCOAL burning is one of the most ancient of industries, and on account of the isolation in which it is carried on it has always been surrounded with a sense of mystery. Charcoal was made in the great Wealden Forest of the South of England, and used in the furnaces and forges of the ancient Kentish and Sussex ironworks. The demand for charcoal still continues, and to-day the substance is used for an enormous variety of purposes. It is interesting to note that in the Great War the soldier in his trenches and dugouts at the Front was thankful for the warmth and comfort of a charcoal fire. The first efforts in this direction were by no means successful, but subsequently there were found in one of the regiments some charcoal burners from Epping Forest, and under their expert guidance the making of the charcoal in the forests round Ypres was brought to complete success. In times of peace charcoal burning forms an important industry in France, Germany and other European countries, especially in mountain regions.

The making of charcoal is interesting in every stage of the work, from the selection of the wood to its final storage for use. The best charcoal is obtained from wood that has been felled for one year, and preferably "flawed oak," which is felled in May, and is much better than winter-felled oak. Charcoal produced from this wood has greater heating properties, and also lasts longer. It is prepared for the purposes of hop and malt drying, the making of gunpowder, and general foundry work. The next best quality is made from cherry, apple, pear, plum, chestnut, hawthorn and fir. The softer woods, such as elm, willow and elder, can be used in the production of the charcoal required for the making of paint, blacking, printer's ink, etc. In this, as in so many other processes, it is the human element that counts, and a skilled burner can convert even green and unseasoned wood into good charcoal. The writer has seen old hurdle gates, hop poles and similar derelict wood from the farm turned into excellent charcoal.

The charcoal burner is to be found sheltered from the wind behind a screen of thatched hurdles, busily stacking billets of wood into pyramidal form against a stout post, producing a stack about 15 ft. in diameter and about 6 ft. in height. The billets are carefully placed, leaving a little space between each one and the next for the passage of air. It will be noticed that the stack may consist of different kinds of wood, but that all the billets are of approximately uniform girth.

Having completed the stacking of the wood, the burner proceeds to cover the pile with fine sand, and to seal it from the atmosphere. When this has been done the centre post is removed and the pile is ignited. By the side of a pyramid that is just smoking sometimes may be seen a miniature volcano in which the burning process is well advanced. The smoke will be issuing from the top and from small holes purposely made round the sides to admit air. Here lies the secret of the art, in securing that the wood will burn, but will not be wholly consumed. In consequence of the heat, part of the combustible substance is consumed, part is volatilised, together with a portion of the water; and there remains behind the carbon of the wood. The time occupied in burning is influenced by many conditions, among them being the size and uniformity of the wood, its condition, and its relative hardness. A stack composed of small wood would require to burn only two days; but with one composed of large wood and tree roots or stubs the time would be extended to four or five days.

When the burning is finished, holes are made in the sand covering and some 200 gallons of water are poured on the charcoal. This water is readily sucked up, and the fire is eventually extinguished. This must be done thoroughly before the air is admitted, for one live spark will soon re-kindle the whole pile and consume it. This sometimes happens even after the lapse of several days, for charcoal is a treacherous substance in more ways than one. Many farm buildings have been set on fire as the result of a slumbering spark having remained unobserved when the charcoal was stored for use.

Photo] [*W. Coles Finch*

A Charcoal Burner at Work.

The quantity of charcoal obtained from a stack of the dimensions we have described would be about 200 bushels, and many are the uses to which it is applied. It is brittle, porous, tasteless and inodourless and possesses many remarkable qualities. It is insoluble in water; it absorbs a large quantity of air; it is valuable as a deodoriser and disinfectant; it purifies water and prevents the putrefaction of animal matter. It is used as a fuel where great heat is required without smoke, and charcoal fires are superior to any others for the purpose of broiling meat. It is used in the manufacture of gunpowder, polishing powder and toothpowder; and at one time was largely employed as a lining in cold storage plants, on account of its being a non-conductor of heat. During the Great War charcoal was very extensively used in the manufacture of masks for protection against poison gas. For this purpose not only wood charcoal but also charcoal made from coco-nut shells and the stones of various fruits was used.

A curious feature of wood charcoal is that when dry it floats on water, although it is denser than that liquid. The reason is that sufficient air is absorbed in its pores to reduce its density below that of water. If the air is expelled from a piece of wood charcoal it sinks. This can most simply be done by prolonged boiling in water, the charcoal being immersed by attaching a lead sinker to it.

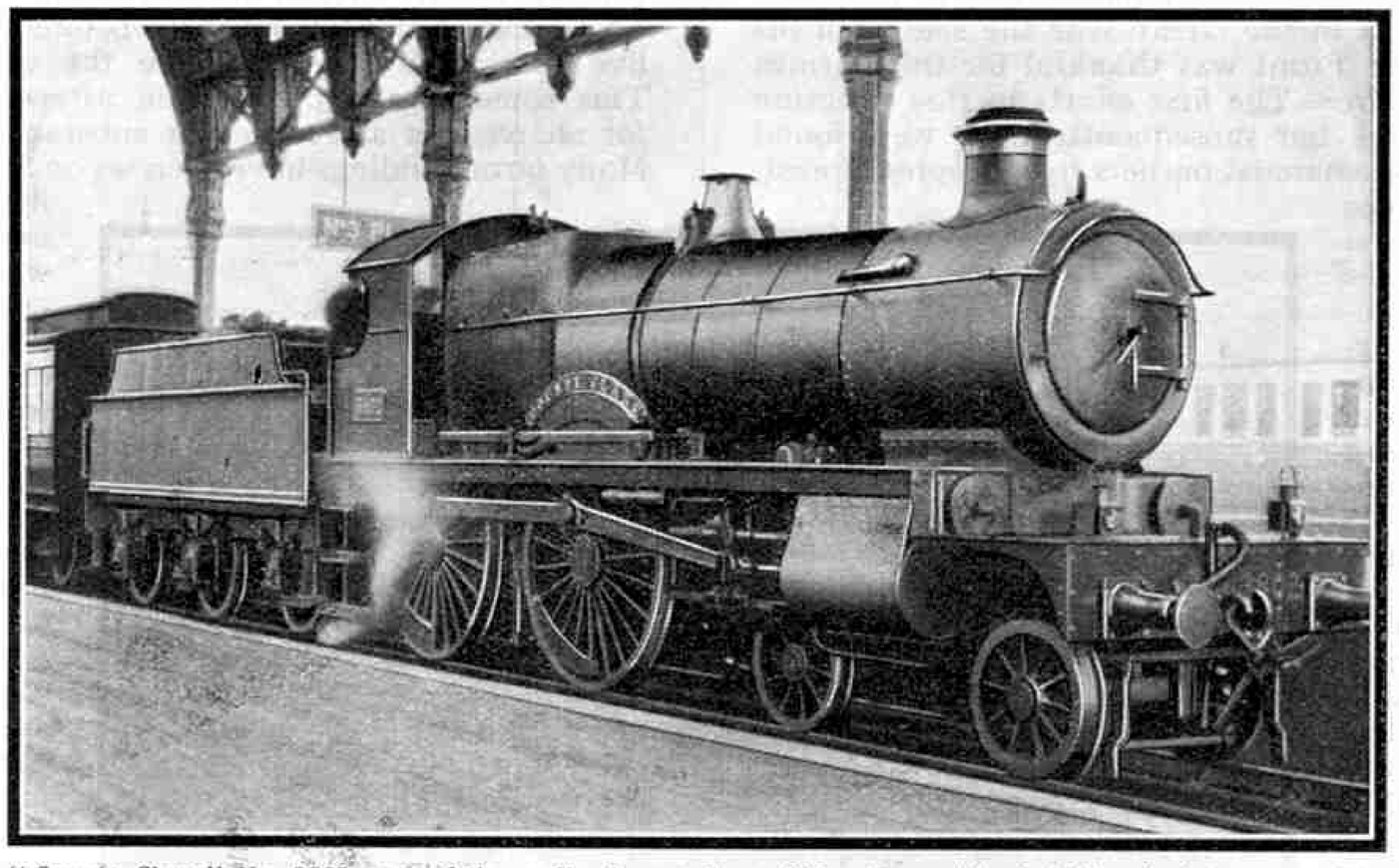
Charcoal burning appears to be an uneventful occupation, but nevertheless it is not without risk. On one occasion a burner had occasion to stand on the top of the pile, as is sometimes necessary. Somehow the pile gave way, and the poor man fell in, and was dead before he could be rescued. It was impossible for him to extricate himself, and he was probably quickly stifled by the fumes. There are many instances on record in which charcoal burners have kindled a charcoal fire in their tent or hut in order to provide themselves with a little warmth and comfort and, not having been sufficiently careful to allow for the entrance of fresh air, have been found dead next day.

The burners are a homely body of men, ready for a chat whenever their duties allow. If any of our readers should see the smoke of a pile when they are on a ramble through the woods, they will be well repaid if they can get on friendly terms with the charcoal burner and learn something of the mysteries of his art.

The "County" Locomotives of the G.W.R.

Unique Features of a Famous Class

AMONG many notable classes of 4–4–0 express locomotives that have been built for British railways during the past 30 years, the Great Western "County" class takes a foremost place. This wheel arrangement has long been popular in Great Britain, and over a long period of years it was practically the standard express type. It has been superseded to a great extent on the heaviest and most important duties by six-coupled locomotives, either 4–6–0 or 4–6–2. The type has been multiplied recently by the Southern Railway, however, the locomotives in question, the "Schools" class, being the most powerful 4–4–0 locomotives in the country. The popular "Shires" of the L.N.E.R. provide another example of the type, and have rapidly made a name for themselves since their introduction a few years ago.



"County Clare" No. 3802, one of the earlier locomotives of the class with straight raised frames. The engine is waiting to leave Paddington with a Weymouth express.

The 4–4–0 locomotives that preceded the "Counties" on the G.W.R. were of several classes, all of which proved very successful. In common with most other British locomotives of that period they had inside cylinders; but they were notable for having outside frames to all wheels, and outside cranks and coupling rods. The highest speed reliably recorded on any British railway, 102.3 m.p.h. was attained by one of these locomotives, "*City of Truro*": and both the "City" class and the preceding "Atbara" class were noted for their swift running. They were also highly efficient in regard to hauling and hill climbing, so that their all-round performance was thoroughly good. The "Cities" were further notable in that they were the first locomotives to be fitted with the now familiar coned domeless boiler that is characteristic of modern G.W.R. practice.

A great change in appearance was effected by the introduction in 1904 of the first engines of the "County" class, of which the "*County of Middlesex*," then No. 3473, but now numbered 3800, was the first to appear. Outside cylinders were employed, together with inside frames; the running plate was raised to clear the cylinders with the valve chests above them, and it remained at this level throughout, thus being higher than the tender frame. This may be seen in the accompanying illustration of "*County Clare*," which was built in 1906; the cab perched high above the rails having a curiously stunted appearance. The elaborate steps necessary to reach the cab will also be noticed.

The following are the numbers and names of the "County" Class Locomotives of the G.W.R.:—

3800.	County of Middlesex.	3820.	County of Worcester.
3801.	County Carlow.	3821.	County of Bedford.
3802.	County Clare.	3822.	County of Brecon.
3803.	County Cork.	3823.	County of Carnarvon.
3804.	County Dublin.	3824.	County of Cornwall.
3805.	County Kerry.	3825.	County of Denbigh.
3806.	County Kildare.*	3826.	County of Flint.
3807.	County Kilkenny.*	3827.	County of Gloucester.
3808.	County Limerick.	3828.	County of Hereford.
3809.	County Wexford.	3829.	County of Merioneth.
3810.	County Wicklow.	3830.	County of Oxford.*
3811.	County of Bucks.*	3831.	County of Berks.*
3812.	County of Cardigan.	3832.	County of Wilts.*
3813.	County of Carmarthen.	3833.	County of Dorset.*
3814.	County of Chester.	3834.	County of Somerset.
3815.	County of Hants.	3835.	County of Devon.*
3816.	County of Leicester.	3836.	County of Warwick.
3817.	County of Monmouth.*	3837.	County of Stafford.
3818.	County of Radnor.	3838.	County of Glamorgan.*
3819.	County of Salop.	3839.	County of Pembroke.*

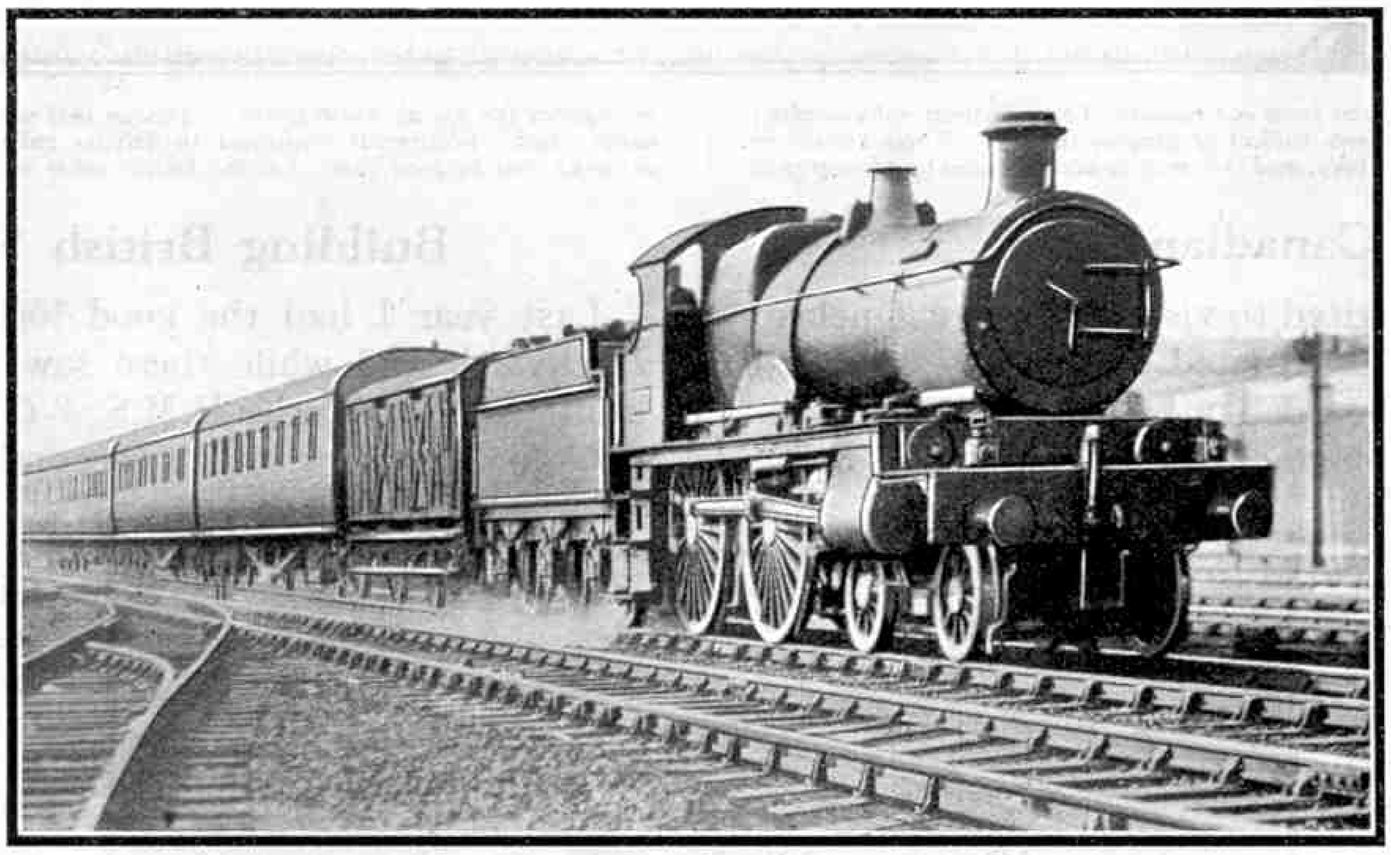
* These engines are now withdrawn from service.

The reason usually given for the outside position of the cylinders is that it was necessary in order to allow a piston stroke of 30 in. to be employed in place of the more normal 26 in. stroke of the "Cities." This long stroke had been used on the pioneer G.W.R. 4–6–0 passenger locomotive No. 100, which made its appearance in 1902. Mr. G. J. Churchward, the then Chief Mechanical Engineer, gave as the reason for its adoption that the long stroke in relation to the bore was the one way he knew of making the simple engine equal in efficiency to the compound; and compound propulsion was receiving a great deal of attention at that time. A long piston stroke makes a longer period of expansion possible, and this, coupled with the long valve travel that has been common on the G.W.R. for the past 25 years, allows the steam to be used efficiently and economically, as the engine may be "notched up" well without trouble.

A further advantage is that increased leverage is afforded on the cranks, and this is particularly valuable in climbing gradients. Theoretical objections to this long stroke, on the grounds of greater friction and the increased area exposed to condensation, do not seem to have materialised in practice, for the two-cylinder G.W.R. 4–6–0's are notably fast runners, while the "Counties" are by no

means sluggards. In this connection it is interesting to note that Mr. Collett in his magnificent "Kings," has provided the 16½ in. diameter cylinders with a piston stroke of 28 in. which is an increase of 2 in. as compared with the previous four-cylinder engines.

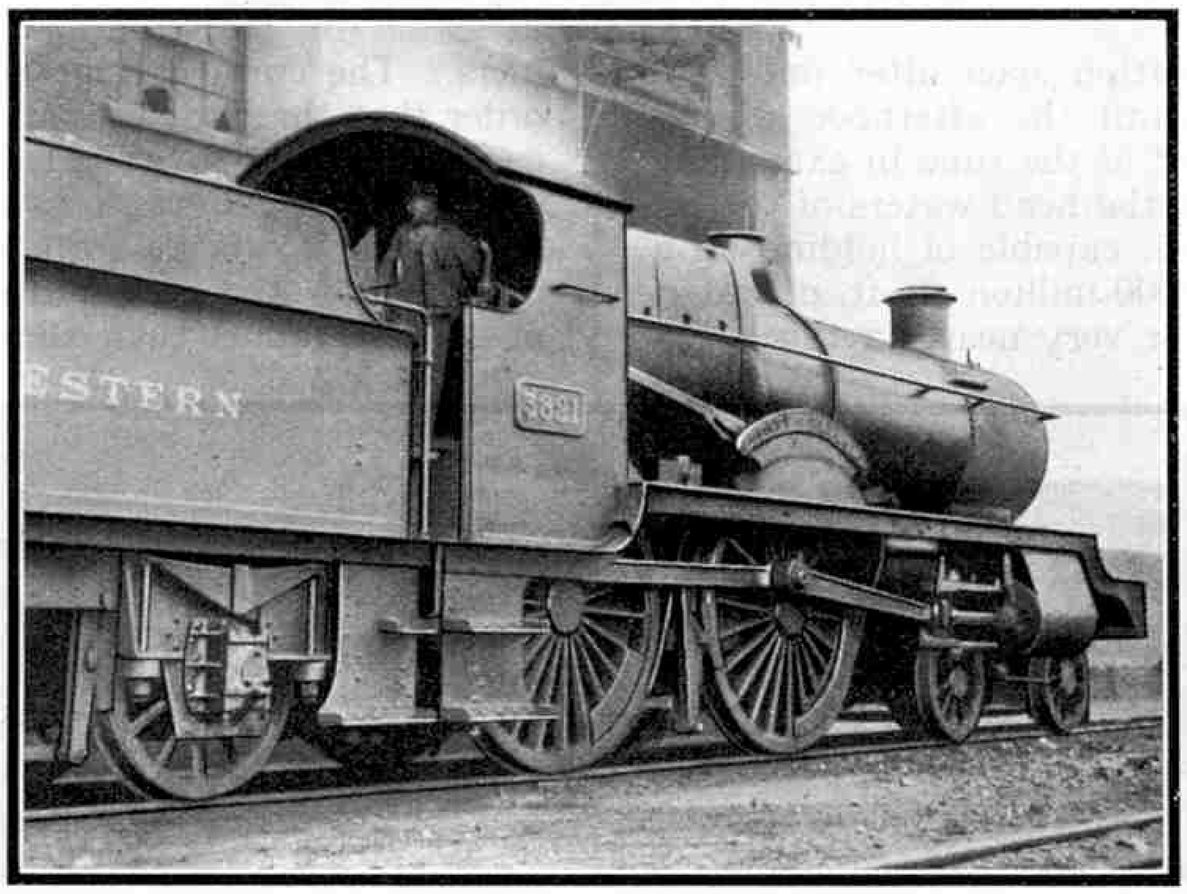
A start has been made recently in withdrawing the "Counties." The class consisted originally of 40 engines, bearing the numbers 3800 to 3839. No. 3800 and Nos. 3831-39 came out in 1904, and further engines, Nos. 3801-20 appeared in 1906, all of these having the straight raised frame shown in the accompanying photographs of "*County Clare*" and "*County Wicklow.*" Then additional engines Nos. 3821-25 were built in 1911, and the series was completed in 1912 by Nos. 3826-29. All these later engines have dropped footplates with curved ends, as shown by the illustration of No. 3821, "*County of Bedford*"; and their appearance is distinctly more symmetrical than that of the early members of this class.



Photo] [*Railway Photographs*

An "up" Bristol express passing West London Junction, hauled by No. 3810 "County Wicklow."

Several features of American practice were introduced in the "Counties" in common with the two-cylinder 4–6–0's of the G.W.R. The bogies were of the bar-framed type instead of the usual British plate construction; and outside cylinders appeared at a time when the tendency in this country had been for a number of years strongly in favour of the inside position. Each cylinder was cast integrally with half the smoke-box saddle, the two castings being bolted together as on American engines. The piston valves, 10 in. in diameter, were placed on top of the cylinders, and were actuated by means of rocking levers from the inside motion, this also being typical American practice. Further, the cylinders of the straight-framed engines were what is known as "off-set"; that is to say the horizontal centre line of the cylinders, instead of passing through the centre of the driving axle as usual, passed an inch or two above it. This American feature was not followed in the later "Counties," Nos. 3821-29, and has been discontinued in several of the others as they have required new cylinders.



An unusual view of No. 3821 "County of Bedford," the first of the series with curved frames. For this photograph, taken at the coaling stage at Old Oak Common, and that on the opposite page, we are indebted to Mr. F. W. Hutton-Stott of Puttenham.

The engines of 1904 and 1906 were not provided with superheaters, for this apparatus was not in common use at that time. This is in striking contrast to present-day practice, for the superheater is almost indispensable to practically every locomotive, except perhaps the shunting tank, the intermittent duties of which probably would prevent the advantages of the apparatus being realised to any considerable extent. The latest locomotives of the class were built with the "Swindon" pattern of superheater devised by Mr. Churchward, and also with the top-feed pipes that pass round the boiler and enter at the sides of the safety valve casing. The early engines were superheated from 1911 onward.

Since the sequence of the numbers of the "Counties" is not in accordance with the actual order of the various batches, a little explanation will be of value. The pioneer engine, as already mentioned, was No. 3473, and the subsequent engines of 1904 were 3474-3482. The 1906 series were 3801-3820, and those built in 1911 and 1912 were 3821-3830. On 1st January 1913, the G.W.R. re-numbering nominally took effect. No. 3473, as the first engine, then became 3800; and Nos. 3474-82 became 3831-39. The other numbers were unchanged, so that the 1904 engines, with the exception of "*County of Middlesex,*" bear later numbers than the engines of 1906 and subsequently.

Some of the earlier "Counties" were provided with narrow-bore plain cast iron chimneys, as were many other G.W.R. engines at that time; but now all carry the standard copper-capped chimney. A point of difference that will be noticed from the photographs is that whereas on "*County Clare*" the reverse or "bridle-rod" is horizontal and passes outside the driving wheel splashers, that of the "*County of Bedford*" slopes upward towards the cab, and passes behind the nameplate on the splasher. The splasher is set out wider than the others in order to allow for this.

The "Counties" have done and still do notable work. In their early days they were to be seen on long-distance expresses from Paddington to the West, and on one occasion the "*County of Berks,*" then No. 3474, hauled a train of 305 tons non-stop from Exeter

(*Continued on page 473*)

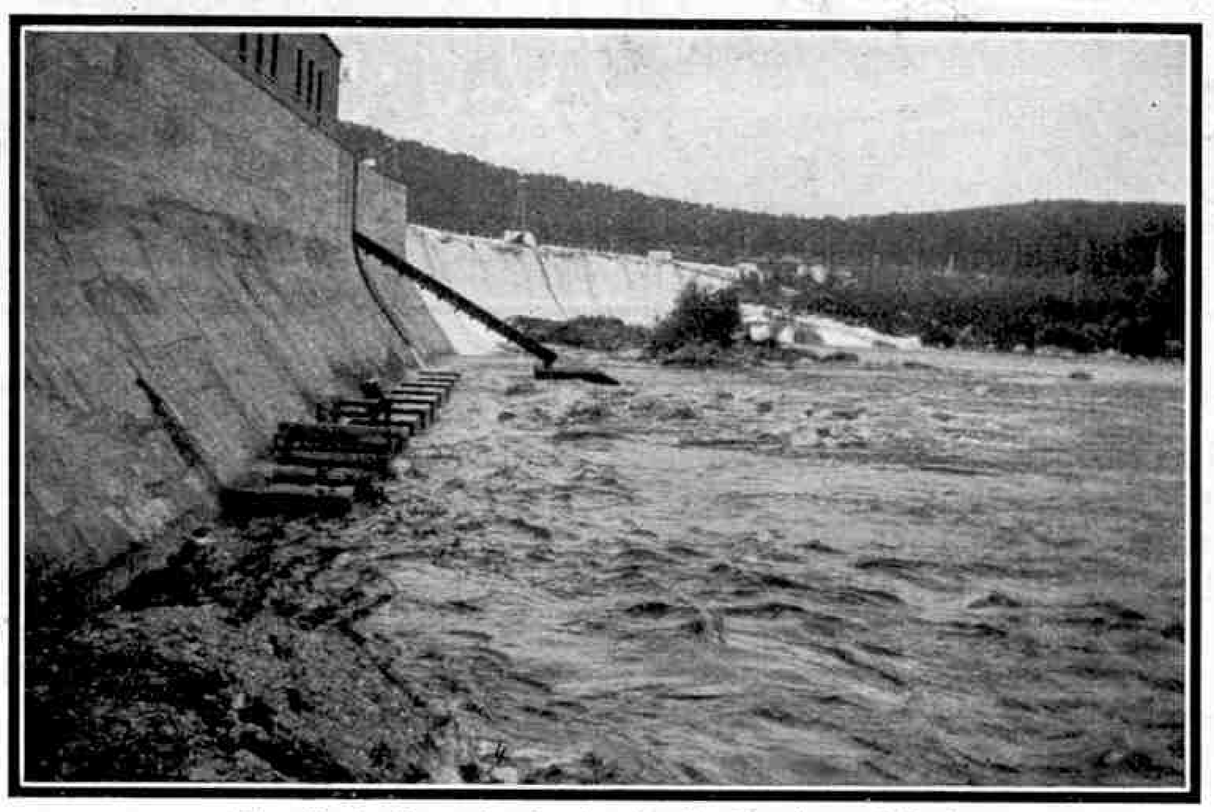
FROM OUR READERS

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

A Giant Canadian Dam

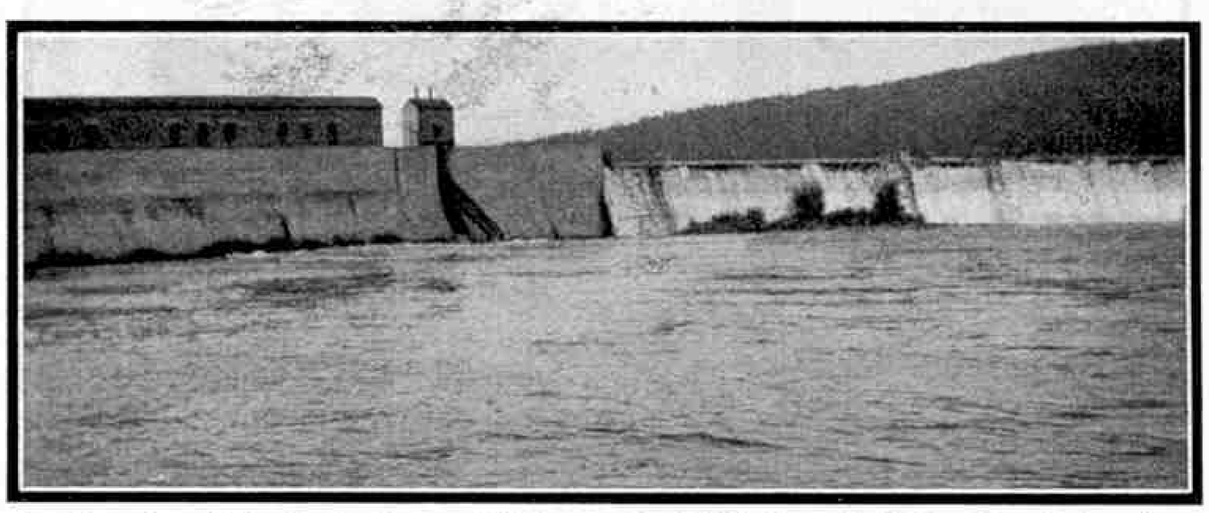
Last summer I was invited to visit La Loutre, Quebec, where the Gouin Dam is situated. I eagerly accepted and a few days later boarded a C.N.R. train for Sanmaur. The train was mixed, the rolling stock being composed of about 50 freight cars and two passenger coaches, and the track passed through dense forests. I found the journey interesting, although it was very slow. At one place the engine was busily engaged in shunting for nearly two hours, and seven hours were spent in covering the 73 miles from Quebec to Sanmaur.

The journey was completed next day. La Loutre is 30 miles beyond Sanmaur, and for 20 miles of this distance we travelled up the St. Maurice River in a motor boat, arriving at our destination soon after mid-day.



The Gouin Dam, La Loutre, in the Province of Quebec.

I stayed at La Loutre until the afternoon of the following day and spent most of the time in examining the Dam. This was built at the head waters of the St. Maurice River in 1917, and is capable of holding up a gigantic lake containing 160,000 million cu. ft. of water. The Dam itself is 1,646 ft., or very nearly a third of a mile in length. Its width on the crest is 20 ft. and at the point where the water is deepest the base is 72 ft. in thickness. The great concrete wall rises to a height of 57 ft. above low water level. The spillway is 10 ft. below the top of the Dam. This is 840 ft. in length and its capacity is about 15,000 cu. ft. per second when the water flowing through it has a depth of 3 ft. The cost of the dam was about £500,000, this including the expenditure on a hydro-electric power station developing 1,000 h.p.



Another view of the Gouin Dam. This is about a third of a mile in length and rises to a height of 57 ft. above low water level.

The Dam dominates the entire district, for its height is increased by that of the buildings containing the machinery for operating the gates of the spillway. Even when in bed I could not forget it, the roar of the water rushing down the overflow sounding continuously in my ears.

C. BUNBURY (Quebec).

Building British Submarines

Last year I had the good fortune to visit Chatham Dockyard, and while there saw two submarines being built. The first was H.M.S. "*Odin*," then being fitted out in dry-dock. The second vessel was H.M.S. "*Parthian*," the keel plate of which had been laid down recently. Her framework was being erected and I was greatly interested in the bending of the great steel bars of which it was being formed. The bending is done on an iron floor that is perforated with holes about six inches apart, and on which the required curve is marked out. Each bar is made red hot and one end is clamped down at the beginning of the marked-out curve. It is then bent to shape by means of hydraulic jacks and sledge hammers. The curve is marked out between the holes in order that the bar may be clamped in position, and on cooling a perfectly curved framework member is obtained.

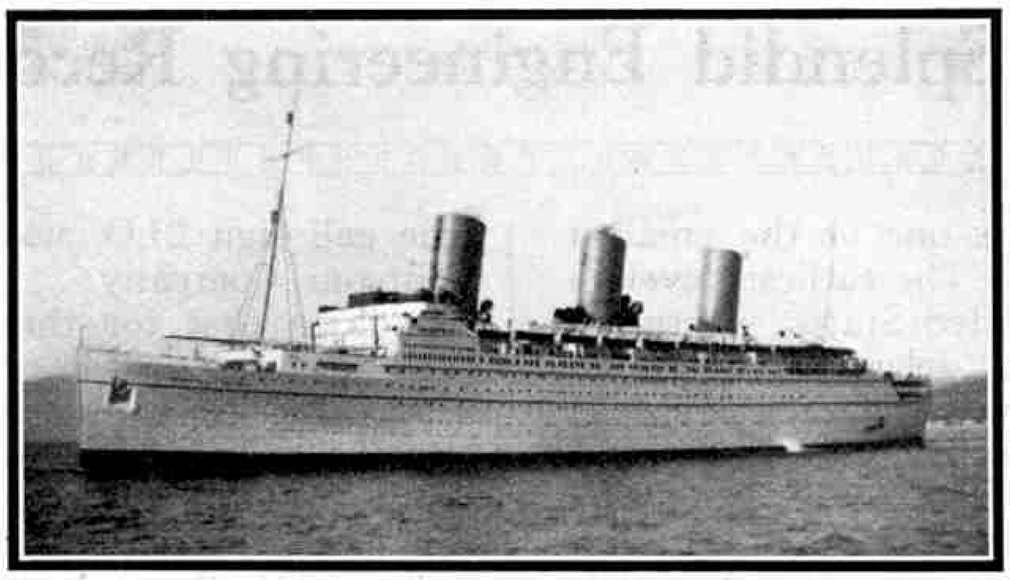
The bars are bent into two semi-circles, and are welded together in pairs to form complete rings, the frames intended for the bow and stern of a submarine being of smaller radius than those that form the amidships section. They are then fitted with the necessary brackets and bolted into their correct positions on the keel plate. After they have been strengthened the side plating is put on and caulked.

The next step is to build up the external tanks. The oil supply is kept in certain sections of the tanking and the remainder can be opened to the sea when the vessel is being submerged. Space is left in the stern and in the fore part for torpedo tubes, and while a submarine is still on the slipway, the conning tower and gun emplacement are bolted and riveted into position, the shaft lines are got in and the rudder bearings are set up. The submarine is launched in the form of a steel shell and is then taken into dry-dock and basin in order to be fitted out.

K. T. CLUETT (Penton).

"*Empress of Britain*" Goes to Sea

Sunday, 5th April, was a memorable day in the annals of Clyde shipbuilding, for then the newly-completed "*Empress of Britain*" passed down the river to the sea. This giant vessel, the second largest ever built on the Clyde, is 758 ft. in length and 97 ft. 6 in. in breadth. Her gross tonnage is 42,500, and she is designed to have a speed of 24 knots. She was built for Canadian Pacific Steamships Ltd., by John Brown and Co. Ltd., Clydebank, and since her launch on 11th June last year by the Prince of Wales, she has been lying in the fitting-out basin of that firm, in which her equipment was completed.



The "Empress of Britain" off Greenock after her voyage down the Clyde from the yard in which she was built.

Towing the great liner into the Clyde required the greatest care, for her keel was only a few inches from the bed of the channel and the slightest error would have had serious consequences. The tugs brought her out, stern first, and slowly manœuvred her until she was in the middle of the channel with her bow facing seaward. Then they escorted her down the river. After negotiating the difficult double bend at Dalmuir, her engines were set in motion and her propellers revolved for the first time, urging her forward at about 4 knots. Off Dumbarton Rock the speed was increased to 8 knots and the vessel arrived at Greenock 15 minutes ahead of her scheduled time.

The stately liner presented a beautiful picture, her white hull and yellow funnels gleaming in the brilliant sunshine. Her passage aroused enormous interest. Nearly 750,000 people gathered on the banks of the river to see her pass, and a flight of aeroplanes from Renfrew Aerodrome manœuvred in formation over the river and dipped in salute as they came above the vessel.

I obtained a specially good view of the "*Empress of Britain*," for at Gourock I boarded the "*Glen Sannox*," a Clyde pleasure steamer, and in this vessel I cruised round her several times. Not until I saw the liner at close quarters did I realise to what an amazing height her white hull and superstructure towers above the water. I secured several excellent photographs of the vessel, one of which accompanies this article, and was very sorry when the time came to return to Gourock. Next morning the wonderful liner carried out her trials, after which she went to Liverpool. There she was berthed in the Gladstone dry dock, the largest in the world, for a final examination of her hull, after which she left for Southampton. H. S. YOUNG (Coatbridge).

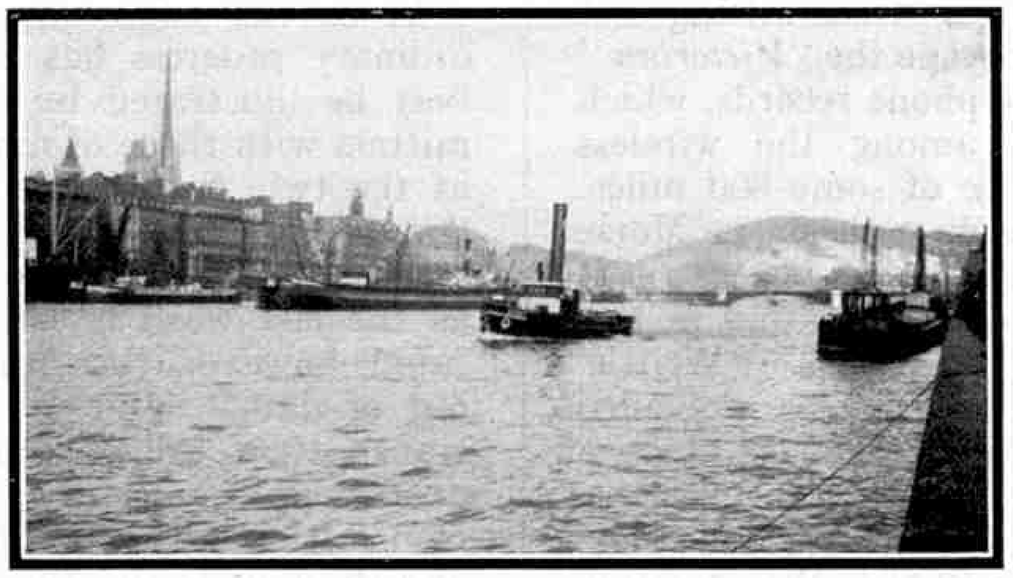
A Day In Rouen

Recently I had the good fortune to spend a day in Rouen, the busy French port at the mouth of the Seine. Previously the city was best known to me as the place where Joan of Arc was condemned and burned, and I was greatly interested in a statue of Joan that marks the place where she was martyred. This was erected three years ago and shows the Maid surrounded by flames. In a neighbouring square is a larger statue that to me seems less impressive than the modern one.

Rouen stands at a point beyond which large ships cannot ascend the Seine. The banks of the river form continuous quays and at these are moored both ocean-going steamships and barges that carry loads of wine or oil and other merchandise between the city and Paris. I was interested to find that many of the cranes used for loading and unloading these vessels were built by a Glasgow firm.

Statue of Joan of Arc at Rouen. This marks the spot on which the Maid was burned.

Two main bridges cross the river. One of these is so low that even small tugs have to fold their funnels when about to pass through its arches. The second bridge is of the transporter type. The moving roadway is wide enough to accommodate a double line of traffic in addition to foot passengers, but it is chiefly used for light vehicles. The platform is about 4 ft. above the water. It moves across the river very smoothly, but often considerable delay is caused by the intensity of traffic up and down the waterway. A. E. DAVIS (Boston).



The Seine at Rouen. Both sea-going vessels and river barges are moored to the quays that line the banks of the river.

Afloat on Lake Tanganyika

Recently my father and I journeyed by motor car from Broken Hill, Northern Rhodesia, to Lake Tanganyika. For most of the distance of about 500 miles the road consisted merely of two tracks for the wheels of the car, and we found accommodation in rest huts in the small towns and villages through which we passed.

Lake Tanganyika is a beautiful expanse of water 400 miles in length and 70 miles in width. We ventured on it in a native canoe formed by hollowing out a single tree trunk. During our voyage we saw a hippopotamus, and also several crocodiles which from a distance resembled logs as they floated on the water. My father shot four crocodiles, one of which was 15 ft. in length.

We returned to Broken Hill via Elizabethville, a city in the Belgian Congo that has the reputation of being the most sanitary in the world. V. SOUTH (Cape Town).

The Growth of Broadcasting

A Splendid Engineering Record

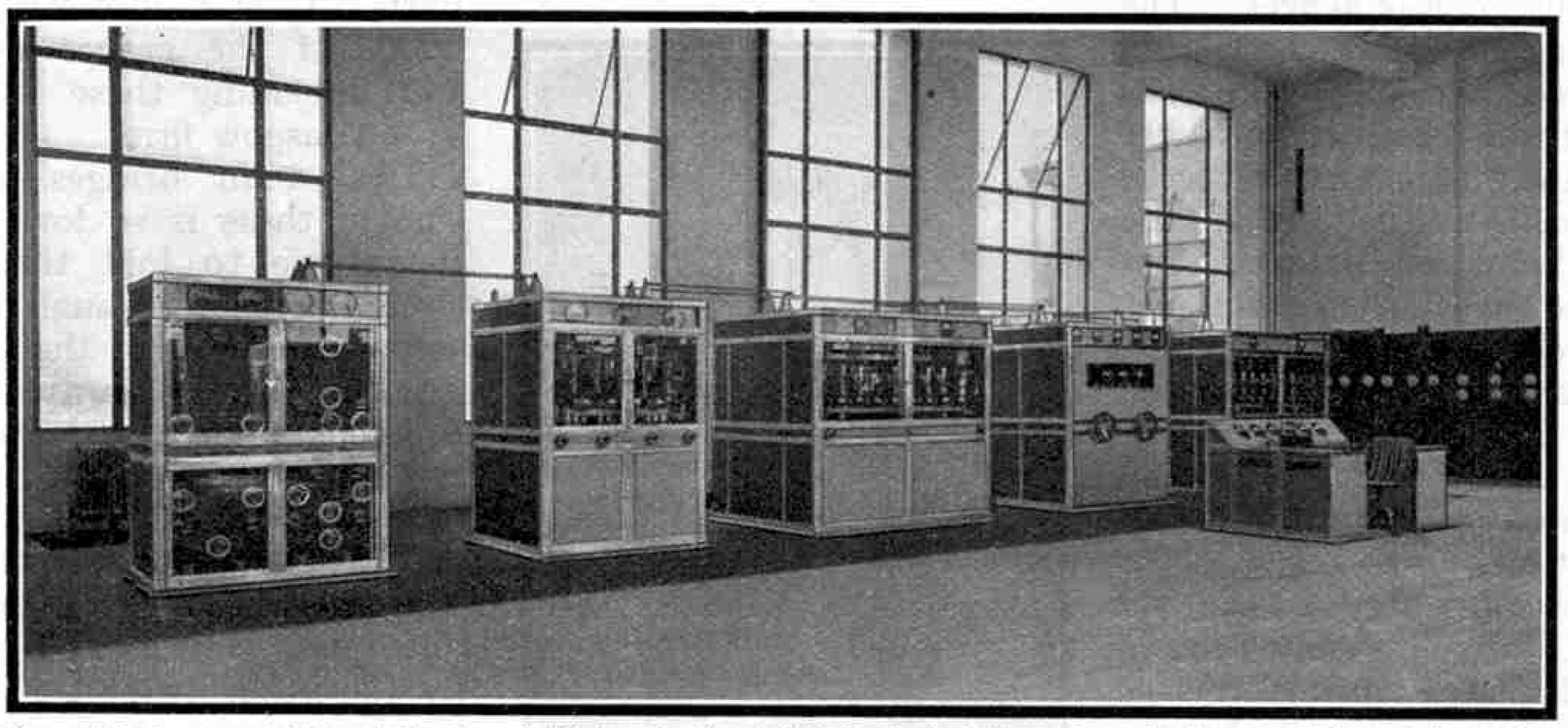
THE growth of broadcasting is one of the greatest romances of modern times. The earliest developments took place in the United States, where the possibilities of wireless telephony seem to have been appreciated much more quickly than they were in Great Britain. Stations were erected there as early as 1920 and were in full operation for at least two years before any organised effort was made in Great Britain. There is little doubt that this delay was an advantage rather than a drawback, however, for it enabled the authorities to avoid troubles that had arisen in America through too rapid development. From the first, broadcasting in this country was organised and controlled by a single authority, and it has developed steadily in accordance with a definite policy, no private enterprises being allowed to interfere with the steady progress of the national scheme.

The first wireless transmissions in this country came from Chelmsford and were organised in 1920 by the Marconi Company. The concerts then broadcast created a tremendous sensation. Dame Nellie Melba, the great Australian soprano who died recently, was one of the artists to take part in them, and it is interesting to recall that her voice was clearly heard in Madrid, Berlin and even in Northern Persia.

In July 1920 the Imperial Press Congress was held in Canada, and many of the delegates crossed the Atlantic in the "*Victorian*," which had a transmitting set installed on board. During the voyage the "*Victorian*" broadcast a large number of gramophone records, which caused the greatest excitement among the wireless operators on vessels within a range of some 800 miles. The "*Victorian*" was besieged with requests in Morse for a repetition of the records.

The next step in the history of broadcasting in this country was the establishment of the station at Writtle. A number of amateur wireless enthusiasts prevailed upon the Post Office to transmit from this place a half-hour programme every week. These transmissions, which were under the direction of Capt. P. P. Eckersley, afterwards Chief Engineer of the British Broadcasting Company, became extraordinarily popular, and they continued until early in 1923, by which time regular transmissions were being carried out by the B.B.C.

The London Station, soon to become famous under the call sign 2LO, was opened in May, 1922, by the Marconi Company. At first it was subject to the handicap that for three minutes out of every ten it had to close down in order to listen for distress calls or important messages sent out by Government stations; and its programmes were limited in character. Later in the same year 2LO became part of the system of the newly-formed British Broadcasting Company. This began with three stations at London, Manchester and Birmingham, which commenced operations on 14th, 15th and 16th November respectively. The transmitting plants were operated by large electrical companies established in these cities, and the staff of the B.B.C. was accommodated in a large room in the premises of the General Electrical Company in Kingsway, London. The programme director worked in the studio of 2LO in Marconi House.



One of the two transmitters at Brookman's Park. On the right is the desk of the engineer in charge, and beyond it may be seen part of the main switchboard.

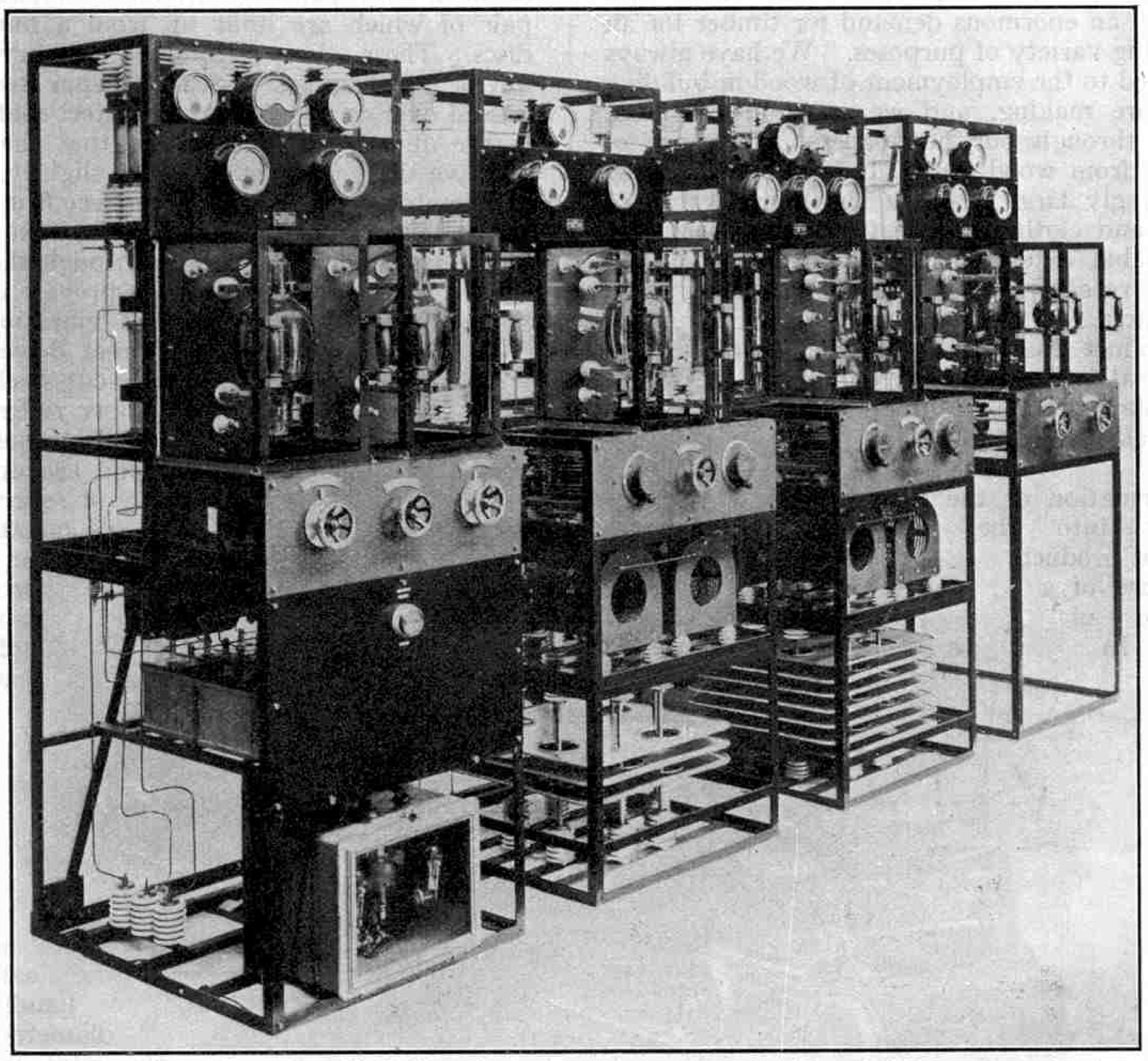
The contrast between broadcasting at the close of 1922 and to-day is very remarkable. The early organisers had to carry on their work in cramped conditions in temporary offices, and the difficulties of maintaining regular programmes were enormous. From that time conditions have steadily improved in every direction, and now there is under construction for the B.B.C. in London one of the most remarkable buildings that has ever been erected. We shall hope to refer to this building in a later issue.

From the engineering point of view really extraordinary progress has been made. Perhaps this can best be illustrated by comparison of the early transmitters with those of modern type, such as are installed at the twin broadcasting station at Brookman's Park. Our second photograph to this article shows an early transmitter, which only a few years ago was regarded as the last word in efficiency. Progress has been so rapid, however, that this transmitter is now hopelessly out of date. Our first illustration shows one of the transmitters at Brookman's Park, which came into operation last year. As compared with the earlier transmitter it is much less complicated in appearance, and it suggests the efficiency that it actually possesses.

The Brookman's Park Station incorporates two complete transmitters, only one of which is shown in the photograph. It is therefore capable of broadcasting two separate programmes simultaneously, and for this

purpose two aerials have been erected. The four masts that carry these aerials are of the steel lattice type, and each is 200 ft. in height. Probably the engineers of the B.B.C. would have liked to build even taller masts in order to increase the effectiveness of their aerials, but Government restrictions in the part of the country in which the station is situated prevented them from doing so. The earthing system is as interesting as the aerials. It consists of an enormous number of wires buried in the ground at a depth of 1 ft. These wires radiate outward like a fan, and extend to a distance of 200 ft. all round the aerials.

The station itself is really a gigantic power-house containing 15 Diesel-driven generators that provide currents at widely differing voltages for special purposes. The machinery in the generator room is enclosed within a steel cage in order to prevent the risk of anyone accidentally receiving a shock from high-voltage current.



An early transmitter. Comparison with the illustration on the previous page suggests the wonderful improvements that have recently been made in transmitter design.

The four main generators run at 300 r.p.m. and deliver direct current of 2,700 amps. at 230 v. Steadiness is an essential feature of the generators employed for broadcasting purpose, and those at Brookman's Park are therefore mounted on thick beds of concrete resting on cork mats. These beds are quite separate from the main foundation of the building. A storage battery system with a capacity of 2,000 ampere-hours is used in conjunction with this generator plant.

The high-tension current for the anodes or plates of the giant valves in use is provided by three motor generators of a special type, their armatures being built in two sections and entirely insulated from the spindles. Four commutators are fitted to each armature, and the generators have outputs of 160 k.w. at 7,000 v. to 12,000 v. Three motor generators are also installed for heating the filaments of the valves, current of 1,300 amps. being delivered by these at 15 v. to 30 v. For normal working two generators supply high-tension current and two fulfil the low-tension requirements of the plant; the remaining generators are kept in reserve for use in emergency. The extensive equipment of the station is completed by small motor generators that supply grid bias current and the power required for the drive and modulated stages of the transmitters.

In each of the twin transmitters a drive stage is followed by a separator stage. Then comes the modulation equipment, in which the output of the transmitter is controlled. The power from this stage operates two water-cooled valves that form the first power stage, and these in turn supply the last stage, which consists of two banks of eight water-cooled valves arranged to give "push-pull" amplification. All operations are under the complete control of the engineer-in-charge, the various meters and other indicating instruments, which show him exactly how each stage of the transmitter is carrying out its duties, being suitably mounted on his desk.

A curious room in the gigantic building at Brookman's Park is the studio, the chief interest of which lies in the fact that it is seldom if ever brought into use! The only purpose of this studio is to act as a standby in the event of any interference or breakdown preventing current from reaching the transmitting station from the microphones in the studios in London. Brookman's Park is connected with Savoy Hill by means of four underground telephone cables, and the station radiates the programmes that are provided in the London studios. As a further precaution against breakdown a specially efficient receiver is installed at Brookman's Park. If necessary, the programme being radiated by the station at Daventry may be received on this apparatus and re-transmitted.

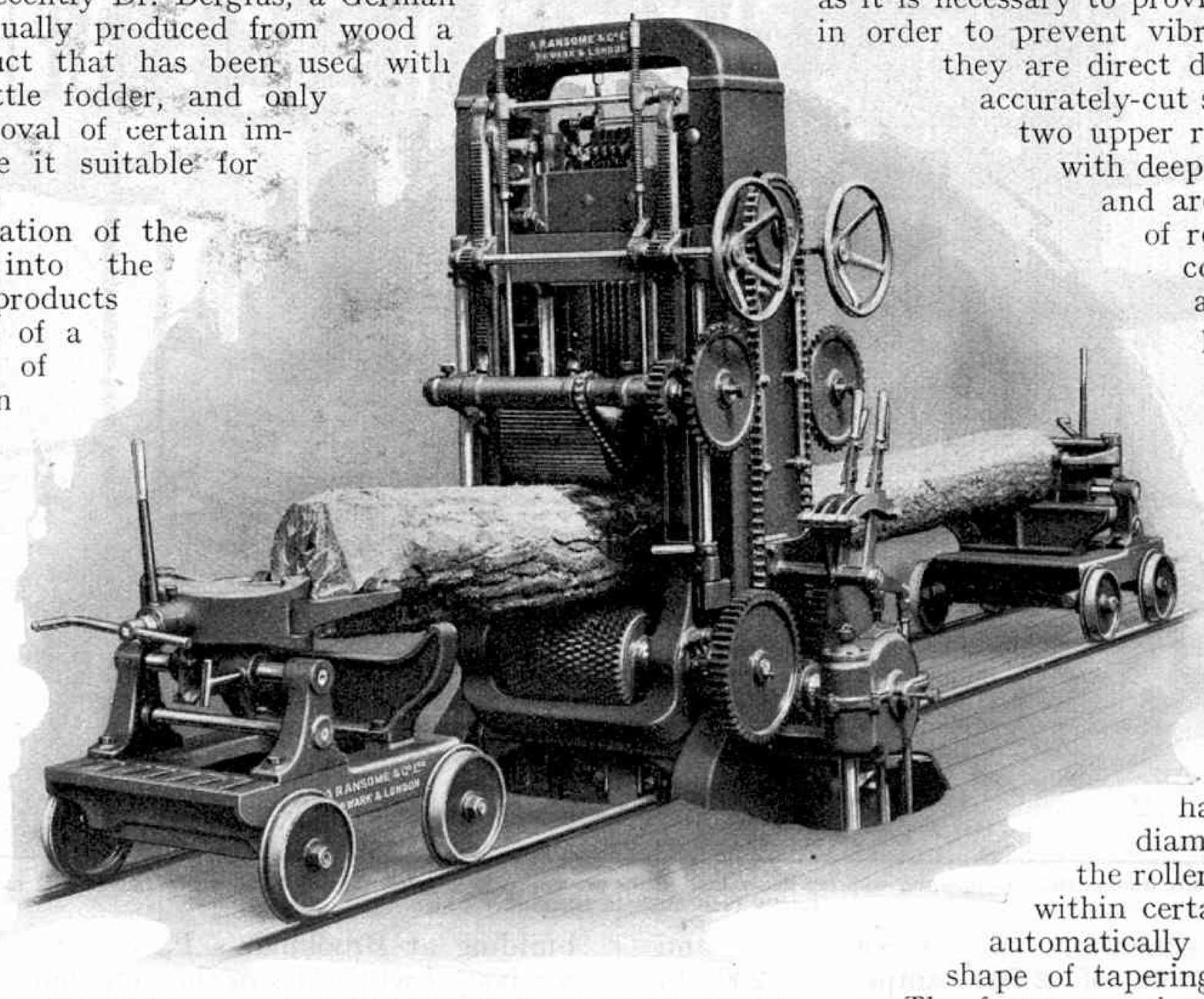
Brookman's Park is the first of a series of twin stations that are to be erected in various parts of the British Isles in order to enable people in all but the most remote parts to receive alternative programmes on different wavelengths. The work that was completed at Brookman's Park early last year has since been repeated at Moorside Edge, a bleak plateau (*Continued on page 527*)

High-Speed Log-Sawing Machines

Splendid Subjects for Meccano Models

DURING comparatively recent years there has grown up an enormous demand for timber for an astonishing variety of purposes. We have always been accustomed to the employment of wood in building and in furniture making, and we come into contact with it daily through our newspapers, the paper of which is made from wood pulp. It is also being used on an increasingly large scale in the manufacture of artificial silk, and clothing made from it is displacing to an appreciable extent that made from wool and cotton. More recently Dr. Bergius, a German chemist, has actually produced from wood a flavourless product that has been used with success as a cattle fodder, and only requires the removal of certain impurities to make it suitable for human use!

The transformation of the felled timber into the various finished products involves the use of a great variety of machinery. In this article we propose to deal with the log-sawing machine, by means of which the tree trunks are reduced to a convenient size and shape for further treatment. These machines are of particular interest to Meccano boys, as they provide splendid subjects for reproduction as working models.



A modern high-speed log-sawing machine, manufactured by A. Ransome & Co. Ltd., Newark, to whom we are indebted for this photograph.

The machine illustrated on this page is one of a type used for cutting up soft logs, and it represents the latest trend of design in log frames generally. Modern log frames are required to work at very high speeds in order to maintain economically the large output required; and while they are necessarily of massive construction, simplicity of operation is one of their outstanding features.

This machine consists essentially of a massive bed-plate that carries the main bearings for a crankshaft, and to which the sides of the machine are bolted. In the machining of a very heavy log great stresses and strains are set up, and the side frames are provided with ribs and cross ties to ensure perfect rigidity under the severest work. Logs are fed into the machine between two pairs of driven feed rollers, the lower pair of which are built up from a number of spiked discs. These discs resemble ordinary gear wheels, having steel spikes instead of spur teeth. They are passed over and keyed on to a steel shaft, the keyways in the discs being so arranged that the spikes of consecutive discs are "staggered" slightly. This method of assembly provides a sure and very firm grip on the log.

The lower pair of rollers have to take the full weight of the log while it is passing through the machine, and as it is necessary to provide a positive drive in order to prevent vibration or jerkiness, they are direct driven by means of accurately-cut steel gearing. The two upper rollers are provided with deep longitudinal flutes, and are driven by means of roller chains from a countershaft situated in the lower portion of the frame. By means of handwheels, which actuate finely cut pinions working through racks, both the upper and the lower pairs of rollers can be adjusted vertically in order to handle logs of various diameters. In addition the rollers are self-adjusting within certain limits, and will automatically conform to the shape of tapering trunks.

The frame carrying the saw blades is composed of steel castings connected together by a number of weldless steel tubes that serve the two-fold purpose of giving a solid and at the same time lightweight construction. The frame reciprocates at the feeding-out side of the machine in massive V-shaped steel slides, and at the feed-in side adjustable flat-section slides are fitted to enable any wear to be quickly taken up. The lower end of the frame is provided with a gudgeon pin that passes through the upper end of an "H" section connecting rod, the end of which houses specially-designed roller bearings in which the crank-pin of a balanced crankshaft is journalled.

The crankshaft is operated from a driving pulley carried at one of its ends, and a loose pulley fitted alongside enables the machine to be brought to rest without stopping the main drive. At the other end of the crankshaft is a two-speed pulley that transmits the drive to the feed roller mechanism. When the

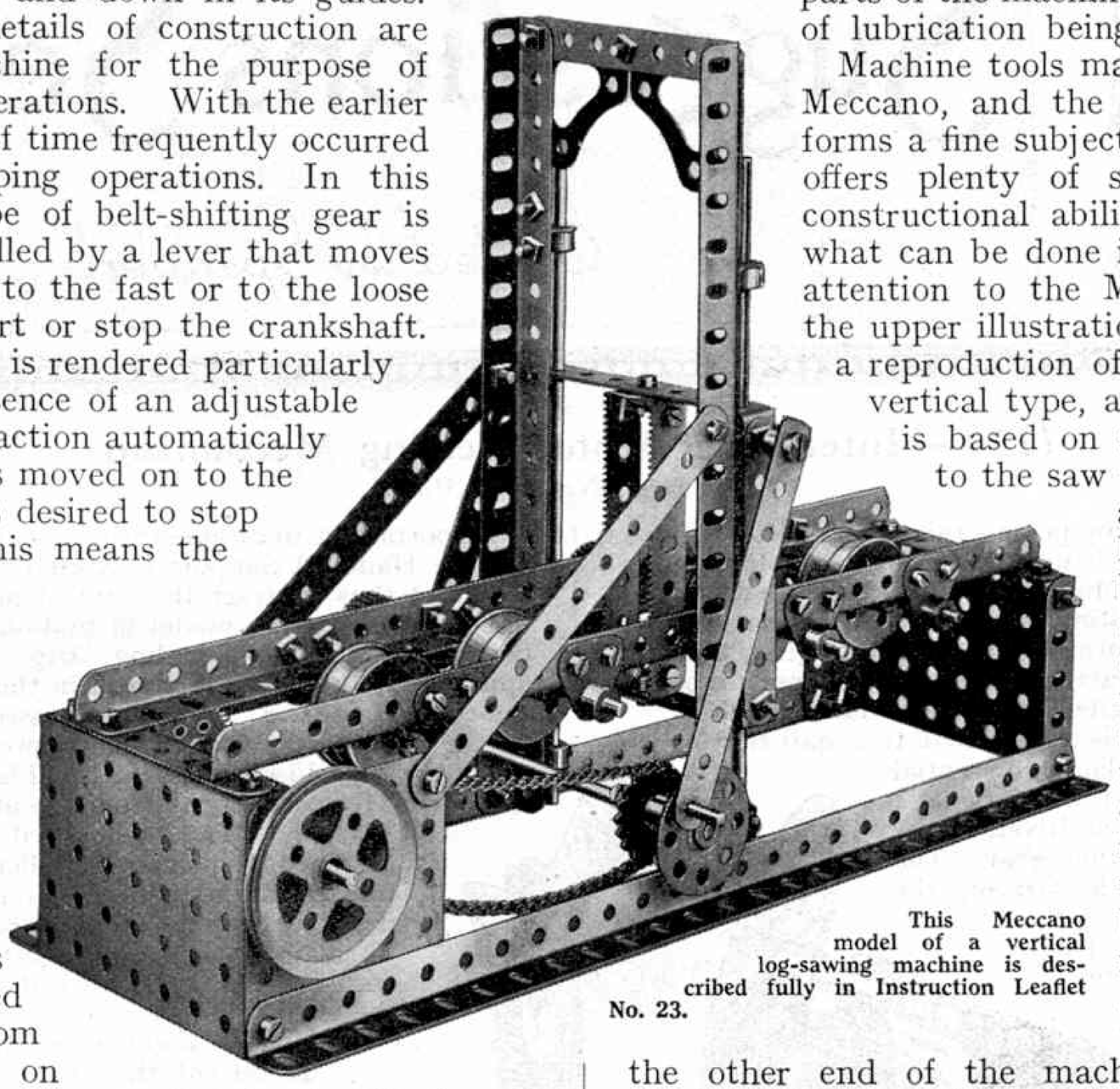
crankshaft is rotated the connecting rod pushes and pulls the saw frame upward and downward, the whole movement being carried out smoothly, so that the frame slides freely up and down in its guides.

Several important details of construction are embodied in the machine for the purpose of speeding up cutting operations. With the earlier machines a great loss of time frequently occurred in starting and stopping operations. In this machine a special type of belt-shifting gear is introduced, and controlled by a lever that moves the driving belt either to the fast or to the loose pulley, in order to start or stop the crankshaft. The action of this gear is rendered particularly interesting by the presence of an adjustable brake that comes into action automatically immediately the belt is moved on to the loose pulley, when it is desired to stop the machine. By this means the machine may be brought instantly to rest, whenever it is necessary to change saws or logs.

Another interesting feature consists of a friction variable-speed feed mechanism that is specially useful in cutting logs of various hardness. The feed rollers are driven from the two-speed pulley on the crankshaft in the manner already described, and interposed between the pulley and the rollers is a cast iron disc driven by belt from the pulley, and normally held in contact with a slidable friction wheel. The two-speed pulley on the crankshaft may be readily turned end for end simply by removing it from the shaft and reversing it. This means that the necessity of running the friction wheel near to the centre of the driving disc when a low range of speeds are required, is obviated. A foot pedal is provided, and pressure on this moves the driving disc out of contact with the friction wheel, thus bringing the feed mechanism to a standstill, but allowing the saw frame to continue reciprocating.

The sliding friction wheel just mentioned moves on a vertical shaft, and operates the feed roller gearing through a worm and wheel. The rate of cutting may be varied at any time while the log is in the machine, by means of mechanism controlled by a lever placed in a convenient position. If desired the direction of feed may be reversed.

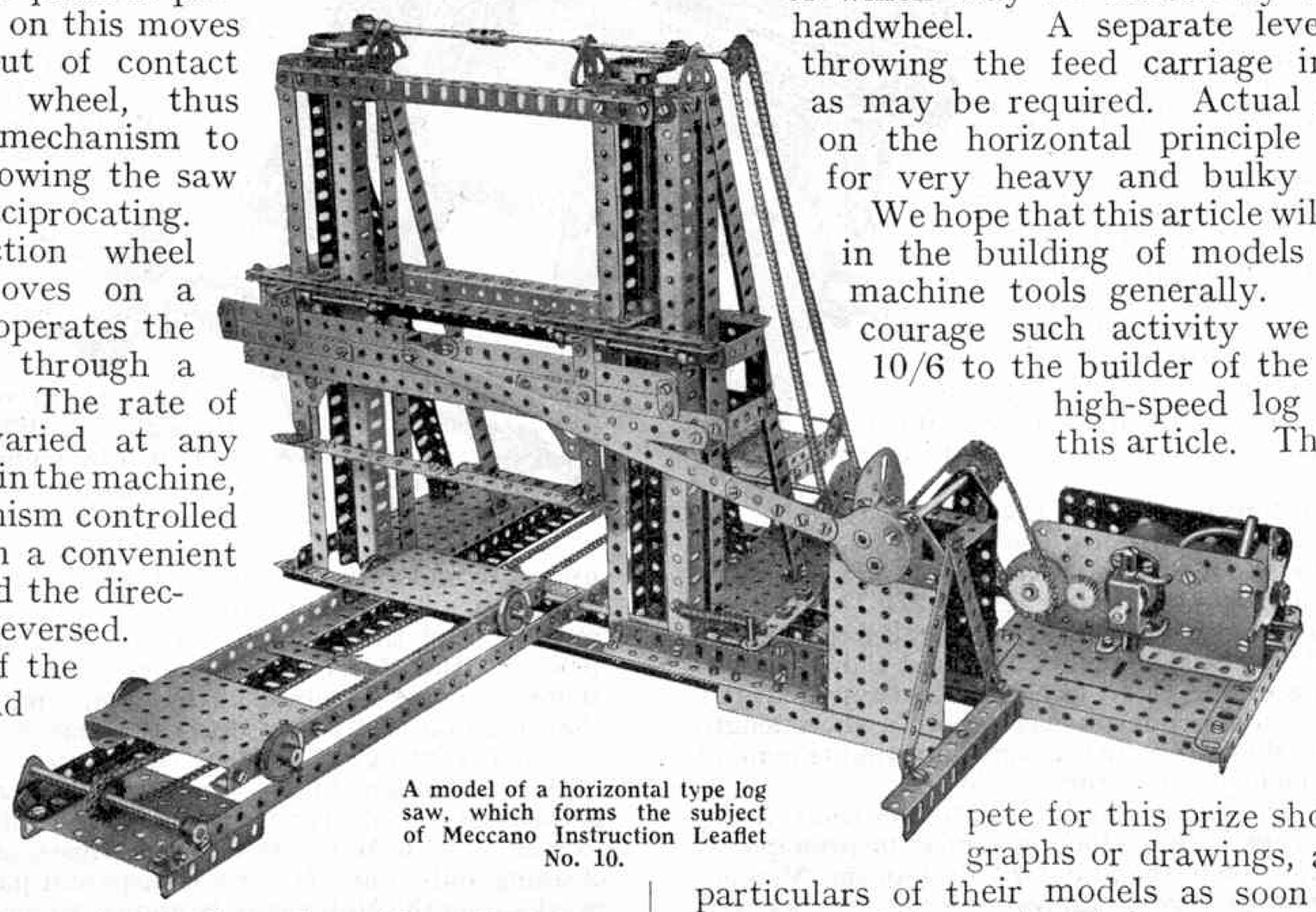
The crankshaft is of the built-up type, and has a separate crank-pin that carries the inner races of the ball bearings at the large end of the connecting rod, and enables them to be easily placed in position. The bearings of the crankshaft are cast in one piece with the bed-plates, so that perfect rigidity and little danger of overheating is assured. Roller bearings are used freely in various parts of the machine, resulting in a minimum of lubrication being required.



This Meccano model of a vertical log-sawing machine is described fully in Instruction Leaflet No. 23.

Machine tools may be readily modelled in Meccano, and the log frame just described forms a fine subject for a keen builder, as it offers plenty of scope for ingenuity and constructional ability. As an example of what can be done in this direction we draw attention to the Meccano model shown in the upper illustration on this page. This is a reproduction of a typical log saw of the vertical type, and it will be seen that it is based on similar general principles to the saw that is the subject of this article. In the model, however, everything has been designed as simply as possible, in order to avoid the necessity for the use of a large number of parts. The timber is fed lengthwise into one end of the machine, and is carried along automatically on rollers, and brought into contact with reciprocating saw blades. After they have been cut the planks emerge from the other end of the machine. The constructional details of this machine are fully described in the Super Model Instruction Leaflet No. 23.

A model of another type of log saw is also illustrated on this page. This model, which is described in Super Model Leaflet No. 10, is of a machine of the horizontal type, and its chief feature is that the saw blades have a side to side instead of a vertical movement. The model is driven by an Electric Motor, and the mechanism includes a vertically-adjustable saw frame, the elevation of which may be altered by the operation of a handwheel. A separate lever is provided for throwing the feed carriage in or out of gear as may be required. Actual machines working on the horizontal principle are used mainly for very heavy and bulky work.

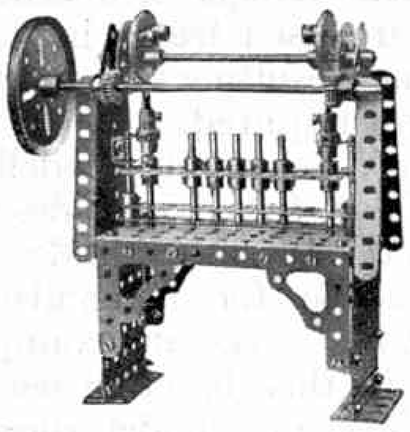


A model of a horizontal type log saw, which forms the subject of Meccano Instruction Leaflet No. 10.

We hope that this article will stimulate interest in the building of models of log saws and machine tools generally. In order to encourage such activity we offer a prize of 10/6 to the builder of the best model of the high-speed log saw described in this article. This offer is available for two months only, and entries received after 31st July, 1931, will not be accepted for consideration.

Meccano boys who wish to compete for this prize should submit photographs or drawings, and brief but clear particulars of their models as soon as possible. The actual models must not be sent.

Models of distinct merit will be illustrated in the "*M.M.*"



Suggestions Section

Edited by "Spanner"

(234)—Interesting Motor Testing Mechanism

(F. Fowler, Newport, Mon.)

Many Meccano enthusiasts who possess two or more Motors have asked for a simple form of mechanism that would enable them to compare the powers of these Motors. The Meccano model illustrated in Fig. 234 is an interesting mechanism of this nature. It does not give an exact measure of power, but it gives a fairly reliable indication of the relative powers of different motors.

The main feature of the model is a differential through which the drive from the Motor is transmitted to a shaft that carries a braking device. The differential consists of two $\frac{7}{8}$" Bevels 1 and 2, the Bevel 1 being secured to the end of a Rod driven by the Motor through a 9 : 1 reduction gear. The Bevel 2 is secured to a Rod 2a carrying the brake drum. The inner ends of the two Rods are journalled in the longitudinal bore of a Coupling in the transverse centre bore of which is secured a short Rod 3, which has mounted loosely on it two further $\frac{7}{8}$" Bevels. The latter mesh with the Bevels 1 and 2. The ends of the Rod 3 engage with the centre holes of two $1\frac{1}{2}$" × $\frac{1}{2}$" Double Angle Strips that are bolted to a 2" Pulley Wheel 4 free on the Rod 2a, and also to a Bush Wheel that is loosely mounted on the Rod driven by the Motor. A Washer is placed on each of the bolts retaining the Double Angle Strips in place, between the ends of the Double Angle Strips and the Bush Wheel and Pulley.

The Rod 2a has secured to it a Worm, which meshes with a 57-teeth Gear Wheel on a Rod carrying the take-up Roller 9. This Roller consists of a Sleeve Piece and two Chimney Adapters with a Face Plate placed against each end of the Sleeve Piece. A Spring Clip placed on the Rod inside the Sleeve Piece prevents the latter from rotating on the Rod. The second Roller 8 is constructed in a similar manner except for the fact that its axle is free to rotate in its bearings.

The 2" Pulley 4 is connected by a short length of cord wrapped round its circumference to an Eye Piece 5, which is free to slide on a transverse $3\frac{1}{2}$" Strip. A short piece of Spring Cord 11 connects the Eye Piece to a tensioning device 7. This consists of a $\frac{3}{4}$" Bolt working in the tapped hole of a Handrail Support, and it is fitted with a handle in the shape of a Collar and 1" Rod. A 1" Rod is fixed in the boss of the Eye Piece and has secured to it a Coupling, which carries in its end transverse bore a short length of pencil lead, the pointed end of which is kept in intimate contact with the paper by a weight 6 consisting of a Worm.

A variable retarding effect may be applied to the shaft 2a by means of a strap and lever brake, which is similar in principle to that described under S.M. 105 in the Standard Mechanisms Manual. A Handrail Support, mounted by its tapped holes on the Screwed Rod, is attached to a length of string, which passes round the $1\frac{1}{2}$" Pulley forming the brake drum. The end of the cord is tied to a fixed portion of the framework so that on turning the hand wheel 10, the Handrail Support is caused to travel along the Screwed Rod and thus contract the cord about the Pulley.

Before setting the model in motion, it is necessary to place in position the paper recording strip. A long strip of paper of approximately the width shown in the illustration is wound on to the take-off roller 8. Its end is passed under a guide rod secured to the base of the model and between the $3\frac{1}{2}$" Strip on which slides the Eye Piece 5, and a $3\frac{1}{2}$" Flat Girder. The Flat Girder and Strip are spaced away from one another by the thickness of a Washer. The paper is led under a second guide and is attached to the take-up roller 9, so that when the latter is rotated through the medium of the Worm gearing, the paper is drawn slowly beneath the point of the pencil. Normally the spring controlling the pencil is slack, and the pencil traces out a line near the margin of the strip of paper.

So long as there is no load on the Motor the drive is carried through the differential gear and the cage 4 remains unmoved. But when resistance is introduced by tightening the string passing round the $1\frac{1}{2}$" Pulley, the Bevels mounted on the Rod 3 must move round the Bevel 2, the action being similar to that of the differential of a motor car when one rear wheel is braked slightly, while both are rotated in a forward direction.

The Bevels mounted on the Rod 3 carry the cage 4 round with them and so the pencil is moved across the paper. The movement of the cage takes place against the tension of the spring 11, and the Motor then drives the $1\frac{1}{2}$" Pulley against the friction of the brake. The more powerful the Motor, the further the spring will be stretched, and the further the pencil will move across the paper. Two Motors may thus be compared by noting the distances to which the pencil is moved by them when used in turn to drive the braked shaft 2a through the differential gear.

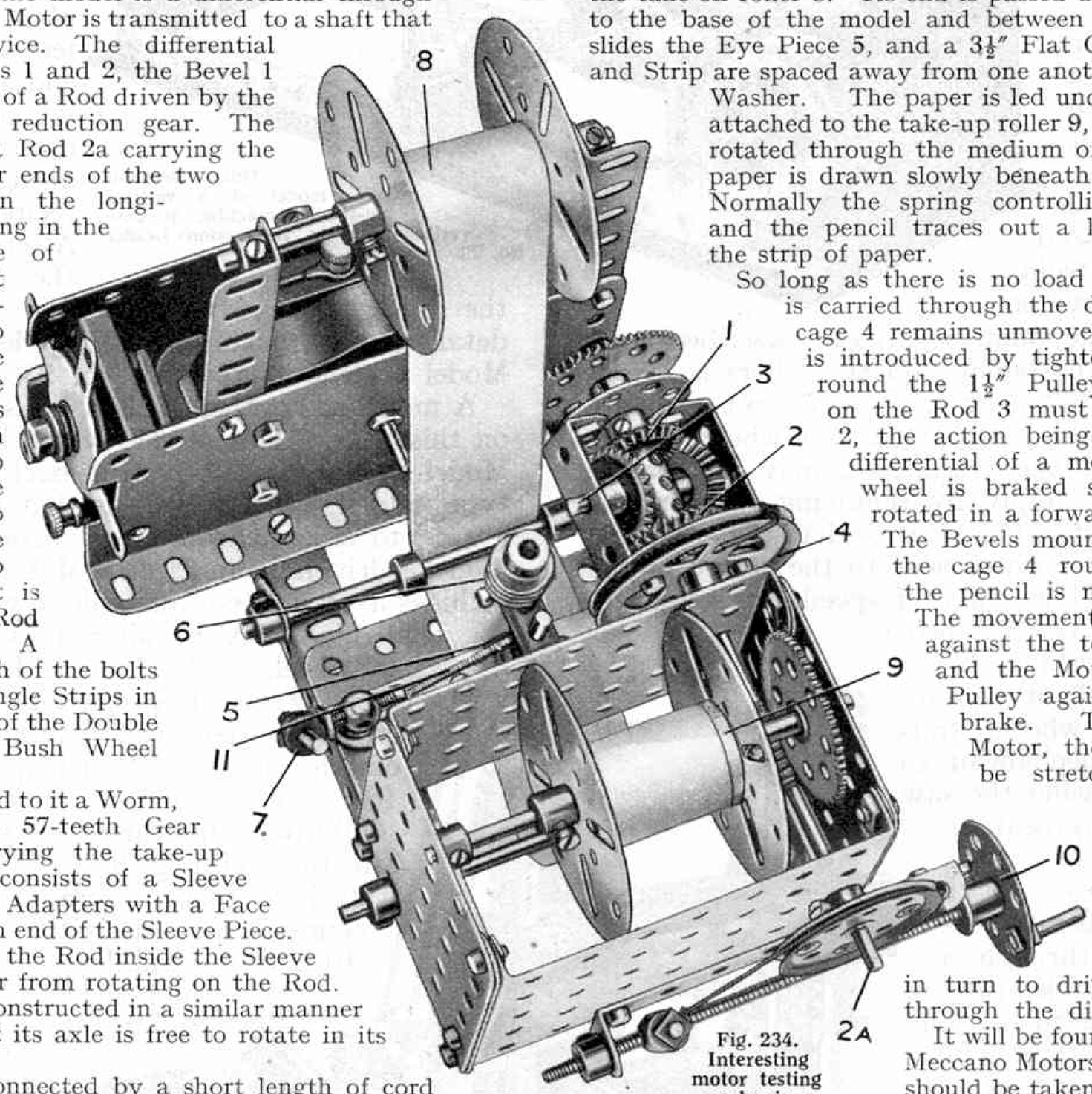


Fig. 234. Interesting motor testing mechanism.

It will be found interesting to compare Meccano Motors in this manner, but care should be taken to carry out the tests in fair conditions. For instance, it would be useless to make trial of a Motor that has run for a long time without attention. The commutator may be dirty, the brushes may require renewal, and the bearings may need oiling in order that the full power of the Motor may be developed. No results of any value therefore could be obtained by comparing its turning power with that of a practically new Motor that has only been run long enough to bring it into good working condition.

One advantage of the mechanism described is that it gives a permanent record. For this reason it is useful for comparing the performances of a Motor at different times, such as before and after cleaning and oiling. If fairly transparent paper is used, the effect of overhauling the Motor may be shown by placing the strip marked in the second test upon that employed in the earlier one, the two "zero" lines coinciding.

(235)—A New Internal Expanding Brake

(George Hunter, Edinburgh)

The making of a compact and efficient internal expanding brake from standard Meccano parts is no easy task, but a glance at Fig. 235 will show that both these factors have been combined in a truly remarkable manner. The manner in which the road wheel (a Boiler End) forms also the brake drum is a noteworthy feature of this ingenious brake.

The brake is shown fitted to a back axle of the type used in the standard Meccano Chassis, but it may be quite easily fitted to the front wheels. In adapting it for the last-mentioned purpose, care will have to be taken to ensure that the operating lever on the Pivot Bolt comes immediately above the stub axle pivot, otherwise the swivelling movement of the road wheels will affect the application of the brakes.

If it is contemplated using Bowden wire control for the purpose, a reference to Suggestion No. 210 (Front Wheel Brake), appearing in the December 1930 "Suggestions Section" will make clear how this may be done.

Two 1" Triangular Plates 1 are attached pivotally by lock-nutted $\frac{3}{8}$" Bolts to a Face Plate in the positions indicated in the illustration, a Washer being placed on each bolt for spacing purposes. A $\frac{3}{8}$" Bolt, secured by lock-nuts to each of the Triangular Plates, serves as a brake shoe, and a short length of Spring Cord connects the two $\frac{3}{8}$" Bolts together.

The operating cam is a Collar 2, the tapped hole of which is screwed on to the end of a Pivot Bolt. The Collar is prevented from turning on the end of the Pivot Bolt by a Grub Screw, which is inserted in the opposite tapped hole of the Collar and screwed against the end of the Pivot Bolt. The Pivot Bolt is journalled in a reinforced bearing comprising a Flat Bracket spaced by a Washer from the Face Plate, and a $\frac{3}{4}$" Bolt 3 is attached by a Collar to its shank. A Loom Heald, or length of wire, connects the $\frac{3}{4}$" Bolt to the brake lever.

When the road wheel is in position, a slight movement of the $\frac{3}{4}$" Bolt results in the Collar being turned, thus causing the Triangular Plates to ride up on to the Flat surfaces of the Collar and, as a result of this being thrust apart. The $\frac{3}{8}$" Bolts comprising the brake-shoes are therefore brought to bear against the inner periphery of the Boiler End, thus producing a powerful retarding effect, which is surprisingly great when the fact is taken into account that the effective braking surface is the comparatively small area provided by the heads of the $\frac{3}{8}$" Bolts forming the brake shoes. This model is in many respects the best example of an internal expanding brake that we have so far come across. Other interesting examples of this type of brake will be found in the "Suggestions Section" of the "*M.M.*" for July, 1927, and readers who are contemplating constructing such a brake would do well to compare the designs adopted by the builders of these different models.

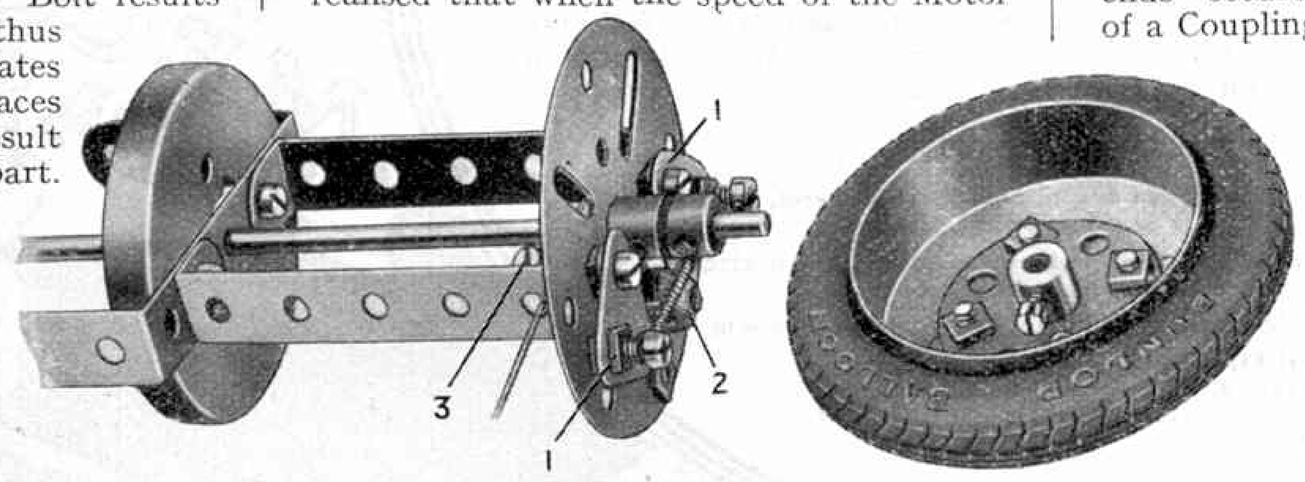


Fig. 235. Ingenious model of an Internal Expanding Brake.

(236)—An Automatic Clutch

(By H. Potter, Sydney, Australia)

One of the most important considerations in building a mechanism that is to be driven by means of the Meccano Electric Motor is the provision of some means by which undue overloading of the Motor may be prevented. If care is not taken to do this, the useful life of the Motor is greatly shortened, and its power is gradually but surely weakened. A simple yet effective device that will prevent overloading, by disconnecting automatically the Motor from the driven unit, is illustrated in Fig. 236.

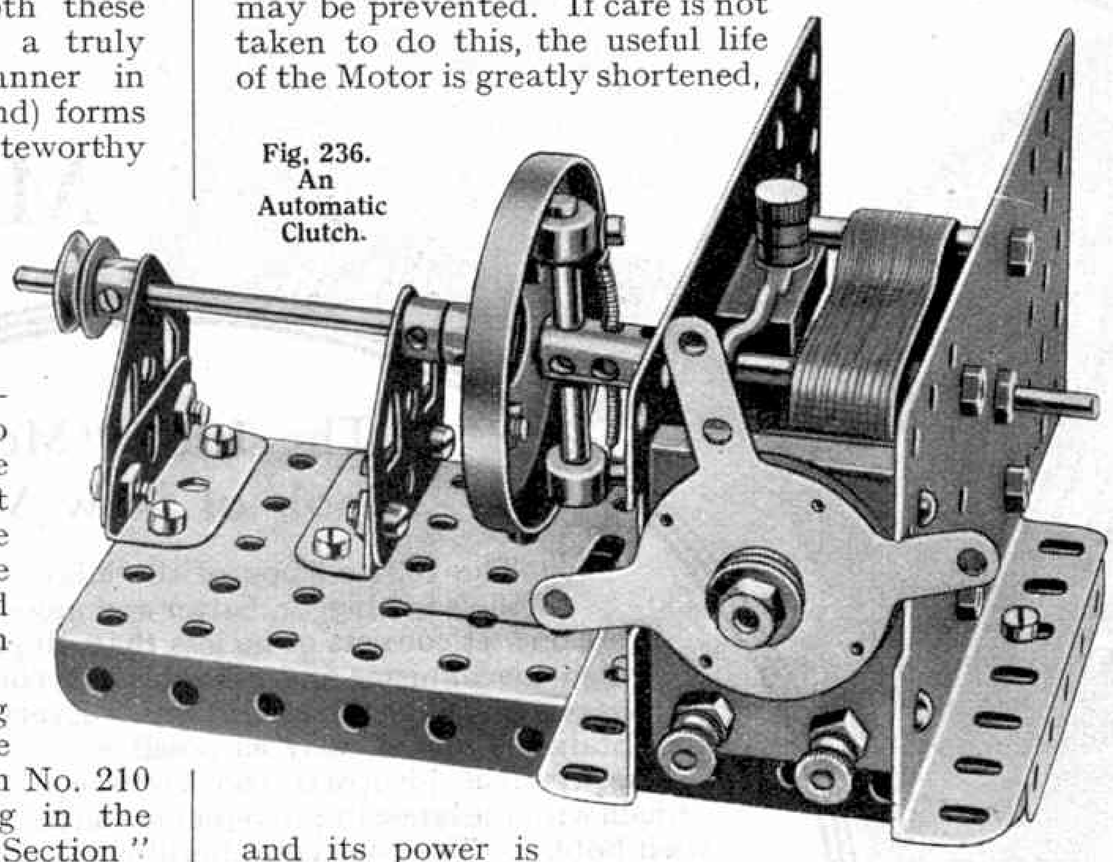


Fig. 236. An Automatic Clutch.

It will be seen that a Coupling is secured to the end of the armature shaft of the Motor, and carries in its end transverse bore a 2" Rod, which in turn carries at each end a Collar that is free to slide on the Rod. The Collars are connected together by means of a short length of Spring Cord, the ends of which are anchored to the Setscrews on the Collars. When the Motor is running above a certain speed the Collars move outward, under the influence of centrifugal force, towards the end of the Rod, and against the tension of the Spring Cord, until they come into contact with the inside rim of a Wheel Flange. This Wheel Flange is bolted to a Bush Wheel that is nipped on a Rod connected by any suitable means to the model to be driven. It will be realised that when the speed of the Motor drops below a certain limit, as the result of the imposition of too great a load, the Collars come out of contact with the Wheel Flange owing to the tension of the Springs overcoming the diminishing force, thus allowing the Motor to rotate freely. Many other interesting uses for this remarkable device will readily suggest themselves to our readers. A development of the idea is to incorporate it in the drive of a roundabout, so that the model accelerates slowly and realistically.

Miscellaneous Suggestions

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

(M.122). A Novel "Surprise" Box.—A model that will be sure to cause much amusement among one's friends is the surprise box by R. Apps, Ilford. One end of the box (a $2\frac{1}{2}" \times 2\frac{1}{2}"$ Flat Plate) is attached rigidly at right angles to one end of the bottom, which consists of a $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flat Plate. The other end of the box is also a $2\frac{1}{2}" \times 2\frac{1}{2}"$ Flat Plate, but it is connected by means of a piece of flat clock spring to the $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flat Plate forming the bottom. The sides, which are $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flat Plates, are connected in a similar manner to the fixed end. To assemble the box the sides are swung round into contact with the edges of the bottom, and the end is bent up to meet them, a $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flanged Plate being then placed over the whole to act as a lid. The flanges of the lid keep the sides and end of the box in place, so that the box looks quite innocent. When the lid is removed the box collapses, however, much to the surprise of the person who performs the operation.

(M.123). A Cup for used gramophone needles.—Those of our readers who are the fortunate possessors of an up-to-date gramophone will know that a receptacle is provided in which to place the used needles after playing. The device consists of a cup sunk in the motor board and provided with a cover that is pierced with a hole.

A novel used needle cup may be contrived from a Boiler End, over which is fitted a Wheel Flange. The Boiler End should be lined with paper or thin cardboard in order to prevent the contents slipping through the holes.

(M.124). A new form of Clutch.—A clutch is a notoriously difficult device to design on a small scale, but it must be admitted that J. Shanks, Sharbot Lake, Ontario, Canada, has shown considerable ingenuity in his clutch about to be described. The driving rod has one of its ends secured in the longitudinal bore of a Coupling, in the other end of which is journalled freely the end of the driven Rod. A freely fitting fibre washer is placed on the last-mentioned Rod, together with two Collars. One of the latter is secured to the shaft so that it may be pressed tightly against the end face of the Coupling by sliding the driven Rod longitudinally in its bearings. The second Collar is secured a short distance from the first, so that a bolt-shank on the end of a Strip forming the clutch operating lever, may locate between them. A slight disadvantage of the device is the fact that, owing to the small area of frictional surfaces in contact, it is liable to slip under the application of only moderate loads. As against this drawback, however, may be set the undoubted neatness and compactness of the device; and we recommend readers who are interested in clutches to try out this scheme in one of their models.

1931

Two Books for every keen Meccano Model-builder

The 1931 "Meccano Book of New Models"

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

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

HOW TO OBTAIN THE BOOK

The 1931 Book of New Models may be obtained from any Meccano dealer, price 9d., or direct from Meccano Ltd., Old Swan, Liverpool, price 10½d. post free. New Zealand and South African price 1/– from dealers, or 1/2 post free from our agents. Australian price 1/9 from dealers, or 1/11 direct from our agents. Canadian price, 25 cents from dealers or 30 cents, post paid, from Meccano Ltd., Toronto.

"How to Use Meccano Parts"

Every Meccano model-builder who wants to build better models should have a copy of this Manual. Its main purpose is to outline the principal uses of the standard parts that together constitute the Meccano System. Detailing every function of every part would be almost impossible, but we believe that by pointing out the special purposes for which the various parts have been designed, together with a few of the other uses that have been suggested from time to time by Meccano boys themselves, we shall help Meccano enthusiasts to build more interesting models, and also to construct them on scientific and practical lines.

HOW TO OBTAIN THE BOOK

We advise every keen Meccano boy to obtain his copy of this new Manual as early as possible. It may be obtained from any Meccano dealer, price 6d., or direct from Meccano Ltd., Old Swan, Liverpool, price 7d. post free. (Overseas price 9d. from dealers, or 10d. post free from our agents. Canadian price, 15 cents from dealers or 20 cents, post paid, from Meccano Ltd., Toronto.

MECCANO AGENCIES

AUSTRALIA : E. G. Page & Co., 52, Clarence Street, Sydney (P.O. Box 1832K).

NEW ZEALAND : Models Ltd., P.O. Box 129, Auckland (Kingston Street).

CANADA : Meccano Ltd., 34, St. Patrick Street, Toronto.

SOUTH AFRICA : Arthur E. Harris, 142, Market Street, Johannesburg (P.O. Box 1199).

MECCANO LTD.
OLD SWAN
LIVERPOOL

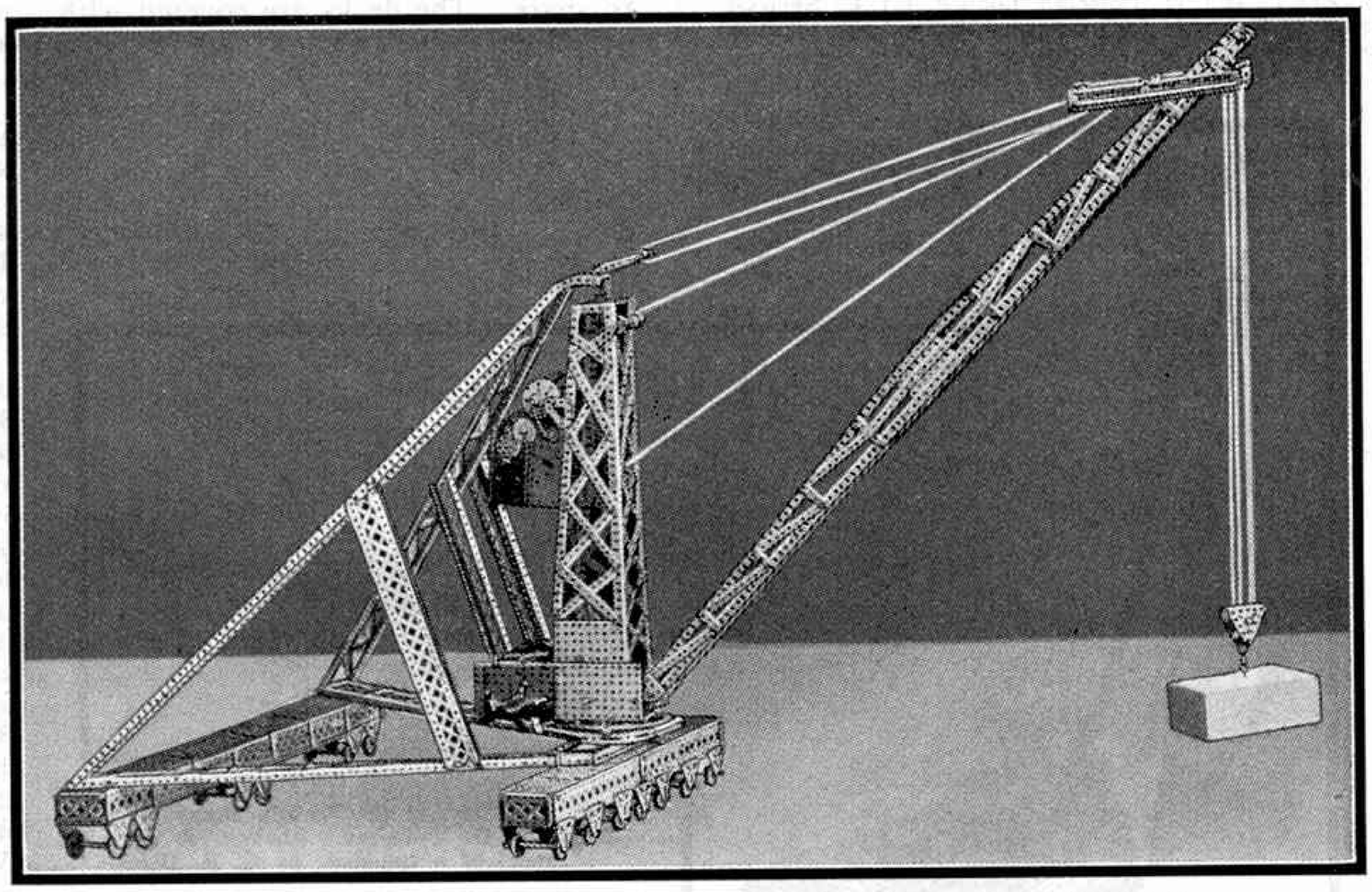
Grand Model-Building Competition

Big Prizes for Meccano Cranes

Models of any Type of Crane may be Entered

FOR this month's Contest we have chosen Cranes—a subject that should prove very popular, for cranes of all types have always played a most important part in Meccano model-building.

Competitors may base their models upon any type of crane they prefer, or with which they are most familiar. Derricks of all types, gantry, floating and all other kinds of cranes will be acceptable under this heading, and they may range in size from small portable cranes to the giant block-setting structures. Models may be built with any size Outfit or any number of parts. Competitors may, if they wish, submit more than one model, but in this event all entries must be sent under the same cover. No competitor will be awarded more than one prize, and if more than one model is submitted they will be considered jointly.



Our illustration shows a fine derrick crane, built by W. G. Barrett, Observatory, South Africa.

Entries will be divided into three sections as follows :— Section A, for competitors over 14 years of age living in the British Isles. Section B, for competitors under 14 living in the British Isles ; and Section C for competitors of all ages living Overseas. Sections A and B will close 31st July, 1931. Closing date for Section C, 30th September, 1931.

The fine list of prizes shown in the panel on this page will be awarded for the best entries received, in order of merit.

Important Note to Competitors

The following instructions must be followed closely. Actual models must not be sent. All that is required is a clear photograph or a good drawing, together with any explanations considered necessary, although these should be as short as possible. Any model entered must be the competitor's own unaided work both in design and construction, but photos or drawings need not be his own handiwork. We think it well to remind competitors that reproductions of models described in any of the Meccano Manuals or other publications are not eligible for entry in this contest, and any such models received will be disqualified.

Competitors must write their age, name and full address clearly on the back of each photograph or sheet of paper sent in, together with the name of the contest ("Crane" Contest) and the letter A, B, or C, indicating the Section for which the model is eligible. Envelopes containing entries should be addressed "Crane" Competition, Meccano Ltd., Old Swan, Liverpool.

We wish to draw special attention to the fact that several instances have occurred in recent competitions where competitors who had done good work lost their chance of a prize, simply because they omitted to state their age, or their name and address. Any entries from which this vital information is missing are, of course, automatically disqualified.

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

Models displaying features of unusual interest will be described, and where possible illustrated, in future issues of the *"M.M."*

The Prizes

Sections A and C

First Prize, cheque for £3-3s.
Second Prize, cheque for £2-2s.
Third Prize, cheque for £1-1s.
Six Prizes of Meccano goods value 10/6.
Twelve Prizes of "Famous Trains," by C. J. Allen.

Section B

First Prize, Meccano goods value £2-2s.
Second Prize, Meccano goods value £1-1s.
Third Prize, Meccano goods value 10/6.
Six Prizes of Meccano goods value 5/-.
Twelve Prizes of Meccano Engineers' Pocket Books.
Twelve handsome "Merit" Certificates also will be awarded in each Section.

Next Month's Contest

The July *"M.M."* will contain details of a "Realism" Model-building Contest, in which big prizes will be given for the best models incorporated in realistic surroundings. A model motor car outside its garage, or a steam navvy at work in a "quarry" are examples of what is required.

Results of Meccano Model-Building Contests

By Frank Hornby

"Ship" Contest (Home Section)

THE entries in this Contest include reproductions of almost every type of sea-going vessel and river craft, and among the prize-winners are to be found large models of Atlantic liners, torpedo boats, tugboats, sailing vessels, and even a Roman galley! Awards in the Home Section have been made as follows :—

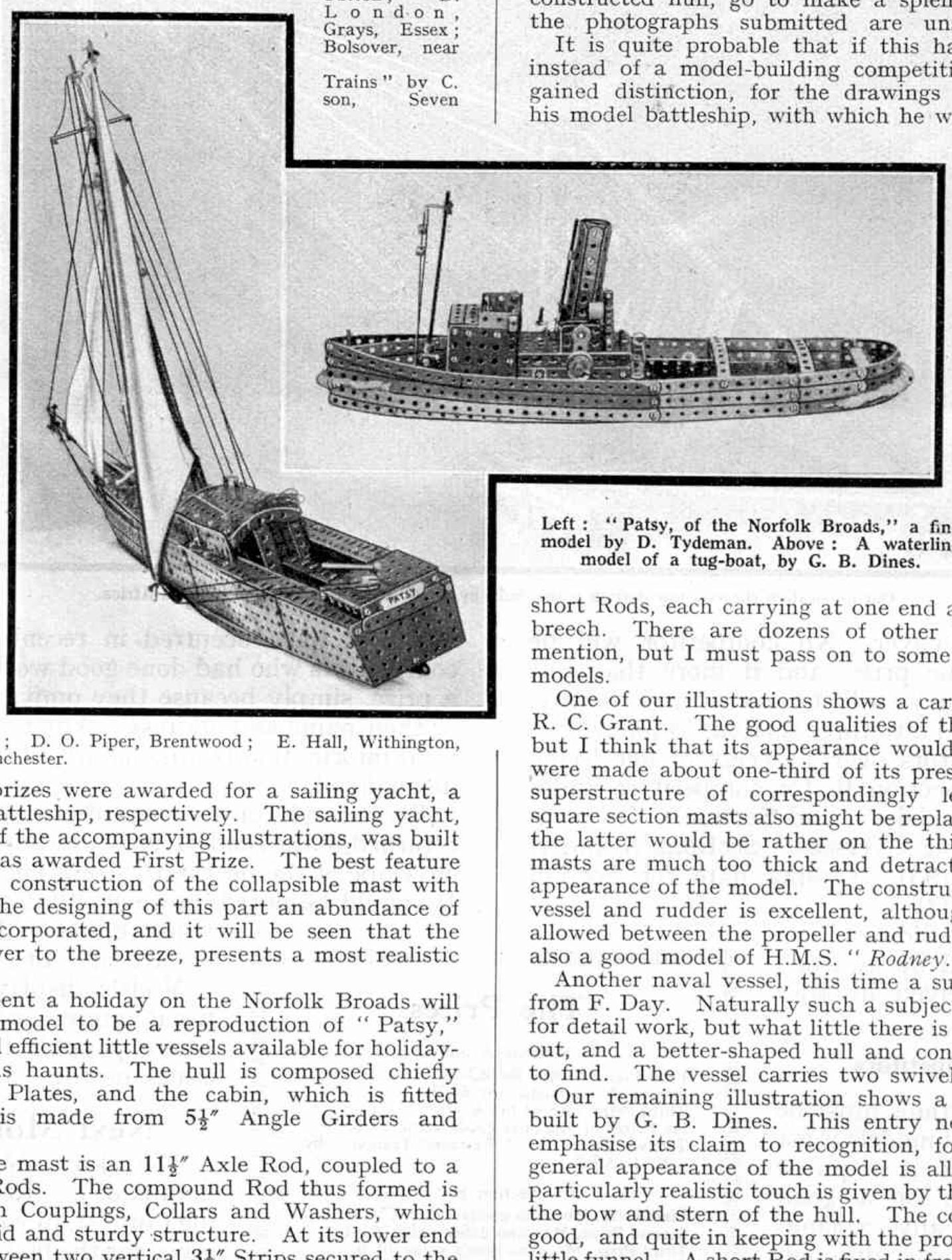
Section A (for competitors of all ages living in the British Isles).

FIRST PRIZE, Meccano goods value £2-2s.: D. Tydeman, London, E.C.4. SECOND PRIZE, Meccano goods value £1-1s.: K. Taylor, Gateshead-on-Tyne. THIRD PRIZE, Meccano goods value 10/6: R. Foster, Dorchester, Dorset.

SIX PRIZES, Meccano goods value 5/-: T. Robson, Scarborough; R. C. Grant, Sutton; D. London, Grays, Essex; Bolsover, near Trains" by C. son, Seven Aberdeen; F. Day, Kelk, Honor Oak Park, S.E.23; G. B. Dines, W. A. Pemberton, Chesterfield.

SIX PRIZES, of "Famous J. Allen: G. F. Ander- Kings, Essex; K. M. Hart, Coombe Dingle, near Bristol; A. C. Skeels, King's Lynn, Norfolk; J. Sullivan, Manchester; H. S. Darling, Lurgan, Co. Armagh; M. Hutchings, Frodsham, near Warrington.

SPECIALLY COMMENDED (Certificate of Merit and Engineer's Pocket Book): B. A. Richardson, Chadwell Heath, Essex; F. A. Uren, Plaistow, London, E.13; H. J. Cockayne, Walsall; D. Morgan, Bromley, Kent; W. H. Cook, London, W.9; J. R. Broadhurst, Portsmouth; A. R. Hurrell, St. Fagans, near Cardiff; I. F. Wray, Gt. Bedwyn, Wilts.; A. Mutch, Aberdeen; G. Scales, Scarborough; J. Montagu, Worthing; W. K. Coupar, Dundee; J. R. Leech, Sandiway, Northwich; N. B. Peake, Southend-on-Sea; R. Culley, Carlton, Nottingham; R. M. Rankin, Horsham, Sussex; G. J. Gill, Folkestone; A. R. Huben, London, S.W.14; D. O. Piper, Brentwood; E. Hall, Withington, Manchester; H. Cape, Manchester.



Left: "Patsy, of the Norfolk Broads," a fine model by D. Tydeman. Above: A waterline model of a tug-boat, by G. B. Dines.

The three principal prizes were awarded for a sailing yacht, a cargo steamer, and a battleship, respectively. The sailing yacht, which is shown in one of the accompanying illustrations, was built by D. Tydeman, and was awarded First Prize. The best feature of the model lies in the construction of the collapsible mast with which it is fitted. In the designing of this part an abundance of good detail work is incorporated, and it will be seen that the finished ship, heeling over to the breeze, presents a most realistic appearance.

Readers who have spent a holiday on the Norfolk Broads will perhaps, recognise the model to be a reproduction of "Patsy," one of the handsome and efficient little vessels available for holiday-makers to these famous haunts. The hull is composed chiefly from Strips and Flat Plates, and the cabin, which is fitted with sleeping bunks, is made from 5½" Angle Girders and 5½" Strips.

The foundation of the mast is an 11½" Axle Rod, coupled to a 6½" and two 4½" Axle Rods. The compound Rod thus formed is clothed completely with Couplings, Collars and Washers, which together give a very solid and sturdy structure. At its lower end the mast is pivoted between two vertical 3½" Strips secured to the deck works, and the top is crowned with a ¾" Contrate Wheel, from which six stays descend to the sides of the yacht, two of the stays passing over the ends of a 3½" Rod forming a cross-jack, to which they are held by means of Spring Clips.

Careful study of the illustration will reveal a number of good constructional details, especially in the deck works and bowsprit.

I think it would be interesting if other "*M.M.*" readers tried their skill at this type of model-building, for it offers abundant scope to an ingenious builder, particularly in reproducing old-time sailing ships, with their complicated rigging and mastwork.

Another fine model is K. Taylor's cargo boat, to describe all the good points of which would take much more space than I am able to spare. The decks are covered with a maze of minute details, including an anchor winch, hatches, ship's bell, anchors, ventilators, masthead lights and life-boats; and these, coupled with a rigidly constructed hull, go to make a splendid model. Unfortunately the photographs submitted are unsuitable for reproduction.

It is quite probable that if this had been a drawing contest instead of a model-building competition, R. Foster would have gained distinction, for the drawings he submitted to illustrate his model battleship, with which he won Third Prize, are beautifully prepared and do him great credit.

The whole of the hull is built up from Braced Girders, the decks being filled in with Flat Plates and Strips. The vessel carries four swivelling double gun turrets, and two anti-aircraft guns, the mountings for the last mentioned consisting of End Bearings, secured on short Rods, which are held in the bosses of inverted Flanged Wheels. The gun barrels are formed by short Rods, each carrying at one end a ½" Pulley to represent the breech. There are dozens of other interesting points I could mention, but I must pass on to some of the other prize-winning models.

One of our illustrations shows a cargo steamer, constructed by R. C. Grant. The good qualities of this model will be apparent, but I think that its appearance would be improved if the funnel were made about one-third of its present length, and the bridge superstructure of correspondingly less height. The built-up square section masts also might be replaced with Rods, for although the latter would be rather on the thin side, the present square masts are much too thick and detract from the general graceful appearance of the model. The construction of the after end of the vessel and rudder is excellent, although less clearance might be allowed between the propeller and rudder post. Grant submitted also a good model of H.M.S. "*Rodney*."

Another naval vessel, this time a submarine, formed the entry from F. Day. Naturally such a subject does not offer much scope for detail work, but what little there is in the model is well carried out, and a better-shaped hull and conning tower would be hard to find. The vessel carries two swivelling guns.

Our remaining illustration shows a waterline model tug-boat, built by G. B. Dines. This entry needs no words of mine to emphasise its claim to recognition, for it will be seen that the general appearance of the model is all that could be desired. A particularly realistic touch is given by the hemp fenders fixed round the bow and stern of the hull. The construction of the bridge is good, and quite in keeping with the prototype, as is also the sturdy little funnel. A short Rod is fixed in front of the funnel to represent the exhaust steam pipe.

D. Kelk choose as the subject for his entry a vessel of 1740.

In conclusion, I must mention a steam pinnace, by T. Robson. This is a thoroughly good little model and quite deserving of the success it has achieved.

Results of the No. 000 and No. 3 "Outfits" Contest (Home Sections)

It was especially interesting to examine the entries in the No. 000 Outfit Section of this Contest, for the construction of new and efficient models with the smaller Outfits calls for an equal amount of ingenuity, in my opinion, as that required in the design of more complicated structures when no definite limit is placed on the number of parts to be used.

The quality of the entries in both Sections was quite good and I hope to include one or two of the successful models in future editions of the Meccano Instruction Manuals.

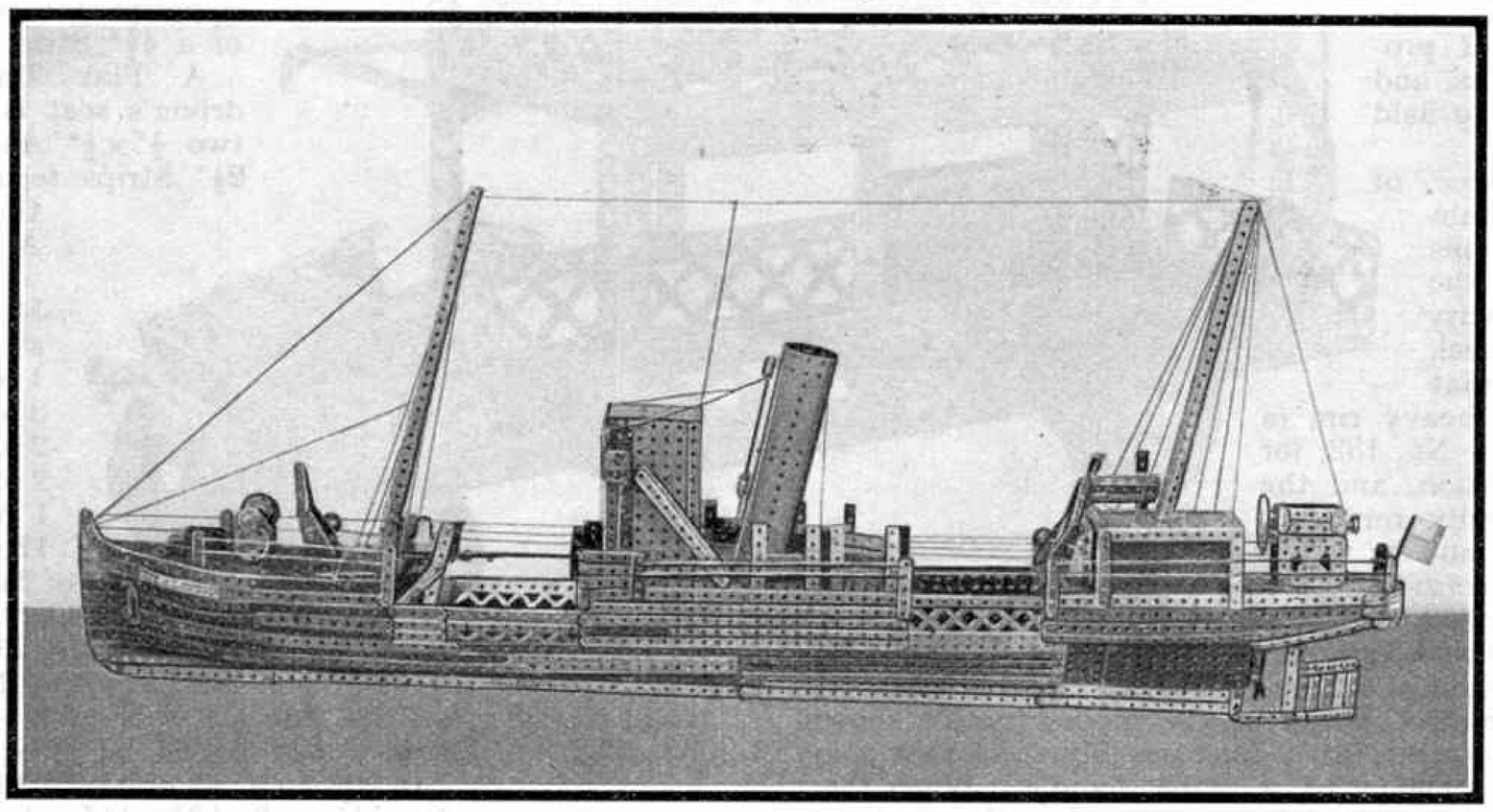
The results in each of the Home Sections of the Contest are as follows :—

Section A (for No. 000 Outfit models).

FIRST PRIZE, Meccano goods value £2-2s. : D. C. Hodgkins, Birmingham. SECOND PRIZE, Meccano goods value £1-1s. : A. Sherriff, Leicester. THIRD PRIZE, Meccano goods value 10/6 : C. O. Davies, London, S.E.20.

TWELVE PRIZES of a range of Meccano parts for converting Outfit No. 000 to a No. 0 : J. Cox, Lower Bebington, Birkenhead ; Miss H. M. Clayton, Clondalkin, Co. Dublin ; M. McMahon, Birmingham ; G. G. Smith, Rhu, Dumbartonshire ; D. Sutherland, Edinburgh ; E. H. Hare, Mullion, Cornwall ; T. Middlemass, Falkirk ; D. C. Stark, Winlaton-on-Tyne ; E. H. Robinson, London, N.10 ; C. C. Reed, Gourock, Renfrews ; W. B. Williams, Blandford, Dorset ; F. H. Parkin, Salterforth, Lancs.

SPECIALLY COMMENDED (Certificate of Merit) : F. E. Day, London, W.12 ; W. H. French, Caterham, Surrey ; J. Hargreaves, Great Harwood, near Blackburn ; W. J. Prestwich, Manchester ; A. J. Treherne, Rotherham ; G. R. Lane, Ely, near Cardiff ; H. Webb, Wood Green, N.22 ; J. A. Lawson, Horsforth, near Leeds.



Cargo Steamer, by R. C. Grant. The patchy appearance of the model is due to the use of both nickelled and coloured parts. Note the realistic deck fittings.

Section B (for No. 3 Outfit models).

FIRST PRIZE, cheque value £2-2s. : C. Burns, Edinburgh ; SECOND PRIZE, cheque value £1-1s. : J. H. Taylor, Chilworth, Surrey. THIRD PRIZE, cheque value 10/6 : R. K. Common, Stirling.

TWELVE PRIZES, Meccano goods value 5/- : A. Chunn, London, S.W.9 ; G. E. Hughes, Bridge-of-Allan, Stirlingshire ; A. Clacey, Crowthorne, Berks. ; D. Crowley, Birmingham ; T. Coughtrie, Motherwell ; T. Ryan, Cahirciveen, Co. Kerry ; W. Farnell, Sheffield ; H. James, Harlington ; L. Marchant, London, S.W.20 ; R. Stock, Birmingham ; E. Huckle, Dunstable ; C. G. Lidbetter, Bromley.

SIX PRIZES, of Meccano Engineer's Pocket Books : G. Emerson, West Drayton, Middlesex ; E. Levaillant, Guildford ; R. O. Curle, Perth ; A. Rosen, West Croydon ; W. B. Hatton, Margate ; F. G. Butterfield, Saffron Walden, Essex.

SPECIALLY COMMENDED (Certificate of Merit) : J. Bedford, Tingley, near Wakefield ; L. Jefferies, Rhondda, Glam. ; R. Moody, Salisbury ; H. Sosnowick, Cheetham, Manchester ; N. E. Chapman, Berkhamsted ; S. Reilly, Haydock, Lancs. ; V. D. Lidbetter, Bromley ; A. Patten, Kingstown, Co. Dublin ; J. M. Finch, Burnham, Bucks ; J. Byard, Stoke-on-Trent ; H. Webb, London, N.22.

The First Prize for a No. 000 Outfit model was awarded to D. C. Hodgkins, who submitted a remarkably realistic representation of a Viking ship as used by the Danish invaders of Britain. The hull is built from 5½" Strips and Double Angle Strips, and a 2½" Strip secured almost vertically in the prows is used to support Flat Brackets, which form the figure-head. A 3½" Rod is used for the mast, and a similar Rod mounted in the stern represents the huge oar that was used to steer the original ship. A piece of paper mounted on the mast completes the model. Hodgkins, although only nine years of age, has certainly made good use of the few parts at his disposal.

A ship also secured the Second Prize in Section A, but this model is of a modern vessel. It is a destroyer, and was built by A. Sherriff, who has reproduced with remarkable accuracy the lines of an actual warship of this type. The effect is somewhat marred, however, by the use of a bolt for the funnel ! Angle Brackets or Double Brackets could have been used instead and would have been more in proportion with the rest of the model.

C. Davies obtained Third Prize with a model of an electric trolley, of the type used at large railway stations and in factories and warehouses for transporting material from one department to another. Considerable ingenuity is displayed in the construction of the model and realism has been obtained without exceeding the contents of the 000 Outfit. The method of supporting the three wheels with which the model is fitted necessitated a great deal of careful thought.

Among other models of outstanding interest D. C. Stark's model of the R.M.S. "*Mauretania*" is worthy of mention. Although the model can hardly be said to bear close resemblance to its famous prototype, it is well put together, and the four funnels with which it is equipped leave little doubt concerning the vessel it is intended to represent.

The highest award in Section B was secured by C. Burns, who submitted a No. 3 Outfit model of the Supermarine Rolls-Royce S.6, the winning machine in the 1929 air race for the Schneider Trophy. The fuselage of the model is formed from Strips, and each of the floats also is built up from Strips. Braced Girders are used advantageously for wings.

A railway breakdown crane secured Second Prize for J. H. Taylor.

An unusual type of model was chosen by R. K. Common, who secured Third Prize in this Section. It is a dentist's operating chair, and embodies all the movements to be found in an actual chair.

Second "Errors" Contest (Overseas)

The Meccano model locomotive that formed the subject of this competition absolutely "bristled" with constructional and technical errors, and Meccano enthusiasts abroad found no difficulty in compiling comprehensive lists of the mistakes.

It took many hours to read through the entries and decide the prize-winners, but eventually the list was completed, and prizes were awarded in order of merit to the competitors who succeeded in finding the greatest number of errors.

The full list of awards is as follows :—

FIRST PRIZE, Meccano goods value £2-2s. : B. Jones, Dunedin, New Zealand. SECOND PRIZE, Meccano goods value £1-1s. : T. Watson, Leichhardt, N.S.W., Australia. THIRD PRIZE, Meccano goods value 10/6 : R. Dale, Cape Town, South Africa.

TWELVE PRIZES, Meccano goods value 5/- : C. Becker, Cape Town, South Africa ; A. Johnstone, Piora, N.S.W., Australia ; T. Sourkes, Quebec, Canada ; A. Jolliffe, Natal, South Africa ; G. Mann, Dunollie, near Greymouth, New Zealand ; J. F. Dennison, Stirling, Otago, New Zealand ; J. A. Rodriguez, Montreal, Canada ; V. L. Noguera, Buenos Aires, Argentine ; A. Shepherd, Bloemfontein, O.F.S., South Africa ; F. Vandera, Brussels, Belgium ; J. Golan, Cape Town, South Africa ; S. Peck, Calcutta, India.

From an examination of the entries it is evident that Overseas boys are as familiar with British locomotive design, as they are with the locomotives of their own countries.

Christmas "Parts Required" Contest (Overseas)

The prize-winners in the Overseas Section of the Christmas "Parts Required" Contest are as follows :—

FIRST PRIZE, Meccano goods value £1-1s. : E. Hall, Vancouver, B.C., Canada. SECOND PRIZE, Meccano goods value 15/- : N. C. Tzitzinias, Salonica, Greece. THIRD PRIZE, Meccano goods value 10/6 : R. Atkinson, Punchbowl, N.S.W., Australia.

SIX PRIZES of Complete Instructions Manuals : L. Black, Sydney, N.S.W., Australia ; B. Richards, Warburton, Victoria, Australia ; E. C. Stonyer, South Canterbury, New Zealand ; D. R. White, Bangalore, Cantt., S. India ; J. Hers, Potchefstroom, South Africa ; N. Voyadjakis, Salonica, Greece.

TWELVE PRIZES of Engineer's Pocket Books : A. Smith, Brisbane, Queensland, Australia ; E. R. White, Bangalore, Cantt., S. India ; J. A. Gomes, Bandra, Bombay, India ; G. R. Nisbet, Mont Albert, Melbourne, Australia ; K. J. Orams, Blenheim, New Zealand ; O. Dose, Cape Town, South Africa ; B. Silva, Kotahena, Colombo, Ceylon ; J. Chugg, Auckland, New Zealand ; B. C. Khambatha, Broach, India ; V. Schmidt, Basel, Switzerland ; I. Zolinski, Warsaw, Poland ; R. Meadway, Cairo, Egypt.

The Contest was well received by Meccano enthusiasts abroad, and a very encouraging number of entries was received. In due course, we hope to arrange still further competitions of the same nature in which a large number of worth-while prizes will again be offered.

New Meccano Models

Motor Omnibus—Saw Bench—Momentum Tractor—Windmill

WHEN "driving power" is mentioned in connection with model-building, Meccano boys invariably think of Clockwork and Electric Motors, and the Meccano Steam Engine. There are several other means of driving a model, however, and while these are not as efficient as the power units just mentioned, they are nevertheless capable of providing quite good results, and they offer an interesting field for experiment.

An interesting source of power is the momentum motor, which functions on the principle of the "energy-storing" capacity of a rotating flywheel. Readers will know that when a wheel with a heavy rim (a Meccano Flywheel, part No. 132, for example) is set in motion, and the driving force is suddenly removed, the flywheel will continue to rotate at high speed for a considerable length of time. This is due to the fact that energy has been stored in the rim of the flywheel and it takes a considerable time before this energy is dissipated by friction at the bearings. The "flywheel effect" has been used to provide the motive power of the model tractor shown in Fig. 4. This model contains a Meccano Flywheel that may be rotated rapidly by means of a crank handle. When the Flywheel is running at high speed, it is connected to the road wheels of the model by means of a clutch and suitable gears, and the model will then be propelled forward until all the energy in the Flywheel has been dissipated. This principle may be applied to various types of Meccano models, and some very interesting results can be obtained in this way.

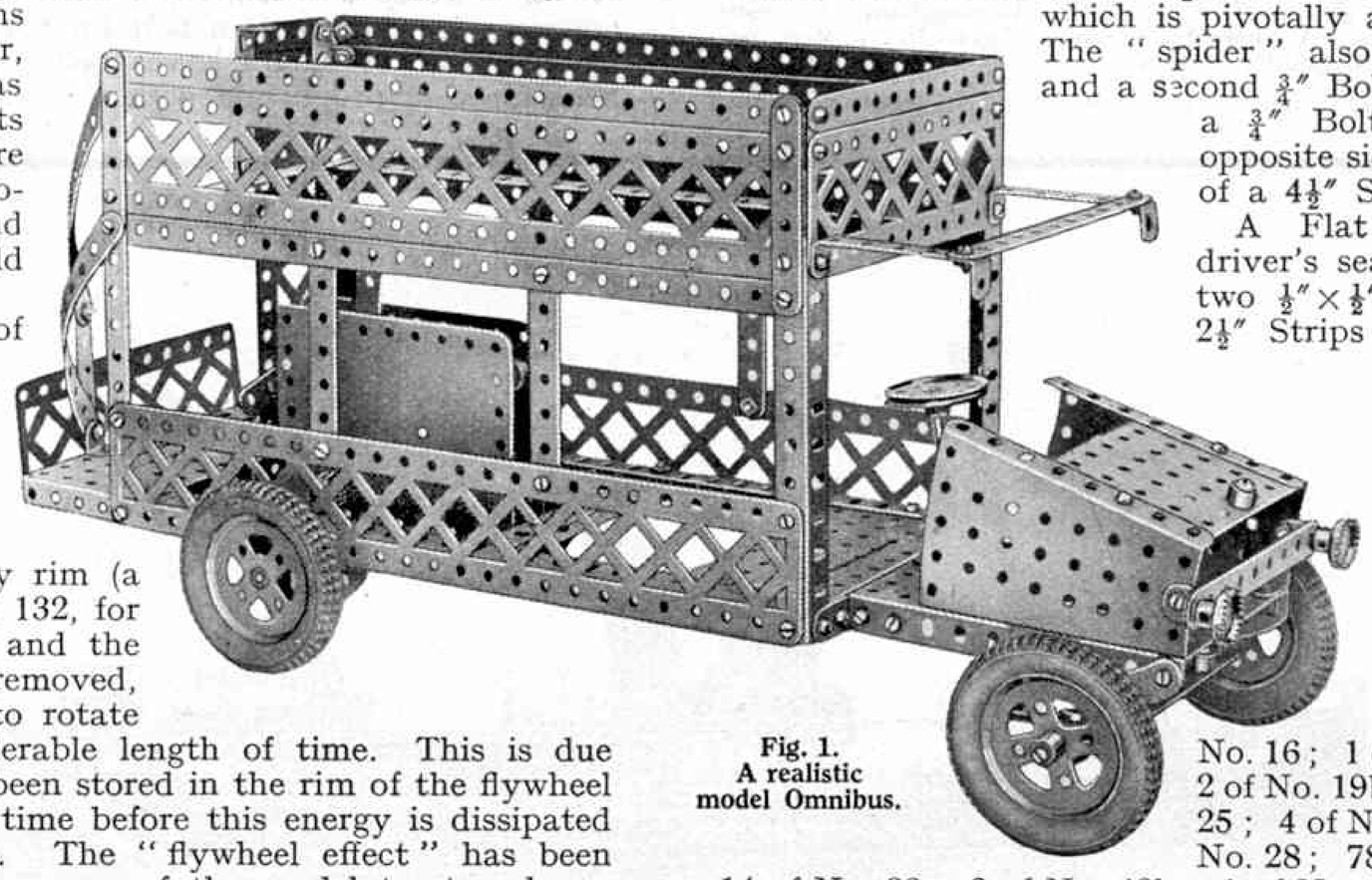


Fig. 1. A realistic model Omnibus.

A Novel Meccano Momentum Tractor

The construction of the model Momentum Tractor may be followed from Figs. 4 and 6.

The shafts driving the Flywheel 2 (Fig. 6) are carried in 3½" Flat Girders secured to the frame of the Tractor by 3½" Angle Girders. The sliding starting-handle shaft carries a 57-teeth Gear, not visible in the illustration, which meshes with a ½" Pinion secured to a sliding Rod carrying a 57-teeth Gear 1, held out of mesh with a ½" Pinion on the flywheel shaft by a Compression Spring and Crank 5.

A second ½" Pinion, secured on the flywheel shaft, engages with a 1½" Contrate 6, which may be disengaged when desired by a "clutch lever" consisting of a pivotally mounted 2½" Strip fitted with a bolt which engages with the Collars mounted on the shaft carrying the Contrate 6. A ½" Pinion, on the same Rod as the Contrate, drives a 57-teeth Gear 7 and ¾" Pinion 9.

The steering column carries at its upper end a 2" Pulley Wheel, which forms the steering wheel, and at its lower end a Crank, which is attached by a locknutted bolt to a 5½" Strip. This Strip is in turn pivotally attached to a Collar carried on a ¾" Bolt, locknutted in one hole of a "spider" taken from a Swivel Bearing, which is pivotally attached to a Coupling 3. The "spider" also carries one front wheel, and a second ¾" Bolt 4 which is connected to a ¾" Bolt and "spider" on the opposite side of the tractor by means of a 4½" Strip.

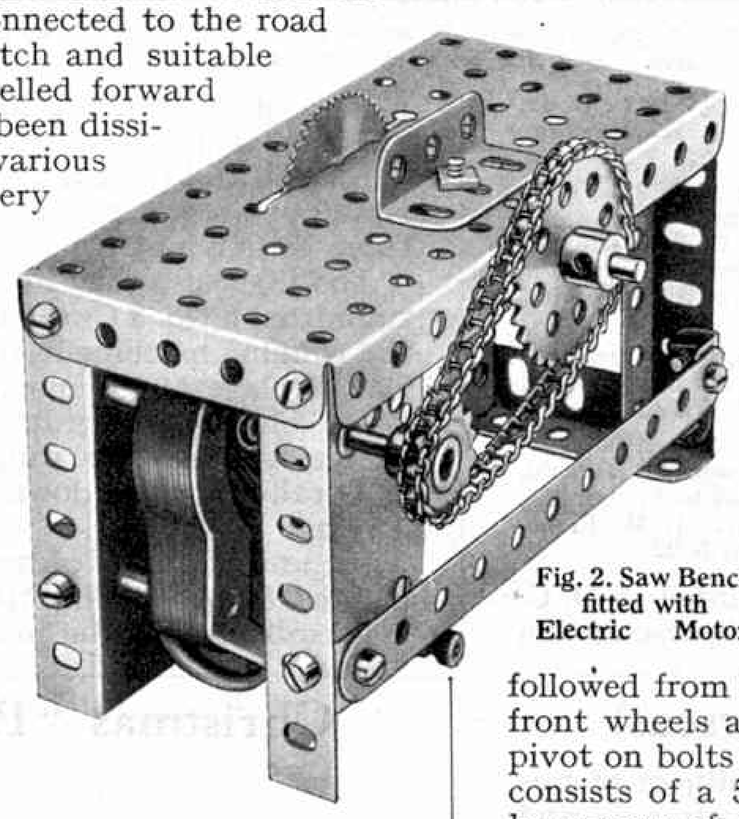


Fig. 2. Saw Bench fitted with Electric Motor.

A Flat Trunnion forming the driver's seat is bolted, by means of two ½"×½" Angle Brackets, to two 2½" Strips secured to the frame of the model by two 1"×½" Angle Brackets.

Parts for building the Momentum Tractor are as follows:—1 of No. 2; 1 of No. 2a; 1 of No. 3; 3 of No. 5; 6 of No. 6a; 2 of No. 8b; 5 of No. 9b; 2 of No. 9d; 2 of No. 9f; 1 of No. 11; 3 of No. 12b; 1 of No. 15a; 2 of No. 16; 1 of No. 16a; 3 of No. 16b; 2 of No. 19b; 3 of No. 20a; 1 of No. 25; 4 of No. 26; 4 of No. 27a; 1 of No. 28; 78 of No. 37; 4 of No. 37a; 14 of No. 38; 2 of No. 48b; 1 of No. 52a; 2 of No. 53a; 14 of No. 59; 3 of No. 62; 2 of No. 63; 1 of No. 72; 4 of No. 103d; 2 of No. 103f; 2 of No. 103h; 3 of No. 111; 2 of No. 111a; 2 of No. 115; 1 of No. 120b; 1 of No. 126a; 1 of No. 132; 2 of No. 133; 2 of No. 142a; 2 of No. 142b; 2 of No. 147b; 2 of No. 165.

Clockwork-operated Motor Omnibus

In Fig. 1 is shown a realistic model of an omnibus. The model is propelled by a Meccano Clockwork Motor connected to the rear axle through reduction gearing. The chassis of the 'bus is built up from 12½" and 5½" Angle Girders and 5½"×2½" Flanged Plates. The front portion of the chassis consists of two 3½"×2½" Flanged Plates overlapped, and bolted together. These plates are, in turn, secured to the main portion of the chassis by means of 1"×1" Angle Brackets. The superstructure or bodywork of the 'bus consists of Braced Girders and Strips, and the assembly of these will be clear from Fig. 1.

The steering gear fitted to the model can be followed from Fig. 3, which is an underside view of the 'bus. The front wheels are journalled on ¾" Bolts secured in Couplings that pivot on bolts lock-nutted to the end holes of the front axle, which consists of a 5½" Strip supported below the chassis of the model by means of Angle Brackets secured to 2½" Curved Strips. The track rod is connected by Swivel Bearings to the Rods 1, 2, which are secured in the inner transverse holes of the Couplings. A Collar is mounted on the end of the Rod 2, and a small Fork Piece is secured to it. A further short Axle is fastened in the boss of the Fork Piece and a Collar is mounted on the last-mentioned Rod. This Collar is coupled to the Crank 3 mounted on the end of the steering column by means of a bolt and nut. The steering Wheel consists of a 1½" Pulley Wheel. The

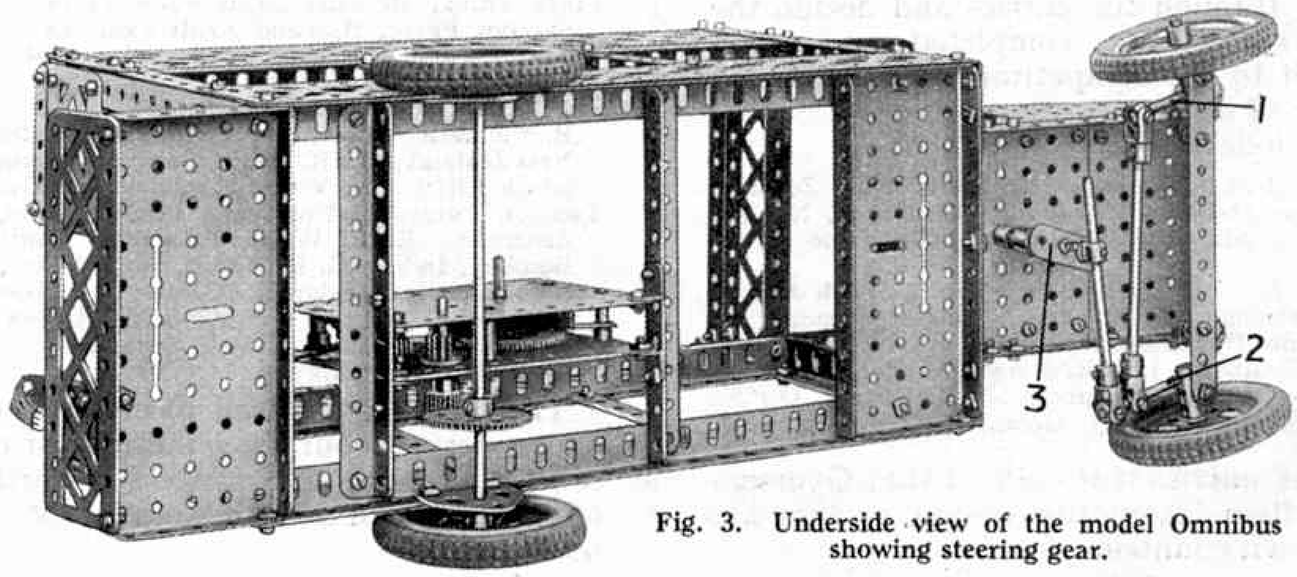


Fig. 3. Underside view of the model Omnibus showing steering gear.

Clockwork Motor is coupled to the back axle through a 3 : 1 reduction gear consisting of a ½″ Pinion secured in the driving shaft of the Motor, and meshing with a 57-teeth Gear Wheel secured to the back axle.

In order to build the model omnibus the following parts will be needed : 2 of No. 1 ; 9 of No. 2 ; 1 of No. 2a ; 4 of No. 3 ; 4 of No. 4 ; 2 of No. 5 ; 4 of No. 8 ; 4 of No. 9 ; 3 of No. 10 ; 14 of No. 12 ; 2 of No. 12a ; 1 of No. 14 ; 1 of No. 15a ; 2 of No. 16 ; 1 of No. 17 ; 1 of No. 18a ; 4 of No. 20a ; 1 of No. 21 ; 1 of No. 26 ; 1 of No. 27a ; 2 of No. 29 ; 98 of No. 37 ; 4 of No. 37a ; 3 of No. 38 ; 3 of No. 48a ; 2 of No. 52 ; 3 of No. 53 ; 2 of No. 54 ; 5 of No. 59 ; 1 of No. 62 ; 2 of No. 63 ; 2 of No. 90a ; 1 of No. 98 ; 4 of No. 99 ; 3 of No. 100 ; 3 of No. 111 ; 3 of No. 111c ; 1 of No. 116a ; 1 of No. 125 ; 2 of No. 126a ; 4 of No. 142a ; 1 of No. 147b ; 2 of No. 165 ; 1 Clockwork Motor.

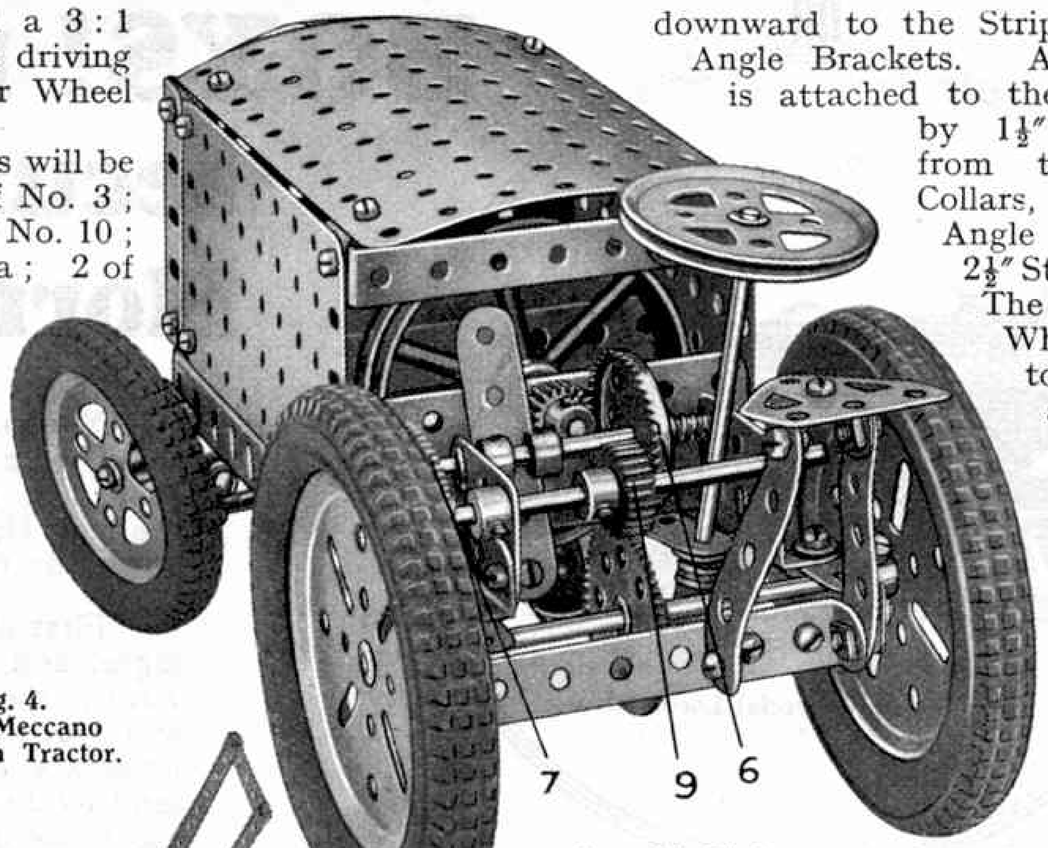


Fig. 4. (Right) Meccano Momentum Tractor.

Model Saw Bench with electrically-driven Circular Saw

The neat little model saw bench shown in Fig. 2 is fitted with a Meccano Circular Saw (part No. 159), which is driven by a Meccano E1 Electric Motor. When the Motor is run at top speed it is possible to cut cardboard, and even very thin wood with the model, but naturally it does not possess sufficient power to cut thick wood.

The top of the bench consists of a 5½″ × 2½″ Flanged Plate, which is provided with special slots so that it can be employed for this purpose. The No. E1 Electric Motor incorporated in the model forms a support for one end of the Plate, the other end of which is supported on 3″ Angle Girders, a 2½″ Girder being secured across their lower ends by means of bolts inserted in the elongated holes. Two 5½″ Strips are fitted as shown to add strength to the structure ; and Angle Brackets may be added to the Motor flanges so that the model may be screwed to a baseboard.

A ¾″ Sprocket on the armature shaft of the Motor transmits the drive to a 1½″ Sprocket on a 3½″ Axle Rod carrying a Circular Saw. A 1½″ Angle Girder forms a guide for the timber, and may be adjusted in the transverse slotted hole of the Plate.

The parts required in the construction of the saw bench are as follows : 2 of No. 2 ; 2 of No. 9c ; 1 of No. 9d ; 1 of No. 9f ; 4 of No. 12 ; 1 of No. 16 ; 15 of No. 37 ; 7″ of No. 94 ; 1 of No. 95a ; 1 of No. 96a ; 1 of No. 159 ; E1 Electric Motor.

Tower Windmill : A Fascinating Model

The model shown in Fig. 5 represents a "tower" type windmill. This differed from the earlier "post" type mill in that the main portion of the structure was fixed and only the "cap" or small upper part carrying the sail spindle and "fantail," revolved. In the post mill the entire structure was rotated in order to bring the sails into the wind.

The octagonal base of the mill comprises four 3½″ × 2½″ Flanged Plates to which 5½″ Strips are secured. The upper ends of each pair of Strips are attached to 12½″ Angle Girders spaced by a 2½″ Strip. Four 2½″ × ½″ Double Angle Strips are fitted between the four pairs of Girders so formed, but the ends of the Strips should be bent slightly outward. At the upper ends, the Angle Girders are held together by 2½″ Strips and Angle Brackets, a 3″ Pulley being attached, boss downward to the Strips by means of Angle Brackets. A second Pulley is attached to the superstructure by 1½″ Strips spaced from the Pulley by Collars, and secured by Angle Brackets to the 2½″ Strips of the frame. The two 3″ Pulley Wheels are placed together to form a substitute for a roller bearing, and an 11½″ Rod is passed through their bosses.

A Rod, journalled in the Plates forming the base of the model, carries a handwheel and a ½″ Pinion. A Coupling, remaining idle on the Rod but held in place by Collars, forms a journal for the rod passing up the centre of the model. A Contrate Wheel is fitted at the base of the Rod, and at its upper extremity a ½″ Pinion is secured, to mesh with a ¾″ Contrate on the Rod carrying the sails. Journals for this Rod are formed by a Flat Bracket and a Flat Trunnion.

Two 4½″ Strips are attached to a Double Bracket bolted to the superstructure to form journals for a short Rod carrying the fantail. A 1″ Pulley on this shaft is connected by a belt of cord to the lower 3″ Pulley attached to the frame, so that as the cap of the mill revolves the fantail is caused to rotate.

Two 1″ loose Pulleys revolving idly on journals at the lower extremities of the 4½″ Strips supporting the fantail form guides for the cord as it passes from the 1″ fast Pulley to the 3″ Pulley that forms the lower half of the swivel bearing. In an actual windmill of this type, the fantail was used to turn the sails into the wind. As the direction of the wind changed, the fantail was forced to revolve and bring into operation a system of gears which rotated the cap of the mill carrying the large sails or sweeps.

The most outstanding feature of a windmill is, of course, the large sweeps or sails. The name sails originated in the fact that they were at first covered with sail canvas and were reefed in a similar manner to the sails of a sailing ship. Mills of later design were provided with sweeps composed of a number of pivoted wood slats, that could be turned at any angle to suit the force of the wind. These were mechanically operated from the interior of the mill.

Fig. 5. Model Tower Windmill.

In the Meccano model 12½″ Strips are used in the construction of the sweeps or sails. Eight Strips are secured to a Bush Wheel in the manner shown and connected in pairs by means of 2½″ Strips. The structure is braced by the addition of 5½″ Strips which connect each of the sweeps.

The Tower Mill contains the following parts :—8 of No. 1 ; 16 of No. 2 ; 2 of No. 2a ; 6 of No. 3 ; 4 of No. 4 ; 16 of No. 5 ; 2 of No. 6a ; 8 of No. 8 ; 5 of No. 10 ; 1 of No. 11 ; 12 of No. 12 ; 1 of No. 13 ; 1 of No. 13a ; 2 of No. 15a ; 2 of No. 18a ; 2 of No. 19b ; 1 of No. 22 ; 2 of No. 22a ; 2 of No. 24 ; 2 of No. 26 ; 1 of No. 28 ; 1 of No. 29 ; 2 of No. 35 ; 126 of No. 37 ; 6 of No. 37a ; 10 of No. 38 ; 4 of No. 48a ; 6 of No. 48b ; 4 of No. 53 ; 9 of No. 59 ; 2 of No. 63 ; 4 of No. 90 ; 2 of No. 90a ; 4 of No. 100 ; 1 of No. 109 ; 6 of No. 111c ; 1 of No. 115 ; 1 of No. 126a.

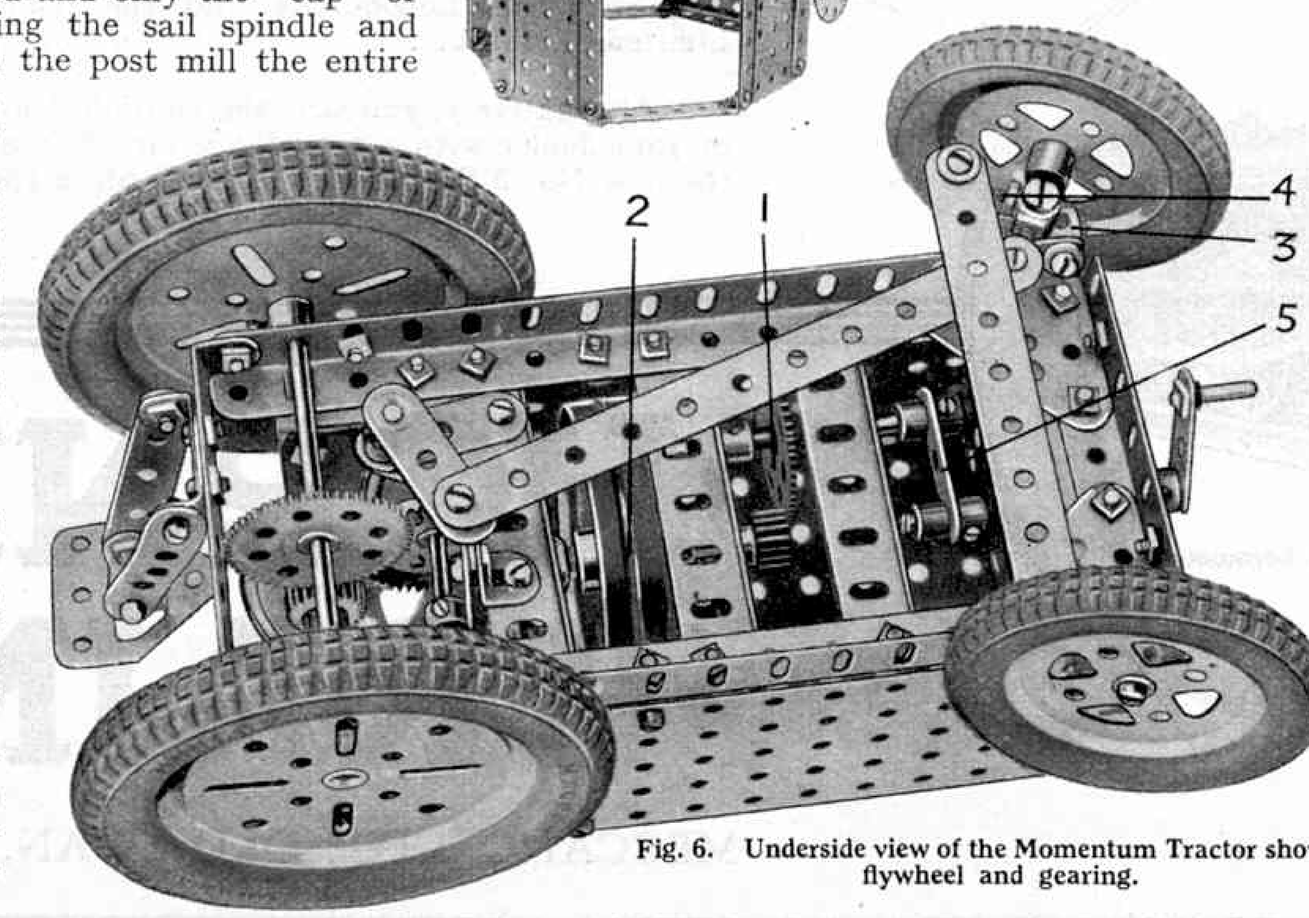
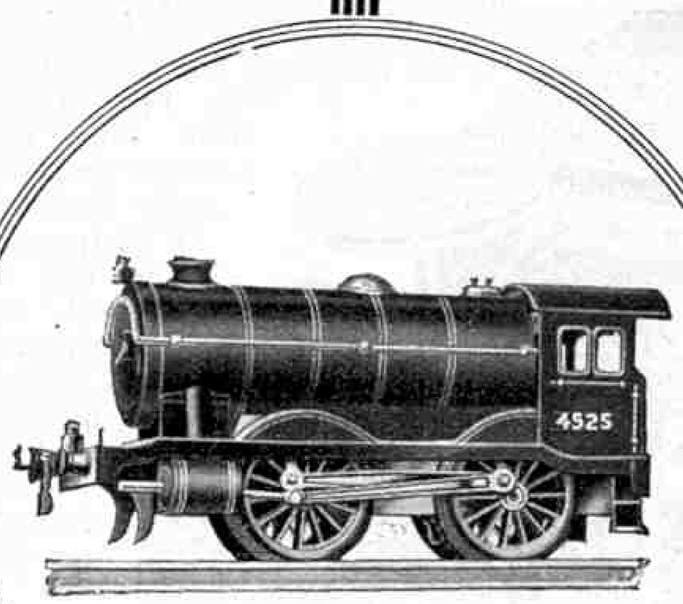


Fig. 6. Underside view of the Momentum Tractor showing flywheel and gearing.



Hornby No. 1 Special Locomotive

BOYS! Here is a plan to secure a fine new Hornby Locomotive

You have probably been using a Hornby Locomotive for some years and would like to own one of the fine new models that now figure in the Hornby Catalogues. The object of the new Hornby Locomotive Part Exchange Scheme is to help you to do this.

First of all, carefully study the latest Hornby Train Catalogue, and select the new up-to-date Hornby Locomotive you want; then carefully pack up your old Hornby Locomotive and post it to us, enclosing your order for the new one and the necessary remittance. You can easily ascertain how much to send by deducting the part exchange allowance indicated in the accompanying list from the price of the new Locomotive, and adding 1/– for postage on the new model you purchase.

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

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

No matter what the age or condition of your old Locomotive, you can exchange it under our "Part Exchange" plan. It is important to note that we cannot accept more than one old Locomotive in exchange for a new Locomotive.

If you decide to send your old Locomotive to us address your parcel to "Special Service Department, Meccano Limited, Old Swan, Liverpool," and be sure to enclose with it your own name and address written in plain characters.

Part Exchange Allowances for Hornby Locomotives

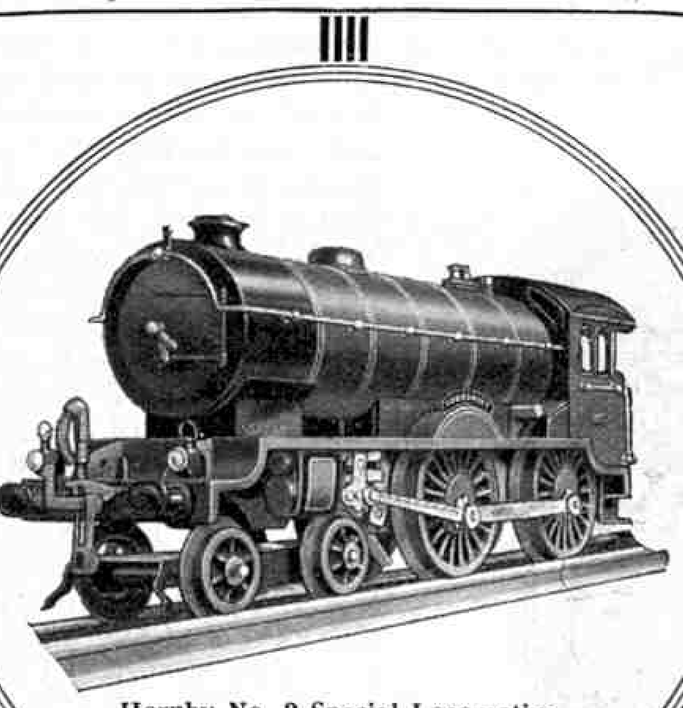
CURRENT TYPES	
M2930 Locomotive	1/–
M0 Locomotive	1/4
M1/2 Locomotive No. 3031	2/3
No. 0 Locomotive	5/3
No. 1 Tank Locomotive	6/3
No. 1 Locomotive	6/3
No. 1 Special Locomotive	8/3
No. 1 Special Tank Locomotive	8/3
No. 2 Special Locomotive	11/3
No. 2 Special Tank Locomotive	11/3
No. 1 Electric Tank Locomotive, Permanent Magnet	12/6
No. 2 Electric Tank Locomotive	18/9
No. 3E Locomotive	18/9
No. 3E Riviera "Blue" Locomotive	18/9
No. 3C Locomotive	13/9
No. 3C Riviera "Blue" Locomotive	13/9
Metropolitan C Locomotive	11/3
Metropolitan E Locomotive	20/–
OBSOLETE TYPES	
George V Locomotive, No. 00 Locomotive (These models were identical)	3/3
M3 Locomotive	4/3
Zulu Locomotive	5/3
Zulu Tank Locomotive	6/3
No. 2 Locomotive	10/–
No. 2 Tank Locomotive	11/3
No. 1 Locomotive, fitted for Hornby Control	7/6
No. 1 Tank Locomotive, fitted for Hornby Control	7/6
No. 2 Locomotive, fitted for Hornby Control	11/3
No. 2 Tank Locomotive, fitted for Hornby Control	12/6
Metropolitan E Locomotive	20/–

What you have to do

Here is an example of how the plan works. Assuming you have a No. 1 Tank Locomotive that you wish to exchange, you see from the list that its exchange value is 6/3. You then look at the Hornby Train catalogue and choose one of the new Locomotives, the cost of which is not less than 12/6 (or, in other words, not less than double the Part Exchange allowance we make for your No. 1 Tank Locomotive).

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, Liverpool.

Alternatively, you can take your old No. 1 Tank Locomotive to your dealer with a remittance for 18/9, and he will give you the new No. 2 Special Tank Locomotive that you require.

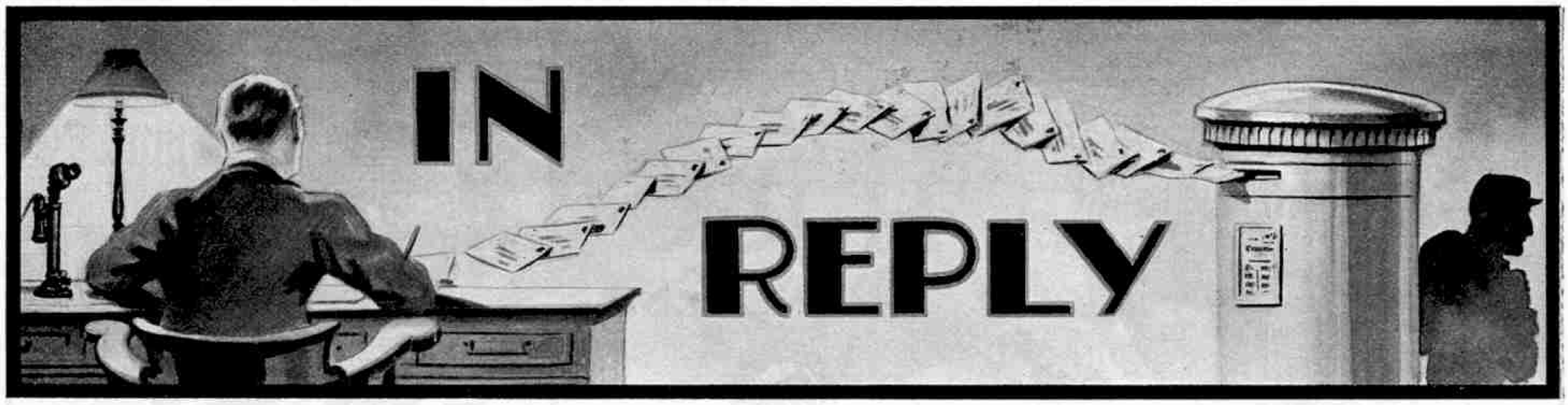


Hornby No. 2 Special Locomotive

HORNBY TRAINS

Manufactured by

MECCANO LTD., OLD SWAN, LIVERPOOL



READERS' SUGGESTIONS FOR MECCANO IMPROVEMENTS

SPECIAL LETTERING.—Special letters and figures cut from metal and perforated, or provided with threaded lugs at the back so that they could be secured to models, would form a novel addition to the system. There are a few instances where lettering is required, but the introduction of a complete range of letters and figures of this type would be a very expensive undertaking and it is very doubtful whether results would justify it. Letters and figures for securing to the cab sides of locomotives and tenders can be cut from the advertisement pages of magazines. (*Reply to T. F. Cox, Toronto, Canada*).

DOUBLE CONTRATE GEAR.—Your suggestion for a new contrate gear wheel is interesting. The wheel would resemble the existing Meccano Contrate Gear (part No. 28), but would be provided with two sets of teeth placed at right-angles on each side of the main face of the gear. This special contrate might be of use where a double right-angle drive is required in a confined space, but there are few instances where two of the existing contrates placed back to back cannot be employed equally well. (*Reply to D. C. Whittaker, Melbourne, Australia*).

NEW WINDING KEY.—This suggestion is for a winding key for the Meccano Clockwork Motor designed on similar lines to a well-known type of gramophone motor winding key. The key portion would consist of a metal tube having two spiral slots cut in one end. The winding spindle of the Clockwork Motor would be fitted with a metal pin that would project on each side of the shaft for a short distance at one end. The slots in the key would fit over the projecting ends of the pin on the winding shaft, so that if any attempt were made to turn the shaft backward the key would immediately slip off the spindle. This arrangement would certainly prevent damage to the spring of the Motor, but it would be costly to produce, and we find that the existing key is perfectly satisfactory if used with reasonable care. (*Reply to J. Duffield, London, W.11*).

NEW GRUB-SCREW.—In gear-change mechanisms, where the Meccano 57-teeth Gear Wheel has to be moved into or out of engagement with the Meccano ½" Pinion, or vice versa, it often occurs that the projecting end of the grub-screw in the boss of the ½" Pinion fouls the teeth of the gear wheel. The only way in which this can be overcome at present is by filing the tip of the grub-screw until the required clearance is obtained. We were therefore interested in the suggestion that a special small grub-screw should be introduced to overcome this difficulty. We shall give this idea consideration. (*Reply to R. O. Sexton, Notts.; F. Blake, Cardiff, and others*).

SMALL MACHINE TOOLS.—Meccano is excellent for building miniature machine tools, some of which can be put to practical use. Several machine tool models, such as power drills, lathes, etc., are shown in the Instruction Manuals, and the suggestion is that small cutting and boring tools should be supplied for use in these models. We shall consider this idea, but in the meantime it should be remembered that small drills and cutting tools suitable for use with Meccano models may be obtained from any tool merchant. For instance, interesting results can be obtained from an electric power drill using a Meccano Electric Motor suitably geared to a shaft fitted with a Coupling carrying a standard 5/32" Morse twist drill. (*Reply to E. Whalley, Blackburn*).

SPECIAL STRIP.—We have noted your suggestion that a three hole strip having a standard nut secured over one hole, should be introduced. This would be useful in screw adjustment mechanisms, but the functions of the part are already covered by the Meccano Threaded Crank (part No. 62a). (*Reply to G. L. Morrison, Luton*).

CHANNELLED PLATES.—Perforated plates fitted with flanges of channel section would have a certain amount of use in general constructional work. They could be employed, for instance, as base plates where the superstructure is required to slide backward and forward, the channel flanges acting as guides, so that the plate forms a grooved bed. Plates of identical section can of course be built up from Meccano Flat Plates and Angle Girders, but the bolt heads are likely to get in the way. This idea will be considered. (*Reply to N. A. A. Cowl, Gt. Yarmouth*).

PREVENTING INTERFERENCE.—This suggestion is for a method of preventing the Meccano Electric Motors from causing electrical interference in a radio receiver. When an electric motor is set in motion the arcing at the commutator sets up "static" in the surrounding ether, and this will be reproduced in the loudspeaker of a radio set in the form of a series of annoying "crackles." This may be overcome by connecting an electrical condenser of about 2 mfd. capacity across the Motor terminals. This will be found effective in most cases. When a high-voltage motor is in use a single condenser may not be sufficient and in this case two condensers of equal capacity should be connected in series, between the terminals of the motor, the centre joining lead also being connected to the metal frame of the motor and "earth." (*Reply to C. W. Beese, Tavistock, Canada*).

Our illustration shows a fine Meccano model of the new Auckland Station, New Zealand's finest railway station. The model well shows the high and low level approaches for traffic.

The station was officially opened on the 24th November last by the Minister of Railways. The number of trains handled in and out of Auckland daily has increased by over 50 per cent during the past 20 years.

This fine model was built by a member of the staff at Models Ltd., Auckland (our New Zealand agents).

TAPERED STRIPS.—Perforated strips of a special tapered shape might be of use in the construction of curved structures such as the fuselages of aeroplanes, motor bodies, etc. We are keeping your designs in hand for reference. (*Reply to M. H. Maufe, Ilkley*).

TEN SHILLINGS FOR A BRIGHT IDEA! Many novel suggestions regarding Meccano parts are forwarded to us, and in order to provide additional interest we are offering a prize of 10/- for the most ingenious idea submitted each month. Each suggestion submitted should be written on a separate sheet, and the name and address of the sender should appear on each sheet used. Envelopes should be addressed to "Suggestions," Meccano Ltd., Binns Road, Old Swan, Liverpool.

The prize of 10/- for the month of April has been awarded to R. Barlow, Sheffield, for his idea for a ball and cone bearing unit.

LARGE TYRE.—We note that you wish to use the Meccano 6" Pulley Wheels as the road wheels of a "super" model racing car and therefore suggest that we introduce special Dunlop Tyres for fitting to these wheels. We must congratulate you on your enterprise in attempting to construct such a large model, but we regret that the introduction of the special tyres is out of the question, owing to their cost and general utility in this function. We suggest that you obtain a quantity of "pram tyreing" and secure a length around the rim of each Pulley. This should give quite a realistic effect. (*Reply to N. MacBoyle, Palmers Green, N.13*).

TUBULAR AXLES.—Your scheme for providing a duplex shafting system in a model gear box is ingenious and has possibilities. Your idea would be to use axle rods slightly smaller in diameter than the existing Rods, and to use special tubes that would fit over the axles to provide a compound rod having the same external diameter as the standard Meccano Axle. It would then be possible to mount Gears and Pulleys on the sleeve and small axle respectively and drive them at different speeds. We hope to give this idea further consideration. (*Reply to M. Strasberg, Brooklyn, N.Y., U.S.A.*).

THREADED COUPLING BLOCK.—Your suggested coupling block consisting of a length of square section metal about 2½" long, having standard Meccano threaded and plain holes bored in it in three directions at standard ½" intervals, is interesting. The part would form a "universal" connecting piece for Strips, Plates and Rods, and no doubt it would be useful in many mechanisms. The drawback to its introduction is the cost of production. (*Reply to J. F. Botham, Colchester*).

2" ARTILLERY WHEEL.—A 2" diameter spoked wheel similar to the 3" diameter Artillery Wheel might be of some use in small models. We shall keep this idea in mind, but it should be remembered that the Meccano 2" Pulley Wheel fulfils many of the functions of the proposed wheel, although it does not perhaps possess the realism of the spoked type. (*Reply to D. C. White, Bangalore, India*).

NEW BEVEL.—A 2½" diameter Bevel Wheel that could be meshed with a ½" diameter Bevel to provide a right-angle drive having a ratio of 5 : 1 would be useful in certain mechanisms. We are considering introducing a new gear wheel to mesh with a Meccano ½" Pinion to provide the useful ratio of 5 : 1, and your special 5 : 1 right-angle drive gears would not then be necessary. We hope to make a further announcement regarding the new gear wheel soon. (*Reply to M. E. Chamberlain, Kettering*).

¼" DIAM. PINION.—A ¼" Pinion is not included in the Meccano system. A pinion of this size is used in the Clockwork Motor and may be obtained separately, price 3d. (*Reply to R. S. Hartnell, Bundaberg, Australia*).

NEW 1½" PULLEY.—A 1½" diameter pulley, without boss or set screw, might be of use in the construction of large multi-sheave pulley blocks. A 1½" pulley is seldom required to be used in confined spaces where the boss would get in the way, however, and unless some very obvious advantages for a "bossless" 1½" pulley wheel can be found, the introduction of this part cannot be considered. *Reply to J. Glaves, (Easingwold)*.

SPECIAL WORM.—An axle rod having a worm thread cut in it for a distance of about 1" would form a novel part. This worm axle could be used in conjunction with a worm wheel having special teeth, and these parts would form a very compact worm drive unit. We shall examine the possibilities of this idea. (*Reply to F. E. Long, Birmingham*).

Railway Photography

For some time past I have been urging H.R.C. Branches to pay more attention to railway photography, with the object of forming an interesting collection for permanent use. Recently several Branch secretaries have written to me pointing out that although some of their members possess cameras, these are only of a small and cheap type, and that the results obtained by means of them have not been encouraging. It seems to me probable that other Branches may be worried in the same way, and therefore I take this opportunity of giving a few words of advice on the matter.

First of all, the fact must be faced that the photography of main line expresses travelling at 60 or more miles an hour requires a camera fitted with a focal plane shutter capable of speeds of 1/800 of a second or shorter. Such subjects are utterly beyond the scope of an ordinary cheap hand camera, the highest shutter speed of which, although it may be marked at 1/100 of a second, is more likely to be 1/30 or 1/25. If the possessor of a slow shutter of this type feels that life is not worth living unless he can capture the "*Flying Scotsman*," the "*Royal Scot*" or the "*Cornish Riviera Express*," he must resort to strategy and catch these famous trains at a weak moment—for instance, when they are emerging from a station and before they have had time to pick up speed.

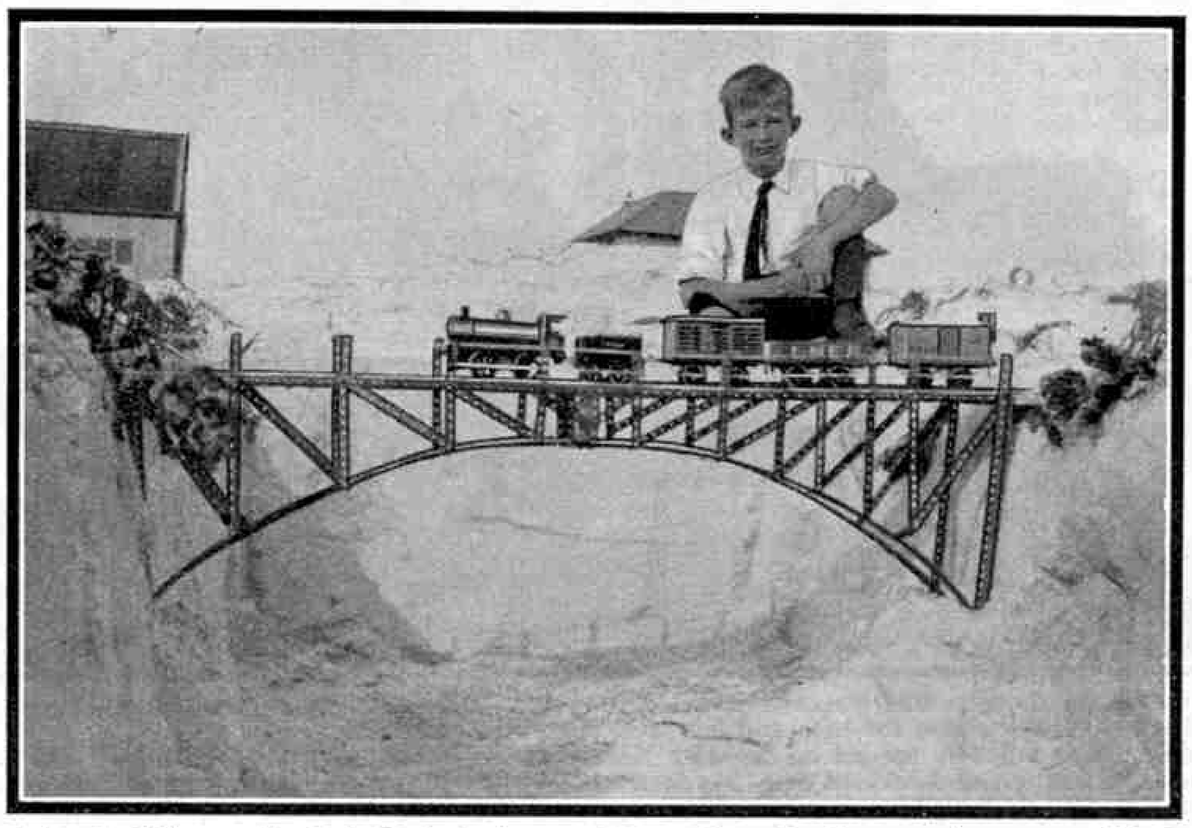
A point that is worth considering is the fact that a high-speed photograph of an express tearing along with comparatively little steam or smoke showing often gives no suggestion of movement; the train appears to be standing still. On the other hand, a train leaving a station is usually producing both steam and smoke in considerable quantities, and a photograph taken at such a moment invariably gives a decided impression of movement. For the same reason some of the most successful train photographs that I have seen are of comparatively slow trains photographed on a severe rising gradient, where the engine is "breathing hard." To sum up this matter, I recommend the owners of cheap cameras to try their hands at trains moving at a very slow speed.

No railway photograph is of any value unless it is sharply focussed. With a small camera it will be found impossible to include a whole train in the view finder without standing back from the train for a considerable distance, and at this distance with a fixed-focus camera the focussing is likely to be fairly sharp. It should always be remembered that a small sharp image is better than a large and fuzzy one, for the former can be enlarged up to a considerable size, whereas the latter is useless for any purpose.

Moving trains, however, form only a very small proportion of the available railway material. For my own part, indeed, I do not even consider that they are the most interesting from a photographic point of view. My own special enthusiasm is for locomotives, and I am much more interested in a collection of what might be called "portraits" of engines taken broadside on. The fact that the engine is stationary gives one ample time to secure a really good and sharply-focussed picture. Here again, if the camera is of the "fixed-focus" type, a small sharp picture should be aimed at. Apart from locomotives there is nowadays an astonishing variety of wagons; and a collection of photographs of a large number of different types would be not only of interest, but of real value.

Finally there is endless scope for photography in and around stations, goods yards, etc. In taking photographs actually inside covered stations it should be remembered that the intensity of the light is greatly reduced, and full allowance should be made for this. In very many cases a time exposure will be necessary, and this can usually be managed by finding something solid on which to rest the camera.

To deal with the subject of railway photography at all adequately would require a volume. All I have done is to make a few suggestions; and if I find readers are interested in the matter I may give further hints later. In the meantime I invite every H.R.C. member who is finding trouble with his railway photography to write to me explaining exactly where his difficulty lies.



A South African enthusiast, R. J. Andrews, of Erme, Cape Province, carries out combined Meccano engineering and Hornby Railway operations in the sand.

Branch Exhibits at Summer Functions

During the winter months many H.R.C. Branches provide railway displays to help things along at bazaars, sales of work and other functions. So far, however, very little has been done in the way of displays at small flower shows, garden parties, etc., and I suggest to Branch Chairmen and secretaries that there are considerable possibilities in this direction. A well-planned model railway is just as interesting in summer as in winter; and the organisers of small functions designed to help some local charity are usually very glad to welcome an additional attraction of this kind. Unfortunately the weather sometimes plays unkind pranks on such occasions, and if the railway material has become wet it should be dried at the close of the event.

The main requirement for success with a railway exhibit of this kind is an organised scheme of working. It is best to plan out a short but interesting sequence of train movements, running to a timetable that gives an ample margin for the completion of every movement within the specified time. This scheme should be carefully rehearsed by the members who are to be in charge of operations, until it can be carried out every time without a hitch. There is of course no need to attempt to keep trains running all the time; the best plan is to run through the pre-arranged programme and then have an interval during which interested spectators may examine the railway and discuss its various features with those in charge. Then the programme should be carried out again, followed by another similar interval, and so on.

For layouts of this kind I strongly recommend that, whenever it can possibly be managed, a tunnel should be included of sufficient length to hide a complete train for an appreciable time. The mild excitement of watching trains disappear into the tunnel, and wondering whether they will come out all right at the other end, adds greatly to the general enjoyment. As a rule a considerable proportion of the members of a Branch are also Meccano enthusiasts, and by combining forces they might produce a large model that would add greatly to the interest of the layout.

Branch Notes

SOUTH BIRMINGHAM.—Many improvements to the Branch layout have been effected during the month. Station buildings, sidings, etc. have been re-built. The main terminus "Friary" has been renamed "St. Davids" and enlarged to a six platformed station. The sidings of the L.M.S.R. section have been enlarged to a three-way marshalling yard. Controls are now worked from two lever frames situated in the control space. Colour light signalling is proving very successful for remote signals and allows faster working. Fast main line traffic is very popular and forms the chief feature of the train operations carried out. Two railway companies are represented in the Branch. These are the L.M.S.R. and G.W.R., and extremely keen competition exists between the two sections. Secretary: Eric Sharp, 156, All Saints Road, King's Heath, Birmingham.

HIPPERHOLME AND DISTRICT.—An interesting lecture has been given on "*Goods Trains and their Running, and Observation Cars.*" Visits have been paid to some local mills and also to an Exhibition of Model Engineering. The Branch is hoping to have all double track shortly, and also to publish its own magazine. Secretary: D. Turner, "Bretonneux," Hipperholme, Yorks.

"EAGLEHURST" (PALMERS GREEN).—A large amount of time has been devoted to engine running and testing. Extensive experiments have been made with various layout formations and the layout adopted gives ample room for at least ten engines to be either running or stationed in a siding. As soon as the engine tests are complete, time-table working is to be installed. Secretary: R. Cotton, 236, Princes Avenue, Palmers Green, London, N.13.

HAROLD WOOD.—Several alterations and improvements have been made to the Branch track. Great progress is being made with the installation of colour-light signals on the Branch layout. The members attended a very interesting lantern lecture by C. J. Allen entitled "*Speed and Safety on Railways.*" Mr. Allen dealt with Britain's most famous expresses and the manner in which they are run. A debate has been arranged on the subject "*Which is the Best British Express?*" Secretary: E. N. Tyler, 2, The Ridgeway, Harold Wood, Romford, Essex.

OXTON (BIRKENHEAD).—A debate was held on the motion "*That British Railways are better than American Railways,*" and after a very interesting discussion this was carried. A visit has been paid to Morpeth Dock, Birkenhead, and the members were conducted around. Among the many items of interest seen was the special handbrake peculiar to the G.W.R. trucks. Electric Cantilever and Mobile Cranes were also demonstrated to the members. The loading of the night goods train was then watched, and the building where grain is stored inspected. Arrangements are being made for a lantern lecture to be given by the Chairman. Secretary: M. G. Wright, 2, Arnside Road, Oxton, Birkenhead.

FIRST BOLTON.—Regular visits are paid to Lostock Junction where the passing expresses are always a source of great interest. A trip is being organised to Horwich. The H.R.C. official railway forms are in constant use and the Branch track is always operated to a timetable. The Branch layout has been altered recently and the well-known expresses, the "Flying Scotsman" and the "Harrogate Pullman," are now run in addition to an extensive goods service. Experiments are now being made with colour light signals. Secretary: Arnold Ainley, 11, Stirling Road, Astley Bridge, Bolton.

HILL TOP (WILMSLOW).—The Branch has paid interesting visits to Victoria Station, Manchester, and the Tiviot Dale line at Stockport. At Stockport the members were very interested in some Sentinel-Cammell steel rail cars that they saw. It has been decided to purchase a locomotive for express passenger work and also several more signals. The layout is now properly signalled and members who fail to observe the signals are punished! It has been decided to hold one railway trip and one lecture each week during the summer months. Secretary: J. Manby, "The Croft," Hill Top, Wilmslow, Cheshire.

MARLBOROUGH (SOUTHPORT).—This Branch is the fortunate possessor of a very extensive layout, which is laid in three underground rooms. Deepdene Station is situated on a low level and is carried underneath Marlborough, and a branch line is deflected off the Deepdene line via a tunnel through Newton Hills, the wall between the first two rooms. This will connect up with New City (low level) and Claxonby, Reddington and Rossendale, in the third room. An additional tunnel is to be driven in the neighbourhood of the first one in order to afford connections with a number of villages in the Newton Hills. Secretary: G. R. Bartram, "Milestones," Blundell Drive, Birkdale, Lancs.

BLACKPOOL (SOUTH SHORE).—This Branch had the misfortune to lose its club room, and for some weeks the members could only meet together for debates. They have since been allowed the use of a garage in which shelves have been built and track laid down. Some of the members visited South Shore Goods Yard armed with pocket books and pencils and made sketches of various wagons. The Fretwork Section are now reproducing the wagons in miniature. Secretary: R. V. Bentley, 9, Bamton Av., Watsons Road, South Shore, Blackpool.

Some of the members of the "Robert Hill" (Kidderminster) Branch, No. 157. President, Mr. R. Hill; Chairman, Mr. C. P. Harris; Secretary, Mr. W. Barker. This Branch was incorporated eight months ago and in that time has nearly doubled its membership.

Further Branches in Course of Formation

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

BIRMINGHAM—E. J. Howell, 162, Lightwoods Hill, Warley Woods, Birmingham.

CHORLTON-CUM-HARDY—F. Darlington, 26, Higson Avenue, Chorlton-cum-Hardy.

DAGENHAM—S. Pashley, 84, Holgate Road, Dagenham.

HAMBLE—R. Williams, 2, Sydney Avenue, Hamble, Hants.

HAMPTON-ON-THAMES—F. C. W. Drake, "Beaulieu," Broad Lane, Hampton-on-Thames.

ILKESTON—F. Caddick, "Woodthorpe," Catherine Avenue, Ilkeston.

LONDON, E.9—David J. Lewer, 92, Gore Road, South Hackney, London, E.9.

PADIHAM—Alec Wood, 102, Burnley Road, Padiham.

PARKGATE—Fred Healey, 8, Broad Street, Parkgate, Nr. Rotherham.

RICKMANSWORTH—Frank Dines, 7, Hill Rise, Rickmansworth.

SKEGNESS—P. Allen, Avenue Cottage, The Park, Skegness.

THURMASTON—Keith Mann, 8, Colby Road, Thurmaston, Nr. Leicester.

OVERSEAS

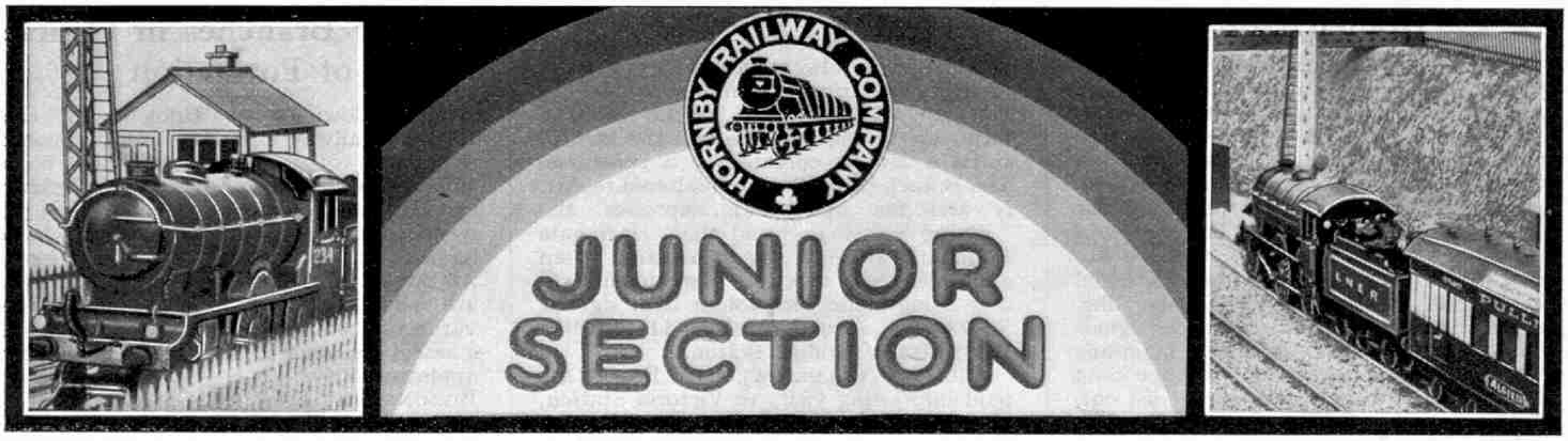
NEW ZEALAND—D. Thompson, P.O. Box 54, Blenheim.

NEW ZEALAND—R. Hall, 110, Albert Street, Palmerston North.

AUSTRALIA—J. R. Isherwood, 32, D'Arcy St., South Hobart, Tasmania.

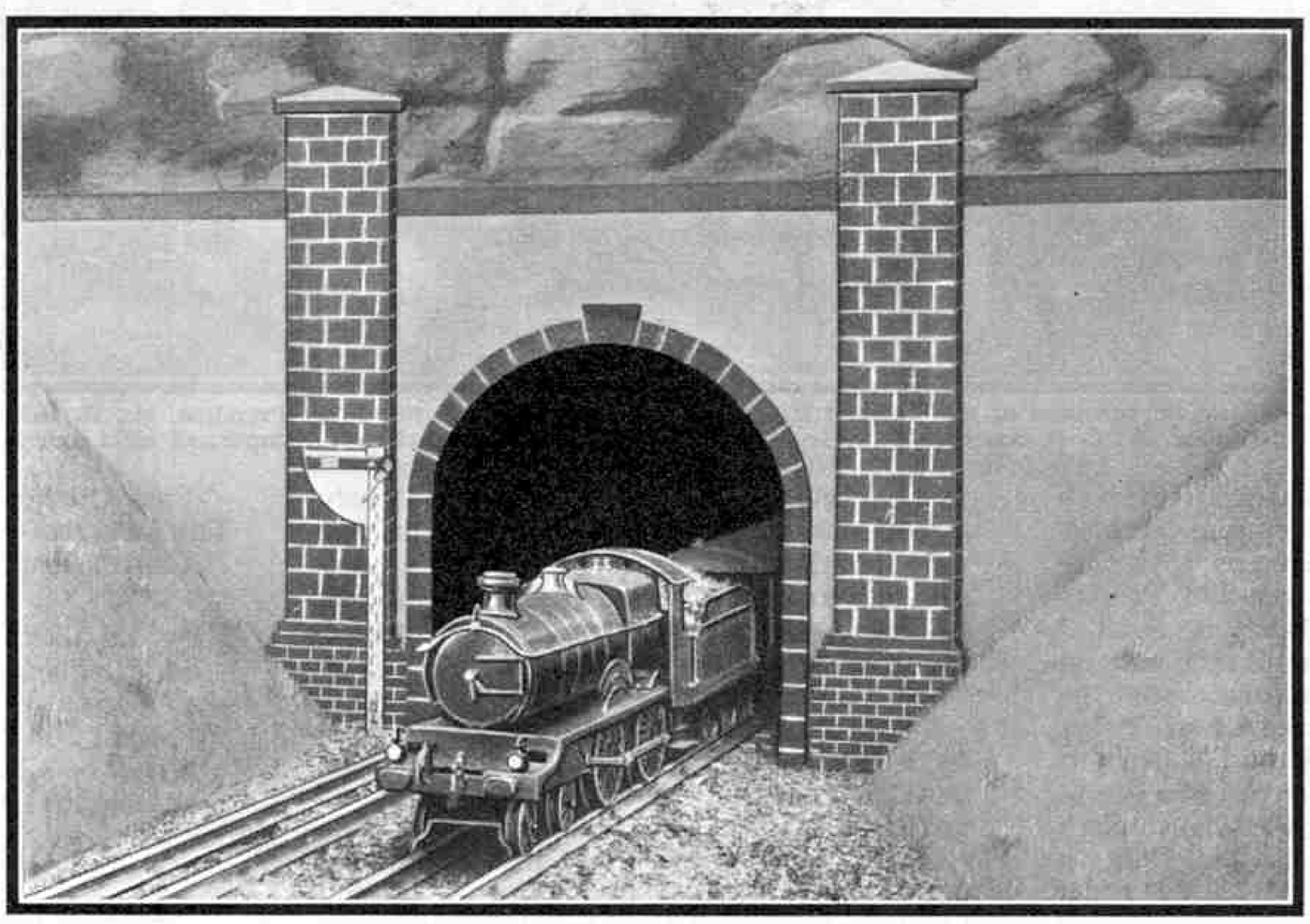
Further H.R.C. Incorporated Branches

168. BAMFORD HORNBY RAILWAY CLUB—Alan S. Harman, Police Station, Bamford.
169. MARLBOROUGH (SOUTHPORT)—G. R. Bartram, "Milestones," Blundell Drive, Birkdale.
170. NEILSTON—R. Montgomery, 2, Millview Terrace, Neilston, Renfrewshire.
171. WESTBURY HOUSE MODEL RAILWAY CO.—Peter Chamberlin, Westbury House, West Meon, Hants.
172. BOLSOVER & DISTRICT—J. L. Lee, Mooracre Lane, Bolsover, Nr. Chesterfield.
173. ALDERSHOT & DISTRICT—M. Charles, "Bandon," Church Hill, Aldershot, Hants.
174. THE RAILWAY CIRCLE (KING EDWARD SCHOOL)—P. J. Worlock, King Edward School, Southampton.
175. HIPPERHOLME & DISTRICT BRANCH—J. D. G. Turner, "Bretonneux," Hipperholme, Nr. Halifax.



XXX.—THE USES OF CARDBOARD ON MINIATURE RAILWAYS

IN each of the photographs on this and the following page are shown various accessories that have been constructed of cardboard. Junior enthusiasts will notice how realistic these look, and no doubt will be eager to attempt similar structures for use on their own layouts. Suitable accessories of this type add considerably to the interest and attractive appearance of a miniature railway, and provided ordinary care is taken, there is no difficulty in their construction. In this article we propose to explain the general method by describing in some detail the making of one of these accessories—the tunnel mouth—and from this description readers will find it quite simple to construct the coal stage and the plate girder bridge. We shall be glad to help readers who find any difficulty in making these accessories.



The cardboard tunnel mouth referred to in this article. Signals in positions such as the one shown are provided with a white "artificial background" as they are apt to be difficult to see.

Before commencing building operations we will consider the materials required. For the main part of the work cardboard of average thickness is suitable. All that is necessary is that the board should be strong enough to retain its shape without bulging, which rules out the very thin cardboard of which some boxes are made. In addition a small amount of thicker cardboard or strawboard is required for the construction of sections that are required to carry weight. This strawboard is difficult to cut and to handle generally, and it should only be used where required. The pieces for the sections for which this thick board is used may with advantage be made of wood if suitable wood and tools are at hand; but this is not at all necessary, and the thick board will do all that is required. As regards the adhesive for fixing together the various sections of our structure, there is nothing to beat Seccotine for simplicity of use and holding power. In every case, where two sections have been Seccotined together, they should be placed on one side under even pressure of some kind until the adhesive has set quite hard.

Finally, the actual cutting should be done with a sharp knife, using as a straightedge either a steel rule or a Meccano Girder. It is difficult to cut even thin cardboard satisfactorily with scissors, and thick board cannot be cut without hurting both the hand and the scissors. A sharp knife carefully used will give a clean-cut edge, and any slight roughness that remains is easily got rid of by gentle application of fine sandpaper.

We will commence by describing the construction of the tunnel mouth. In order to make this we require a sheet of medium cardboard 18 in. in length by 11 in. in breadth. Having obtained our sheet the next step is to mark it out; and this must be done accurately, otherwise, when the mouth is complete, it may be found to be of the wrong dimensions. It would be annoying to find it too small to allow trains to pass through! Fortunately the marking-out process is quite easy.

The first step is to mark an upright centre line on the board and other vertical lines at a distance of $3\frac{1}{2}$ in. on each side of it. These outer lines mark the edge of the opening or bore of the tunnel. On the centre line a point is marked 5 in. from the bottom edge of the card. Then, with a pair of compasses, a half-circle is drawn with this point as its centre, so as to meet the two outer lines. We now have the outline of the tunnel bore, and this should be plainly marked, so that no mistakes shall occur when cutting it out. The outer edge of the course of bricks lining the bore may now be indicated by lines drawn about half-an-inch outside those already marked.

The two towers may now be prepared in the following manner. Their general shape is clearly shown in the photograph, and the strips of which they are made should be of the thickest cardboard, or at any rate of

board thicker than that used for the tunnel mouth. The towers are 13 in. high, and 3 in. broad at the base, where they are widest. The pointed capping is $2\frac{3}{4}$ in. wide, and the centre portion between the capping and the base is $2\frac{1}{4}$ in. wide. Where this centre portion meets the base the latter may be "stepped" as shown in the illustration. This stepping improves considerably the appearance of the towers, but of course it is not necessary and may be omitted if desired. The position of the towers is easy to determine, as the inside edges of the bases are made to touch the outside edges of the bricks lining the bore.

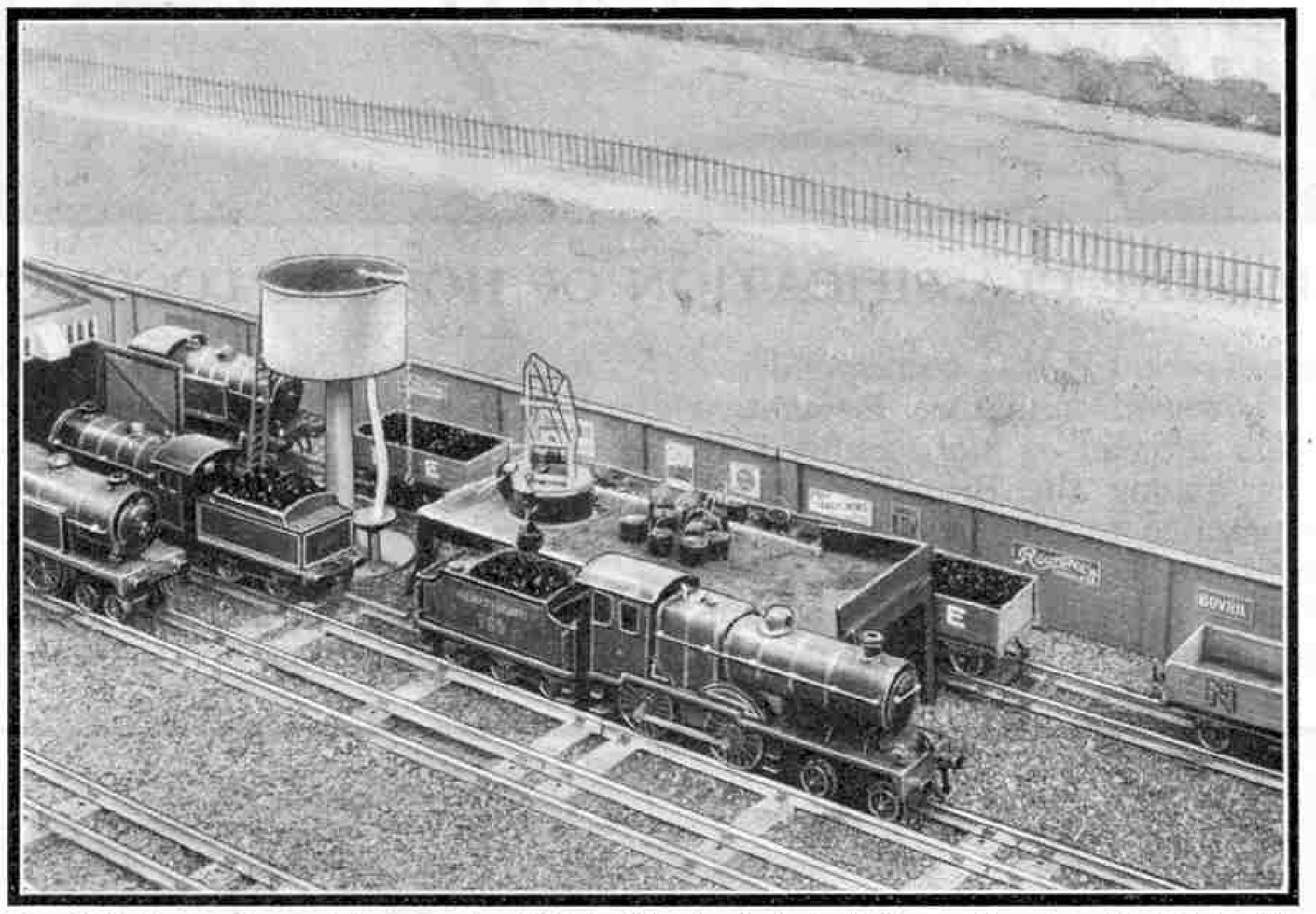
When the towers have been cut to shape, they should be laid in place on the tunnel face and a pencil run round them in order to mark their position. Seccotine should now be spread over the portion of the face outlined in this manner; and the backs of the towers also should be coated with it up to the level of the top of the tunnel face. The towers should then be placed in position and pressed firmly down, care being taken that good contact is made all over the surface to be fixed. Then should follow setting under pressure, as advised in an earlier paragraph. This may be done between two boards.

Two pieces of board of the same shape as the portion of the tower that projects above the tunnel face should now be cut and Seccotined to the backs of the projecting portions of each tower. In order to stiffen up the construction a further strip may be added in each case to reach to the bottom of the tunnel face.

The appearance of the tunnel face will be greatly improved by fixing across the top of it a strip half-an-inch in depth as shown in the photograph, this strip being broken where the towers come. The arch itself may be made more realistic if the large "keystone" at the top is cut out and fixed on in position, so that it is slightly raised above the general level of the tunnel face.

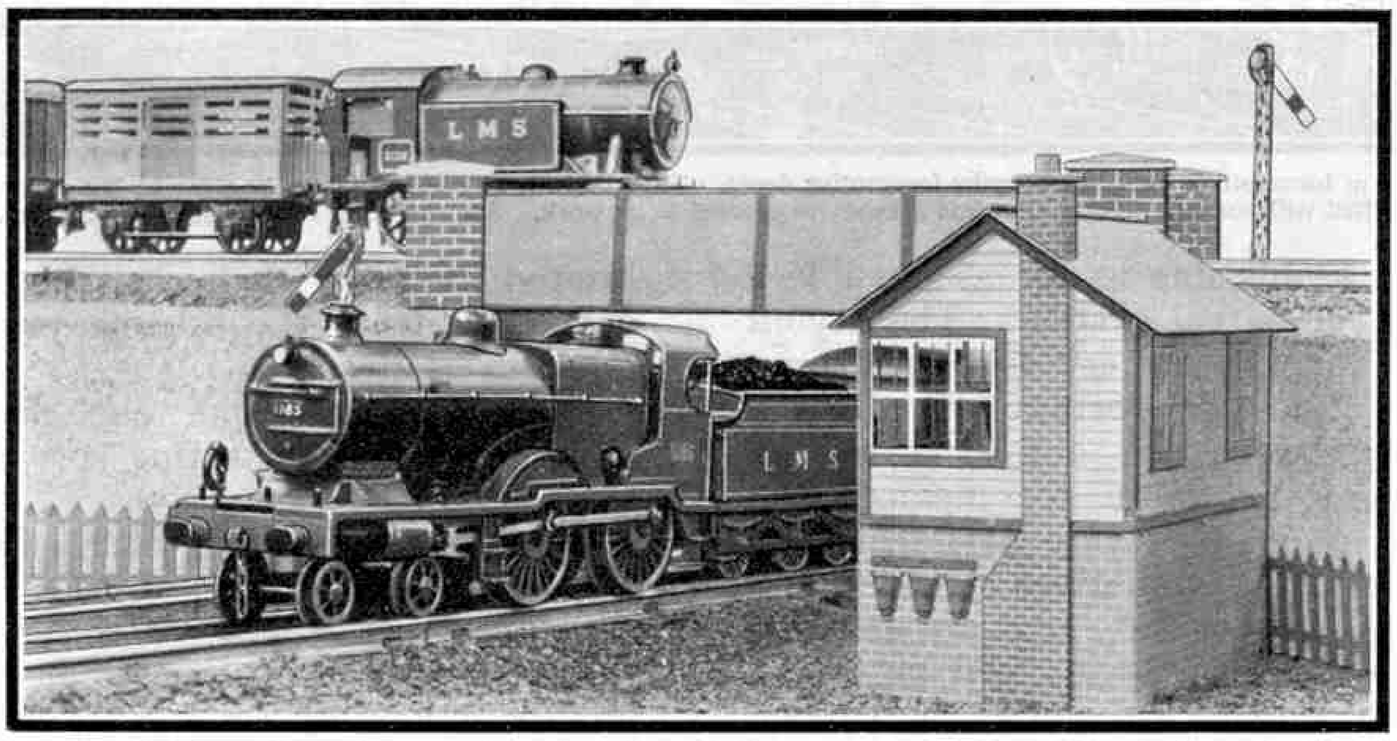
When the construction has been completed, and all the parts are firmly set, a commencement may be made with the finishing. This may be varied as desired, but perhaps the most realistic results are obtained by using a medium grey paint for the face itself, and a darker grey for the top strip, the towers, and the bricks forming the arch. The paint should not be put on too thickly, as otherwise the effect of the model will be spoiled. When it is dry the outlines of the bricks of the arch and the towers should be marked out in white paint. This marking must be done accurately, in order to look effective; and for this reason it is best to do it first in pencil and then go over the pencil lines with paint.

When the paint is dry the complete tunnel mouth is ready for use, and it is equally suitable for a permanent line, or one where the rails have to be taken up each time after use. For a line of the latter type the actual tunnel may be nothing more complicated than a wooden or cardboard box, the inside of which should be painted black to give the effect of darkness inside the tunnel. The hill through which the tunnel is supposed to be driven may be represented by green cloth placed over the top of the box.



A realistic locomotive yard in a country district. The simple but effective cardboard coaling stage adds considerably to the general appearance. Locomotives may be coaled by means of the Hornby Crane mounted on the stage, which handles the tubs in a business-like manner.

Little need now be said in regard to the other two accessories. The coal stage consists essentially of a platform resting on four supports. Both the supports and the platform should be of the thickest cardboard available, and to prevent the platform from sagging an additional support should be placed beneath it in the centre. A Hornby Platform Crane is mounted on the platform. The base portion is detached by turning back the lugs in the circular platform of the crane. Small slots are made in the platform of the coal stage to correspond with these, and the crane is then fixed in position by passing the lugs through and turning them over. The tubs or skips for the coal are small pill boxes. For finishing the coal stage plain black paint is the most suitable.

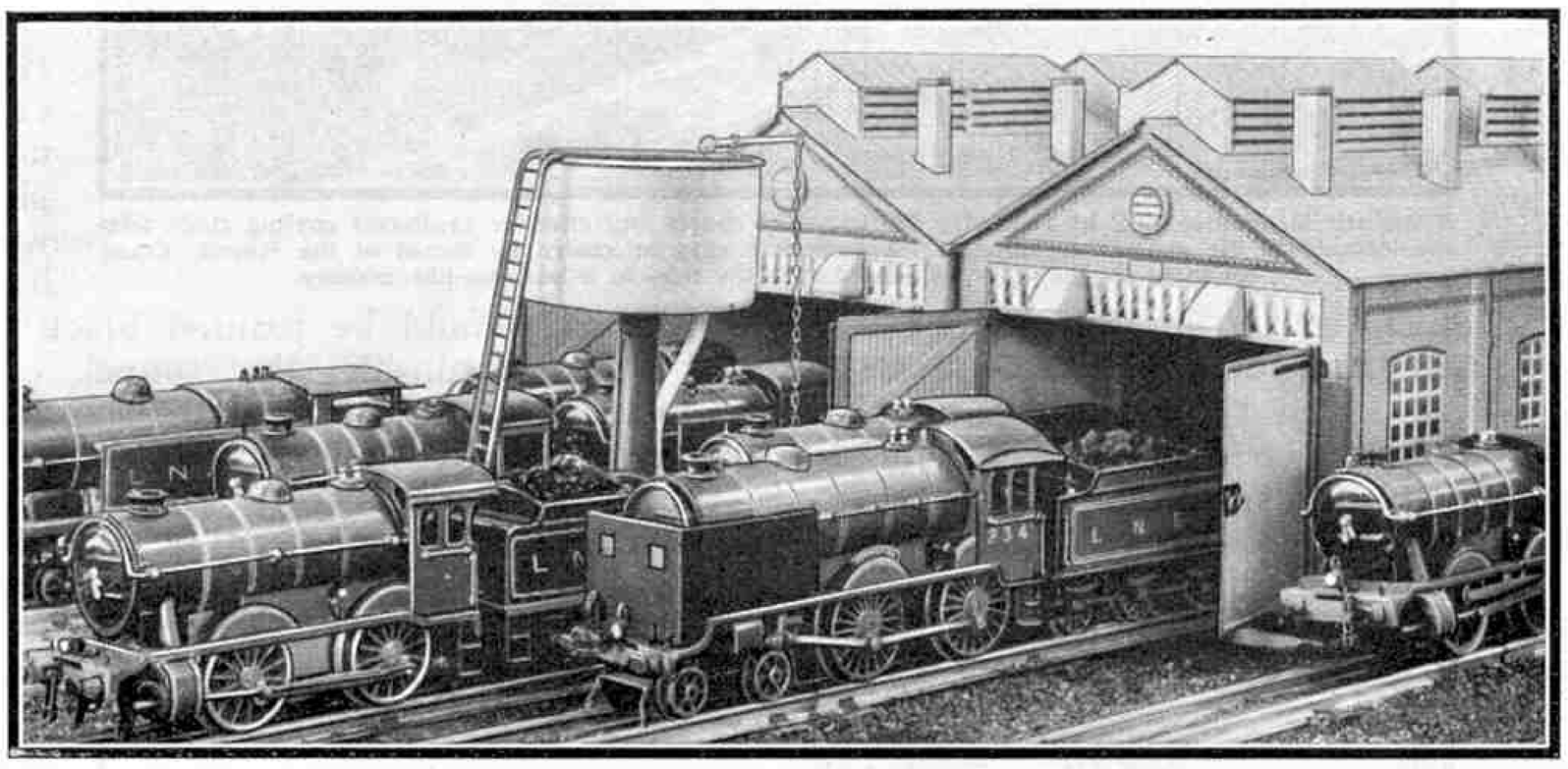


An attractive plate girder bridge carrying a single line of railway across a double track main line. Cardboard is used in its construction, and it is strong enough to bear the weight of the train shown crossing it.

The plate girder bridge should now present no difficulty. The floor and the supports should be of the thickest cardboard or of wood.

XXXII.—THE CLASSIFICATION OF HORNBY LOCOMOTIVES

A STRIKING feature of recent H.R.C. correspondence is the interest shown in miniature locomotive performance. This interest is not confined to individual members, for among the Branches also it has become a regular practice to hold periodical locomotive tests as a change from the normal track meeting. At first thought this might appear to be rather a humdrum way of spending an evening, and it is true that proceedings of this kind can be deadly dull if carried out half-heartedly. In a Branch, however, or among individual members when several engines are engaged, the spirit of competition is aroused and the tests become quite exciting.



A group of locomotives outside a Hornby locomotive depot. The L.N.E.R. "Yorkshire" locomotive in the foreground is fitted with an indicating shelter and is ready to proceed to its work. The shelter is easily made of cardboard.

The aim of every model railway owner is, or should be, to make his line as far as possible a miniature reproduction of a real system. The layout should be railwaylike, and the scenery and accessories realistically arranged; most important of all, the train operations should be carried out in a regular and systematic manner, preferably by means of a definite timetable. In order to secure this last condition it is necessary that the locomotives in use should be suited to the various turns of duty that are assigned to them, otherwise confusion and delay will be bound to result. This arrangement of duties is carried out in real practice by the locomotive running superintendent and his department and, as may be imagined, when large numbers of locomotives of different classes are in use, these officials have a difficult task in securing the best possible results from the locomotive material at their disposal. On a miniature railway the suitability or otherwise of the engines for their different jobs can only be found by trial, and here lies the value of the running tests to which we have just referred.

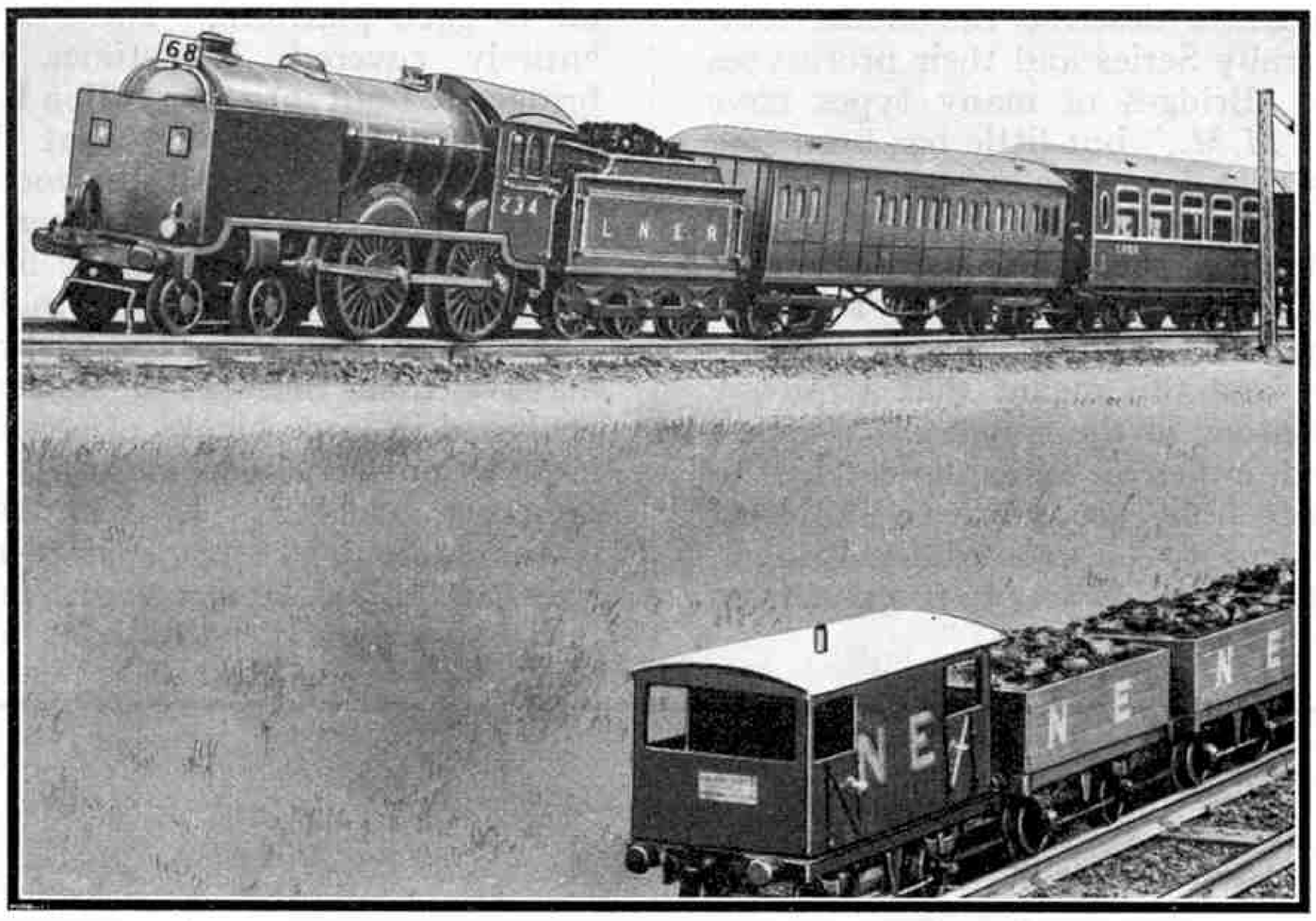
Various standard loads should be made up, and tests made of the running of each locomotive with each different load, the results being carefully noted in the manner described on page 149 of the "*M.M.*" for February last. It is of course necessary that the vehicles used should be in good running order, so as to give the locomotives every chance, and the engines themselves should be in good condition. As a result of these tests the engines may be classified according to the loads hauled and the distances covered; and this classification is of great assistance in drawing up the working timetables. It enables each engine to be suited as nearly as possible to the train it has to haul. Any excess of load over that for which the engine is classified will necessitate division of the train or the employment of a pilot engine. This system follows closely the L.M.S.R. practice of limited loads for each class of engine, which has been developed from the scheme previously in use on the Midland Railway.

From time to time our great railway companies make a practice of testing specially their various types and classes of locomotives. Now and again may be seen an engine running with a big box-like contrivance fixed on the footplate of the leading end, and many people wonder what this is for. The purpose of this erection, which is known as an indicating shelter, is to provide a housing for the observers of the locomotive department who are engaged in recording the results of the tests. Special forms of apparatus are used, and it is to watch these that the observers are carried in the shelter.

Possibly increased weight or speed of the trains is beginning to make its effect felt on the present express locomotives, or it may be that the chief mechanical engineer has several classes for the work and is undecided as to which design he should follow when additional engines are required. He arranges therefore for a series of tests of the various classes upon the hardest duties, and the manner in which the engines acquit

themselves is carefully noted. A great deal of information, generally of a highly technical character, is obtained from such tests, and H.R.C. members will not need to be told that this information is of the greatest possible value. In a similar manner when a new design has been in use for a short time, tests are carried out in order to ascertain how nearly the performance of the engine comes up to expectations. A definite indication of its capabilities is thus given, and its subsequent duties are arranged accordingly.

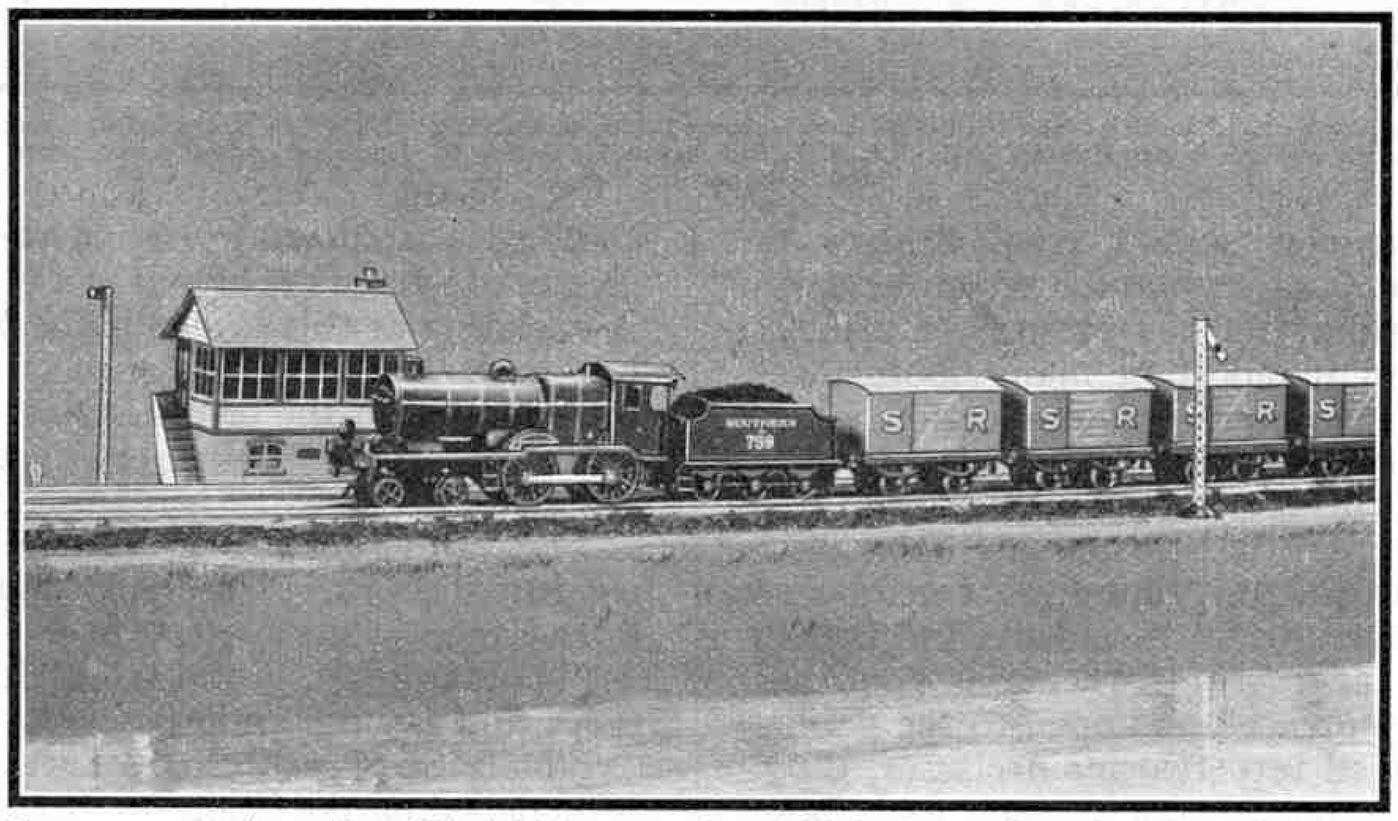
When trials are being carried out on a Hornby layout an interesting appearance may be given to a locomotive under test by fitting it with an indicating shelter at the front end. This shelter may be made quite easily of wood or cardboard and fitted in position, and the effect of the locomotive thus provided is very striking. If a special test train is being run, a special train number should appear on the engine as shown in one of the accompanying photographs.



A miniature "Yorkshire" under test. As it is attached to a specially made up test train, the engine carries the appropriate train number at the foot of the chimney. This feature, in addition to the provision of the indicating shelter gives the locomotive a very realistic appearance.

Locomotives may be divided into two main classes, passenger and goods; and each of these classes may be further subdivided into tender engines and tank engines. Owing to the large number of possible variations it is necessary to have some means of identifying different locomotives; and the most obvious and simple system is that based upon the wheel arrangement. Readers will be familiar with the system in which the wheels of a locomotive are denoted by numerals, the numbers being used in the order in which the wheels of the engine are disposed. Thus the Hornby No. 2 Special locomotives are of the 4–4–0 wheel arrangement; that is they have four bogie wheels in front and four driving wheels, the last figure 0 signifying that there are no trailing wheels behind the driving wheels. With tender engines the wheels of the tender are not counted, but with tank engines all the wheels are included, and the fact that the locomotive is a tank is indicated by the letter T placed immediately behind the numbers. Thus 4–4–2T is the wheel arrangement of the Hornby No. 2 Special Tank Locomotive. On the Continent a similar method is employed, but instead of the number of wheels the number of axles—leading, coupled and trailing—is counted. Thus a locomotive that in British practice would be described as of the 4–6–2 type would be denoted in Continental practice by the figures 2–3–1. Before this number scheme was generally adopted special names were used to refer to certain types. This practice was greatly favoured in America, where most of these names originated. Many of them will be familiar to the majority of readers. Among them may be mentioned "Atlantic" 4–4–2; "Pacific" 4–6–2; "Mountain" 4–8–2; "Consolidation" 2–8–0 and "Mikado" 2–8–2.

In arranging the duties of a locomotive a certain amount of consideration must be given to its wheel arrangement. For instance, it would not be advisable to use an engine such as a 0–6–0 for fast passenger work. The guiding influence of a bogie is considerable, and engines for fast work are almost invariably provided with them. On a Hornby railway the most suitable engines for express passenger duties are those with a leading bogie, and if long-distance running has to be performed a tender engine is advisable. Thus the No. 2 Special locomotives are ideal for fast passenger traffic, and also for express goods trains running on fast timings and made up of a limited number of vehicles. An example of such a train is seen in the photograph on this page, which represents an express meat train composed of refrigerator vans, hauled by a Southern Railway "L1" locomotive.



Express passenger locomotives of the 4-4-0 type are quite suitable for fast goods service with limited loads. The S.R. "L1" class locomotive shown in this picture is hauling an express meat train composed entirely of Refrigerator Vans.

Such engines, of course, would not be suitable for heavy goods traffic. For this kind of work it is not necessary that the engines be particularly speedy, hauling power being the main consideration; and for this reason an engine having all its wheels coupled, so that the whole weight is available for adhesion is almost invariably used. For goods

(Continued on page 519)

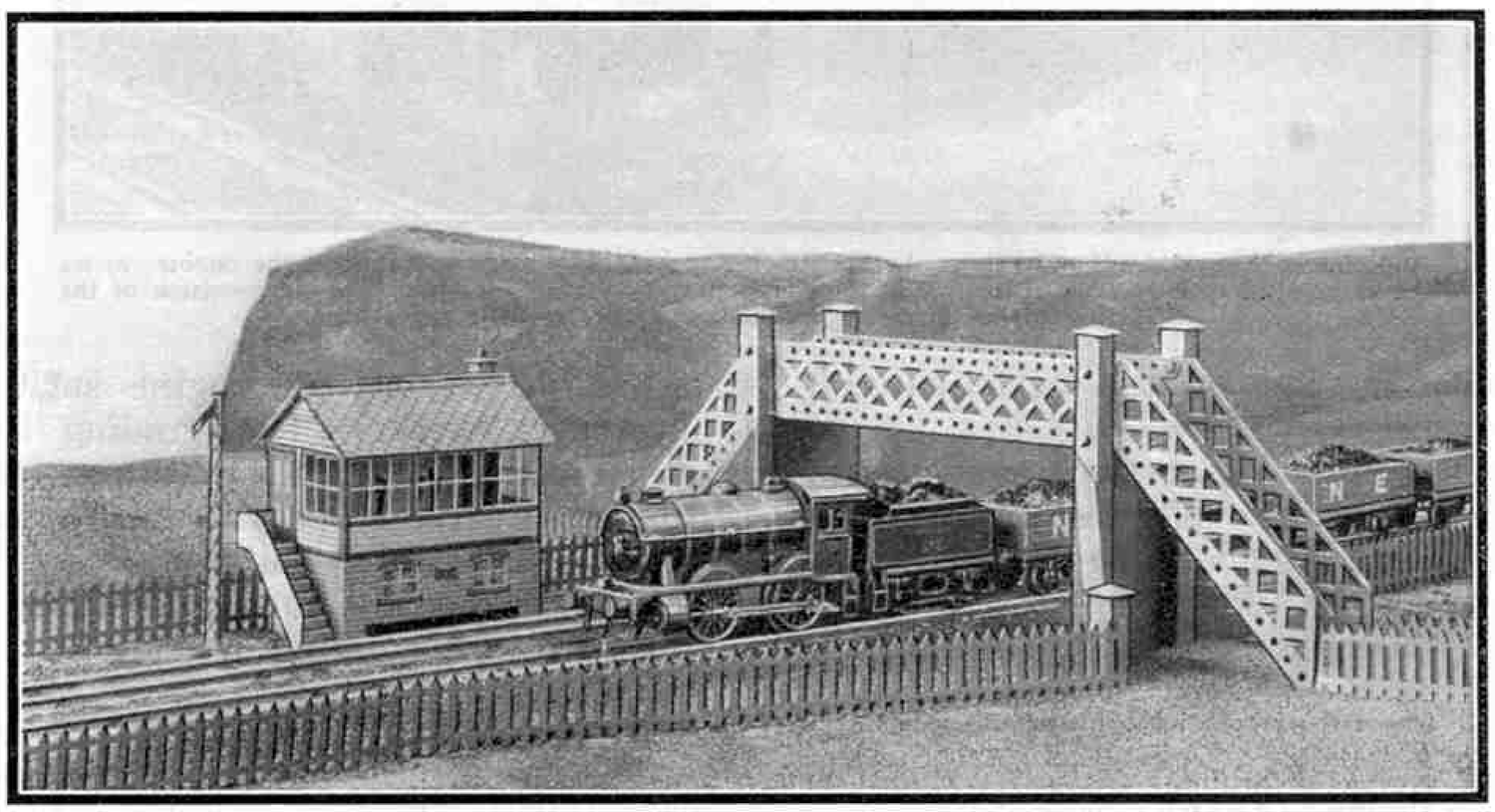
Bridges in the Hornby Series

By "Tommy Dodd"

THIS month I propose to describe the model footbridges in the Hornby Series and their prototypes on real railways. Bridges of many types have been dealt with in the "*M.M.*," but little has been said of the familiar bridges that form the subjects of these pages.

When railways first grew up, the need for many special bridges and viaducts was quickly felt. It was of the greatest importance to avoid as far as possible unfavourable gradients, and this meant that a railway could not follow the contour of the country. Where a valley had to be crossed, either an embankment had to be raised, or a viaduct built according to the local circumstances; rivers had to be crossed by bridges, and means had to be provided for people to cross from one side of the line to the other.

From the first railways met with a good deal of opposition from landowners who, not unnaturally, objected to lines being carried through their estates. Ultimately this opposition was overcome, but the landowners imposed various conditions as the price of their consent. Among other matters they demanded that as their estates were cut in two by the line the railway companies should erect bridges to provide suitable means of communication between the sections. Road bridges for the passage of vehicles had to be erected, and in addition many footbridges had to be provided to maintain communication where previously continuous footpaths had existed. The provision of these footbridges, the fencing in of the railway tracks, and the fact that trespassing upon these tracks is an offence, are factors that have contributed largely to the low percentage of accidents on British lines. Accidents are far more frequent in countries where the railways are unfenced and open to the public.



The Hornby No. 3 Lattice Girder Footbridge is well shown in this photograph. The effect of the railway running near the seashore is very striking. The cliffs in the background are formed of crepe paper, while brown paper and sand make up the "shore."

Footbridges are divided into two main classes, those used to connect the platforms of a station, and those used in the open country and in various other positions. The former type is the more interesting of the two, as it exists in so many varieties. The lattice girder type is the most common and also the most attractive in appearance. Important junctions and through stations are usually fitted with this type of footbridge, the crossing portion running completely across from one side of the station to the other, with flights of steps leading off to each platform. These bridges may be open or entirely covered. Sometimes the approaches to a bridge are built into the station buildings forming part of the station entrance; so that the only portion of the footbridge to be seen is the footway across the tracks.

The type of footbridge used in the open country for providing a way over the line between the ends of a footpath is most familiar in its lattice girder form. The supports of this type of bridge are usually more massive than those of a station overbridge, and are anchored in large blocks of concrete. Such bridges are used extensively also in goods yards and in railway premises generally. In such circumstances they are often required to span a large number of tracks, and then additional supports are provided in the centre.

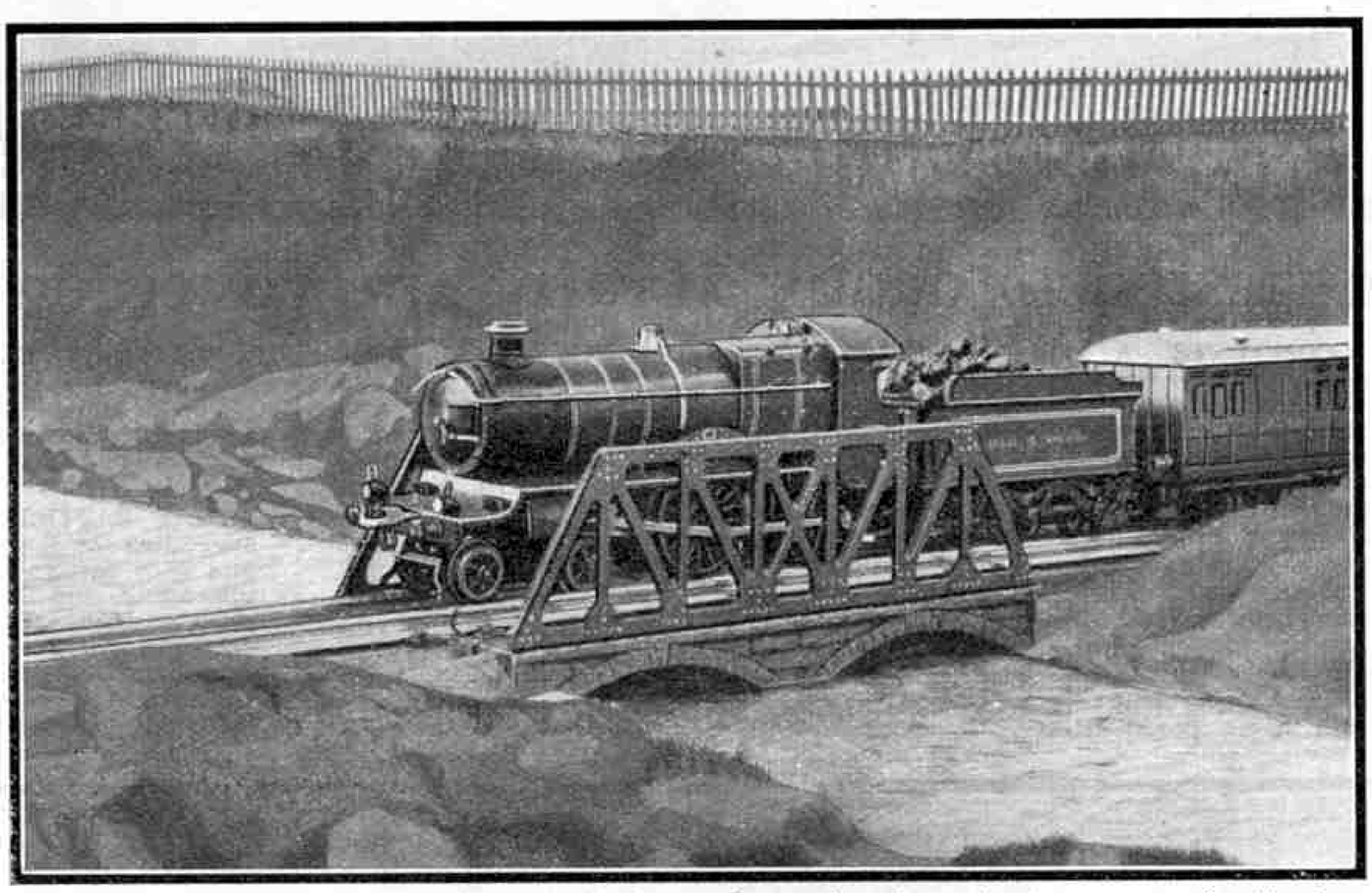
Hornby railway enthusiasts are supplied with four different types of footbridge. First of all there are the No. 1, a model of the ordinary lattice type, and the No. 2, a similar bridge, but with detachable signal posts. The signals supplied with the No. 2 bridge are one of the "home" and one of the "distant" pattern; but two "homes" and two "distants" may be used if desired. An illustration of this footbridge is shown in one of the accompanying photographs of part of the layout of a youthful H.R.C. member. A variation of this bridge is the No. 1A, similar in type, but with "M" Series signals. This is the most recent introduction of the bridge series, and is intended for use with "M" Series trains, or when a cheaper bridge with signals than the No. 2 is required.

These three bridges are of the smaller type generally used in stations. They are enamelled white, and their appearance is very attractive. They are mounted on the standard bases fitted to all Hornby signals, telegraph poles and lamp standards.

Finally there is the No. 3 Lattice Girder Bridge. This is modelled on the bridges so frequently seen in the open country, and is a very fine accessory. It is longer and wider than the bridges already referred to, and the realistic appearance of the stonework and the abutments give to the bridge a fine impression of strength. An important feature about this bridge is that it is sent out in the form of five separate components, each carefully packed. The pieces are the two side stairways, the top portion, and the two abutments, and they are easily and

quickly assembled by means of the nickel-plated standard nuts and bolts provided. Lugs similar to those of a Meccano Angle Bracket are fitted by four nuts and bolts to the stairways and bolted to the floor of the top footway. There are eight bolts $\frac{7}{8}$" in length that secure the abutments and both the top parts of the stairways. The steps, sides and footway of this bridge are enamelled white.

The accompanying photograph illustrating this No. 3 Lattice Girder Bridge has many interesting features. The layout at this point represents a line running by the seashore, and the footbridge leads over the railway to the sands. The realistic cliffs in the background are formed by fixing crepe paper over a wooden framework, the crinkled surface of the paper giving the necessary rough and natural appearance to the scene.



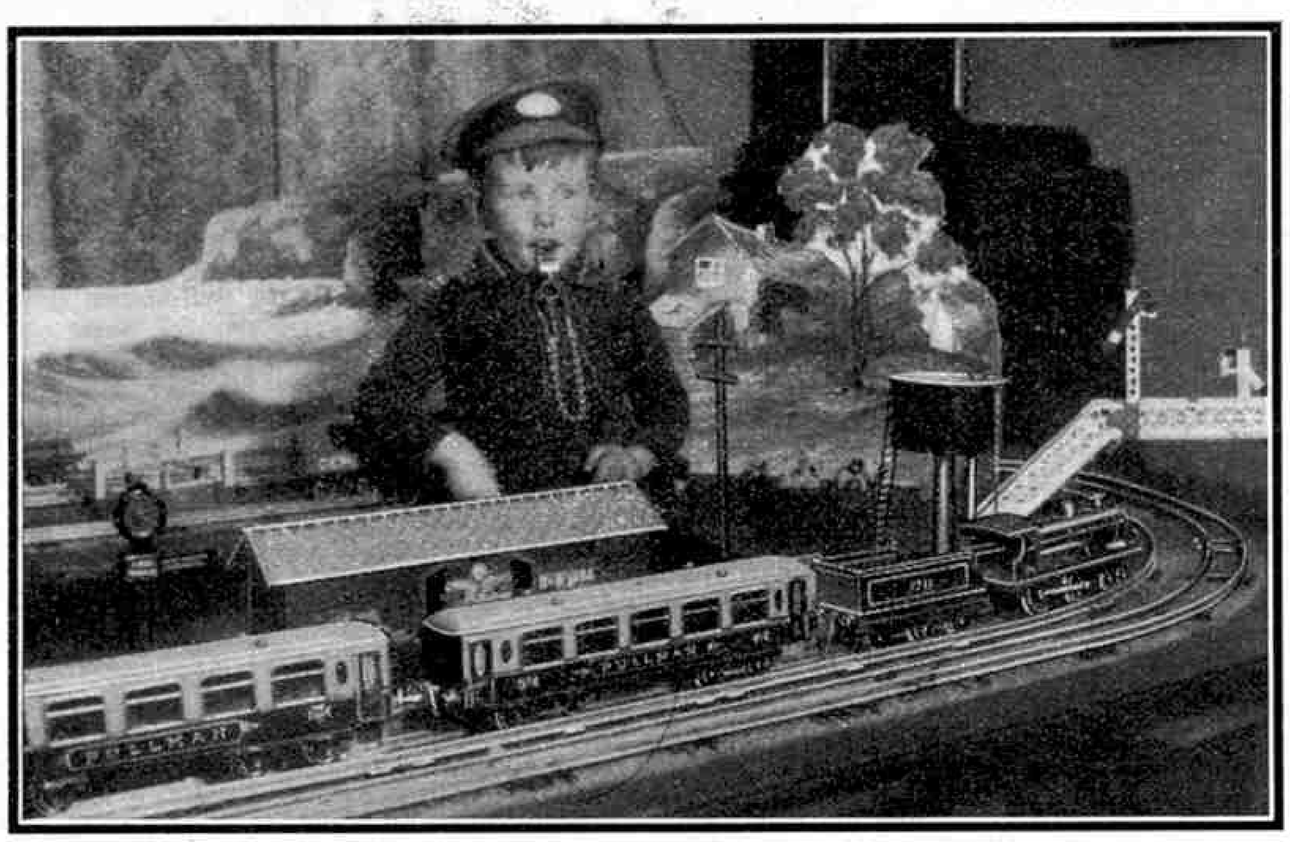
A Hornby Viaduct in a realistic setting. In this layout also good use is made of crepe paper for the river banks. The "stream" itself is represented by glass having a rippled surface.

Although the Hornby Viaduct is not in any sense a footbridge, it is so closely connected with them in layout schemes that it may be mentioned here. This viaduct is an interesting model and is extremely useful when it is required to take the line over a gap of any kind on a model railway. It is built in three portions, the centre one spanning the gap, and the other portions representing two small embankments that approach the centre span and rise up to it gradually. The centre section is made up of two girders standing on imitation stonework; the ironwork of these girders is splendidly represented, and is even complete with dummy rivet heads. The three sections, which are joined together in the usual manner by alternate connecting pins, are each the same length as one Hornby straight rail, so that the complete viaduct is thus $30\frac{3}{4}$ in. in length. The section representing the ironwork is painted green, and in this connection it is interesting to note that the L.M.S.R. some time ago decided to use green paint for their bridges in Derbyshire, so that these would blend with the scenery.

A special variation of this viaduct is available for use on electrical layouts. Conductor rails are fitted to the three sections that compose the viaduct, and these may be joined up without any difficulty to the standard Hornby electrical rails.

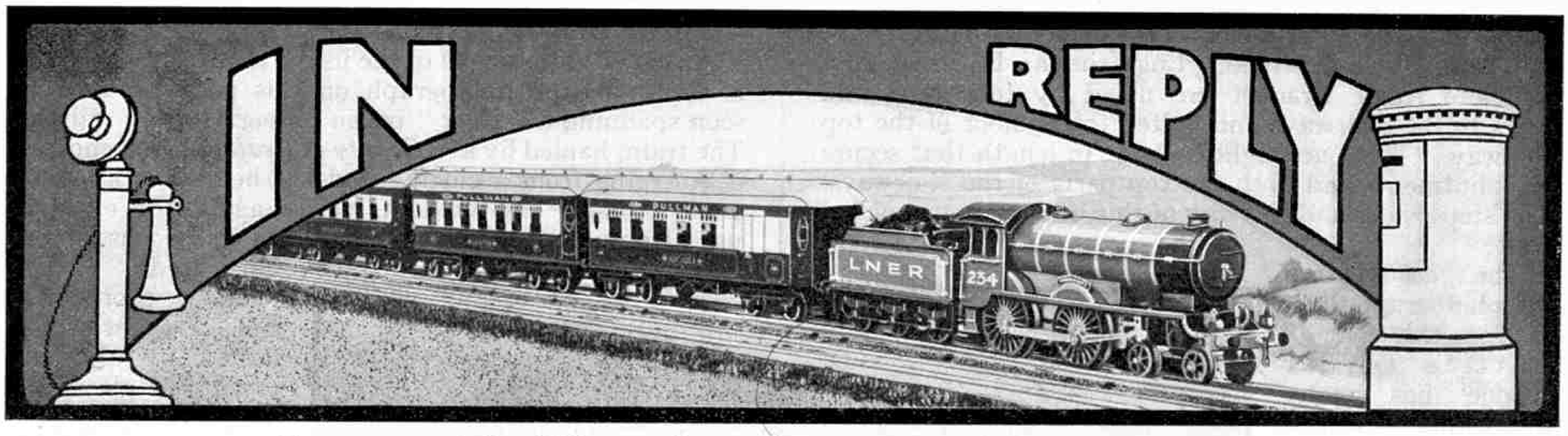
An excellent example of the use of the Hornby Viaduct is shown in the photograph on this page. Here it is seen spanning a "river" on an indoor Hornby railway. The train, hauled by a "*County of Bedford*" locomotive, is emerging from a cutting and has been photographed while crossing the viaduct. Here again the effective use of crepe paper for embankments and rocks is well illustrated. The realistic representation of water is obtained by the use of rippled glass laid on green crepe paper, so that the "river" actually seems to be flowing under the viaduct.

The placing of bridges on a model railway is an important question, for a bridge situated in an unlikely spot will altogether spoil the desired effect. The Hornby No. 1 Footbridge may very well be placed on the station platform, while the No. 2 Footbridge, being fitted with signals, is best used beyond the platform ends. The No. 3 Footbridge may, of course, be placed almost anywhere along a model railway in between the stations. A particularly useful situation for a Footbridge is on a curve where the layout passes by the corner of the room; a bridge placed in such a position does a great deal towards improving the general aspect of the line. The fact that the railway makes a right angle bend by means of a more or less severe curve in the space of a few feet is not entirely disguised, but the bridge provides a pleasing break between two sections of line on each side of the curve. The space between the railway and the wall on the corner may be filled in by a miniature hill, and a pathway led over this from the bridge. This will provide the necessary finish to a somewhat awkward piece of "country."



The Hornby No. 2 Footbridge is included here in the layout of G. M. Sturgeon (H.R.C. No. 1275). As the bridge is fitted with signals it is very suitable for use at the end of a station as in this photograph.

It has often been suggested that some kind of road bridge should be introduced into the Hornby Series, as such bridges are common objects on real railways. For the most part, however, model railway owners prefer to make these themselves of wood or cardboard in order to fit in with the particular conditions on their layouts. Model railways vary so much that it would be impossible to manufacture a bridge suitable for all.



Suggested Hornby Train Improvements

SENTINEL SHUNTING LOCOMOTIVES.—A model of a Sentinel Shunting locomotive such as you suggest would certainly be a good addition to the Hornby System, and one that would be welcomed by all enthusiasts as being a reproduction of one of the latest innovations on actual railways. It is not possible for us to do anything in the matter for some time yet, but the idea will be kept before us for future consideration. (*Reply to R. Malcolm, Shrewsbury*).

CATTLE PENS.—We agree that these would form an interesting addition to a country station and, as we have pointed out previously, we are considering their introduction. (*Reply to N. G. Goldstone, Retford*).

DESTINATION BOARDS.—We are at present experimenting with destination and name boards for trains, and an announcement concerning them may be made before long. (*Reply to E. H. McIntosh, Grangemouth*).

ADDITIONAL DETAIL ON WAGONS.—An elaborate system of detail on our wagons would no doubt considerably enhance their appearance, but since so many different styles would be required, the number of transfers necessary would be so large as to be impracticable. (*Reply to D. Prince, Woking*).

VAN WITH DETACHABLE BODY.—We think your scheme for a van with detachable body will be covered by the Containers with which we are now experimenting, and which we hope to introduce in the near future. (*Reply to S. P. Sidwell, Alfreton*).

EXTRA GRADIENT POSTS.—We do not think there would be a great demand for gradient posts figured differently from those already included in the Series. The possibilities in this direction are of course very wide, and we think your best course is to repaint and renumber your posts in accordance with your requirements. (*Reply to R. D. Jenkins, Slough*).

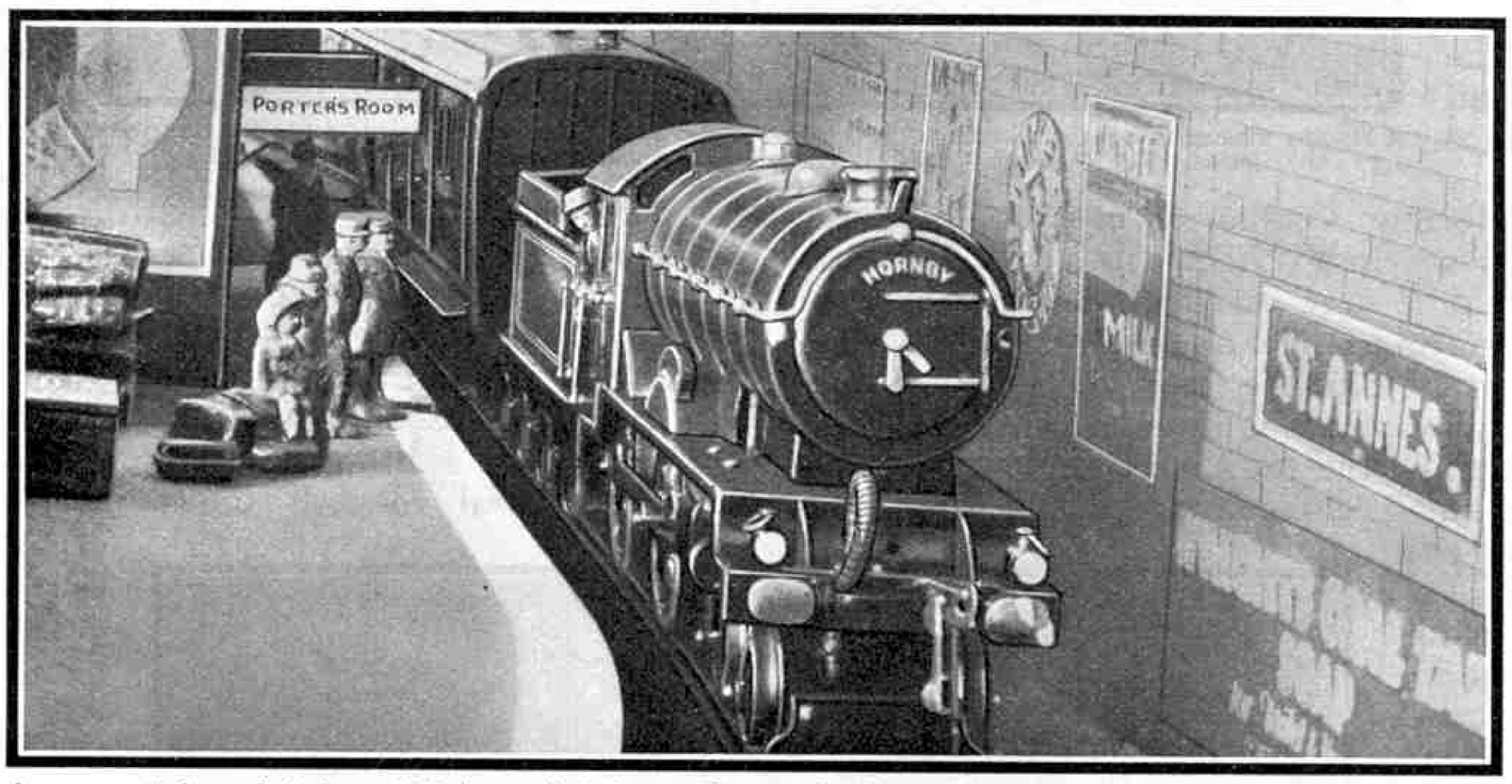
POINT LEVERS PARALLEL TO TRACK.—Point levers are often seen on railways operating parallel with the rails, but they are just as common at right-angles to the track, as is the case with Hornby points. We appreciate your idea that this new position would solve the space problem, but unfortunately such an alteration would not be justified by the expense involved. (*Reply to A. Pearson, Warrington*).

LARGER BOTTLES OF OIL.—We were very pleased to receive your suggestion that the bottles of Meccano oil should be enlarged. This oil, specially graded for use with Hornby locomotives and rolling stock, is certainly in great demand, and larger bottles to hold about double the existing quantity as you suggest would perhaps be welcomed by all Hornby Railway enthusiasts. The idea is being kept before us for attention at the earliest opportunity. (*Reply to H. Milestone, Newcastle-on-Tyne*).

POLE TYPE LEVEL CROSSING.—Your suggestion that we should manufacture the pole type of level crossing is interesting. We must point out however that since this type of level crossing is used on the Continent and in America, such a model in the Hornby System would not prove so popular as you imagine. It is quite probable, however, that in view of experiments at present being carried out in this country with this level crossing that it may become commonly used. In this event we will consider the introduction of a miniature one. (*Reply to W. McLeod, Bath*).

"GARRATT" TYPE LOCOMOTIVES.—We cannot consider the introduction of a free-lance design of this type of locomotive, incorporating details of the existing No. 2 Specials. The "Garratt" type is not yet in extensive use in this country, and we have had no demand for the introduction of a model. We agree that the hauling powers of such a locomotive would be greater than those of the normal type, but this advantage would be outweighed by the cost involved. (*Reply to R. B. Ainsworth, Cricklewood*).

H.R.C. BICYCLE FLAG.—An H.R.C. flag for fixing to members' bicycles, similar in design to the Meccano Flag, probably would prove very popular, and the idea is having consideration. (*Reply to H. G. Jack, Kettering*).



An express train ready to leave "St. Annes" station on the extensive layout of Mr. R. Hardy of Woking. The passengers standing with their luggage are evidently keenly interested in the locomotive, which is the well-known Hornby L.N.E.R. "Yorkshire."

MOTOR-TRAIN SET.—Motor-trains are extensively used on branch lines, but on the L.N.E.R. they are being superseded by steam rail coaches, which are much more efficient. We doubt if it would be worth our while to produce a motor-train set, therefore, especially in view of the fact that the component parts can easily be purchased separately, and any variations made as desired. The make-up should include two Composite Metropolitan Coaches, with a tank locomotive in the middle or at one end as desired. (*Reply to D. Taylor, Hereford*).

WIDER PARALLEL POINTS.—Your suggestion that we should increase the width of our Parallel Points, in order to allow platforms to be placed between the two parallel tracks, is interesting. Our Parallel Points are made to fit up to our standard Double Track, and No. 2 Level Crossings, so that it is hardly advisable to change them; and we are afraid, therefore, that your scheme cannot be adopted. The result you desire could easily be obtained by the use of curved half or quarter-rails added to the Parallel Points, or by using Double Symmetrical Points. (*Reply to R. O. Masefield, Heckmondwike*).

ADDITIONAL "M" SERIES ACCESSORIES.—We have recently been considering the question of introducing additional "M" Series accessories, and an announcement will be made shortly. (*Reply to H. B. Collins, Romford*).

NAMES ON METROPOLITAN LOCOMOTIVES.—We are aware that the Metropolitan Electric locomotives now all bear names associated with the district they serve, and no doubt the Hornby Metropolitan locomotive would look effective if it carried one of these names. Your suggestion will therefore be fully considered. (*Reply to N. Parker, Walthamstow*).

PLATFORM EXTENSIONS.—Evidently you are not aware that additional sections of platform and ramps for attaching to the Hornby stations are already available. By the use of these accessories the Hornby stations may be extended to any desired length. (*Reply to H. E. Dickinson, Cardiff*).

NEW PATTERN OF TRACK FENCING.—Your suggestion for the production of fencing of the wood and wire pattern for placing alongside the track is interesting, and there is no doubt that such fencing gives a very realistic appearance to a railway. On the other hand, it is such a simple matter to make fencing of this kind at home from matchsticks and thread that it does not seem worth while to manufacture it. (*Reply to A. Duckworth, Blackburn*).

No. 2 SALOON COACH G.W.R. AND S.R.—Saloon Coaches in the colours of these two railways would be an interesting addition, and your idea is therefore being kept before us for consideration. The finish of the No. 2 Pullman Coaches approximates in colour to the G.W.R. scheme, and we suggest that you use these for your expresses. (*Reply to M. F. Gustard, Westbury*).

FRENCH BREAKDOWN VAN.—A breakdown van of French pattern would no doubt prove popular, and this suggestion will be considered when we decide to add to our French rolling stock. (*Reply to E. N. Howard, Surbiton*).

STRONGER AXLES.—We have had very few complaints regarding the axles of Hornby Rolling Stock, and experience shows that if they are given reasonable usage they will give long service. Possibly our Mansell Wheels will meet your requirements. These may be obtained from this office price 4d. per pair; one pair, of course, meaning two wheels and one axle. (*Reply to R. F. Stevens, Gainsborough*).

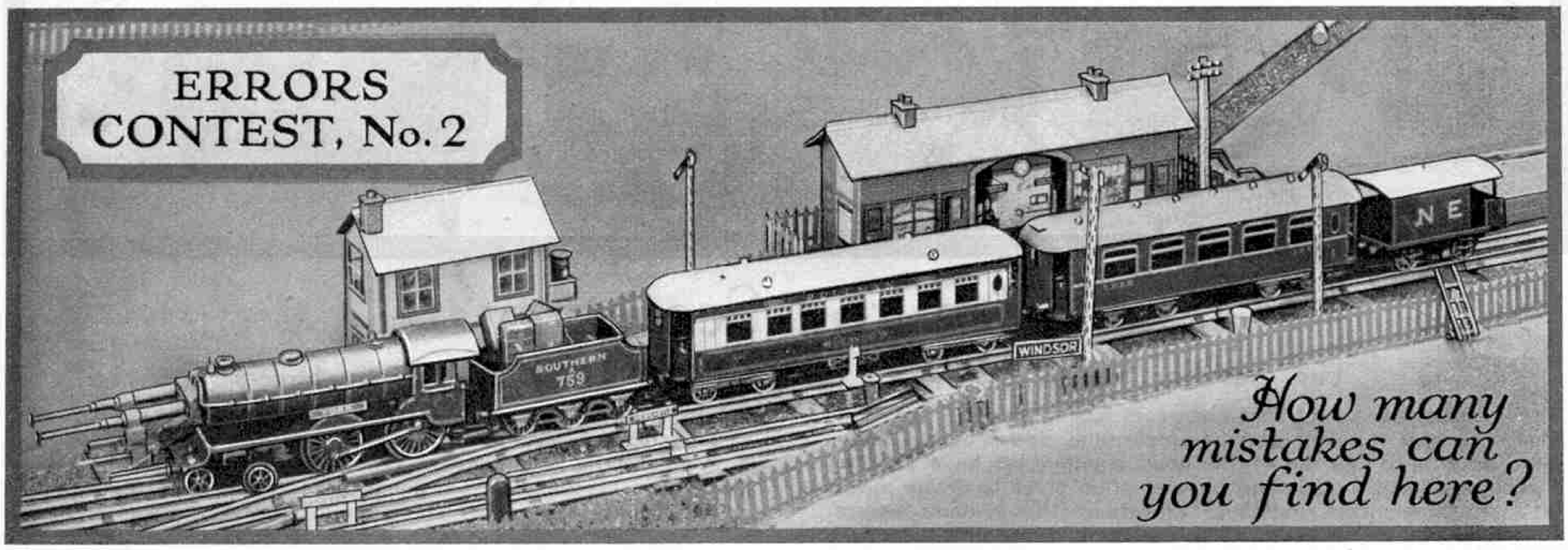
BOGIE PULLMAN CAR FOR 1 ft. RADIUS RAILS.—It is not possible for us to manufacture a suitable bogie coach for use on 1 ft. radius curves, as the vehicle would be unsatisfactory both in appearance and performance. (*Reply to F. Craig, Lowestoft*).

CLIPS FOR SECURING THE BREAKDOWN CRANE TO RAILS.—Clips for securing the Hornby Breakdown Crane to the rails when lifting operations are in progress would no doubt be useful. We will experiment with these with a view to finding a suitable pattern. In the meantime we suggest that you load the van of the crane with suitable weights that will counterbalance the load to be lifted. Alternatively you might attempt to reproduce the required apparatus with Meccano parts. (*Reply to E. W. Hartley, London, S.E.14*).

SNOW PLOUGH FOR ATTACHMENT TO BUFFER BEAM.—A snow plough of the pattern illustrated on page 334 of the April "*M.M.*," for attachment to the buffer beam of a locomotive, would certainly have a realistic appearance. Ploughs of this type are not very frequently seen except in certain districts, however, and the majority of Hornby Train owners prefer the more spectacular rotary plough. Possibly you could make up a suitable fitting of Meccano sheathed with cardboard for use on your line. (*Reply to E. B. Rawlins, Clacton-on-Sea*).

H.R.C. COMPETITION PAGE

Competitions appearing on this page are open only to members of the Hornby Railway Company. Envelopes containing entries, should have the title of the competition clearly written in the top left-hand corner and should be addressed to the Hornby Railway Company, Binns Road, Old Swan, Liverpool. The name, address and membership number of each competitor should appear in clear writing on every sheet of paper used.



The "Errors" Contest announced on this page in the "*M.M.*" of September, 1930, brought an unusually heavy crop of entries, and in view of the evident popularity of the competition we have decided to set H.R.C. members another contest of the same type.

The illustration shown above depicts a Hornby Pullman express at a country station. In this picture a large number of mistakes have been introduced, and competitors are required to point out as many errors as they can. Even at a casual glance many errors are obvious, but competitors who think they can discover all the mistakes in a few minutes are very much mistaken. The errors, in fact, are as numerous as weeds in a neglected garden! The contest gives members of the H.R.C. an excellent opportunity of demonstrating their railway knowledge and sharpness of eye, and competitors will be well advised to scrutinise very carefully every portion of the photograph.

When each entrant is sure that he has tracked down every error, he should make out a neat copy of his list, and forward this to H.R.C. Headquarters, Binns Road, Old Swan, Liverpool, in an envelope plainly marked H.R.C. "*Errors Contest, No. 2.*"

The competition will be divided as usual into two sections "Home" and "Overseas." In each of these the sender of the list that is most nearly correct will be awarded a prize of Hornby Train Goods (or Meccano products, if preferred) to the value of 21/–. For the three entries in each section that are next in order of merit, similar prizes of value 15/–, 10/6 and 5/– respectively will be given. A number of consolation prizes also will be awarded, and in the event of a tie neatness and originality in presentation will be taken into account in awarding the prizes.

Each competitor must give his H.R.C. number, and entries should be posted to reach Headquarters on or before 30th June. The closing date for Overseas competitors is 30th September.

Railway Photographic Contest

At this time of the year many cameras that have been practically forgotten throughout the winter are hauled from their hiding places and prepared for action. H.R.C. members will naturally turn their thoughts towards the securing of a series of good railway photographs. Railway photography is a splendid summer hobby, and in order to encourage it we offer this month prizes for the best photographs of "*A Train Leaving a Station.*" We have selected this subject on account of its simplicity from a photographic point of view. It is within the scope of practically every camera, as only a slow shutter speed is required.

Readers who intend to take part in this competition should read the brief notes on railway photography in "*News from H.R.C. Branches*" on page 498. Competitors may submit as many prints as they desire, but no competitor can win more than one prize. It is extremely important that every print sent in should have on the back the name, address and H.R.C. membership number of the sender.

The contest will be divided, as usual, into two sections, Home and Overseas; and prizes of Hornby Railway material (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded to the sender of the best photographs submitted in each section. In addition a number of consolation prizes will be awarded.

Envelopes containing prints should be clearly marked H.R.C. "*June Railway Photo Contest,*" and posted to reach Headquarters at Meccano Ltd., Binns Road, Old Swan, Liverpool, not later than 30th June. The closing date for the Overseas section is 30th September.

COMPETITION RESULTS

HOME

March "Locomotive Development" Contest.—First: H. Smith (2489), Weymouth. Second: J. L. Lee (19305), Bolsover, Nr. Chesterfield. Third: K. E. Marsden (22546), Southport. Fourth: G. Watts (21908), Newmarket. Consolation Prizes: R. Knox-Little (17640), Fareham, Hants.; A. Feltham (14634), Worthing; A. Jenkins (22166), Keswick; T. H. A. Biggs (18909), Canterbury; C. S. Le Rossignol (10853), Cheltenham; J. S. Bromley (22145), Liverpool.

March "Painting" Contest.—First: C. A. Brunt (10229), Leeds. Second: D. M. Walbourn (2896), Theydon Bois, Essex. Third: C. Shackleford (21022), Cheltenham. Fourth: G. A. Nix (2993), Mickleover, Nr. Derby. Consolation Prizes: L. T. Levitt (7965), Sketty, Swansea; O. Clarke (22800), Northampton; R. A. S. Musker (13162), Hightown, Nr. Liverpool; J. E. Barr (8592), Aberdeen; F. E. Saunders (7989), Folkestone; W. Andrews (19843), Strood, Kent; R. Martin (4283), Cheltenham; J. H. Goodall (13089), Dollar; R. S. B. Knowles (7309), Bognor Regis; G. C. Dover (14699), Beaconsfield, Bucks.; A. J. Burnett (4428), Milnathort, Kinross-shire; A. J. Coad (16511), Plymouth.

March "Voting" Contest.—First: F. Smith (9923), Motherwell. Second: J. Cables (21250), Lee, London, S.E.13. Third: B. C. Boyle (9895), Gilford, Co. Down. Fourth: L. G. E. Poore (17007), Wrotham, Kent. Consolation Prizes: D. A. Newcombe (5903), Cheltenham; E. Droar (7866), Kilburn, London, N.W.6; G. H. Preston (12020), W. Ealing, London, W.13; L. Schofield (22155), Marsden, Nr. Huddersfield; R. Wellby (6359), Highams Park, Essex; E. Dickinson (17977), Clayton-le-Moors, Nr. Accrington; R. G. Jennings (17345), King's Norton, Birmingham; J. W. May (2212), Thornton Heath, Surrey; A. S. Lucking (3556), Witham, Essex; V. C. Kaile (17559), Mayford; C. E. Wrayford (6039), Moretonhampstead; R. H. Mann (18117), Glossop.

OVERSEAS

December "Mystery Locomotive" Contest.—First: W. Fagg (8557), Milton, Otago, New Zealand. Second: H. A. Smith (15308), Gore, New Zealand. Third: A. A. Khandwalla (10438), Karachi, India.

December "Railway Symbols" Contest.—First: K. N. Driver (19495), Poona, India. Second: B. C. Khambatta (8026), Broach, India.

December "Mail Train Drawing" Contest.—First: D. Adams (17401), Sydney, Australia. Second: T. MacLachlan (1965), Dunedin, Otago, New Zealand. Third: D. Dose (15307), Cape Town, S. Africa.

With the Secretary

The Outdoor Season

The experience of the last few years has emphasized the value of arranging a suitable summer programme, and several Leaders have written to tell me of the good results that have followed their adoption of the advice I have so often given to devise means of keeping members together throughout the summer season. Reports from many parts of the country show that attendances at special summer meetings are fully up to the average of those during the winter. This is very satisfactory, and I feel sure that steady and persistent work throughout the summer will enable practically every club affiliated with the Guild to commence the work of the Autumn Session with better prospects than ever.

The Pleasures of Camping

Camping is a very popular feature of many programmes. A club camp is ideal, for it provides one of the best means of encouraging the club spirit in members as well as of enabling them to have a really happy time, and I am glad to find that during the present summer more clubs will spend a period under canvas than in any previous year.

In many instances a regular weekend camp has been organised. The site selected for a camp of this kind is always within easy reach of the homes of members. There they enjoy themselves thoroughly and according to the reports that have reached me, invariably show a magnificient disregard for the state of the weather!

Other clubs may wish to arrange special camping holidays by the seaside or at a distance. I may remind the officials of these that the railway companies give parties special facilities in regard to fares, and also that they have collected useful information in regard to camping sites. For instance, the G.W.R. have issued this year a new edition of their illustrated booklet giving a list of sites for camps situated in the area served by the line. The booklet gives information in regard to the site itself and also explains the nature of the surrounding country. It is practical and precise in character, and in particular does not omit details of the whereabouts of the nearest drinking supply, a very important point that is often overlooked. The booklet may be obtained free on application to the Superintendent of the Line at Paddington Station.

The country served by the G.W.R. is varied in character. The sites given in the booklet include both inland and seaside camp positions, and there is a wide choice open to those who wish to adopt this healthy and interesting form of holiday. Similar information may be obtained from the other British railway companies by officials of those clubs whose headquarters are in parts of the country that they cover, and I advise Leaders who are interested to make immediate enquiries.

Meccano Club Leaders

No. 51. Mr. A. E. Exton

Mr. A. E. Exton is the Leader of Alton Meccano Club, which secured affiliation in March, 1930, and has attained an excellent position under his guidance. The club owns a large number of Meccano parts that have been purchased to enable members to construct super models. Fretwork is one of the special features of the programme.

Club Balance Sheets

I have been very greatly interested in the balance sheet of a well-established Meccano Club that has just reached me, for it is a splendid testimony to the businesslike manner in which the affairs of the club are conducted. A noteworthy feature is that separate accounts are given of the finances of summer outings. Ordinary expenses are practically met by the subscriptions of members, although the individual contributions are on a modest scale, and the proceeds of special occasions, such as Visitors' Nights, Exhibitions, and Concerts are used to defray the expenses of excursions. By adopting this plan, the members are in effect forming a savings bank to which they make contributions throughout the year, for clearly smaller subscriptions would suffice if the more usual practice were followed of using funds raised by special means for general purposes.

The balance sheet to which I am referring reaches me in the form of a printed sheet, copies of which are given to each member and forwarded also to friends who are interested in the welfare and progress of the club. This is a very wise step to take, for the submission of a simple balance sheet that has been carefully checked and audited is one of the best means of showing well-wishers that their efforts are being made on behalf of a group of boys who are worthy of assistance.

While on this point I may remark that there are still a few clubs from whom I do not receive a statement of this kind. Whatever the size of the club, an annual report of income and expenditure should be prepared in order that members may realise the exact position of the organisation to which they belong. I shall be very glad if Leaders of those clubs that have so far omitted to forward balance sheets will do so as soon as possible. An elaborate financial statement is not required for this purpose. All that is necessary is to provide two columns, in one of which the receipts are noted, while in the other, account is given of the amounts expended and the purposes to which the money has been put.

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:—

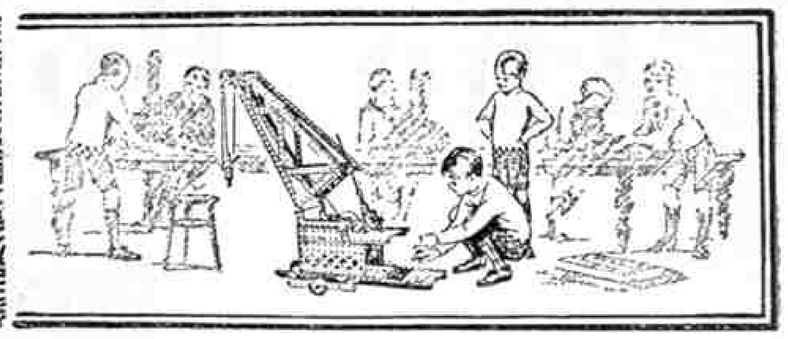
LONDON—H. Clemson, 80, Moyser Road, Streatham, S.W. 16.

LONDON—J. Freedman, 29, Queens Block, Stoney Lane, Houndsditch, E.C.1.

NEW ZEALAND—Derek Thompson, P.O. Box 54, Blenheim.

SOUTH AMERICA—Roberto Pick, Calle: Arganaraz No. 35, Buenos Aires, Argentina.

CLUB NOTES



Twenty-Eight (Edinburgh) M.C.—An interesting feature of the recent Exhibition was a representation of the nursery rhyme "*The House That Jack Built.*" The story was told by a series of Meccano models representing the usual characters, and these were displayed before scenery for the provision of which Mr. B. McCall Barbour, President of the Club, had kindly made himself responsible. A Lecture on "*Railway Engines*" was given by Mr. Ewart, who illustrated his talk by means of photographs of various types of locomotives. Club roll: 19. *Secretary:* Thos. Thomson, 24, Lorne Street, Leith.

Downend M.C.—A Model-building Competition was held on Parents' Evening, and visitors were greatly interested in the earnest manner in which members planned and built entries. Meetings are equally divided between Meccano Model-building and Hornby Train operations, and members are very keen on them. Club roll: 21. *Secretary:* G. Bailey, Downend Farm, Downend, Nr. Bristol.

Whitstable M.C.—An instructive talk on "*The Making of Nuts and Bolts*" was given by Mr. N. Weight, the Leader, and this was followed by a display of Conjuring. Novel Model-building Contests held recently have included a Speed Building Competition and a Memory Contest. An Electrical Section is being started. A talk on the "*Development of the Aeroplane*" has been given by a member and a Debate was held on "*Coloured v. Nickelled Parts.*" Club roll: 20. *Secretary:* L. Dale, "Maycott," 77, Albert Street, Whitstable, Kent.

Clacton High School M.C.—Through the kindness of Captain Pennell members visited the Kinema Picture House, where the operating box was inspected and the use of the machines explained. On Model-building Evenings Bridges for use in connection with the club's Hornby Railway have been constructed. Club roll: 23. *Secretary:* D. E. Mills, "Isworth," Vista Road, Clacton-on-Sea.

Selwood House School M.C.—Entries in Model-building Competitions are judged by an experienced engineer, and are of high standard. In a recent Contest the First Prize was awarded to the constructor of a Bristol "Bulldog" Aeroplane. Other prize-winning models represented Cranes, Breakdown Car and Motor Cars. Shooting is one of the hobbies of the Club. The Shooting Championship has just been decided, D. White being the winner. Club roll: 28. *Secretary:* P. Lewis, "Brook Villa," Trelawney Road, Falmouth.

Gaywood M.C.—Model-building is the chief feature of the programme. On one evening all members constructed models of Motor Cycles and several Contractors' Evenings have been held. Interesting models built have included two Anti-Aircraft Guns in addition to Cars, Motor Lorries, Cranes and Aeroplanes. The club has been completely reorganised, and a particularly interesting programme arranged for the summer. Club roll: 10. *Secretary:* C. N. Jones, Gaywood, Park Road, Solihull.

Wolverley School M.C.—Model-building Competitions have been the chief items of interest, and in a Simplicity Contest a splendid model of a Submarine secured the prize. The Library is making good progress. A visit to the new school that is being constructed was much enjoyed, and the members took a great interest in the machines at work on the site. A visit to Kidderminster Telephone Exchange has been arranged and will take place later. Club roll: 18. *Secretary:* H. J. Downing, Bury Hall, Wolverley School, Kidderminster.

Marlowe M.C.—A splendid series of Lectures were given by Mr. A. Ainscough, President of the Club. One on soldering was particularly attractive, for it was accompanied by demonstrations and members were allowed to make trials themselves. Essay competitions in which Mr. Ainscough offered prizes followed two of the lectures. The New Year Model-building Contest for original models attracted excellent entries, the first prize being won by a splendid model of a motor boat. A fund has been organised in order to purchase a Cinematograph for use throughout the winter session. Monthly Model-building Competitions are very popular, and are entered into with much enthusiasm. Club roll: 28. *Secretary:* Mr. R. E. Scovell, 73, Poulton Road, Wallasey, Cheshire.

Newcomen M.C.—The Second Annual Exhibition was as successful as that of 1930. The Model-building Section was specially attractive, and the Railway Section arranged an interesting display. Trains were run to a timetable and a very realistic crash, followed by repair operations, formed part of the proceedings. Short Lectures have been given by members on "*Clouds,*" "*The Dead Sea,*" and "*An Ironworks,*" and a Debate on the proposal to build a bridge across the Humber ended in a narrow victory for the supporters of the scheme. A special Members' Night is held monthly, groups of members taking it in turns to provide the programme. A specially enjoyable event was the Second Annual Social held at the home of the Leader. Club roll: 11. *Secretary:* H. Acklam, 103, Newcomen Street, Hull.

A Meccano Club group from Holland. Our photograph shows members of the Alphen M.C. with their Leader, Mr. C. E. Klink, during a visit to the Waalhaven Aerodrome, Rotterdam. They are standing in front of a Fokker monoplane that is ready to commence a flight to London.

Locket Road (Wealdstone) M.C.—Prizes won by members in Model-building and other Competitions were presented by the Rev. T. Watson, Minister of the Church. A Lantern Lecture was given on "*The Production of a Newspaper,*" slides being kindly lent by the "*Daily Express.*" Interesting films on "*Britain's Key Industry,*" and "*Fathoms Deep Under the Sea*" were shown with the aid of a projector provided for the occasion by the Kodak Film Company. Short Lectures by members are a feature of the club's syllabus, and at one on "*High Frequency Electricity*" messages were transmitted from one end of the room to the other. Club roll: 40. *Secretary:* T. Pantry, 4, Rusland Road, Wealdstone, Middlesex.

Stonefield Parish Church M.C.—An excellent realistic model of a Motor Chassis has been built by the members, who have also constructed a large section of the club's Hornby Railway. Fretwork is a favourite hobby, and an interesting Fretwork model of a locomotive is being constructed with the aid of a Treadle Saw installed in the club room. Club roll: 10. *Secretary:* R. Brown, 83, Merrys Rows, Blantyre, Lanarkshire.

Greenock Academy M.C.—At the club's Annual Exhibition the models displayed were of a very high standard. They included the Vertical Marine Engine and Transporter Bridge from Headquarters, and a model of Stephenson's "Rocket" that worked automatically when a penny was inserted in a slot. A plasticine model of a battle cruiser was another interesting exhibit. The receipts amounted to £10 17s. 0d., and of this sum £10 was handed to the fund for endowing a bed in the local hospital in memory of James Watt. Visits have been paid to the Greenock Gasworks, and the "*Greenock Telegraph*" Printing Works. Club roll: 90. *Secretary:* A. Buchanan, 6, Rankin Street, Greenock.

Clacton and District M.C.—In addition to Model-building Nights the programme has included a talk on Dairy methods, including the sterilization and transport of milk. A visit was paid to the local Running Sheds of the L.N.E.R., where the members were interested in the inspection of a locomotive from the cab and underneath. A Social Evening has been held. Club roll: 14. *Secretary:* M. H. Carter, 12, Wellesley Road, Clacton-on-Sea.

Borden Grammar School M.C.—Papers recently given by members have included talks on "*My Visit to Belgium,*" "*Stamp Collecting,*" and "*Local Architecture,*" all of which were very interesting. Visits to local works have been arranged, including one to Messrs. Lloyds Paper Mills at Kemsley. Club roll: 26. *Secretary:* G. J. Dawkins, 27, Trotts Hall Gardens, Sittingbourne, Kent.

Bell Hill and District M.C.—The grant of affiliation with the Meccano Guild has greatly encouraged members and rapid progress is being made. At present Model-building Evenings and Hornby Train Nights are the most popular features of the syllabus. Competitions have been organised, and in these excellent models have been entered. The programme is now being widened and Games Evenings are held regularly. Club roll: 14. *Secretary:* R. Hart, Kingswood Hall, Vange, Essex.

Whitgift Grammar School M.C.—The Meccano Club and the local Branch of the Hornby Railway Company are holding joint meetings. The Second Annual Exhibition arranged by them was a great success and was well reported in the local press. A Lantern Lecture on "*Transport*" formed part of the proceedings. Members have been very active in regard to short talks, excellent papers on "*The Manchester Ship Canal,*" "*The Canals of the St. Lawrence,*" and "*Mediœval Ships*" having been given. Visits have been paid to the Croydon Borough Electricity Works, where the members were shown how various appliances work, the Science Museum, the Fire Station, and the Old Oak Common Locomotive Sheds of the G.W.R., where No. 6009 "*King Charles II,*" a locomotive of the famous "King" class, was carefully examined. An interesting joint meeting was held with the Whitgift Middle School M.C., when an inter-club Bridge Building Contest was won by the Grammar School M.C. Club roll: 31. *Secretary:* J. D. Mellor, 71, Birdhurst Rise, S. Croydon.

Ainsdale M.C.—Lantern Lectures have been recently given on "*London's Underground,*" "*London's Omnibuses,*" and "*London's Tube Railways.*" Members visited Hesketh Park Observatory, and ordinary meetings were devoted to Model-building, Hornby Railway operation, and Stamp Collecting. A programme of outdoor activity has been arranged for the summer, this including visits to Liverpool and inspection of liners. Club roll: 12. *Secretary:* J. Aspinall, 10, Shore Road, Ainsdale.

Victoria (Glasgow) M.C.—A joint meeting was held with the Morison Memorial and the Edinburgh Clubs, when Uncle Phil of the B.B.C. gave a talk on "*Stamps.*" A return visit was paid to the Morison Memorial M.C. on the occasion of their Annual Exhibition. A Lantern Lecture on "*Harbours and Docks*" was given by Mr. H. C. Thompson, Leader of the club. The outstanding event of last session was the Ninth Annual Exhibition. This was a great success, an excellent display of models and a splendid Hornby Railway greatly attracted the many visitors. Club roll: 31. *Secretary:* R. Hannah, 52, Thornwood Avenue, Glasgow, W.1.

Exhall M.C.—At the recent Annual Exhibition the models on view included a Lighthouse, 4 ft. in height, Dredger, Derricking Crane, a model of Stephenson's "*Rocket*" and one of a Torpedo Boat constructed by the youngest member of the club. The Dredger and Derricking Crane were in active operation throughout, the Crane lifting trucks from ground level to a height of 3 ft. The Meccano Bagatelle Table was popular with visitors and brought in 8/4. Profits amounted to £4/15/–, and half of this sum was given to Church Funds. Club roll: 15. *Secretary:* M. Melville, Exhall Vicarage, Nr. Coventry.

Orwell M.C.—Recent outstanding events have included a very successful Concert, the programme of which was provided by members, and the Club's Second Annual Exhibition. The Exhibition was remarkable for the number and variety of models built by members at ordinary meetings. Model-building is keenly pursued and Lectures are frequently given by the Leader on topics of practical interest, such as "*Accumulators,*" or those that lend themselves to simple experiments. Club roll: 28. *Secretary:* Miss E. D. Hepburn, Rutherburn, Milnathort.

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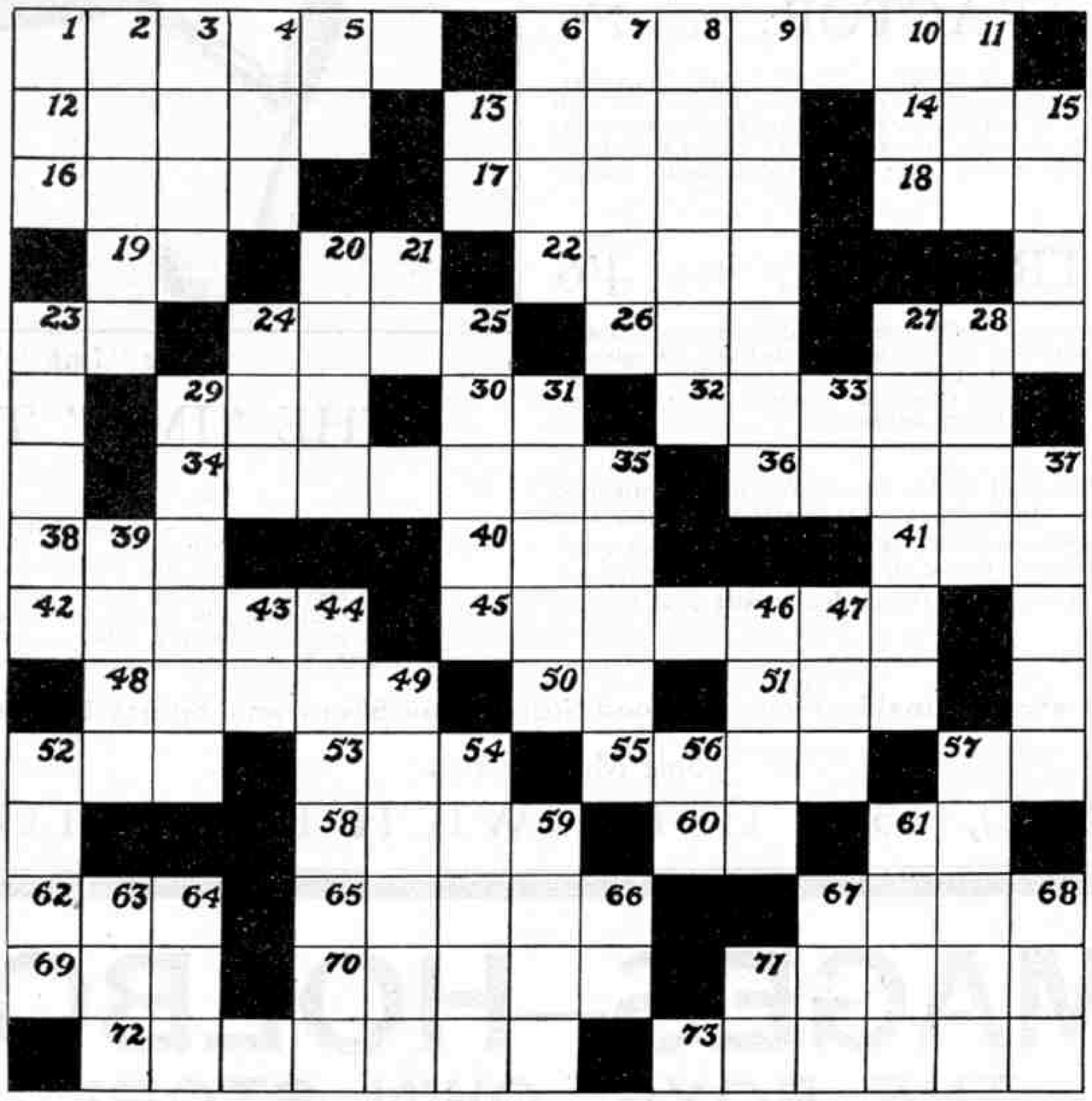
IF IT'S PHOTOGRAPHY – IT'S KODAK

Competition Page

JUNE CROSSWORD PUZZLE



CLUES DOWN

1. Utensil
2. Keen
3. Reptile
4. Decay
5. Shows possession
6. Ravaged
7. Good-bye !
8. Fondle
9. Ingredient
10. Decline
11. Speak
13. Father
15. Sincere
20. Plant
21. Like
23. Artery
24. Plan
25. Fright
27. Roving
28. Sly glance
29. Hurts
31. Burst out
33. Beheaded King
35. Bend down
37. Greek letter
39. Continent
43. Father
44. Give claim to
46. In
47. Begone !
49. One of two
52. Hinders
54. Assurance
56. That thing
57. Let
59. Reward
61. Steal
63. For hearing
64. Change colour
66. Hesitant exclamation
67. Encountered
68. Number
71. Thus

CLUES ACROSS

1. Walk
6. Clusters of Flowers
12. Apart
13. Foot lever
14. Exclude
16. Tidy
17. Alight
18. Secondary
19. Bankers' Symbol
20. Exclamation
22. Swarm
23. Denotes position
24. Disorder
26. Employ
27. Measurement
29. Part of Machine
30. Military Punishment
32. Breathe Noisily
34. Calls upon
36. Weary
38. Colour
40. Choose
41. Part of the verb " to be "
42. Apart
45. Eating away
48. Empty
50. Towards
51. Consists of a kernel and shell
52. Sack
53. Metal
55. Famous Statesman
57. A musical note
58. Particular
60. Towards
61. Exist
62. Colour
65. Number
67. Ditch
69. Utter
70. Bar
71. Consciousness
72. Respected
73. Spirit

The crossword puzzle that we published on our March Competition Page proved very popular and many readers have written asking for more contests of this type. We make no apology therefore for setting another crossword puzzle in this issue.

As far as possible every effort has been made to avoid setting unfair traps and the clues will be found perfectly straightforward. Beyond this it is unnecessary to make any explanation of the requirements of the competition, for the rules governing the solution of crossword puzzles are well known to all our readers. Every word will be found in Chambers 20th Century Dictionary or any other good dictionary.

Prizes of Meccano parts or Hornby Train accessories (to be chosen by the winner from our current catalogues) to the value of 21/–, 15/–, 10/6 and 5/– respectively, will be awarded to the senders of the first four correct solutions, in the order in which they are opened, on the morning following the closing date. In addition there will be a number of consolation prizes, and, in awarding these, neatness and style of presentation will be taken into consideration.

Competitors who wish to preserve their "*M.M.'s*" intact need not cut out the crossword illustration. It will be in order to make a copy of the square and fill that in.

Entries should be addressed " June Crossword Puzzle, Meccano Magazine, Binns Road, Old Swan, Liverpool," and must be sent to reach this office not later than 30th June. Overseas closing date 30th September.

June Photo Contest

Our monthly Photographic Competitions this season are again being run to provide intending competitors with the widest possible scope, the prizes being offered for the best photographs submitted, irrespective of their subjects. The restrictions are of the simplest possible type and are two in number: the exposure must be the work of the competitor and a title must appear on the back of each print submitted.

In order to make these restrictions perfectly clear it should be explained that although the competitor must have made the exposure, it is not essential that he should have carried out the developing and printing of the film and print. In the event of a tie for any of the prizes, preference will be given to a print that is the work of the competitor throughout. The use of a title is made compulsory and a moment's reflection will convince competitors that this requirement is in their interests. Many a simple snapshot is transformed into a splendid picture solely because its title explains what was in the photographer's mind at the time he made the exposure.

Each month's competitions will be divided into two sections, A for competitors aged 16 and over, B for those under 16, and prizes of Meccano or Hornby Train products or photographic materials, as the winners select, to the value of 21/– and 10/6 respectively, will be awarded to the best and second best entries in each of the two sections.

Entries must be addressed " June Photographic Contest, Meccano Magazine, Binns Road, Old Swan, Liverpool," and should reach this office not later than 30th June. The closing date for Overseas competitors will be 30th September.

COMPETITION RESULTS

HOME

The Romance of Transport. After very careful consideration of each of the four first prize-winning essays, the " championship " prize, consisting of a copy of each volume of Mr. H. O. Duncan's work " The World on Wheels," has been awarded to A. M. JOHNSTON, of Dunstable, who gained first prize in the A Section.

My Favourite Competition. First Prizes: Section A, A. F. MILBURN (Chingford, E.4); Section B, A. NASH (Chichester); Second Prizes: Section A, V. KAILE (Mayford, Nr. Woking); Section B, G. A. BATTY (Liverpool).

March Crossword Puzzle. 1. O. S. PEDDAR (Mill Hill, N.W.); 2. D. G. COUPER (Edgware); 3. G. W. WILLIAMS (Cheam); 4. H. A. JENKINSON (Nottingham).

OVERSEAS

The Romance of Transport. First Prizes: Section B, R. E. BERNSTEIN (Johannesburg); Section D, W. F. JONES (Toronto); Second Prizes: Section B, P. BLAIR (Toronto); Section D, S. R. PAGE (Sydney).

Fireworks Essay. 1. B. C. KHAMBATTA (Broach, India); 2. W. FIGGINS (Timaru, N.Z.); 3. R. MASON (Vancouver); 4. L. CARR (Tasmania).

Codewords. 1. A. MCMILLAN (N. Vancouver, B.C.); 2. E. L. MEEK (Wellington, N.Z.); R. J. DAVIDSON (Dunedin, N.Z.); 4. S. F. HUNT (Milan).

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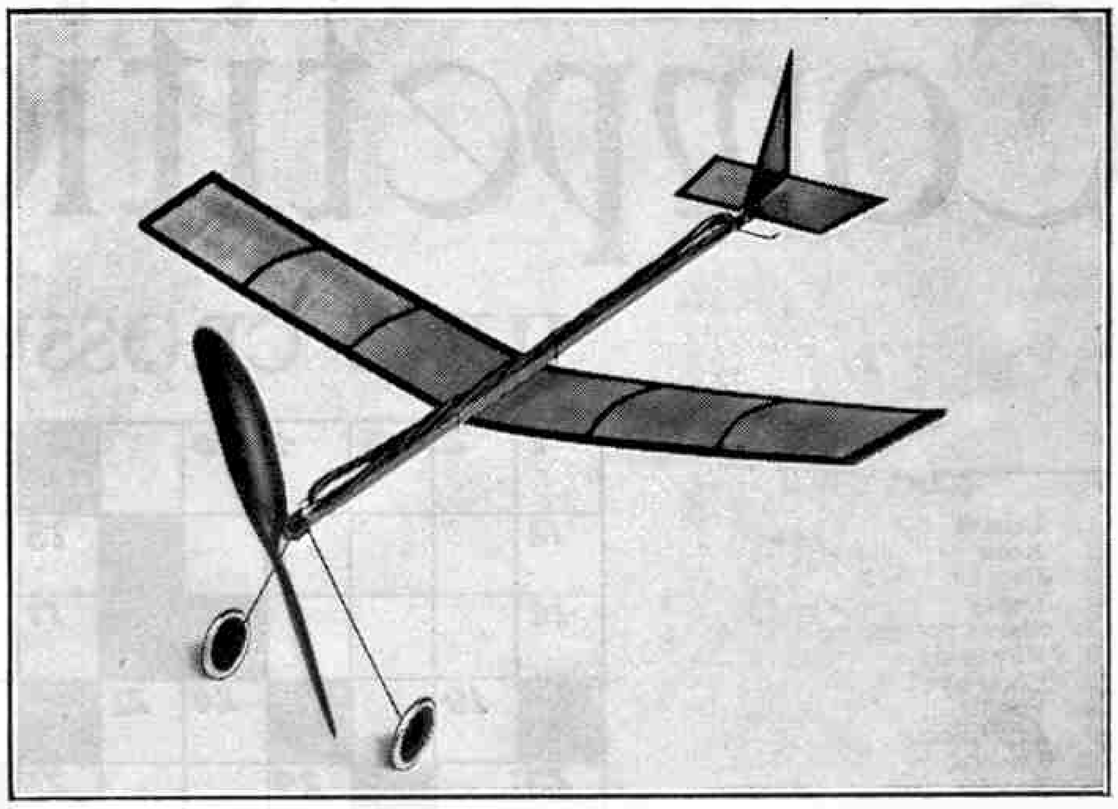
THE "DEMON" TRACTOR. Price 7'6

Length 25½ in., span 23 in. Fitted 10 in. hand-carved and balanced propeller, patent double-bearing and shock-proof chassis, covered yellow proofed silk with identification discs. Weight and wind resistance are reduced to a minimum in this model, giving the utmost duration of flight. PERFORMANCE: Speed 16 m.p.h.; distance, 850 ft. average; ceiling, 80 ft.; rises from the ground. (Patent No. 296946).

THE "MOTH" TRACTOR. Price 4'6

Length 19 in., span 18½ in., fitted patent double bearing and shock-proof chassis. 8 in. hand-carved and balanced propeller, covered with proofed silk. A splendid flyer, and beautifully finished this model at the price is undoubtedly the finest value ever offered. PERFORMANCE: Speed, 15 m.p.h.; distance, 550 ft. average; ceiling 50 ft.; rises from the ground. (Patent 296946).

FREE!! All Warneford Models are capable of a duration of 30 secs. Any pilot who obtains this performance with a duly witnessed flight is entitled to the certificate and Blue and Gold Wings of the Warneford Junior Air League. An entry form and full particulars are enclosed in every box. Descriptive booklet post free on application.



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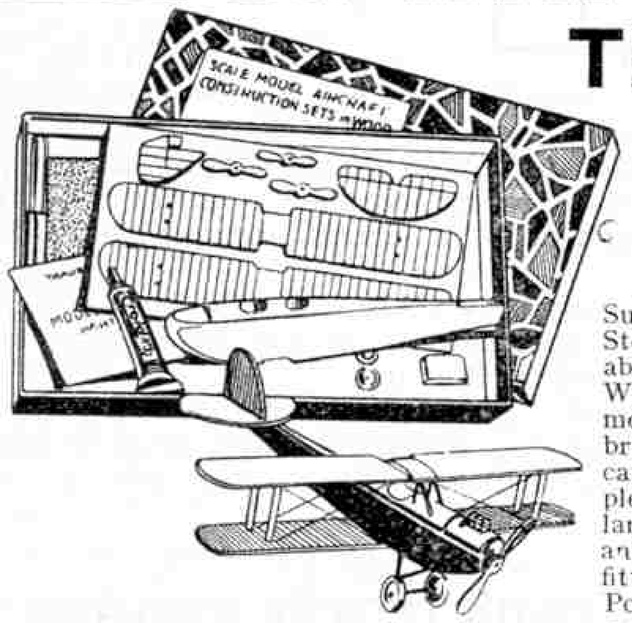

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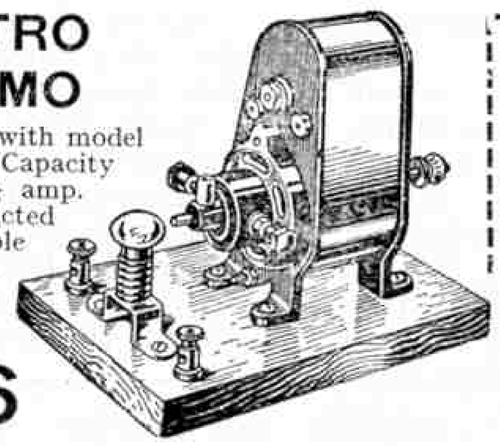

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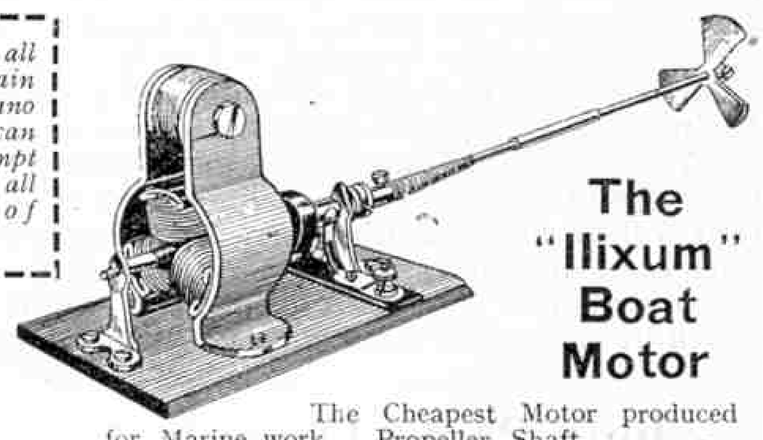

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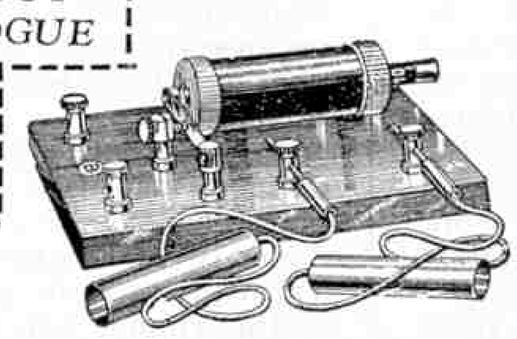

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Fireside Fun

A SENTENCE CUT SHORT

"How long you in jail fo', Mose?"
"Two weeks."
"What am de cha'ge?"
"No cha'ge, everything am free."
"Ah mean, what has you did?"
"Done shot ma wife."
"You all shot yo' wife and only in jail fo' two weeks?"
"Dat's all—den I gets hung."

* * * *

The small boys were discussing their respective families, and after having dealt with everyone else had arrived at their grandfathers.

"Mine was 95 yesterday," said one proudly. "Isn't that wonderful?"

"Not very," was the slighting reply from the other boy, whose grandfather was not nearly so old. "Look how long it has taken him to do it."

* * * *

"In time of trial," said the orator, waxing eloquent, "what is it that brings us the greatest comfort?"

"An acquittal," shouted a man at the back of the hall.

* * * *

The angler was annoyed at being disturbed, but the onlooker did not seem to realise he was not wanted.

"Are the fish biting?" he demanded.

"If they are," replied the angler sarcastically, "they're biting each other."

* * * *

A man "wanted" in Aberdeen was spotted by a new policeman on duty at the railway station. The policeman went to the nearest telephone and rang up his chief.

"The man you want is on the ten o'clock express for London," he said, "Shall I enter the train and shadow him, or wait for the cheap excursion to-morrow?"

* * * *

Teacher: "Smith, give me a brief definition of steam?"

Smith: "Please, sir, steam is, er, er, . . Oh, I know! Water gone crazy with the heat, sir."

* * * *

Stranger: "Do you know which number Mr. Jones lives at, sonny?"

Small Boy: "No, sir, but I expect you'll find it on the door."

* * * *

A FAIR EXCHANGE

Officer (in Chinese rebel army): "Flag of truce, Excellency."

His Excellency: "What do the revolutionists want?"

Officer: "They would like to exchange a couple of generals for a tin of condensed milk."

* * * *

It was Jim's birthday.

"How old are you, old chap?" asked Uncle.

"Thirteen, Uncle," was the reply.

"Thirteen? But you were only six last year."

"Well, six last year and seven this; that makes thirteen, doesn't it?"

ANCIENT HISTORY

Teacher: "Smith, do you mean to tell me that you can't name even twelve of the kings and queens of England? When I was your age I knew them all."

Smith: "Yes, miss, but there must have been only three or four then."

* * * *

A man knocked up the doctor in a small village at about one o'clock in the morning and asked him to come immediately to a place about ten miles away. The doctor dressed speedily, got out his car, and then they drove furiously to their destination.

"What is your fee, Doctor?" asked the man on arrival.

"Half a guinea," the doctor replied in some surprise.

"Here it is then," said the man, "and cheap too! The garage man wanted 30/- to drive me over. You see I'd missed the last train."

* * * *

LOST BUT NOT FOUND

Customer (after shopman has pulled down all but one of the blankets on the shelves): "I don't really want to buy a blanket to-day. I was only looking for a friend."

Shopman: "Well, madam, if you think your friend is hiding in the other one, I'll gladly take it down for you."

* * * *

"Aren't you waiting up for dad to-night, mother?"
"It's no use. With this cold I can hardly speak."

* * * *

The old lady was making her first voyage by steamer and after being shown to her cabin went for a short walk round the ship. When she felt tired she tried to return to her room but was unable to find the way. An officer seeing that she was in difficulty came up and asked if he could be of any assistance.

"Can you remember the number of your cabin, madam?" he said when he had heard her story.

"No, I am afraid I can't," said the lady. It should be easy for you to find it, however, because it was the one with the lighthouse just outside the window."

* * * *

The teacher had been giving the usual end-of-term talk on success and had made a special point of the necessity of starting work at the bottom of the ladder.

"Can any boy give me an instance of a man who started at the bottom of the ladder and is now at the top?" he asked.

"My father did, sir," said Brown.

"That is very interesting, Brown," said the teacher, "tell us all about it."

"Well, sir," the boy replied, "When he left school he got a job as a boots in a hotel, and he's a barber now."

* * * *

Teacher (disgustedly): "I don't see how it's possible for a single person to make so many mistakes."

Small boy: "It wasn't a single person, teacher. Father helped me."

* * * *

The retired sea captain was very proud of his hothouse and was never so happy as when displaying his wonderful blooms to visitors.

"This," he said when showing a new friend round, "belongs to the Fuchsia family."

"Does it really," remarked the bored visitor. "I suppose you are minding it for them while they are away."

WAY TO HATCH CHICKENS

The American did not think much of British poultry-keeping methods. "Why," he said, "twenty-five chickens from a dozen eggs is a daily occurrence in the United States."

"That may be," said an old farmer who had listened to the American for some time. But perhaps you have never seen a hundred chickens hatched by one hen at a sitting?"

"Wall," answered the American. "I can't say I have, but—"

"Well, then it happens that I have," returned the farmer. "Down where I spent my childhood we always fill a barrel with eggs and set the hen on the bunghole!"

* * * *

The very raw recruit had not saluted the officer.

"What do you mean by walking past me puffing a cigarette and making no attempt to salute?" demanded the enraged senior.

"Sergeant said, sir," replied the recruit, "that I was never to salute with a cigarette in my mouth."

* * * *

The prisoner had just been sentenced to six months' imprisonment.

"That settles it!" he remarked before going down to his cell.

"That settles what?" demanded the magistrate.

"The holiday question," replied the lawbreaker. "I've been wondering whether I should have to go to my mother's or my wife's mother's for my summer holidays. Now I won't have to go to either."

* * * *

Uncle: "Well, boys, how are you getting on at school?"

Jim: "I'm first at History."

Bill: "I'm first at spelling."

Uncle: "And what are you first at, John?"

John: "I'm first in the street when it's time to go home."

* * * *

The two tramps had met on the outskirts of a village.

"What are you doing here?" asked the one who was leaving.

"Looking for work," was the reply.

"Then turn round at once; there's plenty to be had."

* * * *

Brown lived on the ground floor of a flat, and he was afflicted with very noisy neighbours in the flat above. Seeing an article in a newspaper on noisy and inconsiderate neighbours he thought his opportunity for protest had come. So he cut it out and took it to Smith above.

As Smith read it a smile crept over his face. "Great!" he cried. "Oh, lovely. Lend it to me for five minutes, will you, old chap? I want to show it to those noisy folk upstairs."

* * * *

IN THE SOUP

It was dinner time at the barracks.

"Any complaints?" shouted the orderly sergeant.

"The stew's funny," complained one man.

"Funny, is it?" queried the sergeant. "Then why aren't you laughing?"

* * * *

"Have you an opening for a man who is intelligent, bright, enterprising and full of ideas?" breezily enquired a confident young man as he entered the managing director's room.

"Yes, I have," was the reply. "And please close it gently as you go out."

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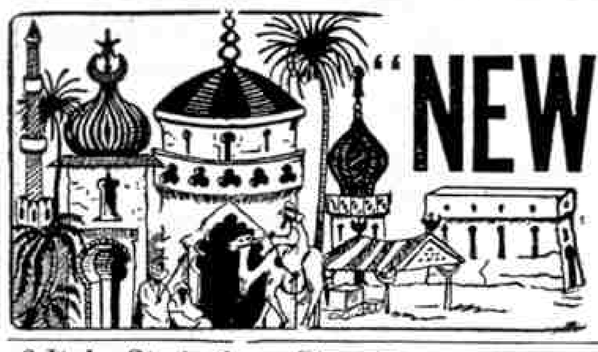

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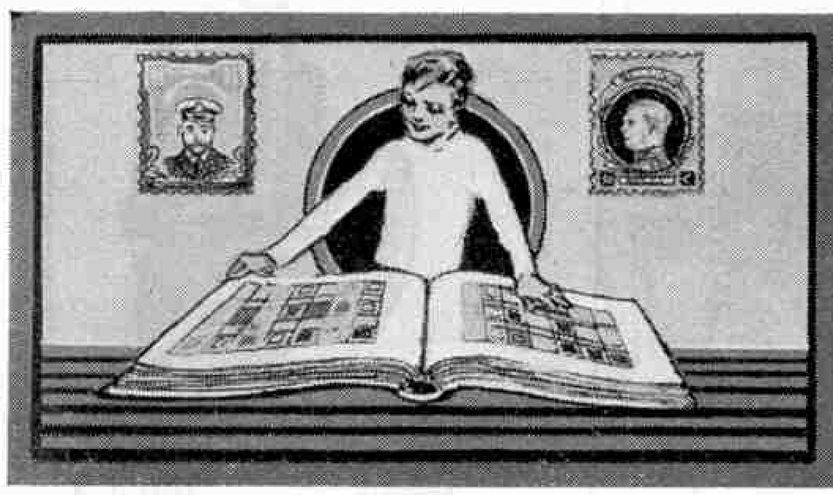
For further stamp advertisements see page 528.



Stamp Collecting

THE AIR MAILS OF NEWFOUNDLAND

AT various times many of our readers have expressed surprise that Newfoundland, a country that has played so great a part in pioneer long-distance air mail carrying, should have remained so long without a special air stamp issue. Now that such an issue has been introduced, the time is opportune to review the activities of Newfoundland in air mail matters and to deal generally with the several famous special issues that now rank as the gems of aero-philately.

Newfoundland's refusal to consider the introduction of specially designed stamps for the air mails carried on transatlantic flights has really been due to a desire to use up certain old stocks of stamps by overprinting them for air use. For instance, in April, 1919, when the late Harry Hawker, accompanied by Commander K. Mackenzie-Grieve, made his attempt to fly across the Atlantic to Ireland in a Handley-Page machine, the correspondence in his small mail bag was franked, not with gorgeously-coloured specially-designed stamps showing biplanes over oceans, but with the 3c. stamp of the current "Caribou" type, overprinted with the simple legend "First Trans-Atlantic Air Post. April, 1919."

Lest any reader should imagine these stamps easy to obtain, it may be well to explain that only 200 stamps were issued. Of these, 18 were damaged and destroyed; 95 were used on letters; 11 given as presentation copies, and the remaining 76 were sold in aid of the Marine Disasters Fund. Authentic stamps of this issue bear on the back the initials of Mr. J. A. Robinson, who was then Postmaster-General of Newfoundland, and the nominal catalogue price of single specimens to-day is £160 for used examples and £300 for unused! Flown covers signed by Hawker are worth a King's ransom.

The flight of Hawker and Grieve was unsuccessful. The Handley-Page machine came down in the Atlantic—several hundred miles from the Irish coast, and Hawker and his companion enjoyed the curious distinction of being the first transatlantic airmen to be rescued at sea.

In June of the same year, when Captain John Alcock and Lieut. Arthur Whitten Brown planned to fly from St. Johns to Ireland in a Vickers-Vimy biplane, Newfoundland contented itself with overprinting 15c. stamps of the John Cabot commemorative series of 1897, with the endorsement "Trans-Atlantic—Air Post, 1919—One Dollar."

The issue in this case totalled 10,000 but it was intended also to be used on all further Atlantic flights in 1919. It was employed in July on the Newfoundland mail sent by air to New York for transmission across the Atlantic by the airship R34. This mail, however, reached New York after the departure of the airship and was sent on to England by mail steamer.

Unfortunately, we have no details as to the actual quantity carried across the Atlantic by Alcock, but, as famous air stamps go, this issue is still to be had cheaply, current prices for used and unused specimens ranging upwards from fifty shillings. It is a striking endorsement of advice that we have frequently given to young air stamp collectors—"Keep the stamps on the cover, and the cover intact"—that flown covers from this flight cannot be bought for less than £100!

It is worth recalling that this flight was the first successful aerial crossing of the Atlantic, and both Alcock and Brown were knighted by the King in recognition of their feat.

Newfoundland's next association with air stamp matters was about mid-November, 1921, when plans were made to carry air mail regularly between Botwood, Newfoundland, and Halifax, Nova Scotia. For this the old Cabot issue was again made to serve, and 5,000 copies of the 35c. stamp were overprinted "Air Mail to Halifax, N.S., 1921." The first flight was not successful, bad weather compelling its abandonment. Later in the month, the 9,000 remaining stamps of the 35c. Cabot issue were similarly overprinted, and many were subsequently used on the local air service between Halifax and St. Johns. Naturally, this particular stamp cannot rank with its predecessors in point of interest, but it will command a good price in the very near future, and specimens that may be had to-day at £1, either in used or unused condition, would be worth buying.

It was not until six more years had passed that the successful flight of the Vickers-Vimy was emulated by Colonel de Pinedo, an Italian airman, who flew from Trepassy to the Azores en route to Italy. Mail was carried on this flight and once again Newfoundland turned out its old stock of "Cabots" to provide a special air mail stamp. On this occasion, 300 copies of the 60c. stamp were overprinted in red "Air Mail De Pinedo 1927." Of this supply, 230 stamps were actually used on mail; 66 copies were presented to Col. de Pinedo, Government officials, etc., and four were damaged and subsequently destroyed. In addition, a quantity of mail bearing ordinary stamps was carried.

Flown covers from the Pinedo flight rank second only to Hawker covers in the aristocracy of air mail souvenirs, and it is difficult even to suggest a market value. Specimens of the overprinted stamps are catalogued at £150 unused and £80 in used condition, but there is no recorded figure for the unoverprinted varieties employed.

The next special issue was in connection with Captain Errol Boyd's flight last autumn in the Bellanca monoplane "*Columbia.*" For this 300 of the 36c. stamps of the "Caribou" issue were surcharged in six lines reading "Trans-Atlantic Air Mail by B.M. 'Columbia' September, 1930. Fifty Cents." This overprint very nearly obliterates the original design. There is definite record of 158 of the stamps having been used on mail, four each were given to Captain Boyd and his navigator, Lieut. Harry Connor, and presumably the bulk of the remainder was secured by collectors, for the whole issue was sold out within minutes of being released for sale.

An interesting story is told of the "*Columbia*" stamp issue in a recent number of "*The Ocean Ferry,*" the official publication of the International Mercantile Marine Company, of New York. It seems that Lieut. Connor sent his block of stamps to his friend, William Gilfillan, the purser of the Panama Pacific liner "*Virginia,*" with a request that he should keep them in safe custody, in anticipation of a big jump in value in the event of the flight proving successful.

On the return of the "*Virginia*" to New York from her next trip, the wireless operator received a request from Connor to send the stamps to him at Ottawa for exhibition, as they were the only specimens remaining on the American continent! At the very moment that the letter was received, a stamp collector who, throughout the voyage, had been urging Gilfillan to sell to him, was pleading "If you won't sell the block of four, I'll give you $500 for one!" Even this remarkable offer proved unavailing.

The "*Columbia*" stamps are already paying the penalty of fame. Forgeries are known to be circulating, and they are good enough to deceive those who have not had the benefit of inspecting genuine specimens. Experts can distinguish them quite easily, for hand-set printers' type was used in a group of

(*Continued on page 517*)

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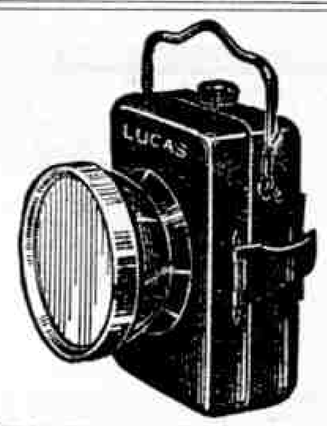

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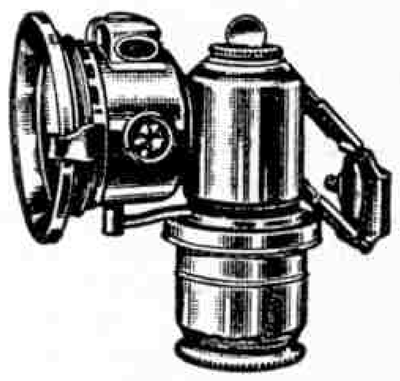

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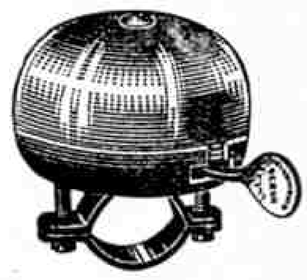

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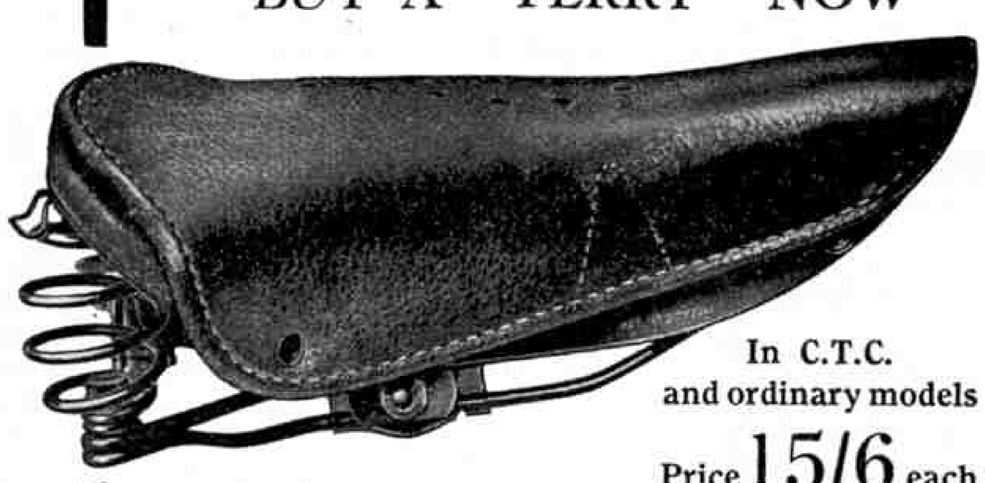

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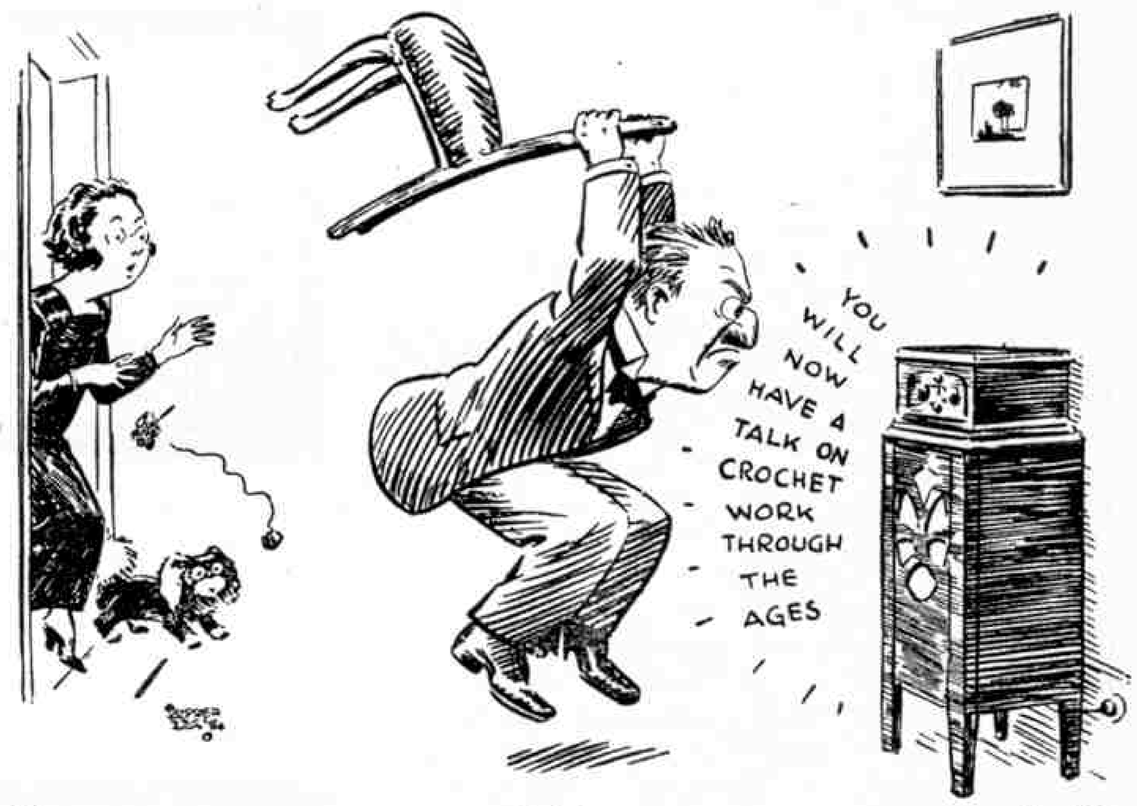

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"STOPS THE BEARINGS WEARING"

Stamp Collecting—(*Continued from page 515*)

four inscriptions to enable four stamps to be overprinted at once. Each of the four overprints had some minor distinguishing features, certain letters being slightly faulty in each, and these provide a ready means of identification.

Newfoundland's newest air venture is a local service between Mount Pearl, Hampton, Western Arm, Condu and St. Anthony. This came into operation in January last, and it is in connection with this *regular* service that the Dominion has introduced its first permanent series of air stamps.

In common with most previous Newfoundland issues, the new series strikes a high level of production, and is of exceptional interest in point of design. There are three values, 15c., 50c., and $1, all of which are illustrated in this article.

The two lower values provide interesting contrasts between old and modern methods of mail transport. On the 15c. stamp a dog team may be seen hauling a post sledge across snow-covered country, while overhead is a biplane. A point of special interest to be noted in this stamp is that the designer has kept in touch with his subject to the extent of equipping the biplane with snow skids on the undercarriage.

The 50c. stamp shows a view of the Narrows off St. Johns, and in the foreground is depicted an early mail-carrying sailing vessel. Soaring above is Alcock's Vickers Vimy biplane and in the left background the Cabot Tower on Signal Hill is shown. In the panel at the foot of the picture is the inscription, which reads :—"Vickers Vimy leaving St. Johns with first transatlantic air mail, passing over the first carrier of Ocean Mail."

The $1 stamp is the most interesting of the series, for the design shows a map of Newfoundland on the left and the west coast of Europe on the right. Across the intervening space are traced the routes taken on seven of the successful transatlantic flights with which Newfoundland has been associated, and against each the date of the flight is given. The list of flights is as follows :—Hawker—uncompleted flight, 1919 ; Sir J. Alcock—St. Johns to Ireland, 1919 ; De Pinedo—Trepassy to Azores, 1927 ; Lindbergh—New York to Paris, 1927 ; U.S. Navy—Trepassy to Azores, 1928 ; Koehl—Ireland to Greenly Island, 1928 ; and Kingsford-Smith—Ireland to Harbour Grace, 1930.

Although Newfoundland has remained aloof from special air mail designs for so many years, the new issue is not the first actually to illustrate an aeroplane on a Newfoundland stamp. The 15c. stamp of the 1928 general issue claims that distinction, for it was used to depict the start of the Alcock flight from St. Johns. As a matter of interest, we reproduce that stamp also, although it has appeared in these pages previously.

! We thank Stanley Gibbons Ltd. for their courtesy in loaning the stamps from which the illustrations for our stamp pages have been made.

Stamp Gossip
and Notes on New Issues

Stamps Illustrating Progress

Newfoundland is not alone in choosing contrasts of ancient and modern achievements as a theme for its air stamp designs. Tripolitania, Italy's North African colony, followed the same lines for the design of its 50c. and 60c. definitive air issues that recently made their appearance.

This is seen on our illustration of the design, which is common to both values and shows a great flying boat passing over the ruins of an ancient building.

A Royal Couple

For almost forty-two years, the portrait of Alfonso XIII has been the dominating feature of the designs of Spanish general stamp issues. Its first appearance was on the issue of 1889 when Alfonso was an infant of 3½ years, and in unbroken succession subsequent general issues have recorded his growth to manhood.

Strangely enough, despite the plethora of Spanish issues of recent years, there had been no composite portrait of the King and his British consort, Queen Ena, until a few weeks ago, when the design illustrated here was introduced by Spanish Guinea for the high values of its new general issue. The issue of the stamp has no bearing on the fact, of course, but that the Royal couple should lose their throne so soon after its appearance, lends it more than passing interest.

"Stamp Collecting For All"

By Stanley Phillips
(Stanley Gibbons Ltd. 1/- net)

We have been interested to see an early copy of the new edition of Mr. Phillips' popular book. The first edition of this appeared seven years ago, and in the interval has done more to popularise stamp collecting than any other book on the subject. In several directions the new edition is an improvement on its predecessor. Special chapters have been brought up-to-date. New ones also have been added, and more interesting illustrations have been substituted for many of those previously employed. A very great improvement is the adoption of a new type of paper that has permitted clearer reproductions of all illustrations, a valuable feature in discussing a hobby in which minor variations of design play so great a part.

As a guide to the new and inexperienced collector "*Stamp Collecting for All*" has no equal. It would be an admirable present for a friend just taking up the hobby, or for one who is still unconvinced of the attractions of stamp collecting.

New Delhi Stamps

Gibbons' Stamp Monthly for April adds one or two interesting facts to those given in our stamp article on India's first commemorative issue, published in the May "*M.M.*"

The Purana Qila, the ancient fort illustrated on the ¼A stamp, is believed to occupy the site of Indraprastha, the legendary city of the Pandus, and in connection with this there is an interesting legend. The story goes that the power of the Pandus was waning, when one day at dinner the king, Yudisthira, on taking off the cover of a dish, discovered a fly. He thought that the impudence of the insect in daring to enter the palace was sufficient indication that the Pandus were no longer a ruling race, so he and all his court promptly packed up their goods and left the city to be occupied by more worthy rulers.

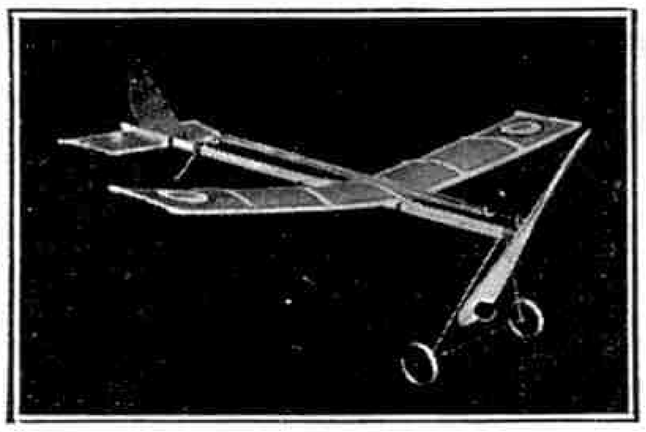
There are at present three gates to the Purana Qila but only that shown prominently on the stamp is used. One remains closed forever because in the dim past a certain king went out to battle and had the gate closed until the time when he would return victorious. Unfortunately he was defeated, and it is said that the gate has remained shut ever since.

The Dominion Columns illustrated on the 1R stamps were presented by Australia, Canada, New Zealand and South Africa. They were designed by Sir Herbert Baker, and follow the style of fourth-century Indian columns. At the base of each is a dedicatory tablet and the arms of the Dominion whose gift it is, while at the top is a globe, upon which the position of India is marked by a star, surmounted by a full rigged sailing-ship.

* * * *

Special stamp issues in connection with Agricultural, Industrial and Scientific Exhibitions have been so frequent a feature of Egyptian life in recent years, that were it not for their very attractive designs, collectors would soon lose interest. We illustrate the 5m. value of the 1931 set issued for the Agricultural and Industrial issue. The stamp was accompanied by the usual 10m. and 15m. stamps, each using the same design, which depicts an ancient freize illustrating a scene in the harvest field.

Each of the stamps is perforated 13½ all round, and the colours are: 5m. brown ; 10m. red ; 15m. bright blue.



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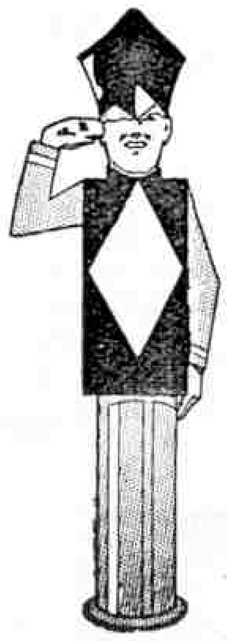

You'll get plenty of opportunities to make snaps. But make sure they are good ones—by using Selo Roll Film which is specially made to help you and cut down wastage to a minimum.

SELO
The fast **FILM**

There is a Selo Film for every size and make of Camera.

Use SELO FILM for your competition snaps and increase your chance of success.

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Free Gifts from Nestlés

We have received from Messrs. Nestlés a copy of the excellent booklet they have prepared to illustrate the gifts they offer in their coupon gift scheme. Many of the splendid articles offered by the firm make a special appeal to boys, and readers of the "*M.M.*" will be particularly interested in them. Those who wish to have further details of the scheme should write to Messrs. Nestlés, Gift Dept., Silverthorn Road, Battersea, London, S.W.8, for a free copy of the booklet. Return postage need not be enclosed if the "*M.M.*" is mentioned.

A Junior Photographic Club

Few hobbies give such lasting satisfaction as photography, and the "Coronet" Camera Company are to be congratulated upon their enterprise in forming a club to encourage boys and girls to take up this hobby.

The principal object of the "Coronet" Camera Club is to help young photographers by giving them free advice in regard to their hobby; and in addition competitions for members will be organised. An attractive enamelled badge is provided to enable fellow enthusiasts to recognise one another. The first number of a small official magazine entitled "The Prince of Hobbies," issued this month, contains interesting photographic hints. A copy of this publication, and a badge, will be sent to "*M.M.*" readers who apply, enclosing 2d. in stamps for postage, to the "Coronet" Camera Club, "Coronet" House, Great Hampton Street, Birmingham.

Essentials in Photography

The most notable developments in photography during recent years have been in the direction of greater simplicity, and valuable work in this respect has been done by Burroughs Wellcome and Company. Their "Handbook and Diary" solves automatically almost every problem that is likely to confront the amateur. It contains a calculator by which the correct exposure for all subjects can be found in a few seconds; and it describes methods of developing and printing, in conjunction with the famous "*Tabloid*" brand chemicals, that are so simple that it is almost impossible to go wrong. Readers who wish to know more about this handbook and of the latest and simplest photographic methods should obtain the attractive new illustrated booklet entitled "*Essentials in Photography*," a copy of which will be sent, post free, on application to Burroughs Wellcome and Co., G.P.O. Box No. 213A, London.

Model Aeroplanes in Airship Shed

An indication of the popularity of model aeroplane construction is provided by the news that expanding business has compelled our advertisers William E. Appleby Ltd., recently of Jesmond Road, Newcastle-on-Tyne, to move to larger premises. Their new factory is none other than Cramlington Airship Station, just outside Newcastle.

Messrs. Appleby have taken over not only the huge airship shed, but also a dozen other buildings that were used to accommodate the staff stationed at Cramlington during the war. The extent of the new premises will enable our advertisers to cope in a more economical and efficient manner with the demand for their popular models.

How to Get More Fun—(*Continued from page 503*)

train working, therefore, an engine such as the Hornby No. 1 Special is the most suitable, though for lighter duties an ordinary Hornby No. 1 will be sufficient. The differences in the loads to be dealt with by the two engines will, of course, be determined by tests. For main line goods work the use of tender engines is more correct, but in miniature practice tank engines are equally suitable.

Tank engines perform a good deal of the general work of a model railway, and they may be used to haul either passenger or goods trains; in fact they can hardly be rigidly restricted to either. The Hornby No. 1 Tank is suitable for a great variety of work and will carry out shunting operations and local goods or passenger work in a satisfactory manner. The No. 1 Special Tank Locomotive may be used on similar duties, and it will, of course, handle heavier loads and probably travel a greater distance.

The largest and most powerful of the Hornby Tank Locomotives is the No. 2 Special, and this is well suited for the longer-distance suburban passenger traffic in the same manner as the various large tank engines in use on real railways. It may be employed for express work on occasions, or even regularly if the trains do not travel very long distances without stopping. The use of tank engines on such duties would be quite in accordance with actual practice, for the Southern Railway operate a number of important main-line trains with them. Even the famous "*Southern Belle*" Pullman express has many times been hauled by tank locomotives.

The allocation of the available locomotives to the various duties as a result of actual tests will result in greatly improved working of the line. Timetable operations will be carried out with no fear of failure, owing to the manner in which the provision of locomotive power is made equal to the demands of the schedules.

Fractional H.P. Motors in the Home

Announcing an Interesting Essay Competition

The distribution of electric current is now so widespread that a very large proportion of homes use it in some form or other—for lighting, heating, cooking or cleaning.

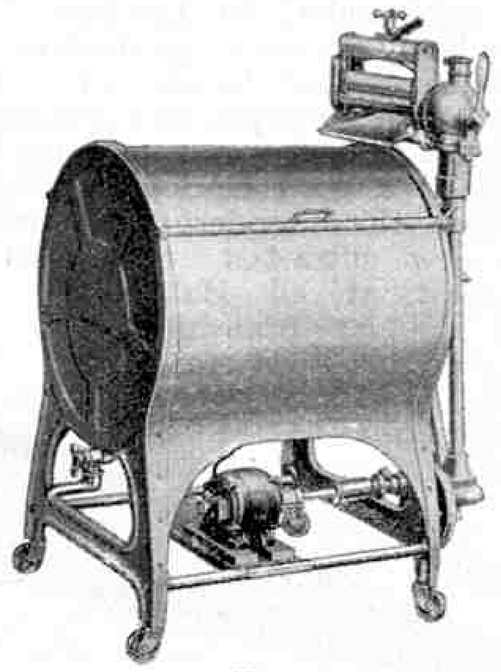
Recently we came across an interesting leaflet issued by the British Thomson-Houston Company, in which the domestic labour-saving possibilities of small electric motors were discussed under the heading: "If you do the work of this motor, you toil for 1d. per hour!" This set us wondering how many jobs in the home a portable electric motor could be made to do. Many of these suggested themselves immediately—driving sewing machines, washing machines, mangles and floor polishers, for example—but we felt that there must be many more.

There seems to be a splendid opportunity for an Essay Competition in regard to the uses of a small motor, and we have decided to run a competition open to every reader of the "*M.M.*" We are offering a first prize of the famous B.T.H. quarter H.P. Motor value £4/10/–, and as a second prize the choice of either a smaller B.T.H. Electric Motor, or a B.T.H. Electric Gramophone Motor. Here are two splendid prizes to be won by keen Meccano boys!

All that competitors are required to do is to write a short essay—not more than 250 words in length—describing the various uses in the home to which they or their parents could put a fractional h.p. motor. We advise would-be competitors to obtain from the nearest electrical dealer, or from the British Thomson-Houston Company at Rugby, a copy of the fractional h.p. motor leaflet. This gives an excellent idea of the possibilities of these motors, and thus forms a splendid basis for the essay.

Entries must be written on one side only of each sheet of paper used, and addressed:

ELECTRIC MOTOR ESSAY, Meccano Magazine, Old Swan, Liverpool.
The Closing Date is 30th September.



Motor Driven Washing Machine

Exploring the Antarctic—(*Continued from page 457*)

however. Marshall became so seriously ill that it was necessary to leave him on the Barrier, with Adams in attendance, while Shackleton and Wild pushed ahead in order to bring relief and assistance. They were long overdue, and Shackleton was haunted by a grim fear that he and his three companions would find themselves marooned in the Antarctic. He therefore made all haste northward in order to intercept the "*Nimrod*" if possible, and after many difficulties and hairbreadth escapes he and Wild succeeded in making their way to Hut Point, a few miles south of Cape Royds. There, in a hut erected by Scott's men seven years earlier, they spent a cold and miserable night. All their camping equipment had been left behind on the Barrier, and the only cover they had was a piece of old roofing felt discovered in the hut itself. Wrapped in this, they huddled closely together for warmth, but they were unable to sleep.

Their anxiety was deepened by a note found in the hut that gave 26th February as the date of the departure of their vessel—and it was already the 28th! Next morning they set fire to a small hut that had been used for magnetic observations, in the hope of attracting the notice of those on board the "*Nimrod*," if she were still in McMurdo Sound. Fortunately the vessel had remained, although the risk of being frozen in increased daily. Her officers and crew were reluctant to abandon hope of the return of their comrades, and their fears of disaster were dissipated when they saw the glare and smoke from the burning hut. Within a short time Shackleton and Wild were safely on board, and Marshall and Adams were quickly brought in by a relief party under Shackleton himself. The "*Nimrod*" then sailed north, just in time to escape from the clutches of the rapidly forming sea ice.

Shackleton returned home to find himself famous. His amazing journey was the most brilliant exploit in Antarctic history, and the courage and determination he had shown in the face of appalling difficulties stamped him as one of the world's greatest explorers.—*We are indebted to the courtesy of Lady Shackleton for the portrait of Sir Ernest Shackleton reproduced on page 456.*—THE EDITOR.

Famous Inventions—(*Continued from page 455*)

of ropes. They were very difficult to use, and it is not surprising that little practical work was accomplished with them.

It was not until 1733 that an Essex man, Chester Moore Hall, discovered that by making the object-glass consist of two lenses, an outer convex lens made of crown glass and an inner concave lens made of flint glass, refraction quite free from the halo of rainbow colours was obtained. Telescopes incorporating this arrangement became known as "achromatic" refracting telescopes, the term achromatic meaning "without colour." Hall never made public his invention, and it was John Dolland, the famous optician, who worked out the principle of Hall's discovery and brought the results to the notice of the Royal Society in 1758. A heavy excise duty on flint glass greatly hampered the manufacture of achromatic telescopes in this country, and the flint glass lenses that were produced were rarely larger than 3 in. in diameter.

Many years later discs of flint glass 6 in. in diameter were cast by Guinaud, a Swiss who earned his living by making bells for repeating watches. Guinaud became interested in telescopes about 1784, when for amusement he fixed some spectacle lenses in pasteboard tubes. About the same time he saw, and no doubt used, an English achromatic telescope. The superiority of this instrument was at once apparent to him, and he resolved to make some lenses of flint glass. He obtained a supply of flint glass from England but it was of poor quality, and in spite of his inexperience he decided to produce some himself. After experimenting for seven years he succeeded in producing satisfactory flint glass discs 4 in. to 6 in. in diameter, but by that time he and his family were brought to the verge of poverty. Eventually he produced discs of flawless crystal up to 18 in. in diameter. Guinaud died in 1823 and his secret passed to his son, and from him to Bontemps, one of the directors of a French glassworks. Bontemps fled to England when the French Revolution broke out, and settled in Birmingham where he became a partner in a firm of opticians to whom he communicated Guinaud's secret.

AEROBOAT *ahead!* . . .

. . here she comes . . . long deck glistening with spray . . . you see the water whipped to foam and, in a flash she's gone . . . she's won! and no wonder, for the new Aeroboat is far faster than any boat she's likely to come up against. At top speed she doesn't glide so much as hurl herself across the water. At "top speed," for she can be tuned to a cruising speed also in which she runs fast for nine minutes (four times as much as a good clockwork boat). You can see this wonderful invention—the new ultra-fast twin-speed Aeroboat at all Halfords and Hobbies branches and good shops everywhere. AEROBOAT II COSTS ONLY 12/6.

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—it gives all details of this new ultra-fast invention and shows illustrations and specifications of all the famous Bowman boats—the steam launches, "Seahawk," "Eagle," "Snipe," and "Swallow," and the clockwork models. Send for *your* copy to-day to:—Bowman Models, Dept. M.M.4, Dereham, Norfolk.

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Aeroboat No. I	32″ × 4½″ Beam	... 15/-
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All models are fitted with a control lever and have a patent wood racing hull, scientifically streamlined and exceptionally light; all are cellulosed in three colours. Postage 1/-.

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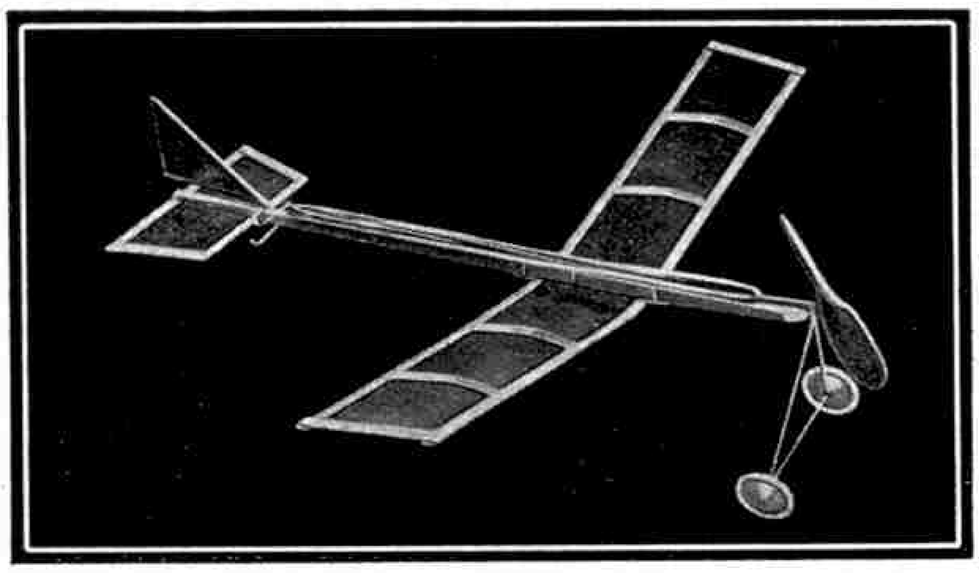
BOWMAN models

THE NEW "SKISAIL" TRACTOR MODEL AEROPLANES

Constructed of highest quality materials. Perfect flight guaranteed.

Patent No. 23533. Patent No. 138210.



All models fitted with **Patent Adjustable Rudder** which controls flight of aeroplane in any direction, **New Lightweight Shockproof Chassis and hand-carved Propeller.**

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The "Skisail Model de Luxe"
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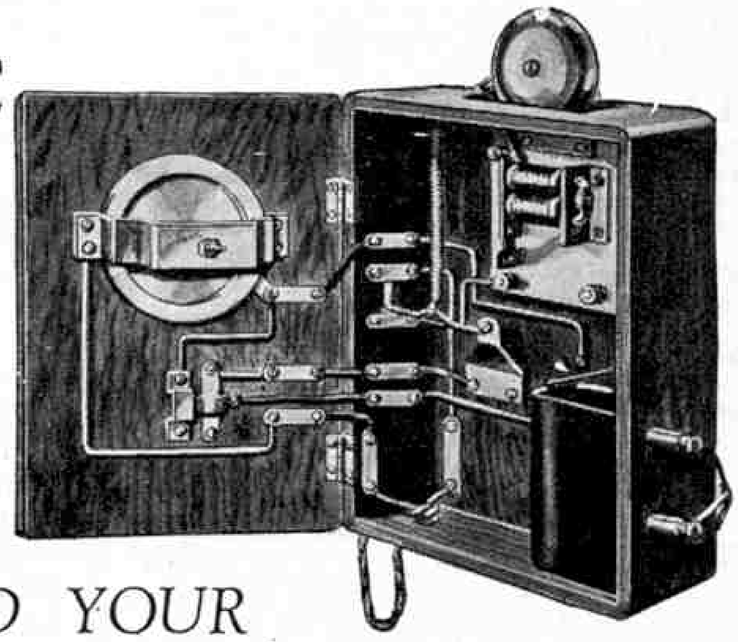
QUITE NEW —a really efficient outfit



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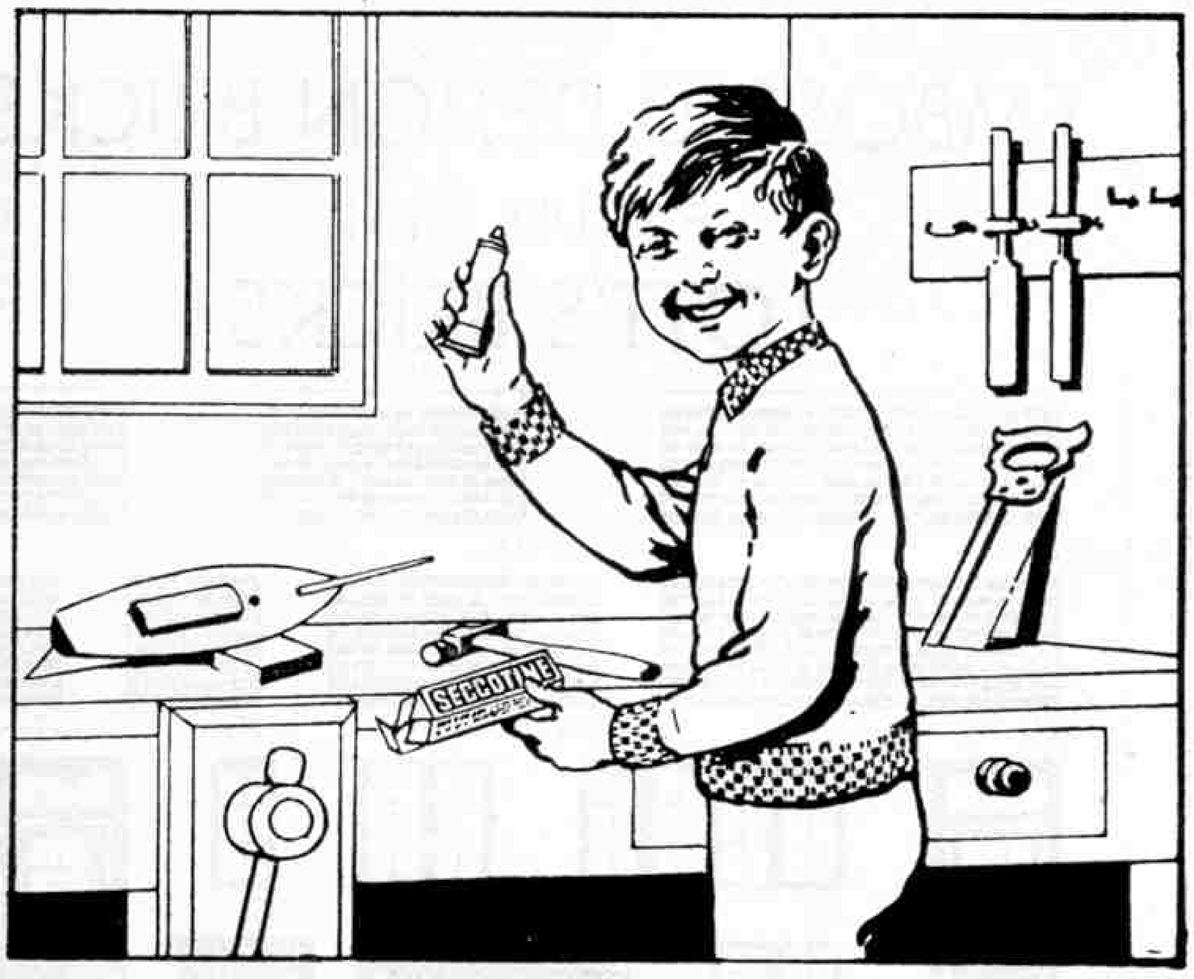

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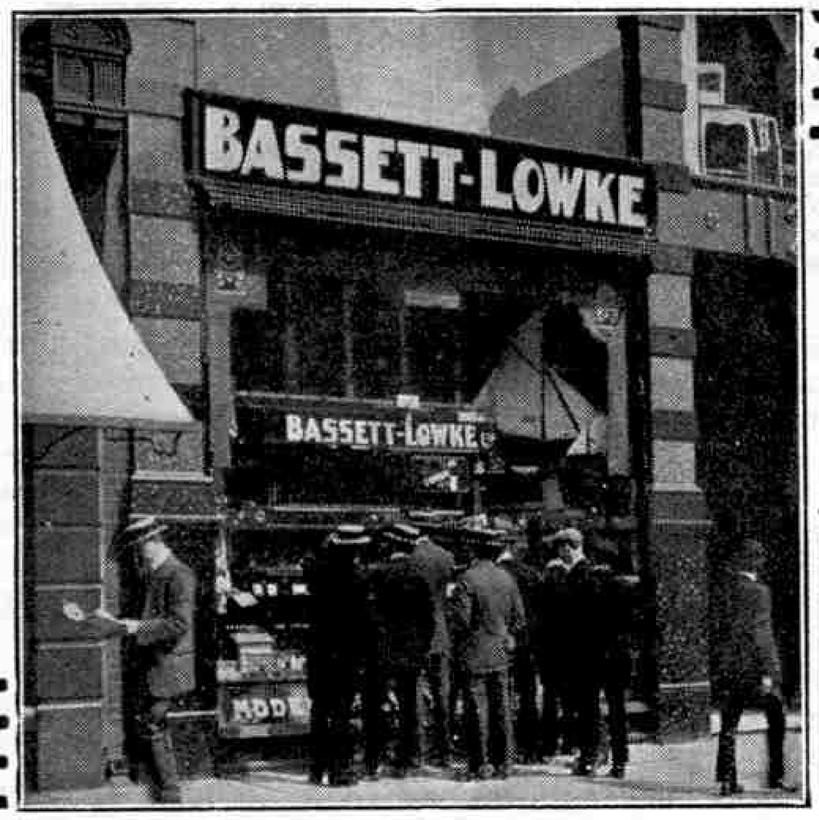

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,, 4.	,,	,,	22".	,,	,,	**18/6** ,,
,, 5.	,,	,,	24".	,,	,,	**25/6** ,,
,, 6.	,,	,,	27".	,,	,,	**42/–** ,,
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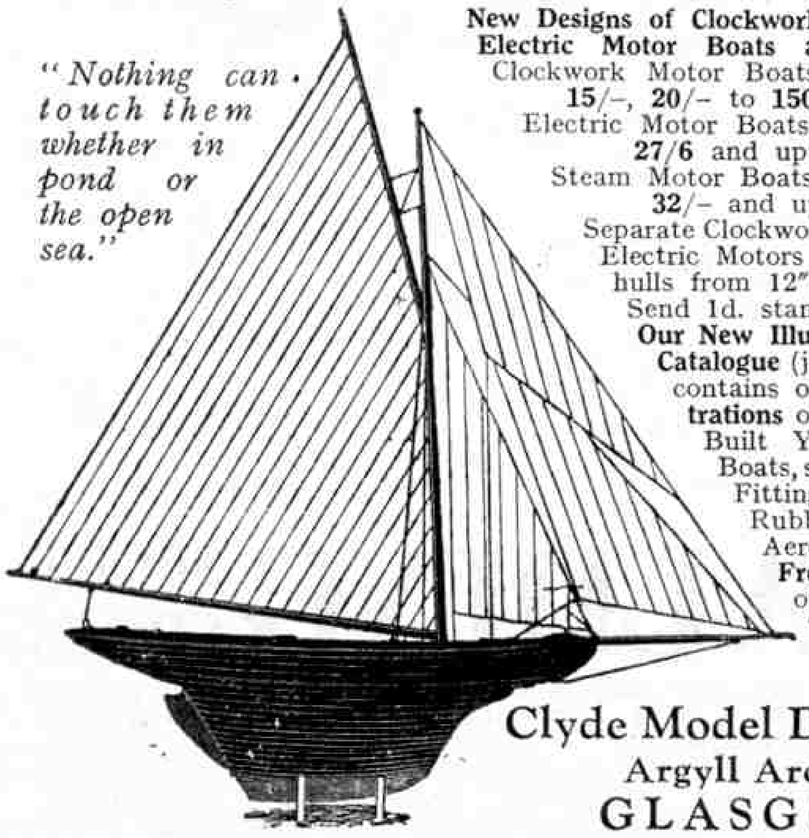
For Larger Sizes see our Illustrated Yacht List below.



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FOR USE WITH

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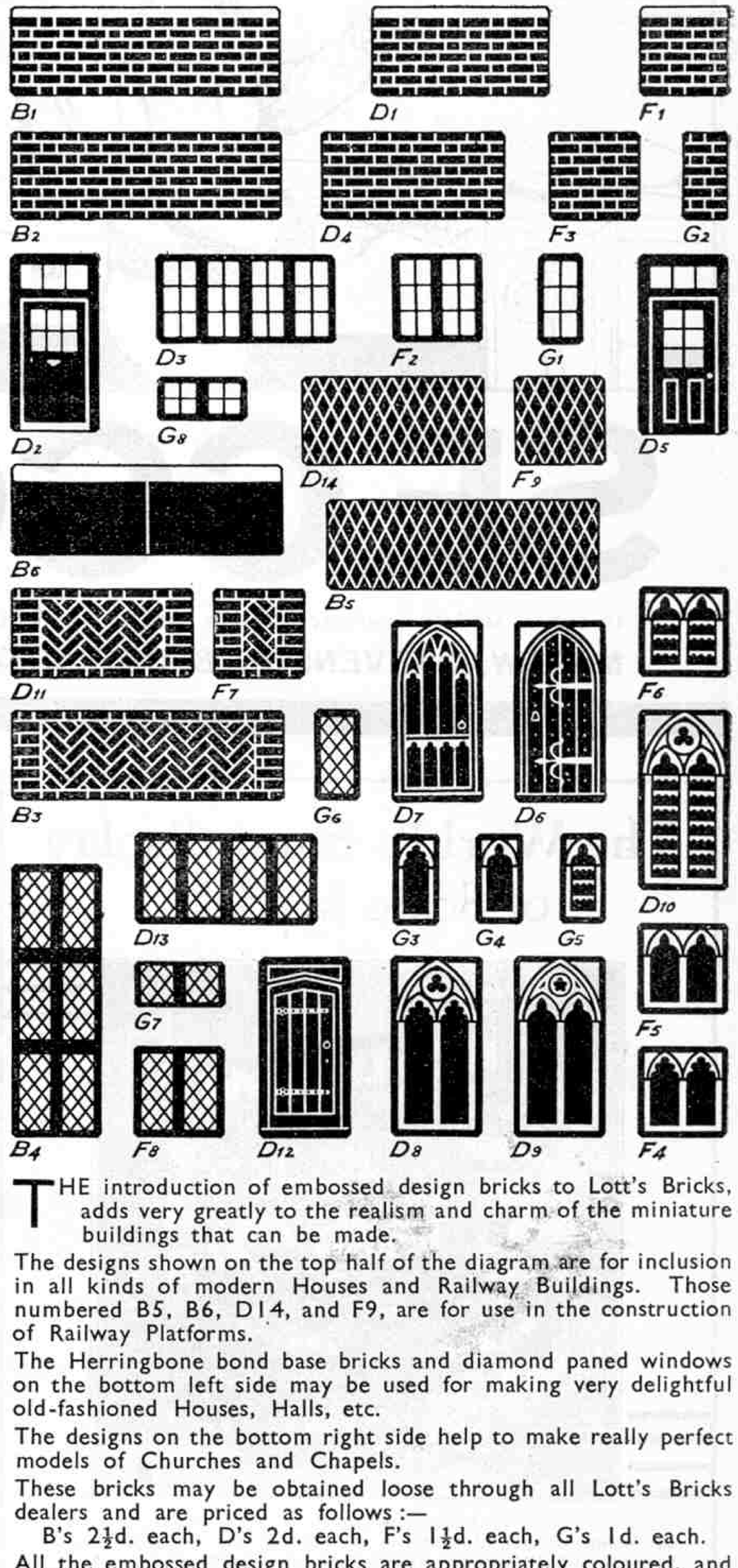

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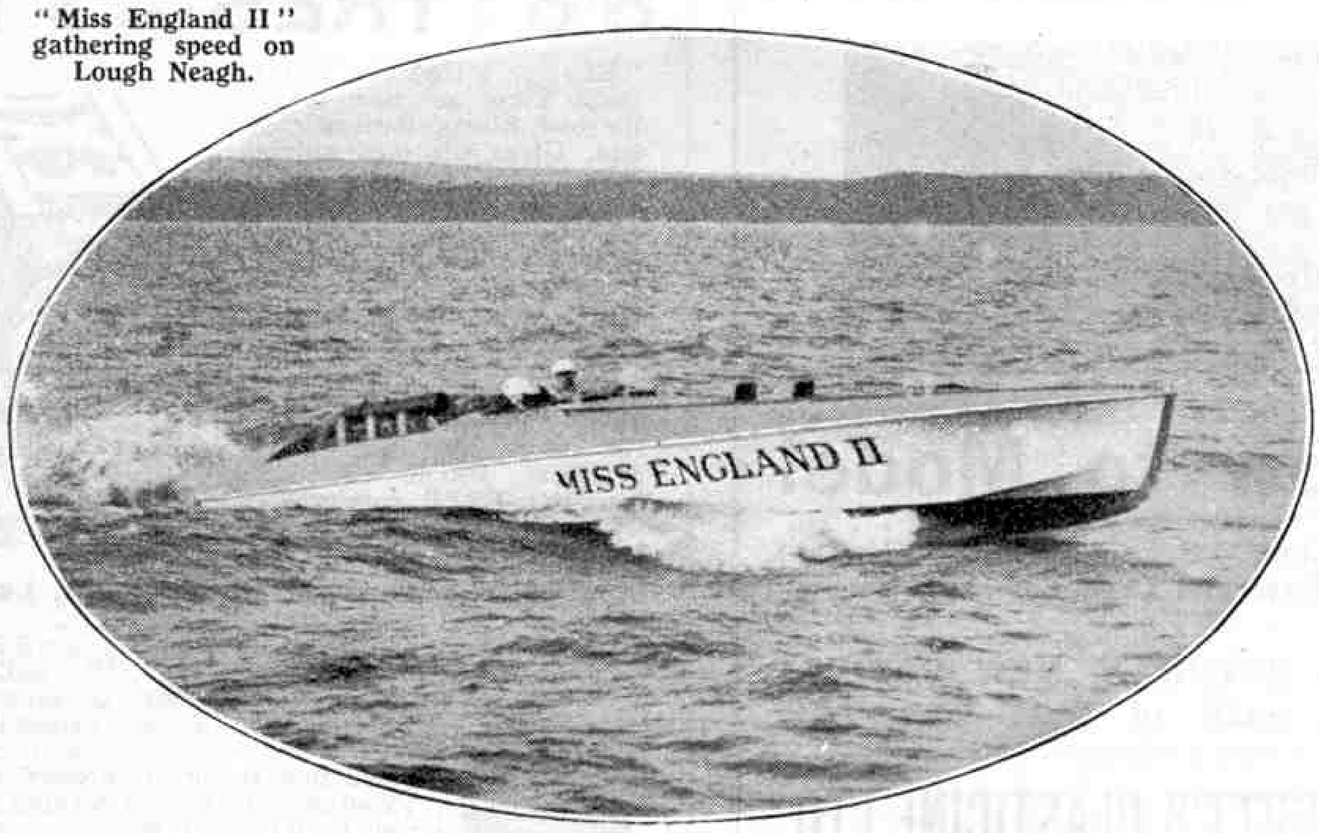

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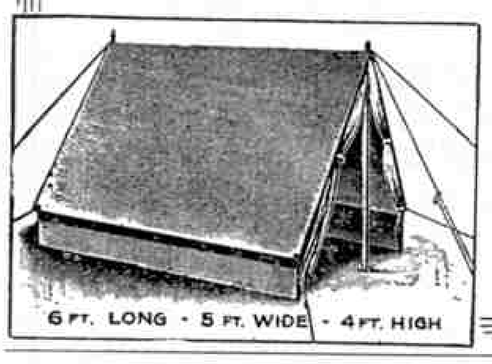

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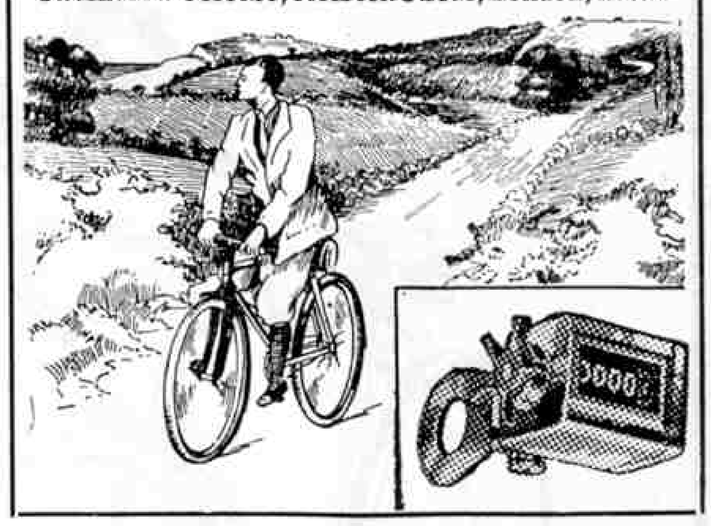

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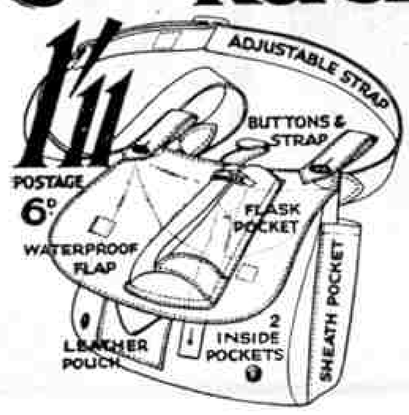

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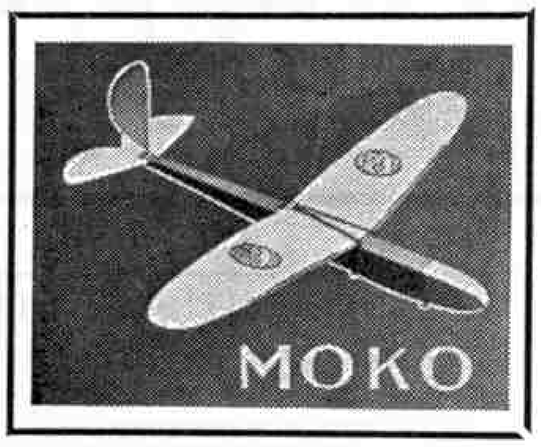

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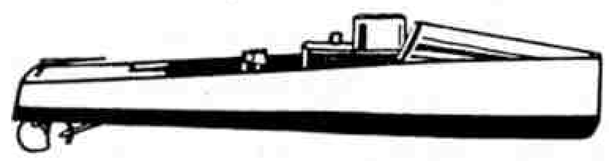

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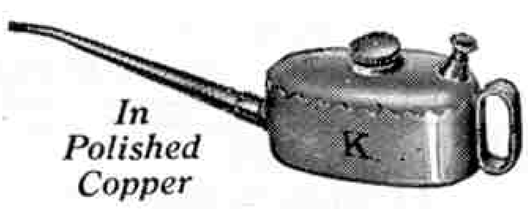

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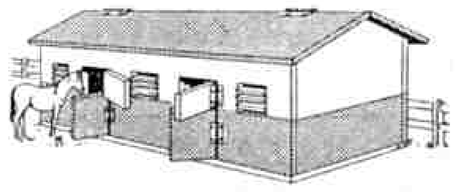

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The Growth of Broadcasting—

(*Continued from page 485*)

on the eastern slopes of the Pennines above Slaithwaite, near Huddersfield; and eventually two programmes will be radiated from the aerials of this station for the benefit of listeners in the north of England. A similar twin station is being erected near Falkirk to serve Scottish listeners, and it is expected that one will be built at a point on the south coast of the Bristol Channel to serve the western region.

When these stations have been completed, practically the only districts in the British Isles that will not be within easy listening distance of a powerful broadcasting station will be in the extreme north of Scotland, where the shielding effect of the Grampians will be experienced. Fortunately, however, these districts may be reached by means of the long wave station at Daventry.

Although the North Regional Station, as it is called, on Moorside Edge, has been built at a distance from a large town, the studios concerned will continue to be in Manchester and Leeds. Careful work by wireless engineers has made underground telephone lines a perfectly efficient means of transmitting programmes from the studios to the stations, from which, after amplification, they are radiated from the aerials.

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Shocking Coil with Magic Lantern Cinematograph, 300 ft. Film, three Continuous Films, 75 Slides, 8/6. Youths' Cycle, 24 in. Frame, £1/1/–, all in, excellent condition, or exchange for Fancy Fish for Pond.—Avery, Greystones, Longford Av., Southall, Middlesex.

Bargain. Bowman Stationary Engine, only used twice. Cost 37/6, sell 17/6.—G. Bradford, 71, Willingdon Road, Eastbourne.

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30/– Bowman Steam Engine, 25/–, new Xmas, used twice. Also Alfa Racing Car, cost 25/–, accept 7/6, or offers.—Bryan, 5, Clifton Gardens, Folkestone.

Sale. Album containing 1,750 stamps, 30/–, enquiries welcomed.—A Sanne, 19, Manville Rd., Wallasey.

B.D.V. coupons wanted. State particulars and price. Apply—49, Mayville Road, Ilford.

Sale. Bowman Steam Engine (4–4–0) with tender, also large oval Bowman Steel Track. Cheap. Apply—D. Wimbs, 18, Highburgh Rd., Dowanhill, Glasgow.

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Sale. Baby Adana printing machine, perfect, 7/6 or offers.—Lingford, 51, Bootham, York.

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34/– Bowman Horizontal Steam Engine (geared), used four times, 15/–; with 10/6 Dynamo, 17/6. 18/6 (Youth's) Cricket Pads, used twice, 12/6; with 5/6 Batting Gloves, 15/–. 18/6 pair of "Jack Sharps'" Boxing Gloves, practically new, 10/6.—Felton, 23, Willoughby Road, Wallasey.

Sale. Model B Simplex Typewriter; Miniature Table Railway Set, cost 21/6; Pair of cheap Roller Skates. What offers ?—L. M. Stanley, Barclays Bank, Malvern.

Sale. "Modern Boys," 1 to date, good condition. 0 "Box Brownie," unused. "Wormar" Steam Engine. Offers.—Dinnick, 6, Emperor's Gate, London, S.W.7.

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35/– Bowman Engine. Perfect condition. Take 25/–, or best offer.—Bullen, 178, Widmore Road, Bromley, Kent.

Sale. Bowman Express Engine and Tender, 15/–, also Electric Engine, 15/–, both good Engines.—Henderson, 125, Burbage Rd., Dulwich Village, London.

Wanted. Clockwork Drive for Pathé Hand Camera, Camo or Motrix.—Pearce, Stone House, Broadstairs.

Sale. 30 "Meccano Magazines," 128 "Modern Boys," 50 "This and Thats," 32 "Skippers." Almost perfect. Cost 50/–. Take 24/–. Would separate.—Ed. Ryan, Curraghpoor, Tipperary, I.F.S.

BUTTERFLIES, BIRDS' EGGS, PLANTS, etc.

Write for full Catalogue of everything necessary for the Collector. Post free per return. Advice freely given.
Trophy Mounting a Speciality.
WATKINS & DONCASTER, Dept. M.,
36, Strand, London, W.C.2 (P.O. Box 126).

Further Stamp Advertisements continued from page 514

FREE. Stamp of Spanish Republic. Send postage.—Cowell, 59, Manor Road, West Ham, E.15.

FREE ! 5 diff. Newfoundland. Request Approvals.—E. R. Pritchard, 17, Brentey Rd., Fishponds, Bristol.

FINE RARE SET OF SENEGAL FREE. Request Approvals. Postage.—J. Watson, 64, Stanton Rd., S.W.20.

100 different stamps free. Send for ½d. approvals.—Cox, 21, Dennis Mansions, Westcliff.

MINT DELHI PICTORIAL. Free to applicants for selected British Colonial Approvals, at ½d. each.—E. W. Small, 32, Downhills Park Road, London, N.17.

*9	**Nyassa Triangular,** 1924. Complete set ...	6d.
*14	**Antioquia,** 1899. Complete set (Cat. 2/11)	6d.
9	**Roumania Boy King.** Complete Set ...	6d.
100	**Diff. French Colonials.** Many rare issues ...	9d.
4	**Belgian Congo,** 1920. Air Mails complete ...	1/6
*1	**Iceland Triangular,** 1930. Air Mail ...	3d.
50	**Diff. Russia.** Interesting issues (Cat. 11/–)	1/6
25	**Diff. Air Mails.** Superior stamps	5d.
*18	**Montenegro,** 1921. Large pictorials complete	6d.
25	**Diff. Greece.** Fine pictorial stamps ...	4d.
*1	**India,** 1931. New Delhi Commemorative	2d.
*1	**Iceland,** 1928. 10 aur Monoplane Air Mail	3d.
*2	**Persia,** 1930. Large Air Mails	3d.
500	**All Different.** Fine Collection	1/6
*100	**Diff. Germany.** Includes Air Mails ...	6d.
21	**Belgium,** 1923. Large Parcel Post up to 5 fr.	4d.

* Unused. Postage 1½d. extra.
W. BENNETT, 53, Marlborough Road, London, E.8.

MECCANO MAGAZINE

Registered at G.P.O., London, for transmission by Canadian Magazine Post.

EDITORIAL AND ADVERTISING OFFICE :—
OLD SWAN, LIVERPOOL, ENGLAND.
Telegrams : "Meccano, Liverpool."

Publication Date. The *"M.M."* is published on the 1st of each month and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price 6d. per copy. It will be mailed direct from this office, 4/– for six issues and 8/– for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

Readers' Sales and Wants. Private advertisements (i.e., not trade) are charged 1d. per word, minimum 1/–. Cash with order. Editorial and Advertising matters should not be dealt with on the same sheet of paper.

Advertisers are asked to note that private advertisements of goods manufactured by Meccano Limited cannot be accepted.

Small Advertisements. 1/6 per line (average seven words to the line), or 16/– per inch (average 12 lines to the inch). Cash with order.

Display. Quotations for space bookings, and latest net sale figures, will be sent on request.

Press Day, etc. Copy should be sent as early in the month as possible for insertion in following issue. We usually close for press on or before 6th of each month for following issue. Half-tone blocks up to 100 screen.

Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher copies. Sent free to advertisers booking one inch or over. Other advertisers desiring vouchers should add 8d. to their remittance and should order voucher copy at same time.

Remittances. Postal Orders and Cheques should be made payable to Meccano Ltd.

Ordering the "M.M." Overseas

Readers Overseas and in foreign countries may order the "*Meccano Magazine*" from regular Meccano dealers or direct from this office. The price and subscription rates are as above, except in the cases of Australia, where the price is 1/5 per copy (postage extra), and the subscription rates 9/6 for six months and 19/– for 12 months (post free); Canada, where the price is 15c. per copy, and the subscription rates 75c. for six months, and $1.50 for 12 months (post paid).

The U.S.A. price is 15c. per copy, and the subscription rates $1 and $2 for 6 and 12 months respectively (post free).

Overseas readers are reminded that the prices shown throughout the *"M.M."* are those relating to the home market. Current Overseas Price Lists of Meccano Products will be mailed free on request to any of the undermentioned agencies. Prices of other goods advertised may be obtained direct from the firms concerned.

CANADA : Meccano Ltd., 34, St. Patrick St., Toronto.
UNITED STATES : Meccano Co. of America Inc., New Haven, Conn. Meccano Co. of America Inc., 200, Fifth Av., New York.
AUSTRALIA : Messrs. E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W
NEW ZEALAND : Models Ltd., Kingston & Federal Streets, Auckland.
SOUTH AFRICA : Mr. A. E. Harris (P.O. Box 1199), 142, Market Street, Johannesburg.
INDIA : Karachi : Bombay Sports Depot, Elphinstone Street, Bombay; Bombay Sports Depot, Dhobi Talao. Calcutta : Bombay Sports Depot, 13/C, Old Court House Street.

The Editor wishes to make known the fact that it is not necessary for any reader to pay more than the published price. Anyone who is being overcharged should lodge a complaint with the Meccano agent in his country or write direct to the Editor.

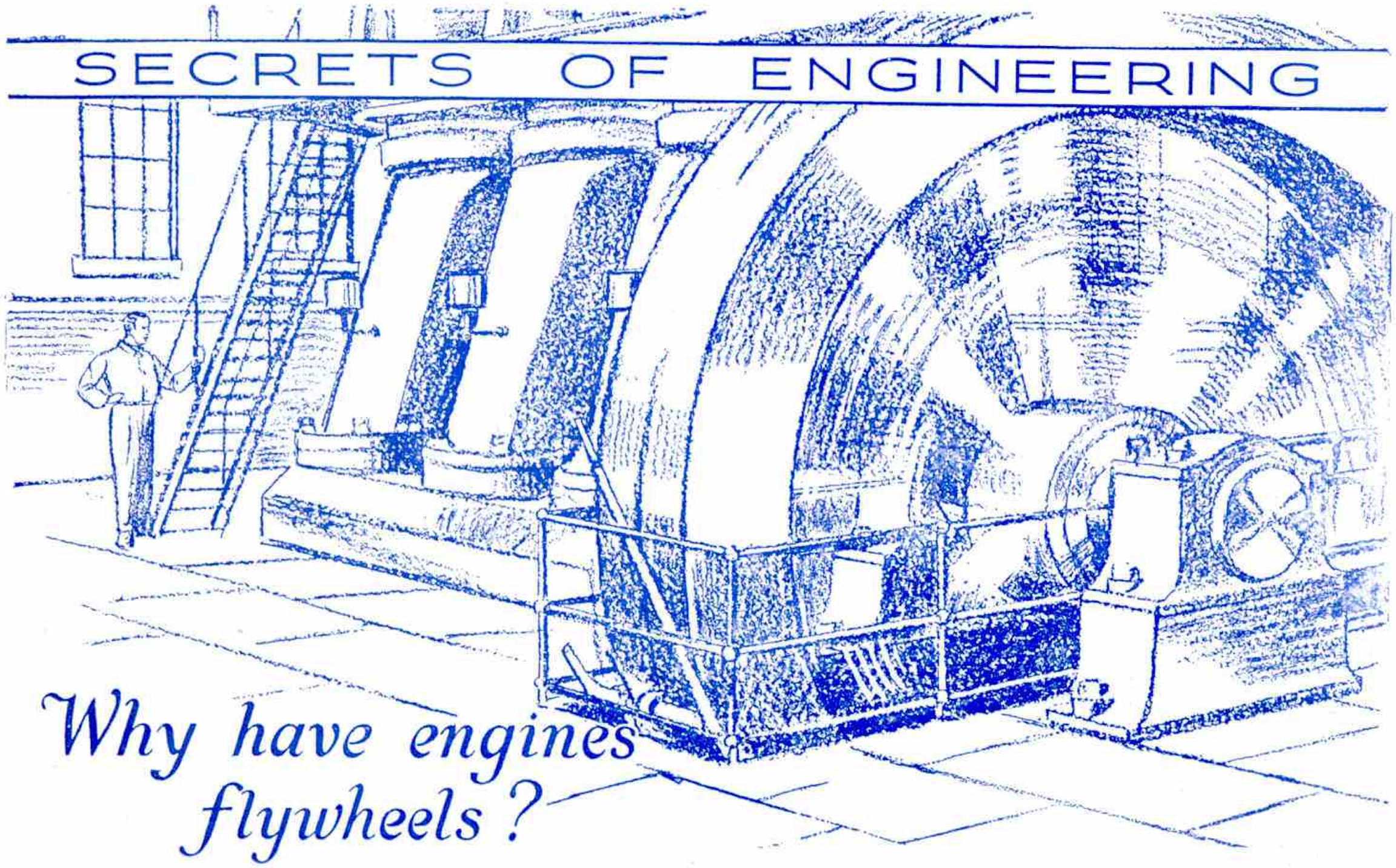
Start using a Camera now. 2¼×3¼ Roll film Cameras, only 5/6. Really good value.—Rowntree, 122, Portsdown Road, W.9.

Sale. Folding Table 10 ft.×4 ft. for Hornby Train. Never used. Particulars—Seamer, Becket Street, Derby.

Patents for Inventions, Trade Marks : "Advice Handbooks" and Cons. free.—B. T. King, Regd. Patent Agent, 146a, Qn. Victoria St., London, E.C.4. 45 years' refs.

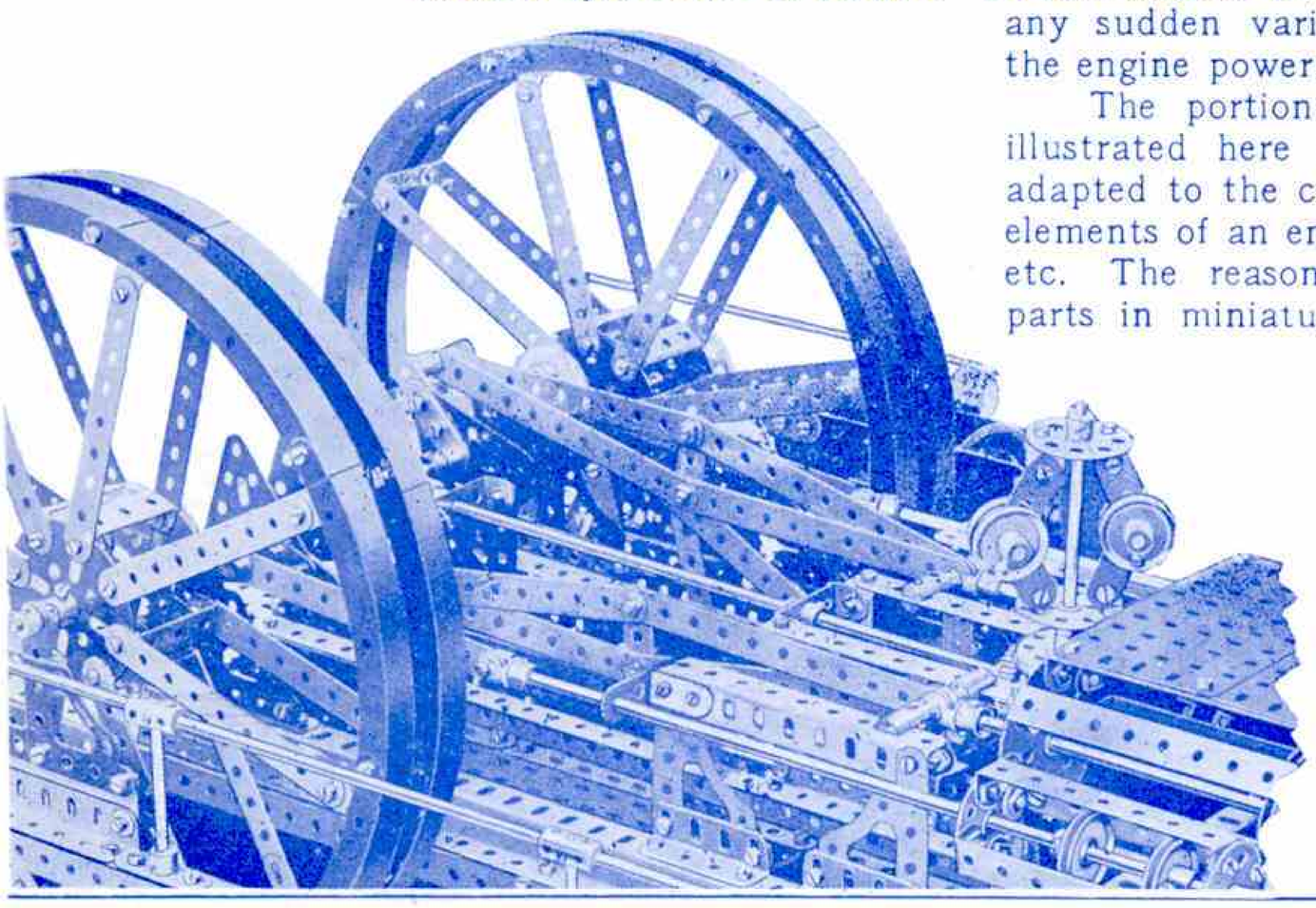
CINEMATOGRAPHS British Made from 37/6
CINEMATOGRAPH FILMS
from 5/– per 1,000 ft.
Write for our Catalogue, post free, or send 1/– for sample length of Film and Catalogue.
Filmeries Co., 57, Lancaster Rd., Leytonstone, E.11.

SECRETS OF ENGINEERING



Why have engines flywheels?

Many types of engines are provided with flywheels in order to distribute their power evenly. A rapidly spinning wheel tries to maintain a uniform speed and resists any force that tends to make it spin faster or slower. In this manner the flywheel of an engine prevents to a large extent any sudden variations in speed resulting from fluctuations in the engine power or in the load.



The portion of a Meccano Twin Cylinder Steam Engine illustrated here shows how effectively Meccano parts can be adapted to the construction of flywheels and to other important elements of an engine, such as centrifugal governors, crankshafts, etc. The reason is that Meccano parts are real engineering parts in miniature—they can all be used in exactly the same manner as the corresponding parts in real engineering practice. More important still, they are all standardised and interchangeable, and thus can be used to make hundreds of different engineering models.

Ask your dealer to show you the latest Meccano Outfits.

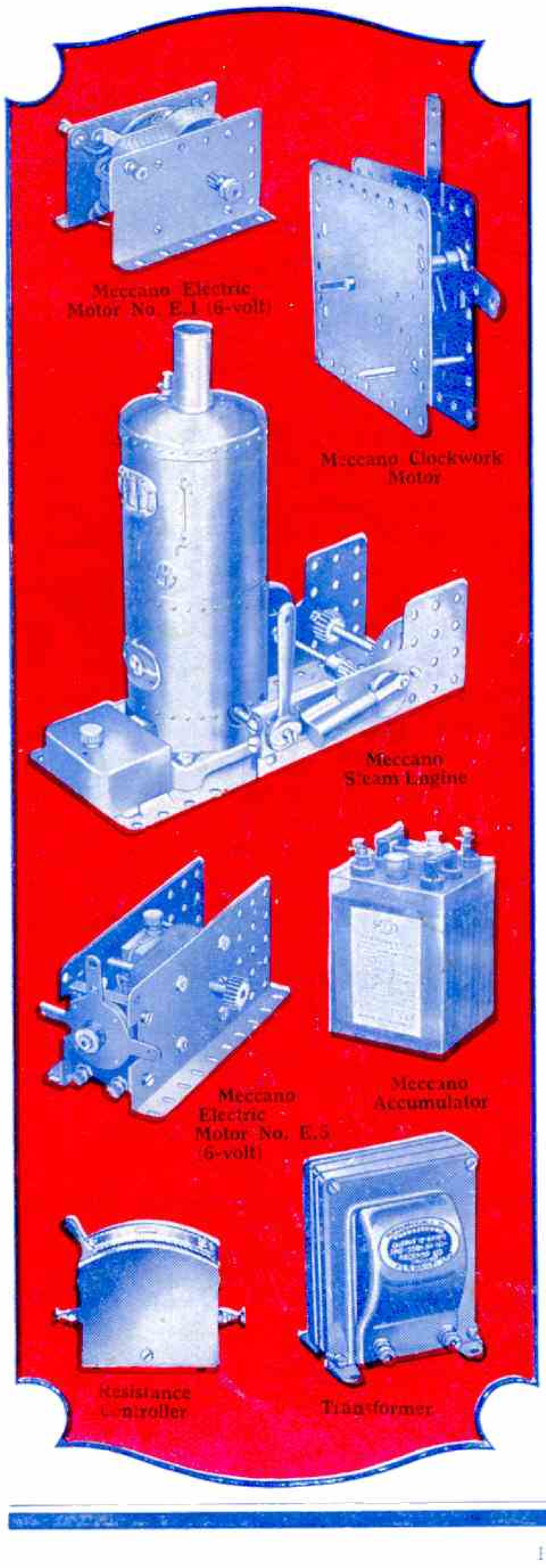
There are Meccano Outfits at all prices from 2/- to 450/-

MECCANO

The Toy that made Engineering Famous

MECCANO LIMITED — OLD SWAN — LIVERPOOL

Run your Model with a Meccano Motor



If you want to obtain the fullest possible enjoyment from the Meccano hobby you should operate your models with a Meccano Motor or Steam Engine. You push over the control lever of the motor or engine and immediately your Crane, Motor Car, Ship Coaler or Windmill commences to work in exactly the same manner as its "big brother" in real life. Could anything be more exciting?

The Meccano Motors and Steam Engine are strongly made and the utmost care is taken in their manufacture to ensure that they will give satisfaction. The side plates and bases are pierced with the standard Meccano equidistant holes, which enables a motor or engine to be built into any Meccano model in the exact position required.

Particulars and prices of the Steam Engine, Motors and Accessories are given below.

Meccano Clockwork Motor

This splendid Motor, which is specially designed for operating Meccano models, is a compact self contained power unit.

An efficient governor controls the spring that is fitted on the motor and ensures a long steady run at each winding. Brake and reverse levers enable the motor to be stopped, started and reversed as required. Supplied complete with winding key and full instructions. Price **7/6**

Meccano Steam Engine

This is a particularly powerful steam unit designed for driving Meccano models. On actual test it has lifted over 56 lbs. A single cylinder of the oscillating type is employed, steam being admitted to it through a special reversing block. Operation of the reversing lever enables the crankshaft, which is fitted with a special compensating flywheel to run in either direction.

The spirit container for the lamp is placed well outside the boiler-casing, eliminating all risks of the spirit becoming heated. The boiler is fitted with an efficient spring safety valve of heavy gauge brass and there is no danger whatever of the boiler exploding. Price **25/-**

Meccano Electric Motor No. E.1 (6-volt)

This highly efficient Electric Motor (non-reversing) gives excellent service. A 6-volt Accumulator will operate it, but it may also be driven from the main (alternating current only) through the Transformer described in the next column. Price **7/6**

Meccano Electric Motor No. E.6 (6-volt)

This 6-volt Motor is specially designed to build into Meccano models. It may be run from a 6-volt accumulator or, by employing the Transformer described below, from the main. It is fitted with reversing motion and provided with stopping and starting controls. The gearing is interchangeable. Price **15/6**

IMPORTANT.—Meccano 6-volt Motors will not run satisfactorily from dry cells.

Accumulator (6-volt, 20-amps)

The Meccano Accumulator is of substantial construction and is specially recommended for running the Meccano 6-volt Electric Motors. Price **28/6**

Transformer

By means of this Transformer the Meccano 6-volt Electric Motors may be driven from the house supply (alternating current only). It is available for all standard supply voltages, from 100 to 250 inclusive, at all standard frequencies. The supply voltage and frequency must be specified when ordering. Complete with length of flex and adapter for connection to an ordinary lamp socket. Price **30/-**

Resistance Controller

By employing this variable resistance the speed of the Meccano 6-volt Electric Motors may be regulated as desired. The controller is connected in series with the motor and accumulator, or with the motor and transformer if a transformer is used as the source of power. It will not regulate the speed of a high-voltage motor connected to the main. Price **4/6**

MECCANO LTD.

BINNS ROAD - OLD SWAN - LIVERPOOL

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