VOL. XIX. No. 2

FEBRUARY 1934

MECCANO MAGAZINE

6D.

WHERE THE COLORADO IS TO BE TAMED. (see page 98)

A Selection of Popular Tri-ang Toys

Regd. Trade Mark

REGD TRADE MARK

Regd. Trade Mark

CLOCKWORK STEAM AND MOTOR LORRIES

Well known road vehicles made as either Steam or Motor Lorries. Strong clockwork, solid rubber wheels, attractive finish. Approx. length, 9½ in.

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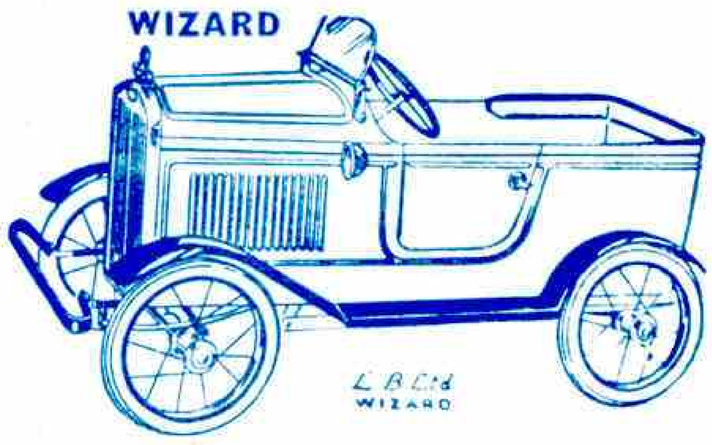
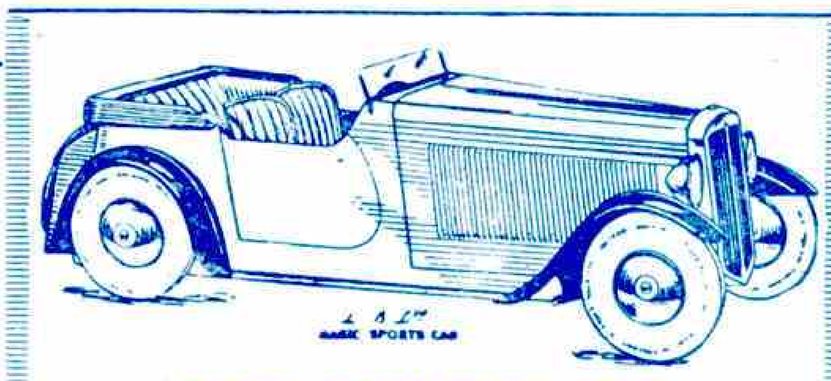


A splendid car with all-steel body. Easy running. Ball-bearing back axle. Windscreen and bumper. Thick white sponge rubber tyres. Length, 41 in. **37/6**



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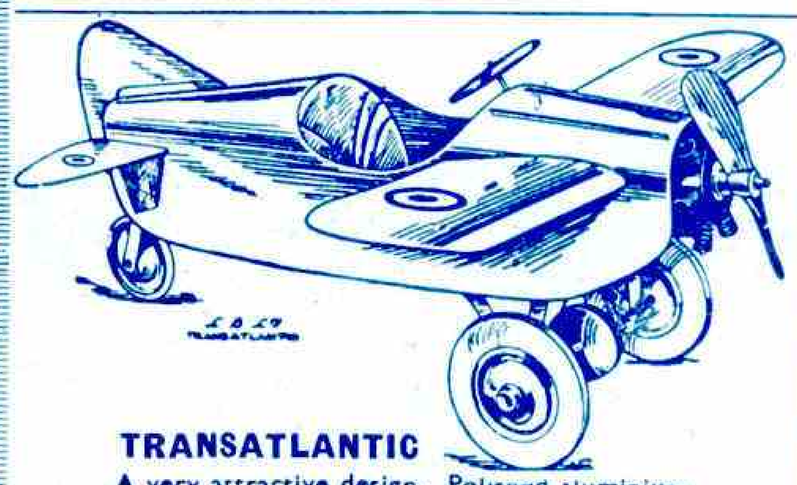

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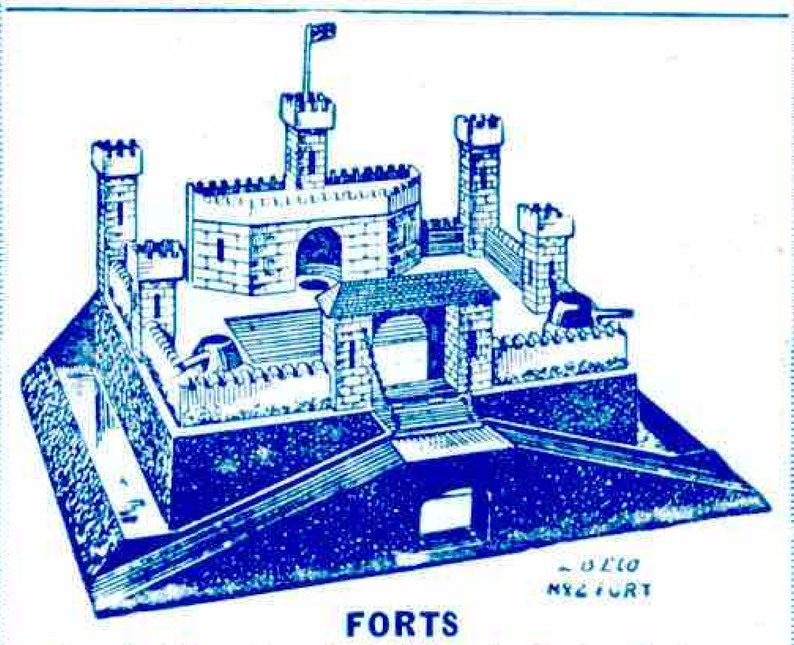

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No. 1a	16 ,, ,,	1 ,, ,,	**6/11**
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No. 4	28 ,, ,,	4 ,, ,,	**19/6**

TRI-ANG TOYS ARE ON SALE AT ALL GOOD STORES AND TOY SHOPS

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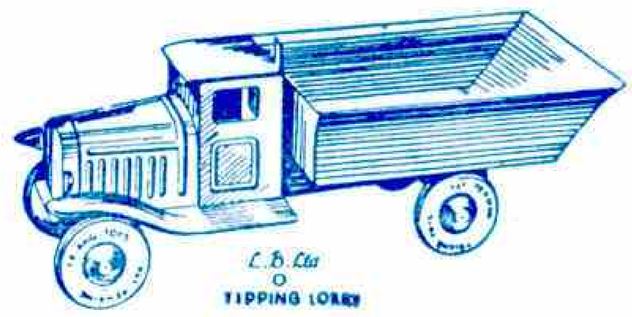

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A popular series of toys. Very strong all-steel construction. Solid rubber wheels. Strong, easy running axles. Size OOO. 7½ in. long. **6d.**

Size OO, 10 in. long **1/-**
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Insist on a genuine Fairycycle.

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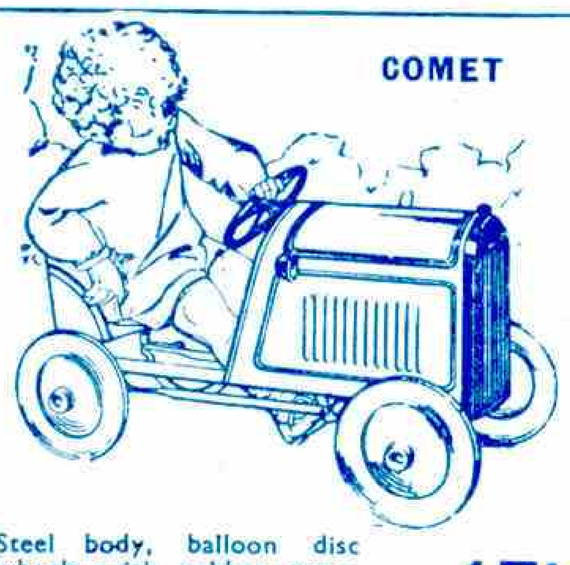

Steel body, balloon disc wheels with rubber tyres. Plated radiator. Length, 31 in. **17/11**

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NEXT MONTH: "ELEPHANT HUNTING IN THE ZAMBEZI COUNTRY." READY: 1st MARCH

MECCANO MAGAZINE

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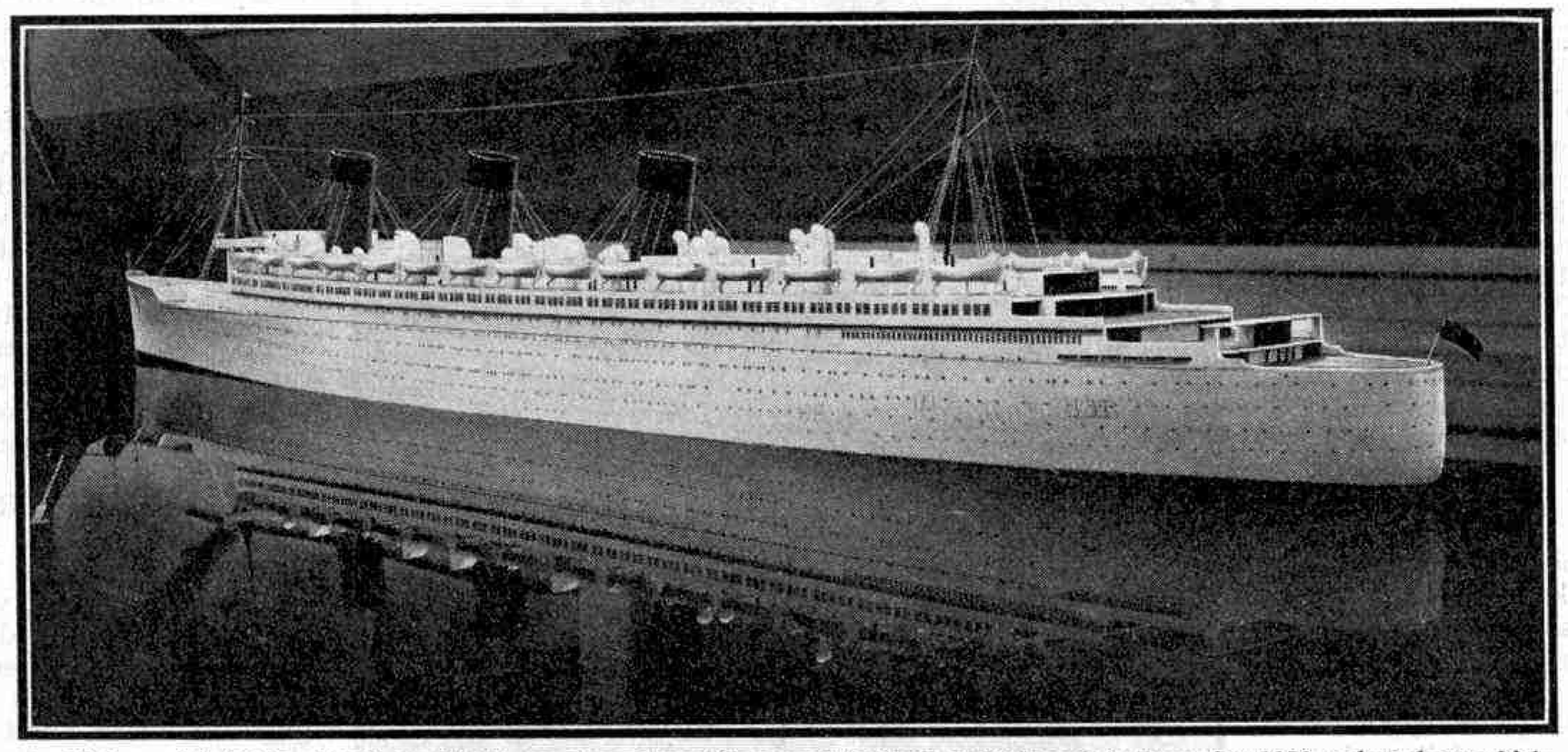
With the Editor

"February Fill-Dyke"

February is in many respects one of the most interesting months of the year. It is by no means the most popular one, however, for it generally lives up to its name of "February fill-dyke" by bringing with it heavy rain. This rain is vital to us, for it plays a great part in preparing the ground for the sowing of the seed of the corn that is to be harvested in autumn. February, March and April mark important stages in the agricultural year. February brings rain that soaks the ground thoroughly. Then comes March with its notorious high winds that dry the ground and leave it in condition for ploughing and harrowing into a fine tilth in readiness for sowing. The success of the crops depends on the thoroughness with which this change is brought about, and for this reason it is said that "A peck of March dust is worth a king's ransom." April follows with its gentler showers of warm rain that provide the moisture for germination; and rich harvests are predicted when the weather faithfully follows the traditional plan.



An 18-ft. model of "No. 534," the 73,000-ton Cunard liner that was laid down at Clydebank in December 1930 and work on which was stopped in 1932. The construction of this vessel is now to be resumed. The model is lying in the experimental tank housed in the shipyard. Photograph by courtesy of the Cunard Steamship Co. Ltd.

This year February will have to provide more rain than usual if it is to live up to its reputation of "fill-dyke," and to repair the effects of the prolonged drought of 1933. To most of us a summer such as that of last year is a glorious experience, but the absence of rain over a long period inevitably brings anxiety to the farmer and to the engineers who are entrusted with the important task of keeping our great towns supplied with the vast quantities of water they need.

The names of the months are of Latin origin, and February was so called from "Februa," a festival of purification that was celebrated on the 15th of the month. There are many legends and traditions associated with it, among which is the one concerning its 14th day, universally known as St. Valentine's Day. We do not now attach much significance to this day, but in the past it was of great importance. St. Valentine himself was a Roman Bishop who was arrested and put in chains by order of the Emperor Claudius II. One Asterius was given the task of trying to induce Valentine to renounce his Christianity and turn back to idolatry, but the Bishop miraculously healed the man's blind daughter, with the result that Asterius and all his house became converted to Christianity and were baptised. After suffering a long period of imprisonment Valentine was beaten with clubs and was finally beheaded on 14th February, 270 or 271 A.D.

The customs now associated with the feast of St. Valentine are of great antiquity. The day seems always to have been regarded as the one on which we receive the first hint of the coming of Spring, and according to country tradition it is on this day that the birds choose their mates and begin to make preparations for nesting. Thus the name of St. Valentine became associated with betrothals, and there grew up the custom among young people of sending to one another "valentines," consisting usually of an ornamental card bearing a few lines of verse. These valentines were sent anonymously, and the receivers were left with the interesting task of guessing the sender. By degrees the practice of sending valentines fell into decay, and in spite of various efforts to revive it it is now observed only to a very small extent. Many interesting beliefs connected with the weather are associated with the second day of February, which is known as Candlemas Day. The name is derived from the fact that in the Roman Catholic festival held on that day there is a procession of candles, and the candles for use during the coming year are consecrated. It used to be firmly believed throughout most parts of Europe that the weather on Candlemas Day afforded an indication to that for the whole of Spring. This belief is illustrated in the following rhyme:—

If Candlemas Day be fair and bright,
Winter will have another flight;
If Candlemas Day be cloud and rain,
Winter is gone and will not come again.

In the Hebrides and in some parts of Germany it was formerly the custom to observe special rites on Candlemas Day to ensure good growths of oats and flax during the coming season.

The British Industries Fair

I take this opportunity of reminding readers of the British Industries Fair that opens on the 19th of this month. At the Olympia section of the Fair one of the most interesting features will be the display provided by the toy industry, and here the Meccano Stand will be prominent. At this Stand all the most recent developments in the wide range of Meccano products will be displayed, and experts will be present to deal with enquiries from buyers from all over the world. I hope that all readers who are able to do so will visit Olympia and inspect the Meccano Stand.

The Story of Hoover Dam

I.—Taming a Great American River

NEARLY 400 years ago Hernando Cortez, the famous Spanish adventurer who conquered the ancient Mexican Empire, sent three ships northward along the west coast of the country he had won, in search of the Seven Cities of Cibola which, according to rumour, were fabulously rich in gold and silver. Francisco de Ulloa, the commander of this expedition, failed to discover any trace of these cities as he slowly made his way up what is now known as the Gulf of California. Instead he encountered a raging tidal bore 36 ft. in height, that swept down on his vessels when they were in water that was unexpectedly shallow and surprisingly muddy, and was compelled to sail southward in order to avoid disaster. He sent a message to Cortez with the story of his failure, and then rounded the tip of Lower California on a voyage from which he never returned. His fate is one of the many unsolved mysteries of the Pacific.

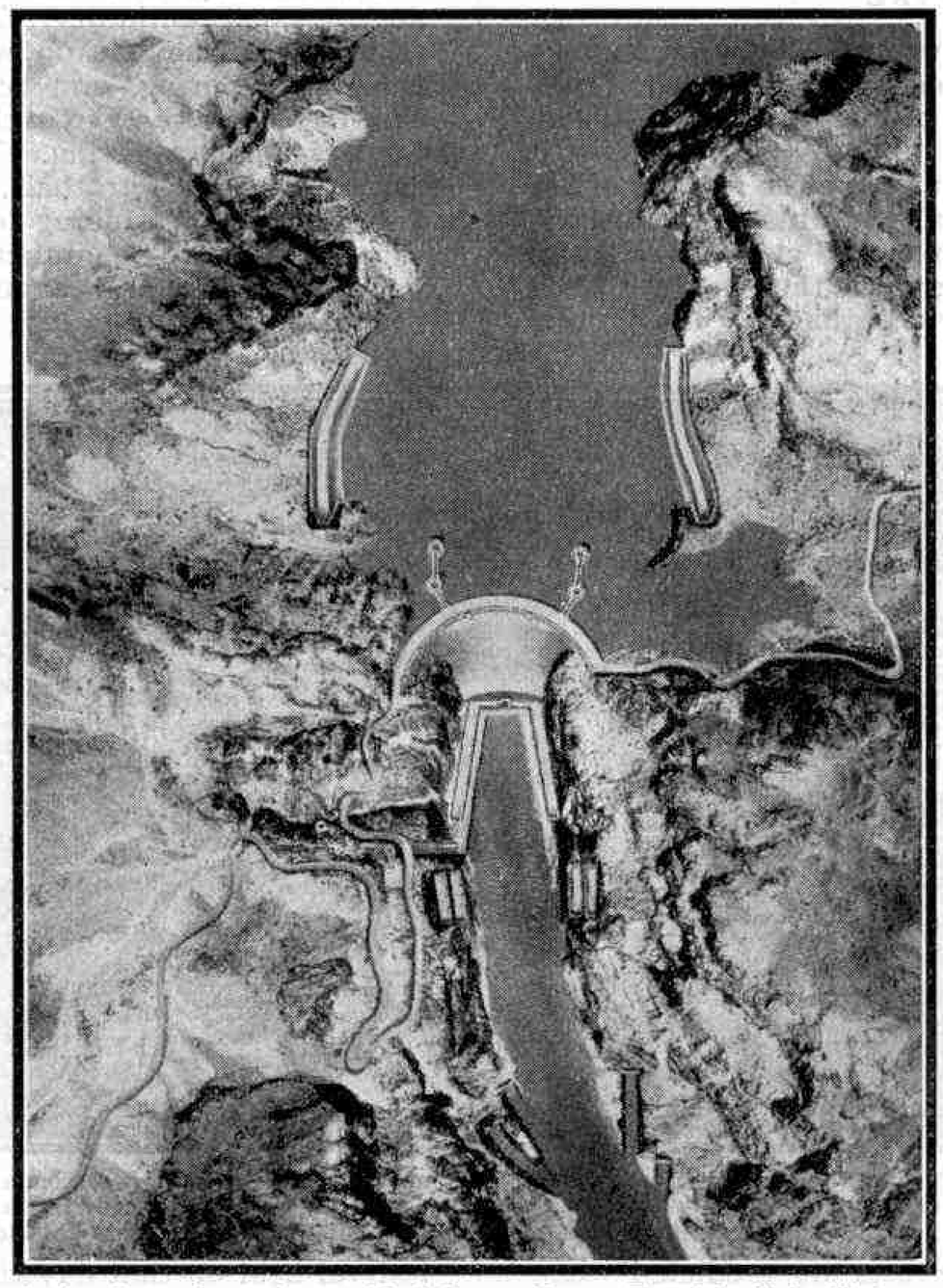
Although he did not know it, Ulloa was the first white man to come into contact with the waters of the Colorado River. The mud on which he commented had been brought down into the Gulf of California by that river, which is now known to be one of the most turbulent in the world. Cortez did not abandon his search for the Seven Cities of Cibola, and although the members of his next expedition were no more successful than Ulloa, they revealed the existence of the great river, and one of them actually looked over the rim of the Grand Canyon of the Colorado, one of the wonders of the world.

The name "Colorado" means "red coloured," and was given to the stream by these early explorers, who were struck by the reddish colour of its waters. It remained comparatively unknown except to hardy Spanish missionaries until little more than 100 years ago, when a venturesome trapper followed its course from mouth to source, travelling partly on foot and partly on horseback. A fur trader was the first to attempt to navigate a boat down the river. His voyage was made in craft covered with buffalo skins, and was a succession of thrills, but unfortunately several members of his party were drowned.

Further explorations, usually conducted at grave risk, extended our knowledge of the river. One of the most remarkable of these ventures was the voyage of the "*Explorer.*" This vessel, under the command of Lieutenant Ives of the United States Navy, was navigated from the mouth of the river to the point where it emerges from the tremendous canyons through which it flows for nearly 500 miles at one part of its journey to the sea. There the "*Explorer*" struck a submerged rock, but fortunately it was possible to repair the damage, and she was able to return downstream.

Subsequently Major J. W. Powell, a veteran of the American Civil War, started from Green River City, Utah, on a voyage down the river that completed its exploration. He launched his four boats in May, 1869, and three months later arrived at a point about 1,000 miles below his starting point after a hazardous trip, in the course of which he lost two boats and four of his nine men. These hardy adventurers must have had extraordinary courage and tenacity, for day after day they faced the unknown at every bend of the river, embarking without hesitation upon swift rapids, knowing that these might at any moment terminate in dangerous rocks, in turbulent whirlpools, or even in gigantic waterfalls.

The Colorado River has now been thoroughly investigated and surveyed. It is 1,700 miles long, and its waters are fed by streams flowing from the snow-clad mountains of the Central Rockies. Passing into Arizona, the river enters a section 500 miles long, in which chasms thousands of feet in depth have been scoured in the rock, which has been carved into fantastic shapes by rain and frost. The mightiest of the canyons that distinguish this region is the Grand Canyon, a mighty gash more than 200 miles long and some 12 miles wide, with almost vertical walls that go sheer down to a depth of a mile. This great chasm, and all the other canyons in this region, are steadily being worn deeper and deeper, for the sand brought down by the river remorselessly scours their rocky beds as it is carried along swiftly by the current.



A view from above of a model of Hoover Dam. The lake that will form above the arch-shaped structure will be 115 miles in length. For the illustrations to this article we are indebted to the "Compressed Air Magazine," and Six Companies, Inc.

During its passage through the canyon region the general trend of the river is westward, but it does not escape into the lowlands until after it has again turned southward to form the boundary between the States of Arizona on the east and Nevada on the west. Its waters are then so muddy that they have been described as "too thick to drink and too thin to be ploughed." Every month there is brought down from the rocky country in the north sufficient silt to cover an area of 105,000 acres to a depth of 1 ft., and the amount discharged in a year is equal in volume to the whole of the earth excavated in digging the Panama Canal.

The Colorado River has been bringing down silt at this rate for ages, and millions of tons of the rocks of which the Rocky Mountains are built have been deposited in its lower reaches. There the accumulations of centuries have created a gigantic delta, and the course of the river across this is liable to sudden changes when its waters are swollen.

At one time the Gulf of California extended nearly 150 miles north of its present limits, and the Colorado entered it 100 miles south of its head. As the delta of the river grew, it formed a jetty of mud that eventually cut off the head waters of the Gulf, which were transformed into a lake. The region is sub-tropical, and in the course of centuries the vast sheet of water thus isolated has slowly evaporated, so that to-day the only portion remaining is the Salton Sea, the surface of which is 278 ft. below the normal level of the Pacific Ocean.

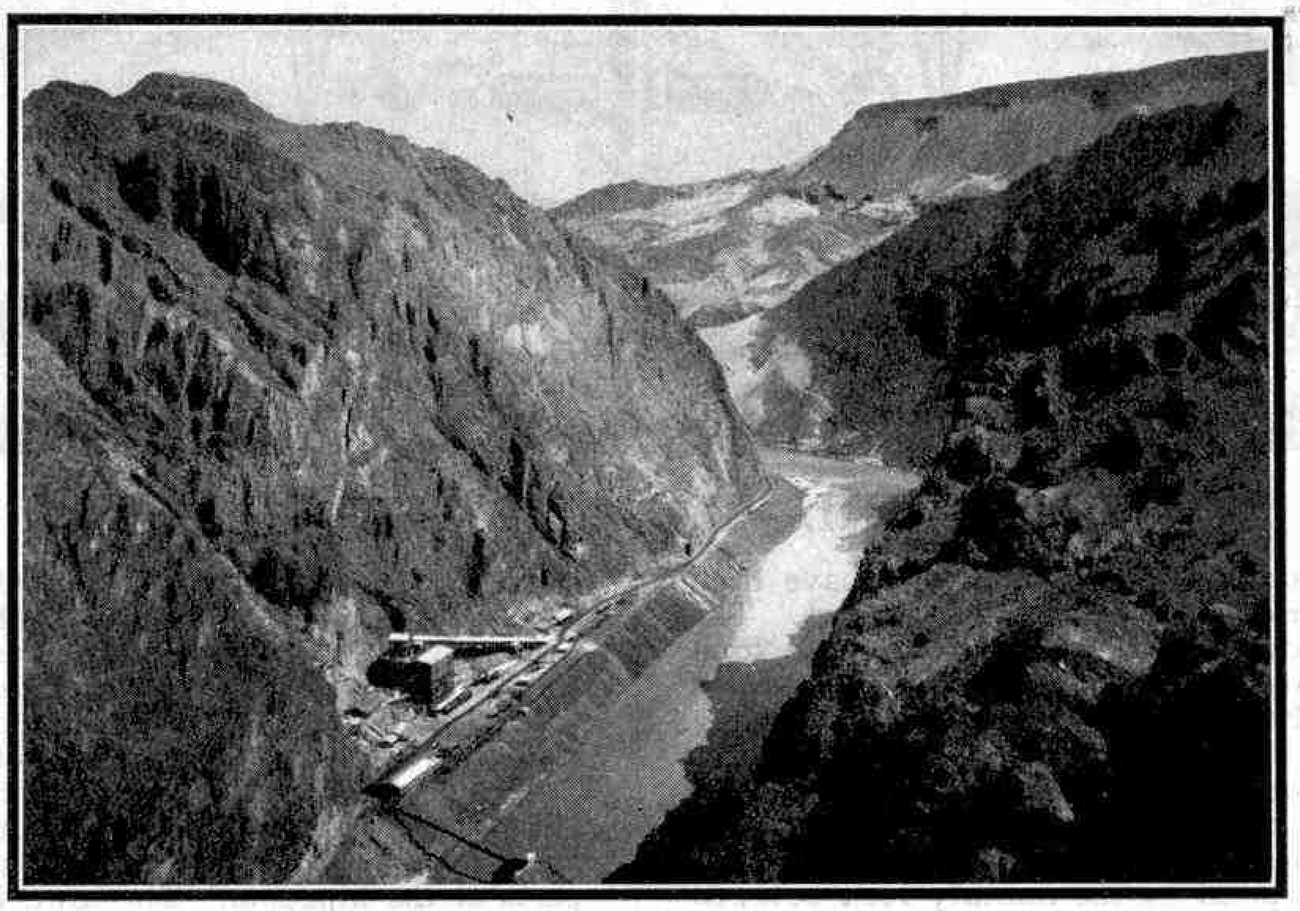
In this manner a great stretch of land was reclaimed from the sea through the agency of the Colorado, and to-day it is known as the Imperial valley. Its soil was crudely irrigated by the Indians centuries ago, and has proved fertile when given an ample supply of water.

By a strange irony the river subsequently became the chief enemy of the land it had created. Part of the mud brought down raised its own bed, and when its flood waters spread over the surrounding country they overflowed into the Valley and drained northward into the Salton Sea. The surface of this lake on occasions has been raised as much as 70 ft. above its normal level, and serious inundations over wide areas have followed.

Since the beginning of the present century the flooding of the Colorado River has become a very serious problem, for the Imperial Valley has been changed from a desert into a garden by irrigating

its parched but fertile soil, and its mild climate has attracted thousands of settlers. Grapes, strawberries and other fruits, and lettuce, peas and garden produce to the annual value of £20,000,000 are grown in it. These ripen earlier than in any other part of the United States, and the great possibilities of the Valley as a gigantic garden, providing occupation for thousands of people and fresh food on an enormous scale for the nation as a whole, made it worth while to consider harnessing the river in order to prevent a repetition of the many disastrous floods that have occurred since the early settlers made their homes in the valley.

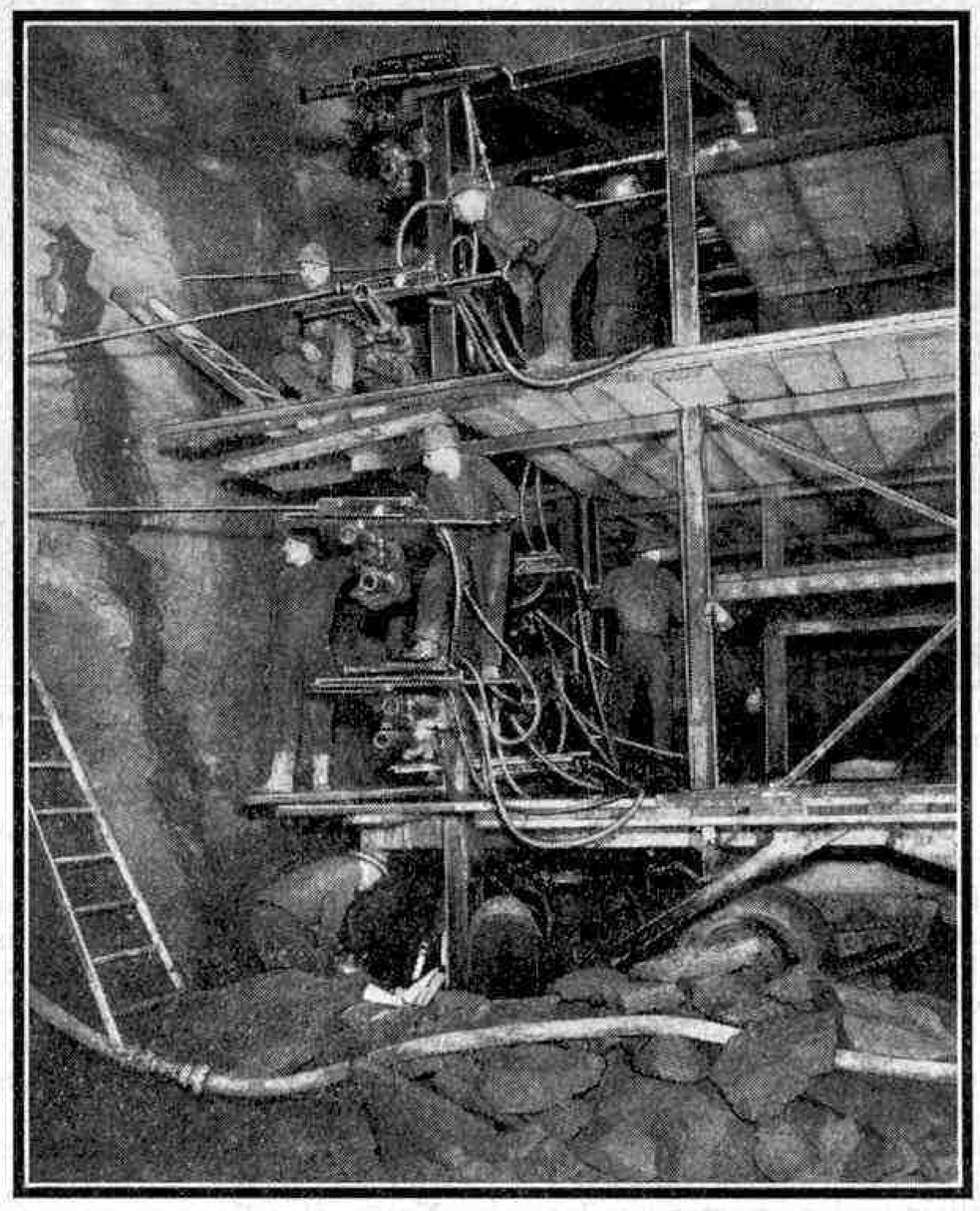
The agitation for devising means of taming the wayward river began more than a quarter of a century ago, and has now been brought to an end with the commencement of great engineering works to bring the stream under subjection. The central feature of this scheme is the provision of a gigantic Dam, of greater height than any previous structure of this kind, behind which the flood waters of the river will be stored. This will put an end to the continual threat of the Colorado to destroy the towns and cities of Imperial Valley and to ruin its industries.



Looking upstream in Black Canyon from a point high up on the Arizona Cliff. This view shows the concrete plant, and a section of the railway built on a shelf constructed under the walls of the Canyon.

Hoover Dam will accomplish far more than this, however. Some of the water it is to store will be conducted across the country through pipe lines for drinking and industrial purposes in populous centres; part will be diverted into irrigation canals for distribution throughout the Imperial Valley, and even farther afield; and further quantities will be employed in the generation of electric power on a gigantic scale. No project of this magnitude has ever previously been planned. The Dam itself will be of record height, and it is expected that the total expenditure on the works to be carried out, including the digging of a great canal for the distribution of irrigating water, will be more than £30,000,000. Constructional work began early in 1931 and will not be completed until 1938.

When the decision to build a dam was made, the first step was to find the most suitable place for the erection of the wedge of concrete behind which the surplus water was to be stored until required. The site had to be in such a position that the electric power generated could readily be transmitted to centres where it was in demand; and in addition ample space had to be available for the accumulation of an immense volume of water on the upper side of the structure. Eventually it was decided to begin work in the Black Canyon, which practically marks the seaward end of the canyon region of the Colorado. The Canyon itself is narrow, and its walls are very steep. The rock is not too hard to drill, but is solid in character, and can be depended upon to carry safely the heavy loads imposed upon it by the weight of the Dam and the pressure of the water.



The crew of a "Jumbo," or drilling carriage, pointing their drills in readiness for work at the heading of one of the four tunnels through which the Colorado River was diverted to enable Hoover Dam to be built.

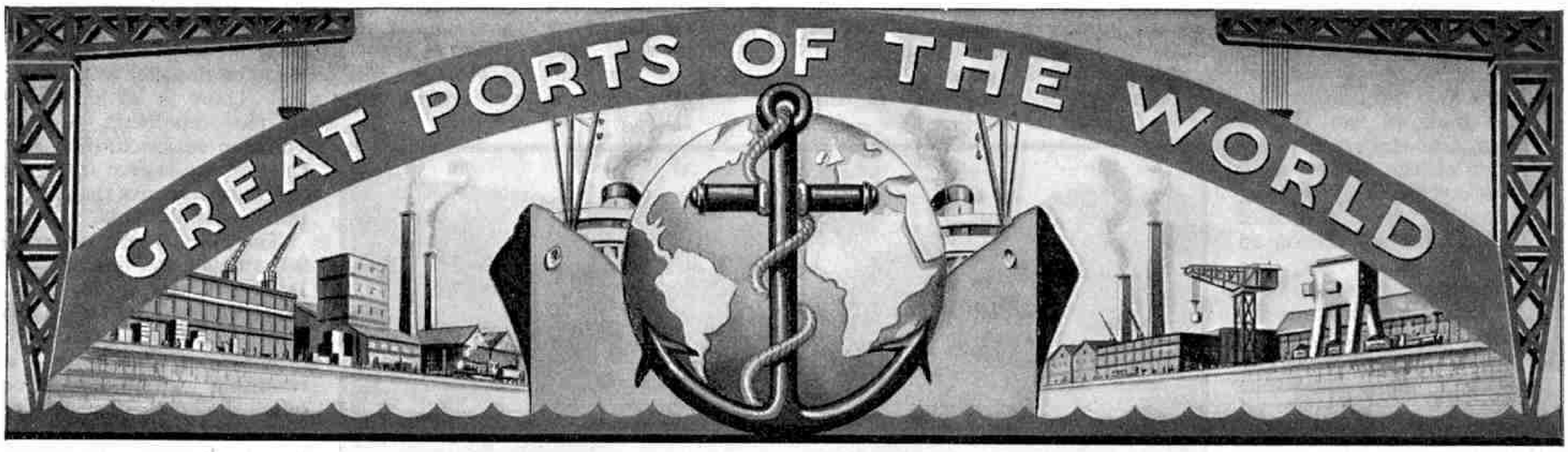
The site for the Dam was only decided after an exceptionally thorough examination of the rock on which it was to rest. Trial holes were bored to a depth of 557 ft. below the low water level of the river, and these revealed the presence of a tough and durable mass of hard rock that is not readily eroded, and presents few fractures or cracks liable to cause leaks or seepage. The rock is what is known as a breccia, or tuff, and is the product of gigantic volcanic eruptions millions of years ago. There is no likelihood of the repetition of any volcanic action to-day, and the district is free from the earth movements that affect parts of California.

The illustration on page 98 shows a plan of the Dam as it will appear when constructed. It is to be built in the form of an arch directed upstream, for a retaining wall of this shape offers the greatest resistance to the pressure of the water held back by it. Its height will be 730 ft., its crest will be 1,180 ft. in length and 45 ft. in width, and at its base it will be 650 ft. wide. About 3,500,000 cu. yd. of concrete will be employed in building the Dam, which will rest on bed rock at a depth of 150 ft. below the low water level of the river.

When the work is finished the waters of the Colorado will accumulate above the Dam until they have formed a gigantic lake extending upstream for a distance of 115 miles, and having a maximum width of eight miles. This lake will be bounded by the sheer walls of the canyons, and its basin will be large enough to contain sufficient water to cover almost the whole area of England, or the State of New York, to a depth of a foot. It will be the largest of man-made reservoirs, and will be capable of controlling even the turbulent Colorado, for its immense basin is of sufficient capacity to hold up two years' flow of the river.

Hoover Dam is being constructed by Six Companies, Inc., and the engineers of this firm began to make their preparations within a few days of signing the contract in 1931. Never before has so much preliminary work been required in a scheme of this kind. Black Canyon is in an arid region, at that time populated only by lizards and rabbits. The only plants that flourish in the sandy soil are mesquites and cactus, and the Canyon itself, hemmed in by sheer walls 600 ft. in height, becomes a veritable inferno in summer. The first task therefore was to provide comfortable quarters in which to house the families of the multitude of workmen required. A site seven miles from the river was chosen for this purpose, and there a new city with shops, banks and recreation rooms has sprung up as rapidly as any of the famous cities of the gold rush days in California. Unlike those of the mining centres of last century, however, the streets of Boulder City, as this rapidly-built centre is called, are well paved and drained, and adequate supplies of water and electricity are available. The community already has telephones and electric light and power, and lawns, trees, flower gardens and a park add comfort to the temporary homes of the builders of Hoover Dam. The new city is not cut off from civilisation, for a branch of the Union Pacific Railroad has been constructed to it.

Roads and railways over which men, materials and machinery could be transported from Boulder City to Black Canyon had to be provided, and a transmission line had to be erected to deliver electric power to the site of the Dam from generating stations in California, 200 miles distant. The steep (*Continued on page 175*)

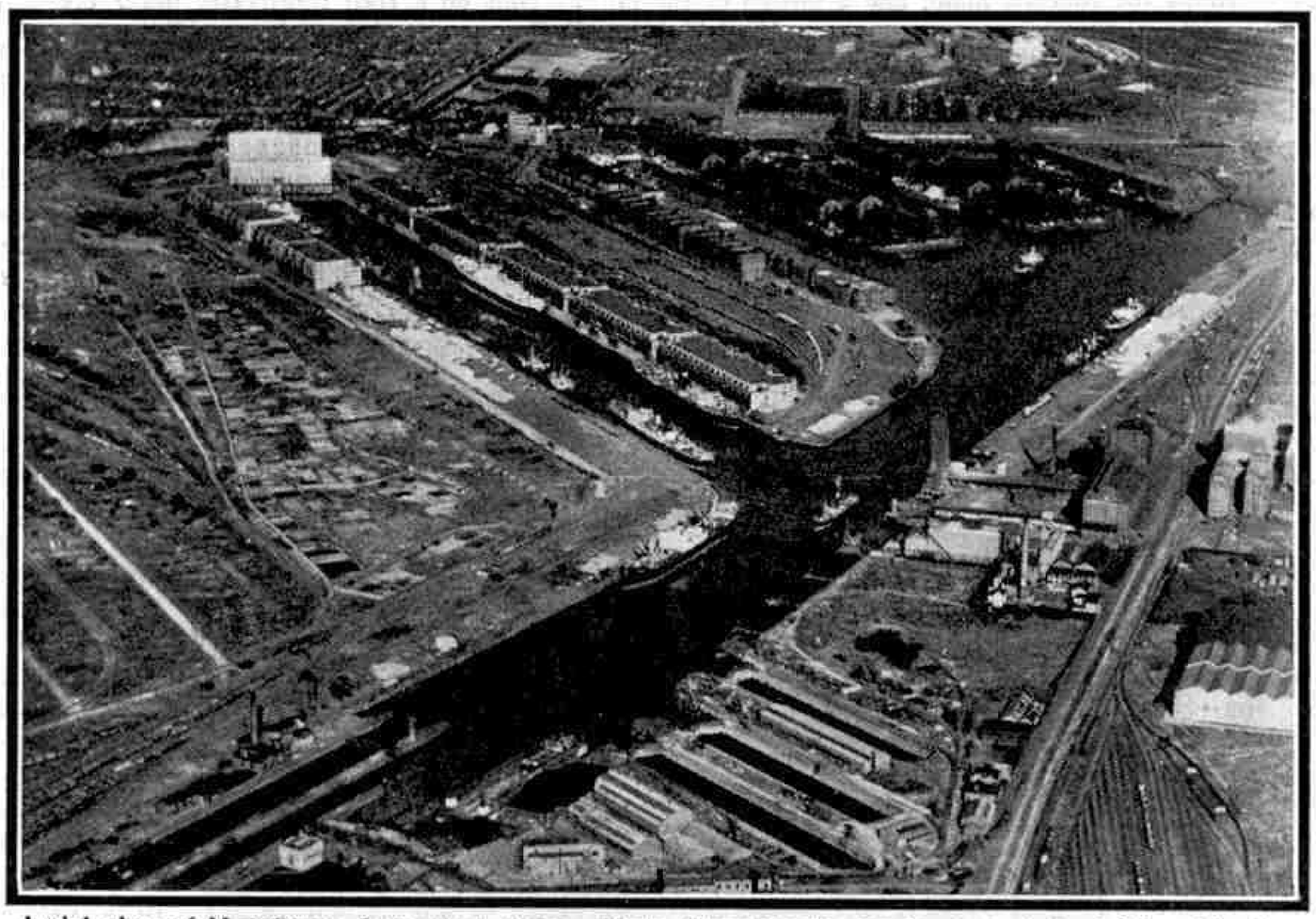


VIII.—MANCHESTER

MANCHESTER differs from the other ports that have been dealt with in this series in being an inland port. The manner in which the disadvantage of its remoteness from the sea has been overcome, and Manchester raised to the position of fourth port in the United Kingdom, is a romance of engineering and commerce.

The earliest that is known with certainty of the history of Manchester is that there was a Roman settlement at the junction of the rivers Irwell and Medlock. This important settlement guarded the main strategical point on the military road between Chester and York, but it declined after the Romans withdrew from this country.

There is no further mention of Manchester until about 500 years later. By that time a new settlement appears to have arisen in the locality, at the junction of the rivers Irwell and Irk, near the site of the present cathedral. It was called Naen-ceaster by the Saxons, and from it has developed the Manchester of to-day. The settlement suffered greatly from the attacks of the Danes, and in 923 Edward the Elder, having driven the Danes out of Mercia, built a fort at Thelwall, near Warrington, on the south side of the River Mersey, and sent a detachment of soldiers to repair and garrison "Mame-ceaster," in the neighbouring kingdom of Northumbria.



Aerial view of Manchester deep-water docks. Mode Wheel Locks can be seen at the left-hand bottom corner, and the dry docks are to the right. The illustrations on this and the opposite page are reproduced by courtesy of the Manchester Ship Canal Company.

At the time of the Domesday survey in 1086 the town appears to have formed part of the Manor of Salford, but when the baronry of Manchester was created shortly afterwards a separation was effected and Manchester came under the control of its own lord of the manor, and began to make good progress. In 1227 the lord obtained from Henry III the grant of an annual three days' fair, to be held on "the vigil, day and morrow of St. Matthew," and it is known that by the close of the 13th century the town had a weekly market, a cloth industry had been established, and a court had come into existence. By 1301 or 1302 the burgesses had so far advanced as to secure from their lord a charter similar in its privileges to one granted by Henry III to Salford, constituting that town a free borough.

Manchester increased steadily in prosperity under the protection of successive barons, and became an important centre of the textile manufactures. The lord of the manor had the right to tax and toll all articles brought for sale into the market of the town, but although the inhabitants were thus imposed upon for his benefit they enjoyed a considerable degree of self-government. The Court Leet, the first recorded meeting of which was held in 1552, had nearly all the powers and functions now possessed by municipal corporations, having control over the watching and watering of the town, the regulation of the water supply, and the cleaning of the streets. At the Michaelmas meeting of the Leet a jury of householders appointed the officials who were to be responsible for the government of the town during the ensuing year. This form of administration continued until the town received its charter of incorporation nearly 300 years later.

An old record gives an interesting glimpse of Manchester in 1650. "The people in and about the town are said to be in general the most industrious in their callings of any in the northern parts of the kingdom. The town is a mile in length, the streets open and clean kept, and the buildings good. The trade is not inferior to that of many cities of the kingdom, chiefly consisting in woollen friezes, fustians, sackcloth, mingled stuffs, caps, etc. There are besides all kinds of foreign merchandise brought and returned by the merchants of the town amounting to the sum of many thousands of pounds weekly." The materials known as fustians were worked from cotton wool imported from Smyrna. Considerable quantities of linen yarn were bought from the Irish traders who regularly visited the town, and this was woven and returned for sale in its finished state.

Between Manchester and the sea lay extensive moss lands, and as late as 1750 there was no carriage road between the town and Liverpool, the seaport from which goods for export were shipped. The riverway, in those days fickle and unsatisfactory, was the best route to the coast for both merchandise and passenger traffic; and it was natural that as trade steadily increased the question of improving the river for navigation began to be seriously considered.

The first record of efforts to improve the river route dates back to 1697, in which year three or four locks were made and some bends in the river were straightened out. In 1712 the number of locks was increased to nine. Eight years later an Act was passed authorising the formation of the Mersey and Irwell Navigation Company to control the navigation between Manchester and Liverpool. The Act gave the company wide powers in respect to straightening the rivers, making cuts, building bridges and developing highways. The tides of the Mersey were sufficiently high to permit small vessels to reach Warrington, and the company established a narrow through waterway by canalising the rivers Mersey and Irwell from there to Manchester.

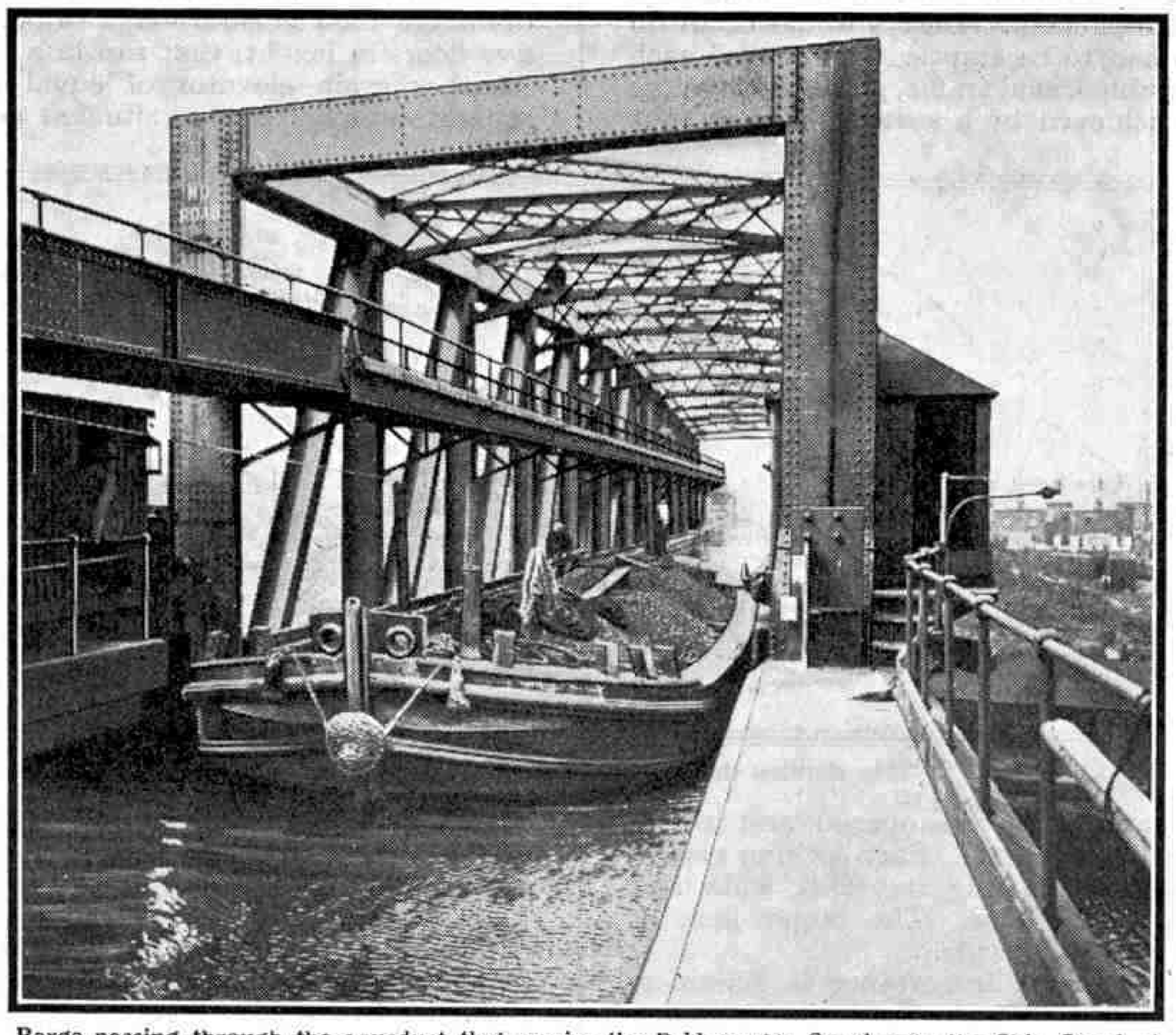
The textile machinery invented by Hargreaves, Arkwright and others about the middle of the 18th century was responsible for a great extension of the cotton industry. Manchester kept pace with this growth, and became transformed from a country market town into a great industrial centre. This development is shown

clearly in the population figures, which rose from 22,000 in 1773 to 182,000 in 1831.

During the two years 1759-1761 the Duke of Bridgewater's canal was constructed by James Brindley, the famous engineer, to enable coal to be conveyed from the Duke's estate at Worsley to Manchester to be sold. The canal was maintained at one level throughout, and was carried over the River Irwell at Barton, about five miles west of Manchester, by a stone and brick aqueduct 200 yd. long and 12 yd. wide. The centre portion of the aqueduct consisted of three arches with sufficient headway to allow the largest barges to pass underneath without lowering their masts. The first boat-load of coal passed over the aqueduct en route to Manchester on 17th July, 1761.

Steamship approaching Eastham locks, on her way out to sea.

The canal soon proved of great practical value, as the supply of coal was then becoming of increasing importance owing to the growing adoption of steam power in the textile mills. Its success encouraged the Duke to extend it westward from Worsley to Runcorn, and there join it with the River Mersey by means of locks. Brindley was re-engaged and entrusted with the work, which was begun in 1762. He had many difficulties to overcome. chief of which was the crossing of rivers, brooks and bogs; and it was not until 1767 that the entire length of the canal to the upper part of Runcorn was completed and opened for traffic. The flight of locks carrying the canal down to the level of the Mersey was not finished until several years later. According to a record left by Brindley, "the gates were opened on December 31st, 1772, when the '*Heart of Oak*,' a vessel of 50 tons burden, for Liverpool, passed through them." The cost of the two lengths of canal was £220,000, but the joint undertaking in due course yielded its owner an income of approximately £80,000 per annum.



Barge passing through the aqueduct that carries the Bridgewater Canal over the Ship Canal at Barton. The aqueduct is a swing bridge 235 ft. long.

Many merchants who objected to the excessive charges of the Mersey and Irwell Navigation Company transferred their custom to the new enterprise, and its great success gave rise to discussions as to the possibility of making a navigable waterway between Manchester and the sea. In 1825 a company was formed that proposed to construct a ship canal 51 miles long to enable ships of 400 tons to reach Manchester from the River Dee, the canal level to be adjusted by means of 14 locks. Nothing came of the project, however. Fifteen years later Sir John Rennie was consulted by Warrington and he proposed a canal from the town's Bank Quay to Runcorn, up which ships of not more than 5 ft. draught would be able to proceed at neap tides. He also advocated an extension of the canal to Manchester. A still more ambitious scheme was put forward in 1840, when the Mersey and Irwell Navigation Company were beginning to feel the effect of railway competition. This scheme was for a canal 12 ft. deep, with six locks, and large enough for ships of from 400 to 600 tons. All that was accomplished, however, was the widening and deepening of the river to accommodate ships of 300 tons.

The idea of making Manchester a port was revived in 1877, when the Manchester Chamber of Commerce, greatly perturbed by the decline of business in the city, expressed the opinion that a waterway capable of bringing large vessels to Manchester was required. Hamilton Fulton, a London engineer, became interested, and he prepared models and plans of a tidal waterway that he submitted to the Manchester Chamber of Commerce and exhibited on the Royal Exchange. His proposals aroused public enthusiasm, and a provisional committee was set up that led to the formation of the Manchester Ship Canal Company. The negotiations that finally resulted in the construction of the Manchester Ship Canal began in 1882, and in the following year the newly-formed company rejected Fulton's plan for a tidal waterway in favour of one for a canal with locks above Runcorn, prepared by Leader Williams, who subsequently carried the work through and received a knighthood for it. Much opposition was encountered before Parliament finally sanctioned the project in 1885, and by that time the prolonged legal negotiations had cost the promoters and their opponents roundly £365,000.

A contract to construct the canal was secured by T. A. Walker, who figured so prominently in the making of the Severn Tunnel. The canal was planned to start from the Mersey at Eastham, 35½ miles from Manchester, and there the first sod was cut on 11th November, 1887. When the work was at its height as many as 17,000 men were employed, and the mechanical equipment included 80 steam navvies and dredgers. The canal was completed in sections, and water was admitted to the last section to be completed, on 2nd November, 1893. The cost of the work proved much greater than had been estimated, being about £15,000,000.

The Manchester Ship Canal, together with the main dock system at Manchester and the smaller systems at Ellesmere Port, Stanlow and Runcorn, constitutes the port of Manchester. It was opened for traffic on New Year's Day, 1894, and the claim to be the first vessel to be registered in the new port was made by a ship aptly named "*Pioneer*," and owned by the Co-operative Wholesale Society. This ship arrived at the port on the opening day with a

cargo of sugar from Rouen, and forestalled the other arrivals by unloading on the same day. The canal was formally opened by Queen Victoria on 21st May, 1894.

The entrance to the canal is on the south side of the Mersey, at Eastham, six miles above Liverpool and 19 miles from the Mersey Bar lightship. From Eastham to Runcorn, a distance of 12¾ miles, the canal follows the southern fringe of the Mersey, from which at places it is separated only by an embankment. Eastward of Runcorn the Mersey follows a narrowing and erratic course, but the canal takes a more direct cross-country route for 10 miles or so to Rixton Junction, where it again meets the Mersey. For the next four miles to the junction of the Irwell and the Mersey it is a canalised section of the latter river, and from that point the remaining 7½ miles follow the course of the Irwell, which was deepened and widened to serve as a portion of the canal.

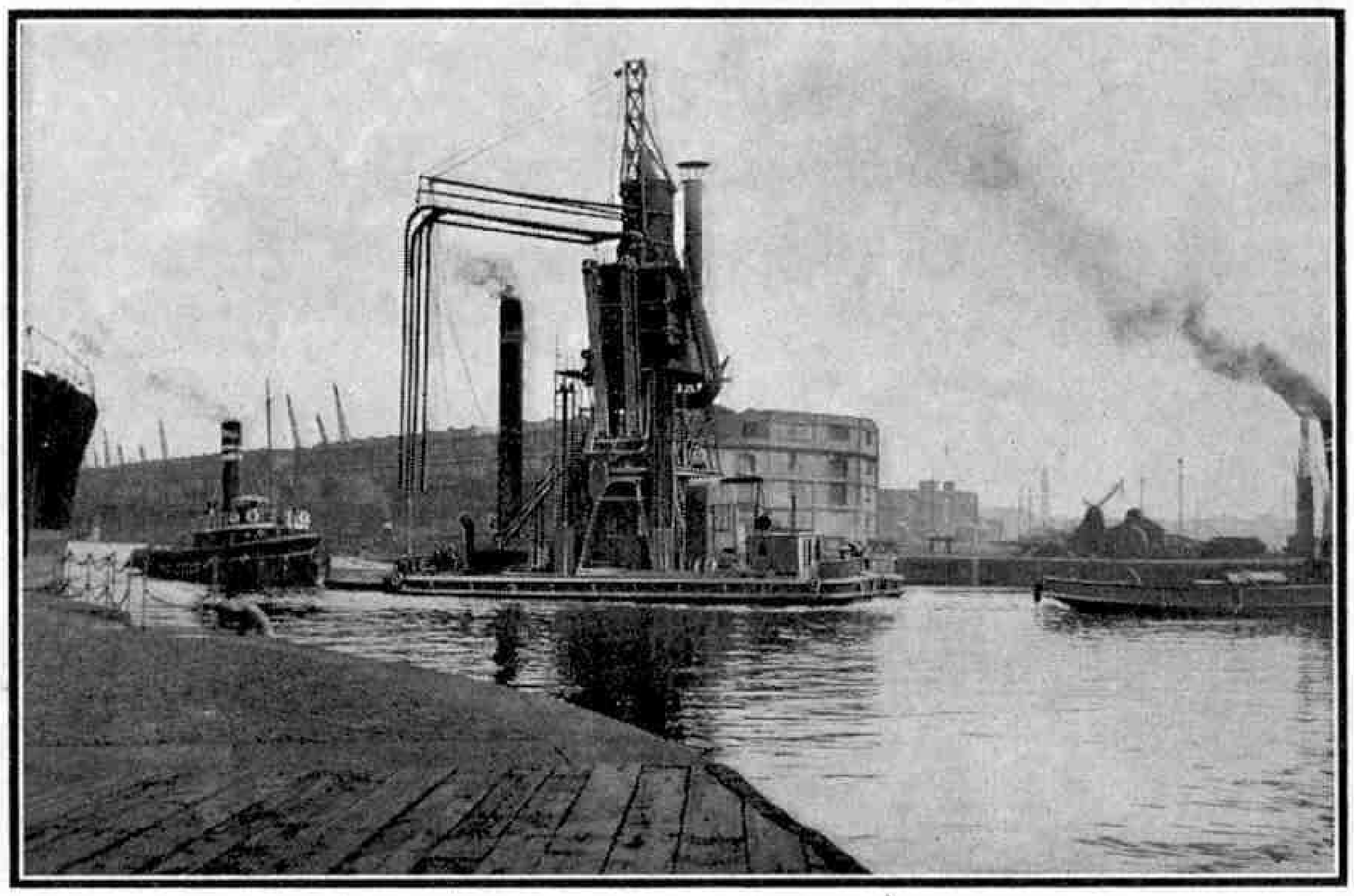
The excavated depth of the canal to Stanlow is 30 ft., and from there to Manchester 28 ft. The general width of the bottom is 120 ft., but at the approach to locks this figure is exceeded, while in the rock cuttings the course of the canal is somewhat narrower. The Bridgewater Canal crosses over the Ship Canal at Barton, where Brindley's historic viaduct has been superseded by a movable aqueduct designed to permit the passage of large vessels along the Ship Canal. The aqueduct is a swing bridge revolving on a central pier, and is built in the form of a trough in order to carry the barge canal. Delays would occur on both waterways if the trough had to be emptied and refilled each time the bridge was opened for Ship Canal traffic, and it is therefore swung full of water. This is achieved by a system of gates that close the ends of the trough and the abutting ends of the canal. The aqueduct is 235 ft. long, 23 ft. 9 in. wide and 33 ft. high, and is turned by hydraulic machinery operated from a control tower on the central pier.

The levels of the several sections of the Ship Canal are maintained by locks, and four locking systems at Latchford, Irlam, Barton and Mode Wheel respectively raise the canal a total height of 58 ft. 6 in. The Eastham locks are tidal, and when the incoming tide of the Mersey equals the level of the water in the canal at Eastham the lock gates there are opened and a free passage for shipping exists up to Latchford. Each locking system consists of two locks, the larger 600 ft. long and 65 ft. wide, and the smaller 350 ft. long and 45 ft. wide. The larger lock at Eastham is an exception, being 80 ft. wide.

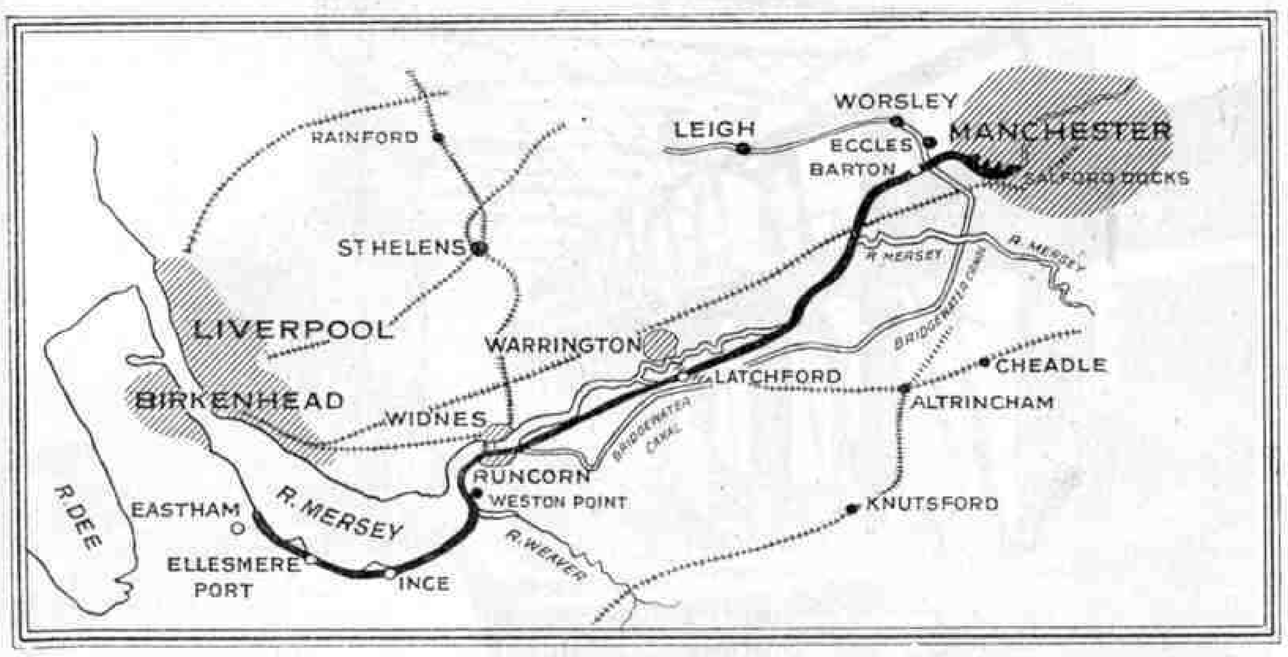
Working eastward the first point of importance is Ellesmere Port, three miles above the canal entrance. There the company have built a new wharf and transit shed and provided modern equipment, including up-to-date coal conveyors. Two miles above Ellesmere Port is Stanlow, which has been made an important oil-importing centre. Specially designed and equipped oil docks have been built, and the principal oil companies have erected storage plant with a total capacity of over 300,000 tons, or more than 80,000,000 gallons. The total oil tankage on the Ship Canal exceeds 130,000,000 gallons, and Manchester is now the second oil port in the United Kingdom.

Farther up the canal are Weston and Runcorn, important as the twin terminals of two inland canal systems, both of which have direct connection by locks with the Ship Canal; and at these points a large amount of trans-shipment business for the Potteries is handled. Partington, 27 miles from Eastham and nine from Manchester, is an important coaling point and is provided with modern coal-tips; and there is also a new wharf and lay-by to serve the re-modelled works of the Lancashire Steel Corporation.

The Dock Estate at Manchester covers an area of 406½ acres, including 120 acres of water space; and there are more than 5½ miles of quay. The four docks for ocean-going vessels range in size from 850 ft. long and 225 ft. wide to 2,700 ft. long and 250 ft. wide. Beyond these lie four smaller docks averaging over 600 ft. in length and 150 ft. in width, used for coasting vessels. The largest dock, known as No. 9 dock, has berthing accommodation for 10 large vessels, and their cargoes can be transferred between ship and transit shed, rail and road vehicle simultaneously, by means of quick-working electric cranes. Under the quays of this dock are subways containing electrically-driven endless belts for carrying grain in bulk at a great pace to the grain elevator that stands at the head of the dock, and is capable of accommodating 40,000 tons of wheat or other cereals, in 341 separate storage bins. By means of these conveyors six vessels in this dock can automatically unload their cargoes of bulk grain into the grain elevator simultaneously at the rate of 900 tons per hour. While they are doing this the vessels can also discharge their general cargo into the ferro-concrete sheds, up to five floors in height, that run in a half-mile series along the quay. Another grain elevator of equal capacity and comprising 268 separate storage bins is situated on the Trafford Wharf, on the opposite side of the canal to No. 9 dock.



One of the floating pneumatic grain elevators being towed to a berth at Manchester Docks. Photograph by A. Phillips, Ashton-under-Lyne.



Map showing the course of the Manchester Ship Canal.

The floating plant at the Manchester Docks includes two pneumatic grain elevators, each capable of discharging at the rate of 250 tons per hour; a pontoon sheers capable of dealing with weights up to 250 tons, with a lift of 21 ft.; six pontoons each of 800 tons capacity, and numerous lighters. The army of cranes at the docks includes some 150 electric cranes for dealing with general cargo; numerous portable steam cranes for heavier lifts, and a floating and self-propelling crane with a main hoist capable of lifting anything up to 60 tons. In addition there are six electric grab cranes with Priestman grabs, and a hydraulic coaling crane for manipulating 12-ton wagons. The 29 warehouses are equipped with movable overhead gantry cranes, while on the roofs of the 40 transit sheds are roof cranes and, inside these spacious buildings, "jiggers" innumerable.

Eighty-five miles of permanent way are laid down within the dock area, and connect with every berth, transit shed and warehouse, facilitating quick discharge of goods from any point on the docks to any part of the United Kingdom. Within a short distance of the docks are three junctions with the main line railways. The Ship Canal Company own 74 locomotives, which are used to carry out the vast amount of shunting on the Dock Estate, and close upon 2,500 wagons are kept busy on transfer of goods within the dock area.

This great inland port provides the nearest shipping point for the cotton, textile, coal, chemical and engineering industries of Lancashire; the West Yorkshire woollen (Continued on page 135)

Climbing Mount Kanchenjunga

Some Recent Notable Expeditions

THE climbing of mountains as a sport originated in Switzerland. There is little doubt that some of the Alpine peaks were climbed in the 14th century or earlier, but the details of these ascents are very meagre, and leave a good deal of doubt as to what was actually achieved. Possibly the first really authentic ascent was that of Mount Aiguille, near Grenoble, in 1492. Since that time the great peaks of the Alps have been conquered one by one, and the exploits of such men as Edward Whymper have passed into history.

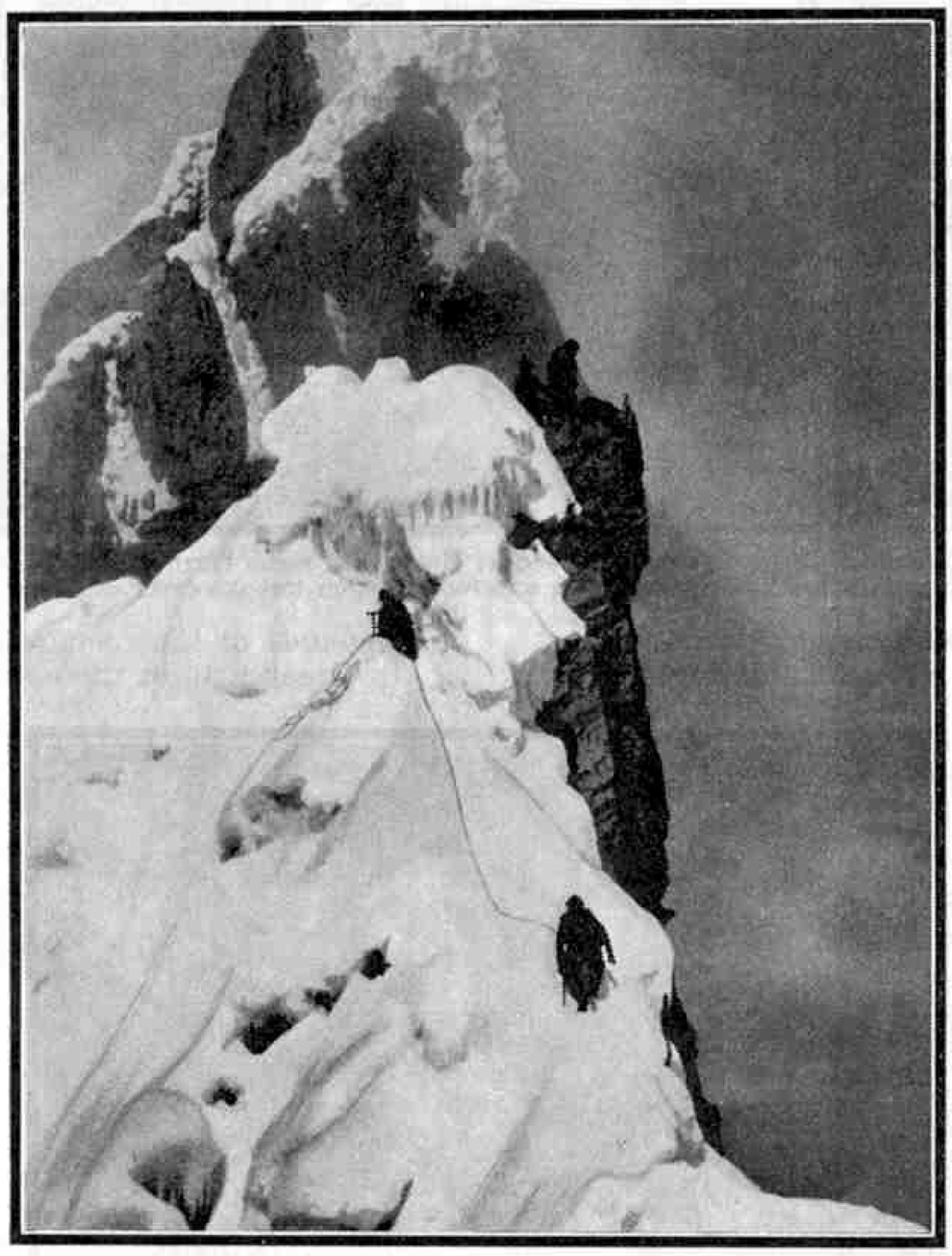
So much has been written about Alpine climbing that many people are apt to overlook climbing achievements in other parts of the world. Many great mountain ranges provide climbing possibilities superior to those of the Alps, but the efforts of mountaineers have been severely handicapped by transport difficulties. It is a simple matter for climbers to arrive at a suitable point for commencing the ascent of an Alpine peak, but in order to reach a convenient base from which to tackle the great peaks of other lands, elaborate and costly expeditions are often necessary.

This has been the case with the attempts made in recent years to reach the highest point in the world, the summit of Mount Everest, 29,000 ft. above sea level. Members of the Houston Mount Everest expedition flew over the mountain on 3rd April last, as described in the September 1933 "*M.M.*," but the summit has never yet been reached by climbers. The great trouble is the rarified atmosphere that exists at such a great height and makes even the slightest muscular exertion extremely laborious. There is little doubt that the peak will be conquered sooner or later, however, and in the meantime courageous attempts have been made to reach the summit of Kanchenjunga, another Himalayan peak only slightly lower than Everest.

Kanchenjunga, 28,146 ft. high, is the third highest mountain in the world and the loftiest peak in the Singalela range, one of the two principal ranges in the Eastern Himalayas, which in turn are only a part of the vast mountain region between India and Tibet. A wonderful view of the great mountain can be obtained from Darjeeling, a hill station 45 miles distant that is a convenient base for climbing expeditions; and the magnificent panorama of mountain scenery that can be seen from there is one of the great sights of the world. The twin peaks of Kanchenjunga tower above a majestic line of snowy summits including not less than seven other peaks rising above 22,000 ft. and none below 15,000 ft. These mighty peaks are both forbidding and alluring in their massive isolation, and they have been very little explored. They rise from the plains much more abruptly than the Himalayan ranges in the north-west of India and the Punjab, and the upper portions of Kanchenjunga are more precipitous than those of Mount Everest.

In 1899 an expedition led by Dr. Douglas Freshfield journeyed round Kanchenjunga, and the observations they made and the data they collected gave geographical science its first real knowledge of the mountain. The first attempt to reach the summit of Kanchenjunga was made in August 1905 by a small expedition that consisted of three Swiss mountaineers and their porters, under the leadership of an Englishman named Aleister Crowley, and ended in tragedy. The expedition set out from Darjeeling and headed for the south-western face of the mountain, and in spite of the fact that this consists chiefly of great granite precipices they reached a height of 20,343 ft. Some of the party continued the ascent and pitched another camp about 1,000 ft. higher. On 1st September two of the Swiss, followed by three of the porters, were descending to the lower camp when the first two porters slipped in crossing a snow-covered slope, and dragged the others down with them. The mishap started a fall of snow, and the party, with the exception of one of the Swiss, were buried and suffocated in the ensuing avalanche.

Other notable attempts to reach the summit of Kanchenjunga were made in 1929 and 1930. The first of these expeditions consisted of a party of Bavarian mountaineers led by Dr. Paul Bauer, and the attempt was made by way of a great spur that projects north-east from a ridge of the mountain. Extraordinary difficulties were encountered, and camp sites had to be created by cutting caves in the solid walls and ridges of ice. The party reached a height of 24,472 ft., when bad weather set in and made further progress impossible, and they were compelled to return. The attempt in 1930 was on a much larger scale and was made by the so-called International Himalayan Expedition. The mountaineers were led by Professor G. O. Dyhrenfurth, of Zurich, and included five Germans, three Englishmen, two Swiss and an Austrian. The Maharaja of Nepal gave the expedition permission to pass through that closed territory, and they then tackled the great north-west ridge of the mountain. After a long and slow climb they reached a height of 21,000 ft., but the impossibility of finding any suitable camping site higher up the exposed ridge, and of getting the porters and supplies nearer the summit, compelled them to abandon the attempt.



Members of the 1931 German Kanchenjunga expedition negotiating the north-east spur of the mountain. Photo courtesy "The Times."

The failure of the Bavarian effort in 1929 did not deter those concerned, and they returned to the attack in the summer of 1931, again selecting the formidable north-east spur as the scene of their endeavour. Successive camps were established as the party progressed steadily upward, and camp seven was pitched 18,565 ft. above sea level. Climbing had now become very difficult, rockslides, avalanches and continuous rain making the task almost impossible. The rain obliterated the paths that they cut at the cost of much energy, and as conditions became worse the health of some of the party began to fail. The task of cutting a path through the ice proved so difficult and exhausting that an intermediate camp was pitched at 19,680 ft., just over half way to the site of camp eight. The accompanying illustration shows this ridge camp, situated on a tower of rock rising from a level section of the mountain spur. After many days of tremendous toil camp eight was pitched at 20,560 ft.

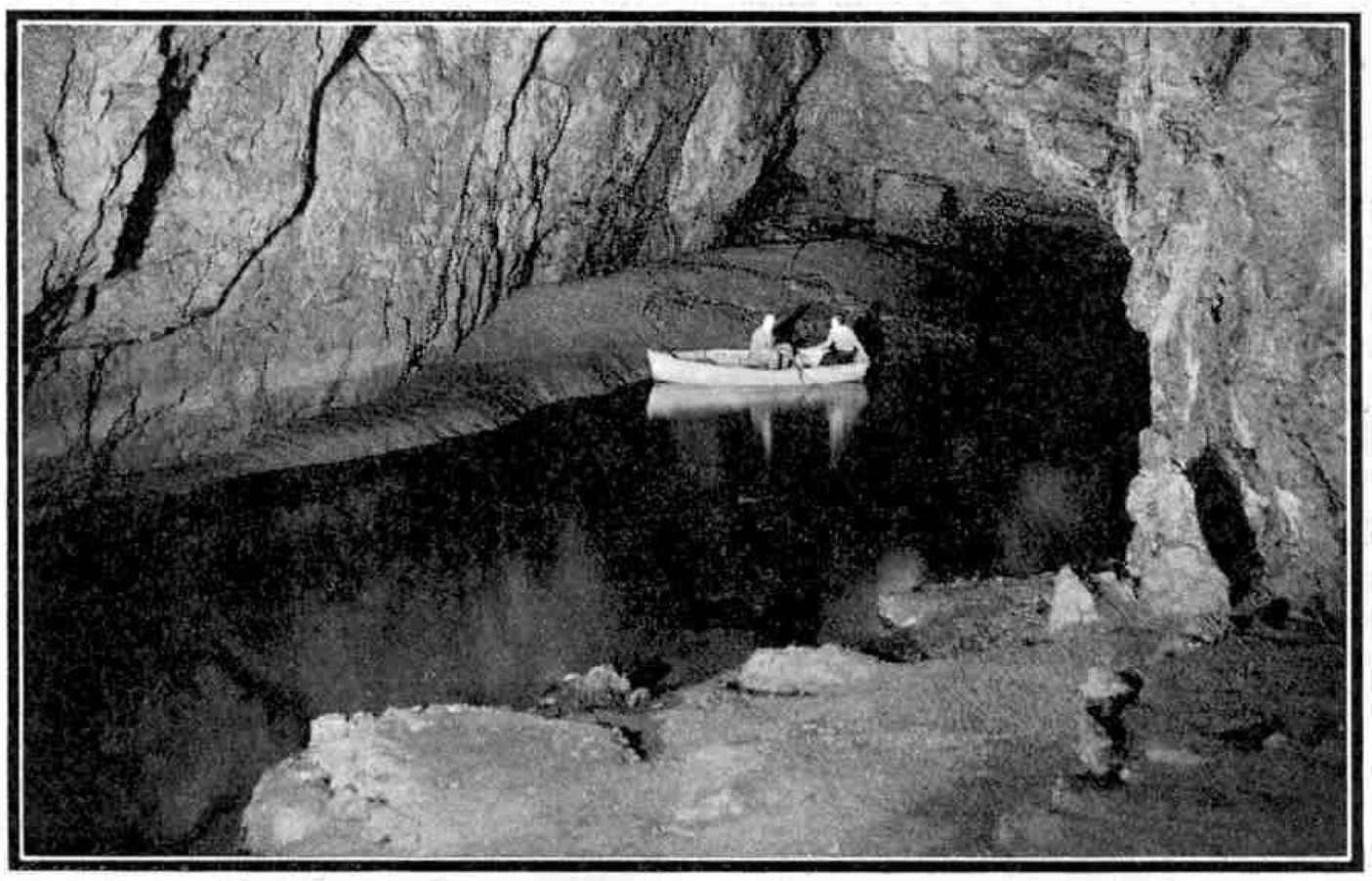
The difficulties experienced so far were eclipsed by a fatal accident that occurred after the ascent was resumed. A member named Schaller and one of the porters lost their foothold while traversing a steep ice gully, and fell to a glacier more than 1,000 ft. below. This tragedy, coming after weeks of almost desperate struggle against great odds, thoroughly disheartened the expedition and they returned to camp six. During the ensuing week they revived their determination to accomplish the task they had set themselves, and seven days after their return to the camp five of them, with porters, again began the ascent of the mountain. The remainder of the expedition were too ill to accompany them.

Just over a fortnight later the five climbers (*Continued on page 175*)

Exploring Underground in the Mendips

Marvels of Wookey Hole and Gough's Caves

CAVES have a remarkable fascination for almost every one of us. This is due no doubt to a variety of causes, but the predominant one is the sense of weirdness and mystery inspired by the gloomy depths. Prehistoric Man must have regarded caves with superstitious awe, but the necessity of finding shelter from weather severities and from prowling animals made him conquer his fears so far as to establish his home in the outer regions of caves. It is evident also that bolder spirits ventured to explore the deeper recesses, for primitive rock drawings and carvings are found in caverns situated far underground. In some cases it is impossible to reach the places where these prehistoric artists worked except by boat on an underground river or lake.

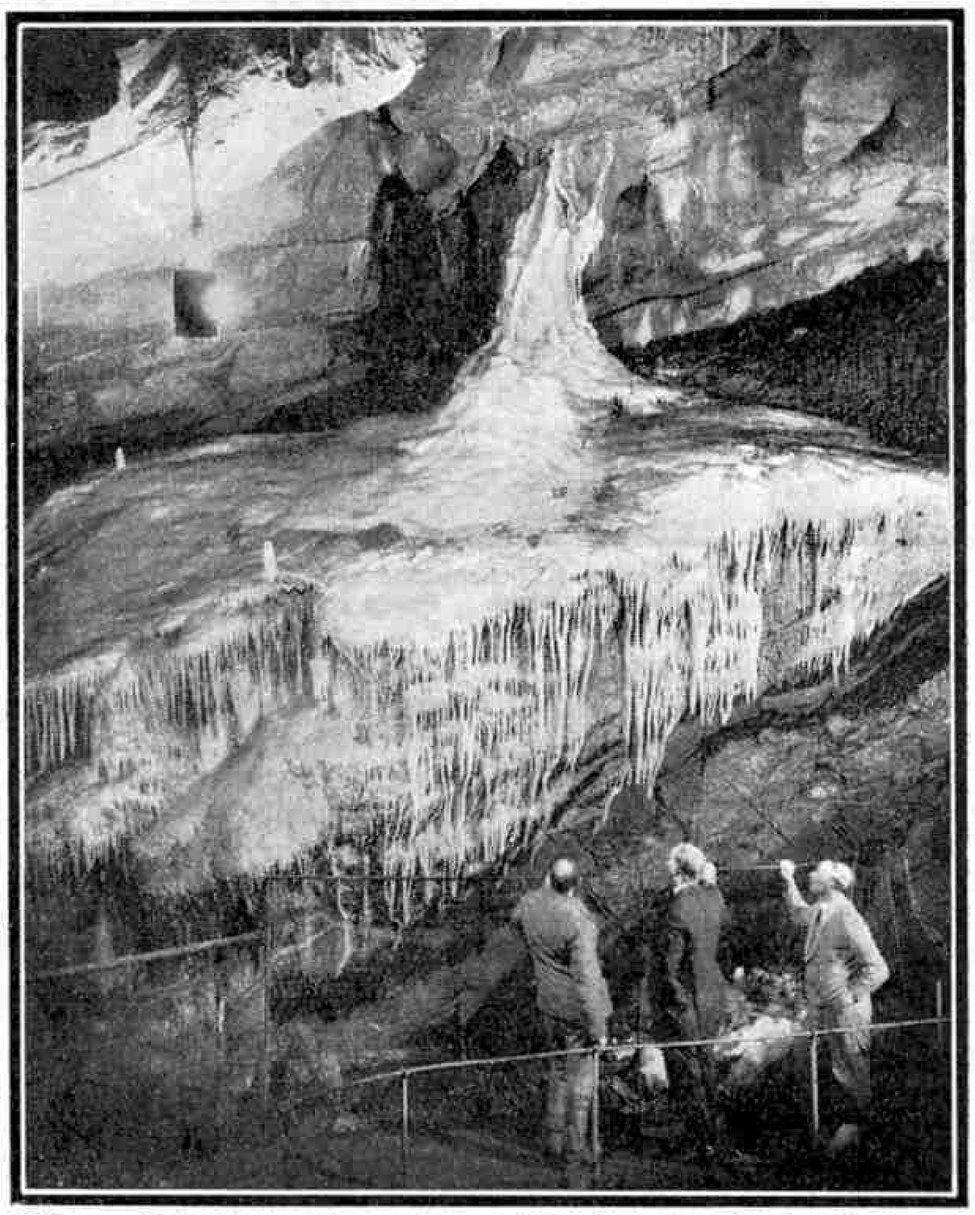


The underground river in a gigantic cavern in Wookey Hole. The water burrows into the hills three miles away and reaches Wookey Hole after a tortuous passage through caves and tunnels.

Caves are to be found in practically every country in the world, but the most famous and extensive underground caverns have been scooped out of vast beds of limestone rock by the action of water containing a small proportion of carbon dioxide, derived from the atmosphere during the fall of the water as rain. This solution is weakly acid, and as it penetrates through limestone it transforms this insoluble material into calcium bicarbonate, which is soluble in water and therefore is carried away, leaving cracks and hollows that in time are enlarged into wide passages and gigantic caverns.

The process is remorseless and continuous, and cave systems of almost incredible size have been created. Mammoth Cave in Kentucky contains no less than 256 known avenues with a total length of 152 miles; and in New Mexico and elsewhere there are enormous caverns, not yet fully explored, that eventually may prove to be still larger. All of them abound in vast halls in which are fantastically carved columns of limestone, either suspended from the roof, when they are called stalactites, or rising from the floor, when they are known as stalagmites.

In limestone caverns through which water is still flowing these columns are growing, for the water dripping from the projections in the roof and falling on the floor loses a proportion of its carbon dioxide, and insoluble limestone is again formed. Each drop contributes a microscopic amount of this material to the stalactites and stalagmites already existing. These very slowly become longer and thicker, and in the course of time form continuous columns from roof to floor that steadily increase in size.



"Niagara Falls," one of the most remarkable formations in Gough's Caves.

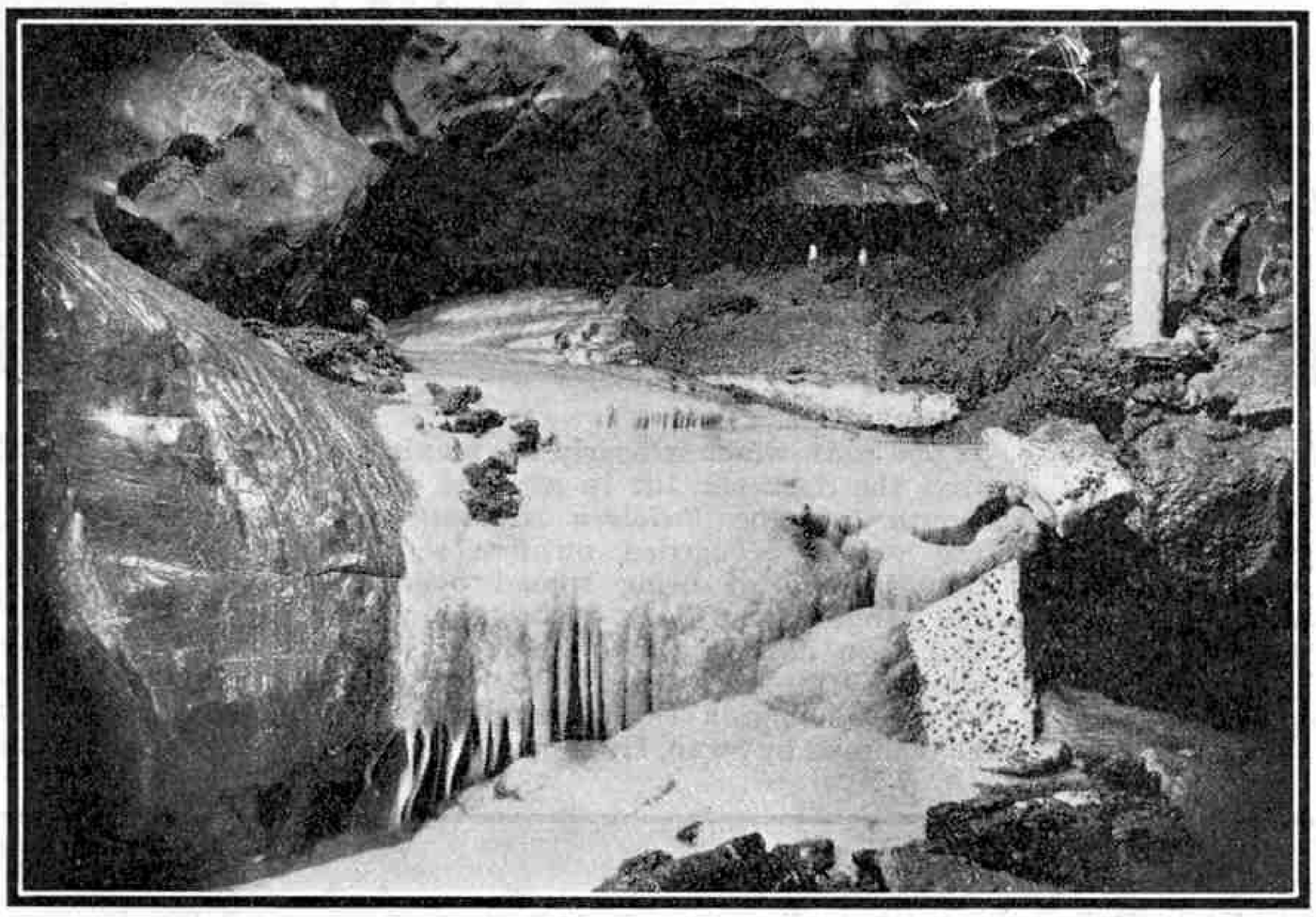
During the thousands of years that have gone to the formation of many of the stalagmitic formations in caves, these have been built up into astonishing shapes as the direction of the flow of water has changed. Some have grown into delicate threads and ribbons and then the flow of water has been diverted from them. In other cases, the action of water for countless centuries has built up the formations into gigantic masses that might have been shaped by a superhuman sculptor's chisel. When seen in the deceptive light of the magnesium flare, these formations have stirred the imaginations of visitors who have penetrated into the depths of the caves, and have been given fantastic names to mark their resemblance to familiar things. To add to their beauty, many of them are coloured, owing to the presence in the water flowing over them of coloured compounds of the metals iron, copper and manganese.

In Great Britain there are many famous limestone caves under the mountains of the Pennine range in Yorkshire and Derbyshire, near Torbay in South Devon, and in Somersetshire. The Somersetshire caves are particularly interesting. They lie in the Mendip Hills, where the beds of limestone in which they have been formed are steeply inclined along the side of a great arch, the crown of which has been completely worn away in past ages. They are of great antiquity; indeed, there are many indications that cave systems created millions of years ago were choked up by the deposition of other rock-forming material, and afterwards re-formed when water again began to penetrate into them.

One of the most famous of the caves of this district is Wookey Hole, from which springs the River Axe. The water of this stream wells out from the foot of a cliff in a ravine, but no entrance to the wonderful cave system from which it comes can be obtained that way. At a slightly higher level there is an open cave mouth, however, and on passing through this the visitor finds himself in a spacious chamber. Man seems to have discovered this place of refuge in very early times, for abundant traces of its occupation in every stage of British culture have been discovered, and similar finds in other parts of the district show that the caves of the Mendips were the homes of a large and industrious settlement.

It is not surprising that Wookey Hole itself should have been chosen as a dwelling place, for it is easily defensible. The entrance

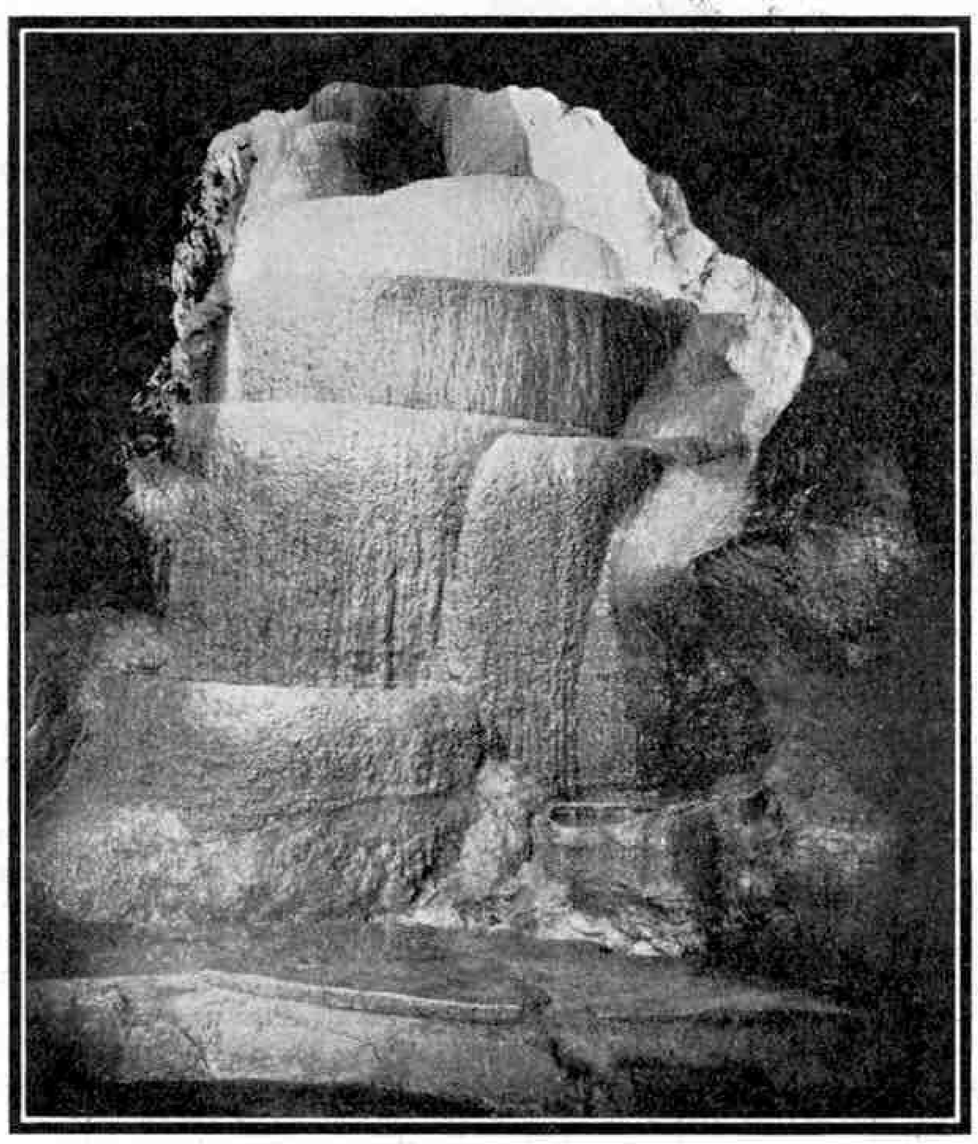
can only be approached by a path wide enough for one man, and attack from above is impossible, as the cliff overhangs the cave mouth. Assailants who did succeed in reaching the entrance would be unable to burn or smoke the inhabitants out, for the immense extent of the passages behind the great hall ensures ample ventilation, and the recesses of the cave are large enough to hide the occupants in sudden emergencies. Even lack of water, the traditional cause of the surrender of many impregnable fortresses, would not trouble those confined to the cave by enemies, for engineering operations on an unprecedented scale would be necessary in order to stop the flow of the river that runs through it.



An underground "river" of glistening white limestone in the Mendip Hills. The limestone has been slowly deposited from water flowing through one of the grottos of Gough's Caves.

The course of the waters flowing through Wookey Hole is an amazing revelation of underground happenings. There are no streams along the sides of the Mendip Hills. Instead, the district is full of springs, because the water falling upon the heights makes its way into the limestone and only comes to light again after passing downward through the caves that honeycomb the hills. In dry weather little water may be seen in the upper holes and chambers in these cave systems, but after heavy rainfall streams trickle in all directions. Many of the traverses or narrow passages are full of water and impassable, and the depths of the hills resound with the roar of great underground waterfalls.

In many cases the water flows several miles underground before emerging from springs and the mouths of low level caves. The source of the river Axe, which flows from Wookey Hole, has actually been traced to Eastwater Swallet, on the top of the Mendips three miles away. Eastwater Swallet is only a tiny hole, scarcely large enough to give shelter to a fox, where a tiny brook disappears from view. The opening has been enlarged and intrepid explorers armed with ropes and ladders, and provided with magnesium flares and candles, have traversed the maze of passages below it to a depth of 650 ft. below the surface. They have made their way down great slopes on which lie shattered rocks of all shapes and sizes, crawled through passages only a foot or two in height, lowered themselves down narrow shafts, and even passed through heavy waterfalls in efforts to find a way to Wookey Hole. Their efforts have been in vain, for they have never been able to get within two miles of the famous cave. The lower passages and caverns probably are full of water, and it seems likely that for this reason they will remain unexplored unless, perhaps, thousands of years hence, climatic changes convert the district into a desert.



The Fonts, a wonderful natural cascade in Gough's Caves.

Many parts of Wookey Hole have been opened up to visitors, whose way through the chamber known as the Witch's Kitchen and other halls beyond it has been made infinitely more easy than it was to the pioneer explorers; but above there remains an immense range of caverns that are beyond the reach of any but the most experienced cavemen.

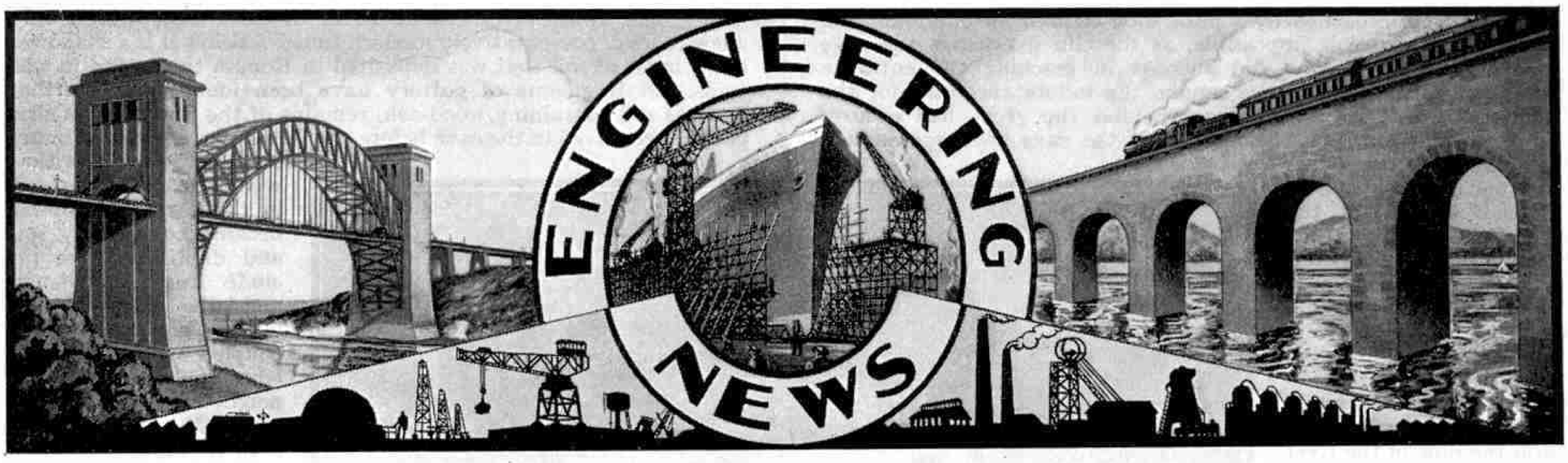
To many visitors the evidence of the occupation of the cave by prehistoric man will be of special interest. This evidence has been obtained by digging through the soil that has accumulated on the floor. The upper layer, about 18 in. in thickness, yielded only a few relics of comparatively modern times. Below it is a shallower black layer of soil that was deposited in Roman times, and in this coins and fragments of pottery have been found. Still further down is soil containing wood-ash, remains of the fires of the Celtic peoples who lived in the cave before the Roman invasion, and many of their belongings that were cast aside, or left in the cave, and slowly became covered by soil and debris. These include iron implements, and the discovery of lumps of crude iron, coupled with the existence of iron ore in the neighbourhood, suggests that the cave was actually the site of a primitive foundry.

The people who inhabited Wookey Hole in the centuries before the Romans conquered Britain were by no means rude and untutored savages. They were able to spin and weave, and some of their spindles and carding combs, loom weights and needles have been recovered, together with nails, drills and ornaments of all kinds. They were also skilful farmers, and a pair of mill stones was found in the cave exactly as if they had been put away after use, together with a stone quern in which corn was ground. These utensils of stone were chiselled with an iron tool. What may well be the tool itself has been unearthed, and near it was found a wooden handle that fits it.

Numerous skeletons have been found during excavations in this remarkable cave, and some of them seem to be silent witnesses of tragic events. One is that of an old man, and was found along with the bones of a goat and kid that had been tethered to a stake that still remained embedded in the floor. Near by was a milking pot made of black earthenware. The old man apparently had died, probably suddenly, and his animals had perished of starvation. Elsewhere part of the skull of a young girl was found, crushed in by a heavy blow; while a more gruesome discovery was that of human bones in a pile of broken marrow-bones of animals, a grim suggestion that the inhabitants were once reduced to cannibalism.

Another wonderful underground system that has its entrance in the Cheddar Gorge, the immense chasm that divides the Mendip Hills, is Gough's Caves, which are named after their discoverer, the late R. C. Gough. The precipitous cliffs of the Gorge are almost perpendicular, and reach their greatest height at Wind Rock, the height of which is 480 ft. above the floor of the chasm. They have been weathered into fantastic shapes, in many of which fanciful resemblances to living things have been detected. One of the best known of these is the Lion Rock, and Gough's Caves are directly opposite. They are brilliantly lighted by electricity, and the path of the visitor has been made easy to enable him to investigate their wonders without the discomfort that was the lot of those who led the way underground in this and many other parts of the world.

Gough's Caves seem to have provided shelter for prehistoric man, for excavation in the floor near the entrance has revealed many flint and bone tools made by the men (*Continued on page 135*



The World's Largest Floating Dock

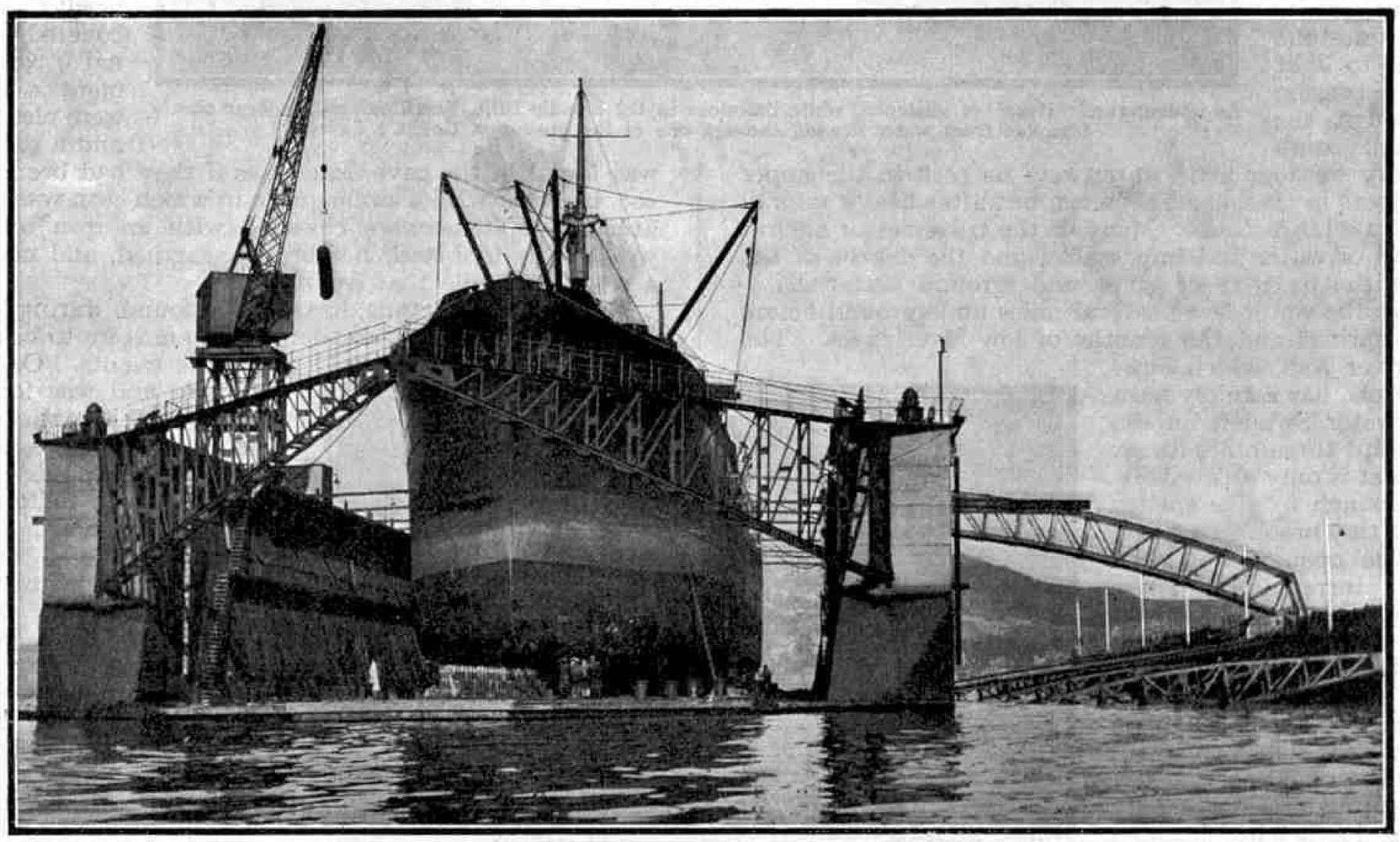
Some time ago we published in these pages details of the largest floating dock in the world, situated at Wellington, New Zealand, where it was towed from this country. This dock has now been in service for about 2½ years and the reports received concerning it are very satisfactory.

An example of the excellent work performed by the dock was given when an American steamship, the "*Golden Harvest*," outward bound from Wellington laden with timber, ran on to a reef at the entrance to Wellington Harbour. She was pulled off by a tug after 22 hours' continuous pull and returned to port, where her hull was inspected by a diver who found a considerable perforation on the starboard side and put a timber patch on it. Some of the water that had gained entry was then pumped out and part of the load of timber discharged, and after waiting three days for suitable weather the vessel was able to enter the floating dock. The ship was in a very "tender" condition, being decidedly top-heavy; and she was rolling freely even when moored between the walls of the dock.

The whole docking operation called for extreme care on the part of those responsible for carrying it out, and the raising of the dock was done very slowly. Although the vessel entered the dock early in the morning, it was not until late in the afternoon that pumping ceased and work could be begun on the necessary repairs.

The deadweight of the vessel and her cargo at the time of docking was about 11,000 tons, which is nearly the maximum that the dock can lift in a vessel of the length of the "*Golden Harvest*," as the weight is carried on five sections only instead of being spread over the full range of the dock. Once the vessel had been docked safely the repair work was very rapidly carried out.

The Wellington Dock was constructed at Wallsend by Swan, Hunter, and Wigham Richardson Ltd., and was towed from the Tyne to New Zealand by two tugs, the distance covered being 14,000 nautical miles, equal to 16,120 land miles.



The S.S. "Golden Harvest" in the floating dock at Wellington, New Zealand. The photographs published on these pages this month are by courtesy of "The Shipyard."

Tug Built in Nine Weeks

An interesting recent shipbuilding feat is the construction of a 45 ft. oil-engined tug in only nine weeks. The tug is intended for service in Peru, where she will be used to assist in the mooring of oil tankers arriving to obtain supplies of oil from a long pipe line. The vessel is named the "*Corona*," and has been built by Brooke Marine Motors Ltd. Immediately after construction she made the passage across the North Sea under her own power to Amsterdam, where she was shipped on board a cargo vessel.

The vessel is 45 ft. long, 11 ft. in breadth and has a draught of 45 ft. She is powered with an 80 h.p. compression-ignition engine.

Underground Transmission Line in Switzerland

Most high-power transmission lines for carrying current from power houses are mounted on lofty towers, but the current from a power plant situated at Handeck, in the Bernese Alps, is carried by a line laid underground. This arrangement was necessary because a line of the usual overhead type would often have been demolished by the avalanches experienced in the district.

The water supply for the power plant is obtained from two artificial lakes more than 6,000 ft. above sea level, with a combined capacity of about 4,000,000 cu. ft. of water. The dam that impounds the waters of one of the lakes is claimed to be the biggest of its kind in Europe. The power station has four vertical type generating units each of which consists of a 30,000 h.p. Pelton wheel and a 28,000 kVA generator that provides current at 11,000 v. This current is stepped up to 50,000 v. and transmitted by four underground cables to a sub-station from which radiates a network of overhead lines. The underground cables are carried in a tunnel 3.1 miles in length and large enough to accommodate a small electric passenger car.

Glass Floors for Lifts

The lifts that were installed in the towers of the Skyway Transporter Bridge at the Chicago Century of Progress Exposition were provided with floors made of glass! This rather unusual material was employed to enable passengers to look down and to follow the movements of the hoisting machinery.

Ferry-Bridge Driven by Steam

A ferry-bridge that is driven by steam and guided by a chain has been installed at Saltash. The ferry is of the floating-pontoon type and is provided with a single prow at each end, a deck in the centre for vehicular traffic, and raised decks at each side for passengers. The central platform is capable of accommodating vehicles up to 20 tons in weight, in addition to lighter traffic such as private motor cars and horse-drawn carts. The ferry-bridge is 144 ft. in overall length and 44 ft. in breadth, and the traffic deck is 25 ft. 9 in. broad. The passenger accommodation includes a large general cabin and a smaller one reserved for ladies. Ample life saving arrangements are provided, 12 life buoys and 120 life belts being carried in addition to a large number of buoyant seats with handles.

The prows at each end bridge are adjustable so that their slope can be altered to suit that of the banks of the river, and they are provided with small hinged flaps to allow for movement of the bridge while vehicles and passengers are embarking or disembarking. The prows may be raised and lowered either by steam or hand gear.

The propelling machinery consists of an engine of the horizontal compound surface condensing type, driving two cast iron chain wheels, one on each side of the ferry, that engage with chains stretching across the river.

The New Forth Bridge

Work on the new bridge over the Forth at Kincardine is to begin at once. It is expected that at least two years will be occupied in the construction of the bridge, which is to be half-a-mile in length and will have 14 spans in all. Twelve of these will each be 50 ft. long, and the two central spans, which will be of the lifting type, will each be 156 ft. The deck of the bridge will be 30 ft. above high water level. It is estimated that the work will cost £527,000.

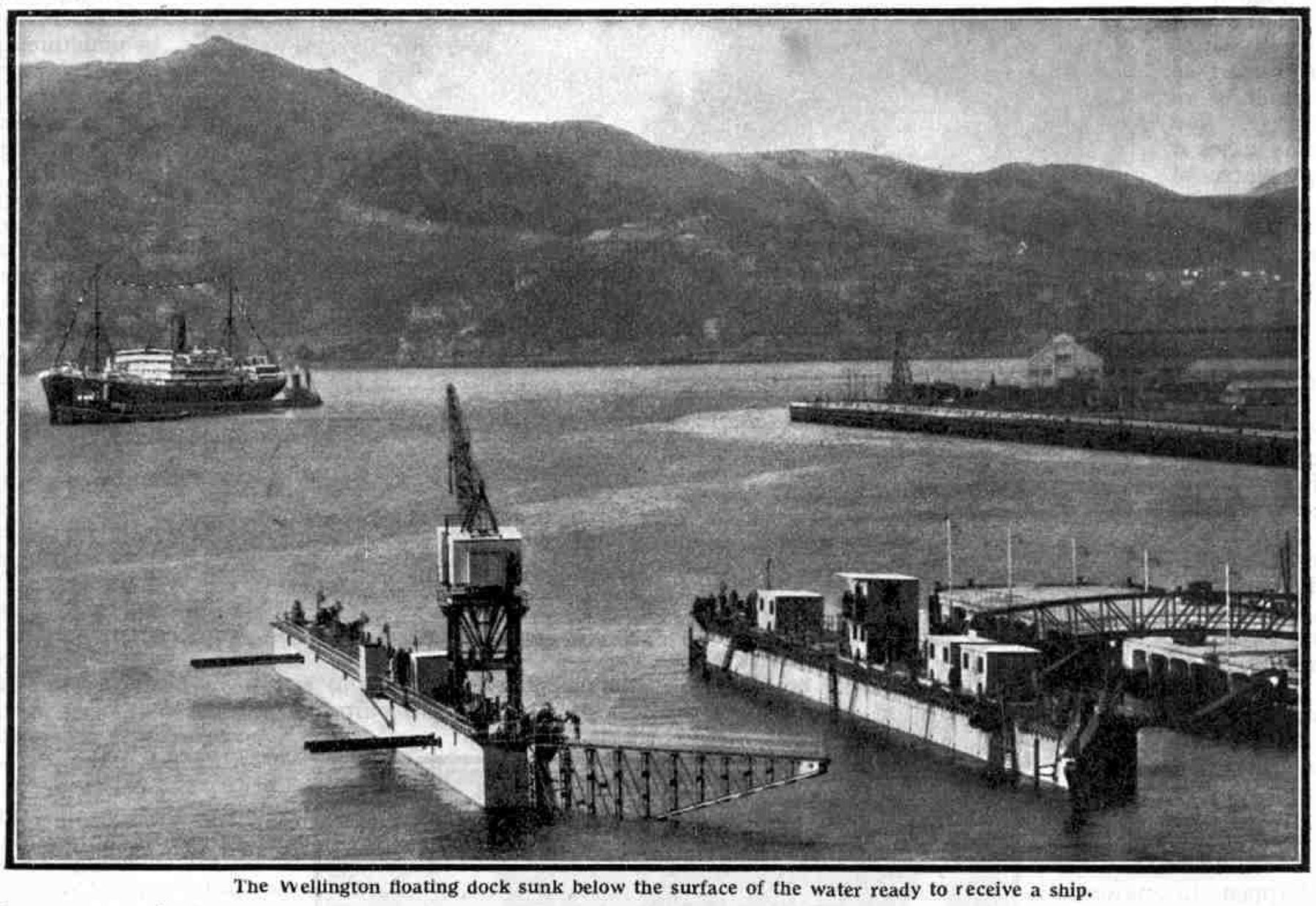
Home Produced Petrol

An Italian engineer claims to have discovered a secret process by which oil can be extracted cheaply from oil shale. A great deal of this material is found below the ground in the vicinity of Weymouth and it is stated that there is sufficient to supply the whole of England with oil and petrol indefinitely.

Hydraulic Press for Asbestos Sheets

A powerful hydraulic press that has been constructed by Tangyes Ltd., of Birmingham, for pressing asbestos cement sheets, is capable of exerting a pressure of 4,628 tons. It is large enough to accommodate sheets up to 8 ft. in length and 4 ft. in width and is claimed to be one of the most powerful ever built for such work. It is 80 tons in weight and is operated by two main rams, each 32 in. in diameter, which work in cylinders made of cast steel.

The asbestos sheets to be pressed in the machine are carried into position on a special trolley built up of steel sections and provided with troughs to collect water forced out of the sheets while they are being pressed. The trolley runs right over the press platen and is lifted clear of the rails while the actual pressing operation is being carried out, so that the load is only received on the surface plate and consequently does not damage any part of the trolley. A second trolley is provided, so that while one is in service over the press platen the other may be loaded up.



The Wellington floating dock sunk below the surface of the water ready to receive a ship.

New Harbour at Port Elizabeth

The first quay of the new harbour that is being constructed at Port Elizabeth, Algoa Bay, South Africa, is now in regular use. It is named the Malan Quay and is the first deep-water berth ever constructed in Algoa Bay. It juts out for 2,000 ft., into the Bay, and eventually a rubble mole, 1,550 ft. in length, is to be added to the end so that if the trade of the port warrants it, it will be possible for the quay to be extended without much difficulty.

Although the quay is in regular use it will be another three years before it is completely finished. At present it is totally unequipped, so that all ships making use of it have to load and unload with their own derricks. The cranes, sheds and other important equipment are expected to be completed by June of this year.

India's Largest Hydro-Electric Scheme

Work is now nearly completed on the Mandi hydro-electric project, which is claimed to be the largest scheme of its kind ever undertaken by the Government of India, and is the first in India to transmit current at 132,000 volts. The station at which the current is generated is built at Jogen on the Denager Uhl river, which is a tributary of the River Bear, in the Punjab. The scheme was undertaken in order to make available a plentiful supply of cheap power, not only to industrial consumers and those living in towns, but also to inhabitants of the rural districts, who will be particularly encouraged to employ it in connection with their agricultural work.

The current is carried by a double circuit trunk transmission line to Lahore, a distance of 173 miles, and there are branch lines to various important towns in the district. In 13 towns a complete system of electric distribution has been provided. It is interesting to note that as there is no coal of commercial value in the Punjab, all that is required has to be imported from Bengal which of course makes it comparatively costly.

An Interesting Trench Digger

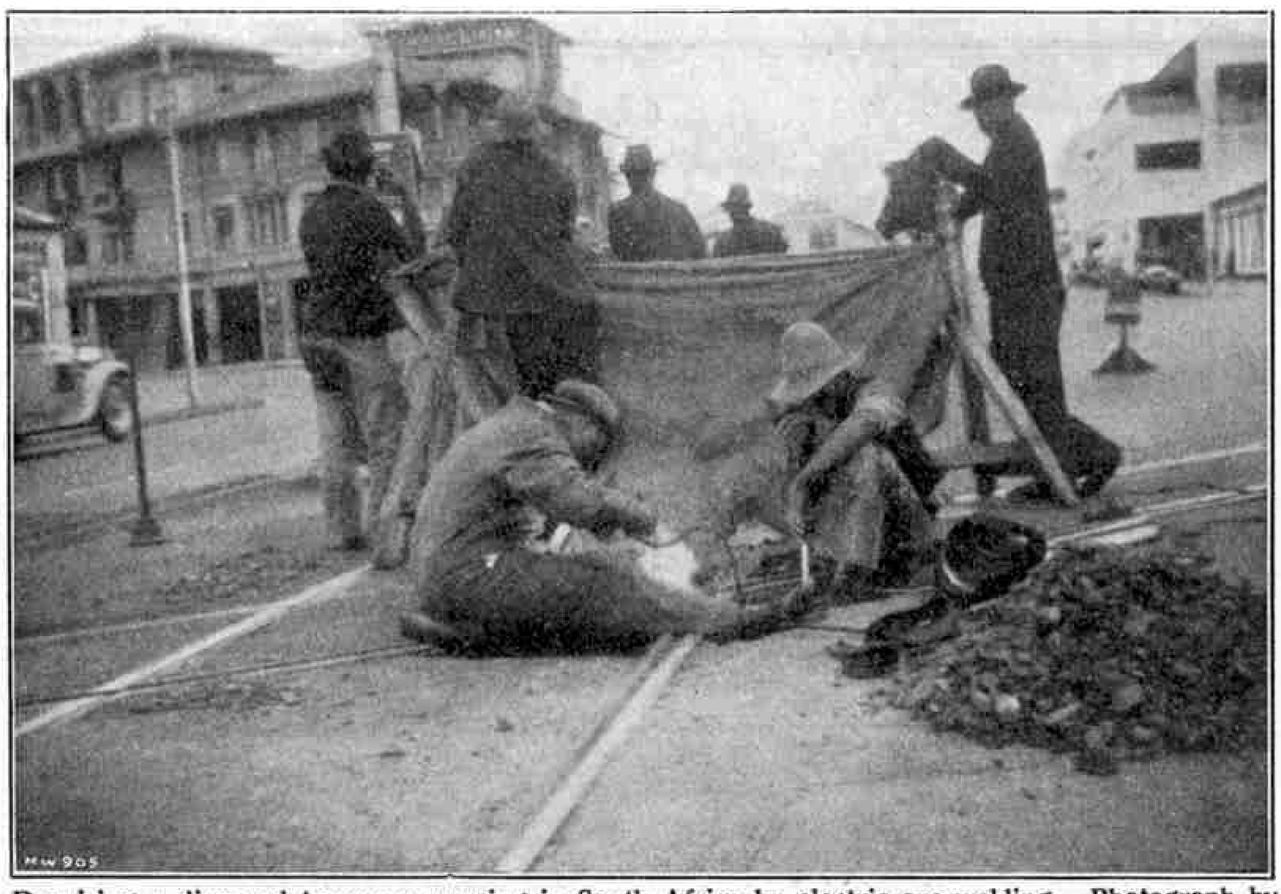
An interesting machine has been produced for the special purpose of digging narrow trenches such as are required for the laying of electric mains or gas or water pipes. The machine cuts a trench 6 in. or 12 in. in width at any depth up to 4 ft., and is rather strange in appearance, consisting of a body somewhat similar to that of an ordinary small bucket excavator, mounted on caterpillar tracks. The telescopic bucket boom projects forward and carries buckets similar in appearance to the buckets of a dredger. When the machine is in operation it can work at any of six speeds, which vary between 2 ft. and 16 ft. per minute. The spoil cut out by the buckets is carried back and delivered on to a transverse belt conveyor that can be made to discharge on either side of the machine as required. The unit is driven by a four-cylinder Ford petrol engine developing 24 h.p., which is employed both for operating the buckets and driving the machine along, the travelling speed being 4 m.p.h. The excavator has a total weight of 5 tons 12 cwt.

Electric Arc Welding

II.—Its Uses in Engineering

LAST month we described the principles of electric arc welding and explained how the great heat of the arc is utilised to join metals together by fusion. This month we deal with a few of the vast numbers of ways in which electric welding is used in the various branches of modern engineering, and show how in many cases it has taken the place of riveted construction.

As confidence in the welding process has been gained, and experience has demonstrated the reliability of arc-welded unions, the applications of this latest method of construction have become increasingly numerous and extensive. Practically every industry employing iron in its various forms can utilise arc welding in one way or another, for apart from the constructional joining together of metals, the process is of great value in remedying faulty material. For example, worn parts of machinery such as shafts, bearings, pinions, and gears, can be built up by the addition of new metal and machined and put back into service, thus obviating the necessity for complete costly replacements. Broken parts also can often be repaired without even dismantling the machine.

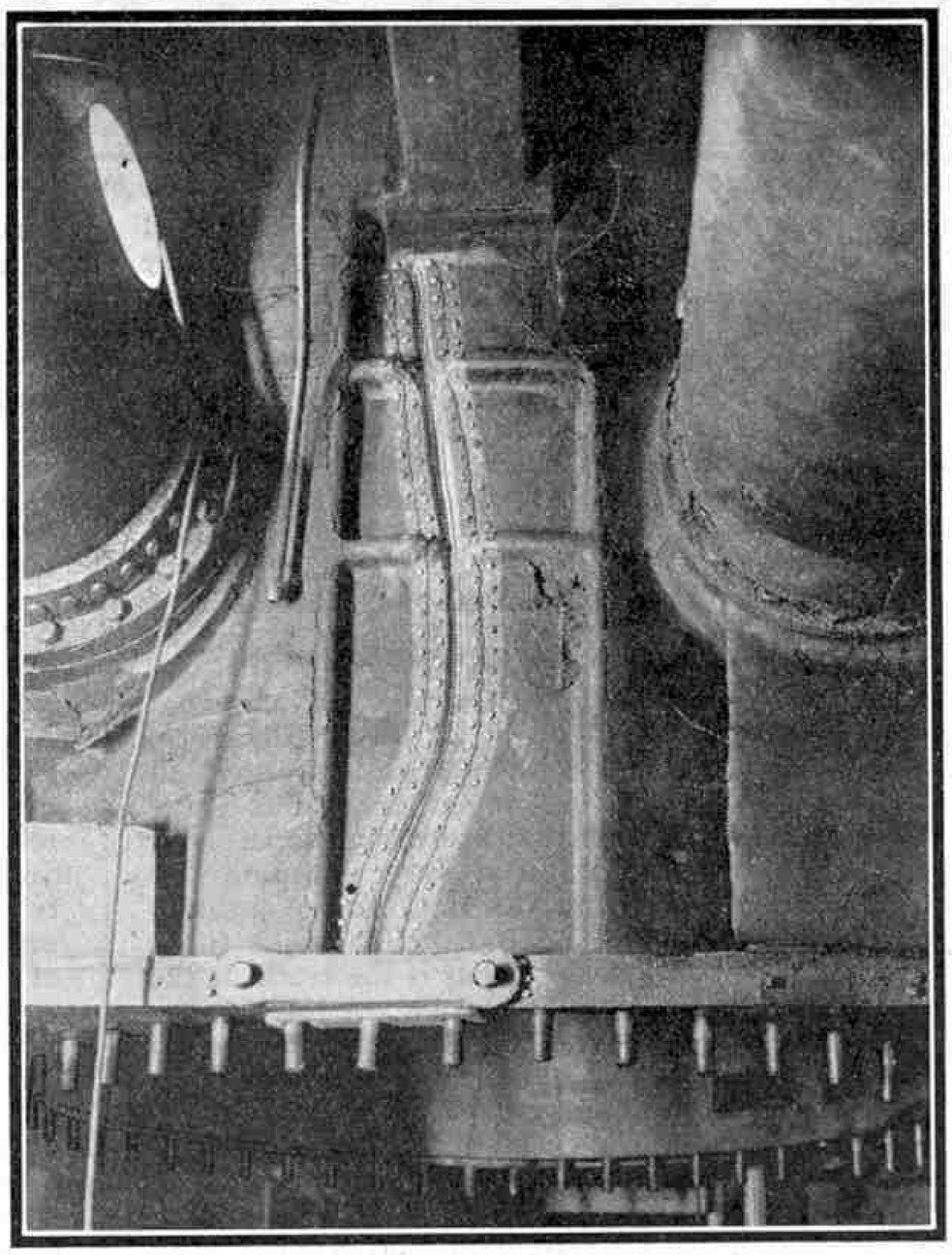


Repairing a diamond tramway crossing in South Africa by electric arc welding. Photograph by courtesy of Murex Welding Processes Ltd., London.

It sometimes happens in engineering shops that a flaw in a casting is not discovered until a considerable amount of expensive machining has been done. With the aid of welding, this can quickly be made good without removing the casting from the machine. Machining mistakes that a few years ago would have necessitated scrapping the whole of a complicated casting can also be readily corrected.

In electrical engineering, too, arc welding is very frequently used. One of the greatest manufacturing developments in this branch in recent years has been in the construction of the stators of electric generators. A stator consists essentially of a frame carrying steel laminations, which are slotted to carry the windings. Before the adoption of arc welding stator frames were made as castings, but nowadays they are built up from heavy sheet steel plates, flame-cut by oxy-acetylene blowpipes to shape, and then electrically welded together. This type of construction has several advantages over the older cast-iron frame, and the overall dimensions and consequently the weight of the welded structures are much smaller than those of the castings that they replace. Further, much less time is required to design and make a welding than is needed in designing and making the patterns for and machining castings. Some of the larger and more complex patterns take many weeks to design and make, and the castings have then to be machined, and may even prove faulty during the operation. A welded structure, on the other hand, can be built up and completed in less time than would be required to make the pattern for a casting.

As an example of the saving in time that can be effected with this type of construction may be mentioned an order received by the British Thomson-Houston Co. Ltd., Rugby, for a large synchronous motor that was urgently required for service in India. The stator for this weighed approximately 50 tons, and was 26 ft. in diameter. By the aid of welding it was completed in six weeks, and the frame was built in two weeks. This achievement would not have been possible if castings had been used, even if suitable patterns had been in existence when the order was received.



The cylinder of a large blowing machine in which a 60 in. crack was repaired by arc welding. The photograph shows the crack "veed" and studded ready for welding. For this and the lower illustration on the opposite page we are indebted to the Westinghouse Electric and Manufacturing Co., East Pittsburg, U.S.A.

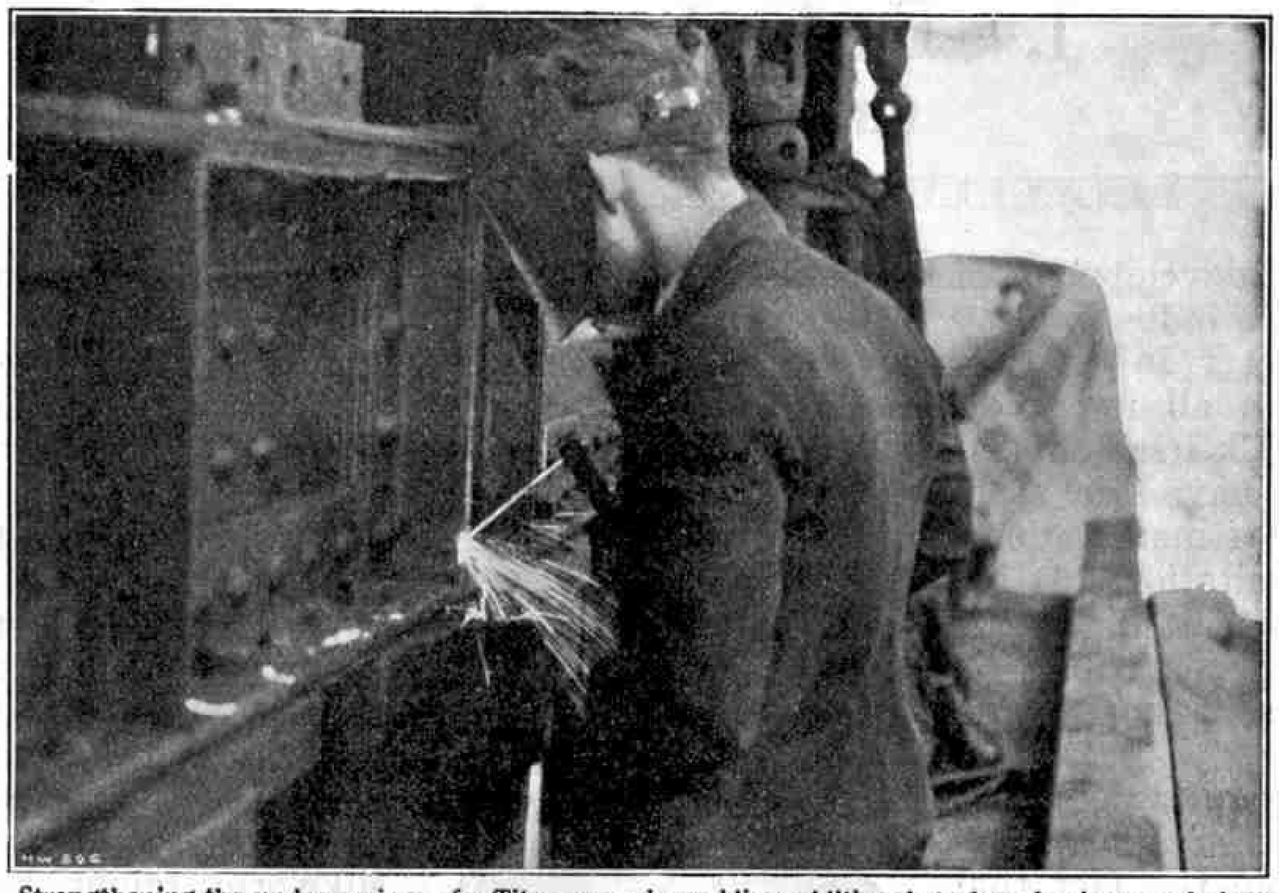
A good example of the great utility of electric arc welding is shown in the accompanying illustrations of the cylinder of a large vertical blowing machine, in the cylinder wall of which a 60-in. crack was repaired, together with a similar crack on the opposite side of the cylinder, by arc welding. The machine was put back into service within 325 hours. What such an accomplishment means will be better appreciated when it is known that a new cylinder would have cost £2,250, and could not have been delivered for nearly nine months. By means of welding the repair was accomplished in less than one-fifth of that time, and at a cost of less than seven per cent. of the cost of a new cylinder.

Owing to the cracks having widened about ¼ in., it was necessary to draw the sides together before starting to weld. This was accomplished by means of rings shrunk on alternately over the cylinder head bolts and two bolts fixed in the outer edge of the cylinder rim. In order to keep the shrinkage strains as low as possible the welding was done very slowly, the operator depositing only about a pound of metal per hour. The metal was deposited in zones by skipping from one section of the crack to another. These zones are clearly visible in the final string of metal as shown in the illustration of the finished weld.

In shipbuilding yards arc welding is used to a great extent. During

and after the Great War several small ships were built by welding instead of riveting the hull plates, and they gave quite satisfactory service. One of the most famous of these welded ships was the "*Fullagar*," an oil-engined vessel of about 500 tons loading capacity, which was built in 1920, and was in service recently in British Columbia.

This vessel has rather a remarkable history. A few years after she was launched she grounded in the River Mersey while loaded with cargo, but she was refloated and completed the voyage. After being discharged of her cargo she was dry docked and thoroughly examined to ascertain the damage done by the grounding. It was found that her bottom plating had been pushed up about 11 in., and the general opinion of the experts who made the examination was that the vessel was a total loss and not worth repairing. The owners did not share this opinion, however, and set to work to push the plating back by means of hydraulic jacks. The operation was carried out successfully, and none of the welded joints failed, neither was there any leaking. Shortly after this the vessel hit a rock while at sea, and on this occasion her bows were severely crumpled up; but even after this unfortunate mishap she was found to be bone dry.

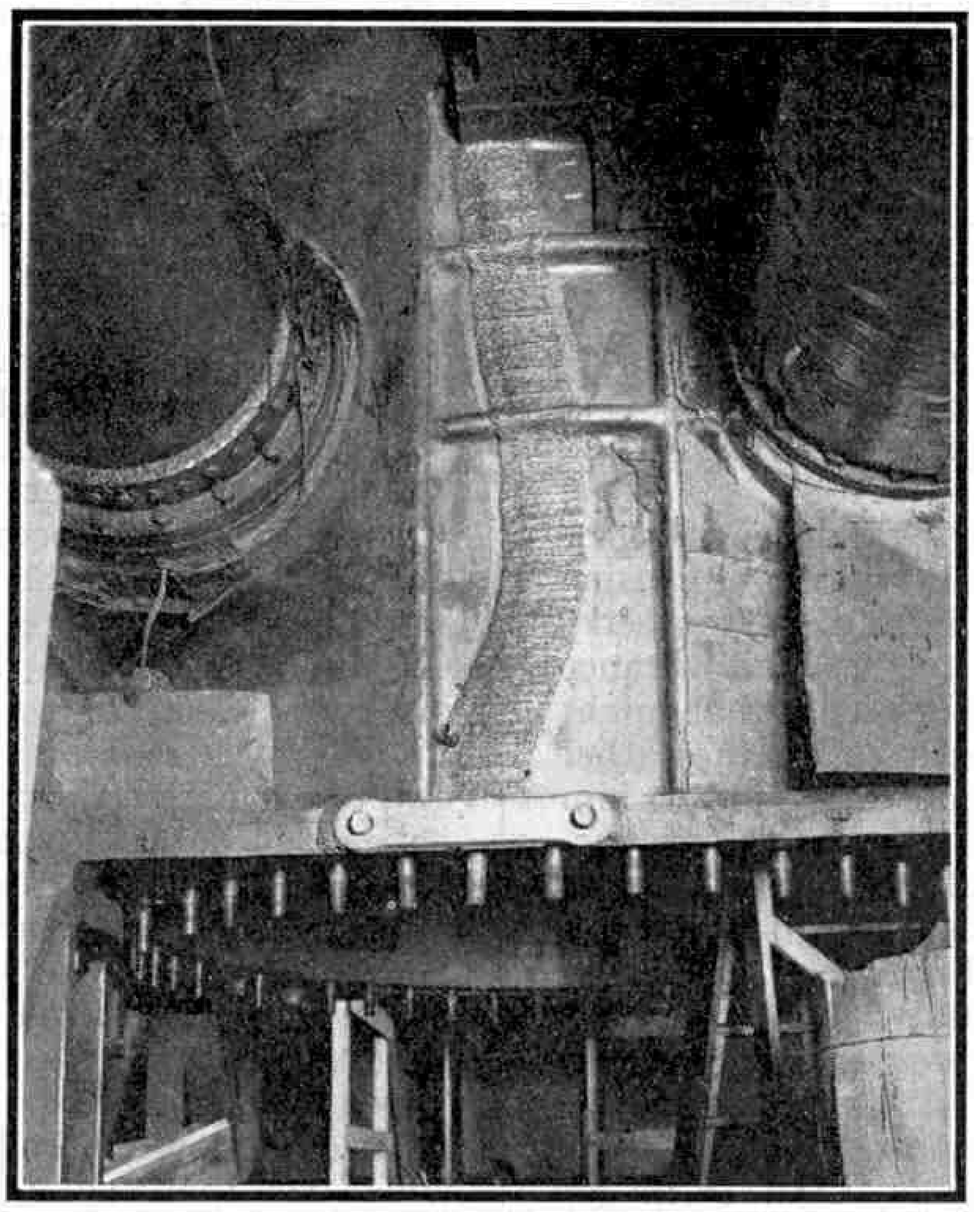


Strengthening the undercarriage of a Titan crane by welding additional steel angle pieces and plates to the stiffening webs. Photograph by courtesy of Murex Welding Processes Ltd., London.

Similarly favourable testimony to welding as a method of ship construction was afforded by a welded barge of 225 tons displacement, built in 1918. This vessel twice went ashore and had her bottom stove in. On each occasion it was pushed back, and the barge remained in service for several years.

Electric arc welding can be used in many different ways in shipbuilding, quite apart from its use in the construction of the hull. For example, bolts can be welded on steel plating for deck plank fastenings, thus obviating the necessity of piercing the decks, with possible damage to fittings below, where fitting-out work is well advanced. Welding can be used also in the manufacture of oil and water tanks for use on board ship, and in building up complicated pipe systems for pumping and draining.

Readers who have had an opportunity of inspecting the engine and boiler room bilges of a ship will be aware of the intricate nature of the pipe systems they contain, and of the confined and awkward spaces in which the various pipes have to be laid and connected together. Before the use of welding the task of joining up the pipes after rejointing or other repairs was one of considerable difficulty, and the writer has himself had experience of lying in the most tiring positions beneath the engine room plates in order to tighten the nuts and bolts of the pipe flanges. Then again trouble was frequently experienced in bringing the flanges of two lengths of piping into line. Nowadays, however, the pipes with their connecting flanges loosely attached can be adjusted to the correct angles and levels, and the flanges just "tacked" by electric welding. Then they can be removed to the workshops and the welding of the flanges completed. Electric welding is also of great assistance in other awkward corners aboard ships where there is not sufficient space in which to rivet.



Another view of the blowing cylinder illustrated opposite, showing the welded repair after completion.

Arc welding is put to extensive use in the repair of tramway tracks and rolling stock, and practically every tramway undertaking in the country possesses a welding set of some description. Many possess several portable plants in addition to the repair shop outfit. When truck overhauls take place no part of the machinery need be scrapped unless it is absolutely beyond redemption. Wear that gives rise to clatter and noise that is so objectionable to the man on the footpath, or the resident on the route, can be rapidly and cheaply replaced by means of welding. In the workshops broken or worn parts such as axle boxes, horn plates, motor and gear cases, teeth of gear wheels, or brake gear, can be readily repaired or built up. The process is also of invaluable assistance in maintaining the permanent way in good condition.

In the construction of steel-framed buildings, bridges, etc., riveting has been replaced to a great extent by welding, and considerable savings in the weight of material, time of erection, and cost of labour have been effected. The number of welded buildings during the past few years has grown very rapidly, especially in America. In Los Angeles a 14-storey office building has been constructed that involved the use of approximately 3,600 tons of steel, 75 per cent. of which is welded. Another 14-storey office building has been built for the Boston Edison Company at Boston, Massachusetts, a unique feature of which is that the parts were first assembled in the workshops by riveted construction and then erected on the site by welding.

Those who have watched a steel building being erected by riveting will be aware of the terrific noise of the riveting hammer. By electrically welding the joints, however, all noise is eliminated. This is a matter of considerable importance when a new building is to be built adjoining a hospital or block of offices.

The first welded buildings to be erected in England were built by a subsidiary company of Alloy Welding Process Ltd. (now Murex Welding Processes Ltd.). They were erected about 10 years ago, and have proved entirely successful.

Among the earliest structures was the stable in the old Olympia buildings in London, which was erected in 1920, and covers an area of 9,000 sq. ft. During the past year or so several single-storey buildings have been erected by electric welding, and Murex Welding Processes Ltd. have recently built a huge extension to their Walthamstow premises by this means. Unlike most of the existing welded buildings, which were originally designed as a riveted job with the subsequent substitution of welds for rivets, the Walthamstow extension was designed specially for construction and erection by electric welding. The building covers an area of 37,000 sq. ft., and has a length of 232 ft. divided into seven 33 ft. bays, and a width of 160 ft. The layout of machinery inside the building necessitated a clear floor space, and this was afforded by a 160-ft. span roof. There are 22 ordinary and 110 cantilever type trusses, suspended from six girders, the girders being supported on 12 braced columns. The total weight of steelwork is approximately 132 tons, and the whole of this was erected without a single rivet. Each of the six main girders weighs 8½ tons, and supports a total load of 47 tons.

The Story of Artificial Silk

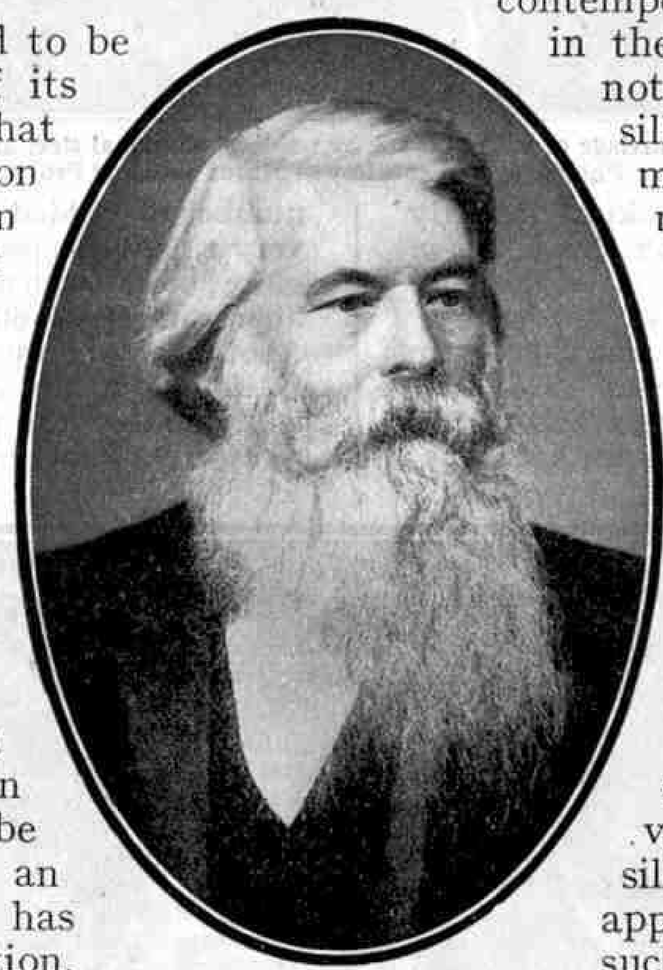
I.—Early Investigators

By W. F. Harrison

THE story of the rise and development of the modern rayon or artificial silk industry may be said to form the latest chapter in the history of the textile arts. Differing from all its predecessors such as wool, flax, cotton, and silk itself, fibres or filaments that in their natural state have lain as it were ready for the transforming hand of man, rayon stands alone as a triumph of scientific imitation. It is a product of the vegetable world, transmuted by the combined skill of the chemist and the mechanician so as to resemble and in certain respects to surpass the natural filament ejected by the silkworm.

As years go, the industry may be said to be still in its infancy; but some idea of its growth may be gauged from the fact that during the year 1931 the world production of rayon lay between 400 and 500 million pounds in weight, rather over a quarter of this being produced in the United States. In Great Britain alone nearly 30,000 persons are employed in rayon making, apart from those engaged in the allied industries of knitting and manufacturing; and the weight of this filament turned out from our own factories during the early months of 1932 averaged about 1,500,000 lb. per week.

Without going further at the moment into the statistics of rayon making in other countries, these figures will be sufficient to indicate the magnitude of an industry which, in a commercial sense, has been in existence for little over one generation. Its beginning is usually dated from 1884, when Count Hilaire de Chardonnet produced for the market an imitation silk made from wood pulp, using as the chief material the trunk and limbs of the mulberry tree. While Chardonnet, owing to his perseverance and his determination to overcome obstacles that might have daunted a lesser man, has been called the father and founder of the industry, this honour is paid to him mainly as being the first individual to make the production of imitation silk a commercial success.



Sir Joseph Wilson Swan, F.R.S.

Sir Joseph Wilson Swan made artificial silk for lighting purposes a year before Chardonnet announced his discovery. He also successfully de-nitrated it, and thus solved out of hand a problem that baffled Chardonnet for years afterwards. It is true that the filaments he made were of a coarse nature, but he made finer threads to please his wife, who used them for crochet work. In this case the man did not realise the consequences of his act. Indeed, the sanguine Chardonnet himself, with a weekly production of 50 kilos of artificial silk from his factory, would have had some difficulty in visualising its distribution by the ton a generation later. This pioneering work had been proceeding for over 40 years before the making of imitation silk became an industry in the true sense of the word.

Before attempting to describe the various processes associated with modern rayon production, from the felling of the timber to the sorting and grading of the gossamer threads, it may be found of some interest to note the successive steps that led to the formation of the artificial silk industry.

It was in 1665 that Dr. Robert Hooke, the redoubtable scholar who contested Newton's claim to the discovery of the law of gravitation, and who was described by a contemporary as being the "greatest mechanick in the world," asserted that silk equal to, if not better than, that produced by the silkworm might be made by mechanical means. In this connection Hooke made reference to a "pretty kinde of artificial stuff I have seen, looking almost like transparent parchment, Horn or Ising-glass . . . to the naked eye it look'd very like the substance of Silk."

In the following century the better-remembered Réaumur, the eminent authority on physics and natural history and the inventor of the 80 degrees thermometer, approached the subject from another angle. He pointed out that silk itself was only a natural gum that dried when exposed to the air, and that it was then possible to make varnishes with the essential properties of silk. From this he argued that it did not appear at all impossible to spin threads from such a solution, when it was considered to what extent art could be carried.

Apart from these conjectures, the first step that has any real bearing on the modern industry was taken when wood pulp was first produced about a century ago by a German artisan named Keller. It was a momentous discovery, destined to affect not only the textile arts, but also the making of explosives, the film industry, and to a greater extent than any of these, the making of paper. Keller did not realise the importance of his invention, but it is significant that almost immediately after his discovery there followed experiments conducted both in England and on the Continent in the making of a spinning solution. To this end wood and cotton were treated with various acids, and as the tree and the "tree wool" are in their essence one and the same substance, namely, cellulose, this formed the basis on which the industry subsequently came to be built.

About the middle of last century spinning solutions of some importance were made by Schönbein and Audemars, the former using cotton as a basic material, and the latter treating the bast fibres obtained from mulberry twigs. These fibres were purified, bleached, and made into a cellulose nitrate, which was dissolved in a mixture of ether and alcohol together with

caoutchouc. From this mixture Audemars was able to draw out, by the age-old method of using a needle, a continuous thread that solidified in the air, and was subsequently wound on to a spool. For this process he obtained in England the first patent ever granted for the making of an imitation silk. Shortly afterwards Ozanam carried the project a step further by squirting a solution through jets of various sizes.

In order to show how in different provinces the minds of men were being directed towards the same objective it may be stated that all these experiments were anticipated in the north of England in 1842 by a Manchester resident named Louis Schwabe, a silk manufacturer and a maker of machinery for embroidery. This ingenious mechanician may be called the herald of artificial silk-making in England, for after long experiments with certain viscous substances he invented and exhibited in Manchester a machine for the production of imitation silk by drawing or forcing the gum through fine orifices into threads or filaments.

No patent was taken out for this interesting machine, and no details of it are now available; but this brief account of forcing a gum through fine orifices indicates the first known use of the spinneret—one of the three vital features of the present-day spinning machine—and entitles Schwabe to an honourable place in the story of artificial silk production.

To anticipate a little it may be noted here that in 1883, a year before the deposition of Chardonnet's formula under seal with the French Academy of Science, Sir Joseph Wilson Swan obtained in England a patent for a similar filament. Sir Joseph's process was directed towards the making of a filament for his incandescent electric lamps, and to this end he dissolved nitro-cellulose in acetic acid. This he discharged or squirted under pressure through a die or fine orifice into a hardening bath so as to form a continuous and homogeneous thread, which he afterwards washed and de-nitrated with ammonium sulphide. In this connection it is interesting to find that in 1885 mats or d'oyleys made from Swan's artificial silk were shown at the Exhibition of Inventions in London.

Feeding silkworms with mulberry leaves. In the upper tray are silkworms in various stages of cocoon spinning.

While progress was being made earlier in the century in the search for a perfect spinning solution and a reliable spinning apparatus, other scientists and industrialists were engaged in developing a new method of treating cotton so as to give it a silky appearance. The most illustrious name in this connection is that of John Mercer, an East Lancashire inventor, who at the age of nine began work as a bobbin winder and lived to become a member of the Royal Society. He it was who effected this by subjecting cotton to the action of caustic soda, a procedure that had a tremendous bearing on the later methods of rayon production.

A later stage in the breeding of silkworms. In this photograph the breeder is seen carefully collecting the cocoons.

This process of mercerisation, so called after its inventor, and by a happy coincidence expressing most appropriately its object, may be regarded as a forerunner of the more perfect phase of silk imitation, and therefore a brief explanation of its purpose and the material acted upon may help to illustrate in an effective manner the difference between mercerised cotton and rayon. The yarn or thread that is to be mercerised by being passed under tension through a strong solution of caustic soda is usually made from cotton of good staple, that is from fibres that are of good length and of tolerable fineness. To obtain the best results (Continued on page 135)

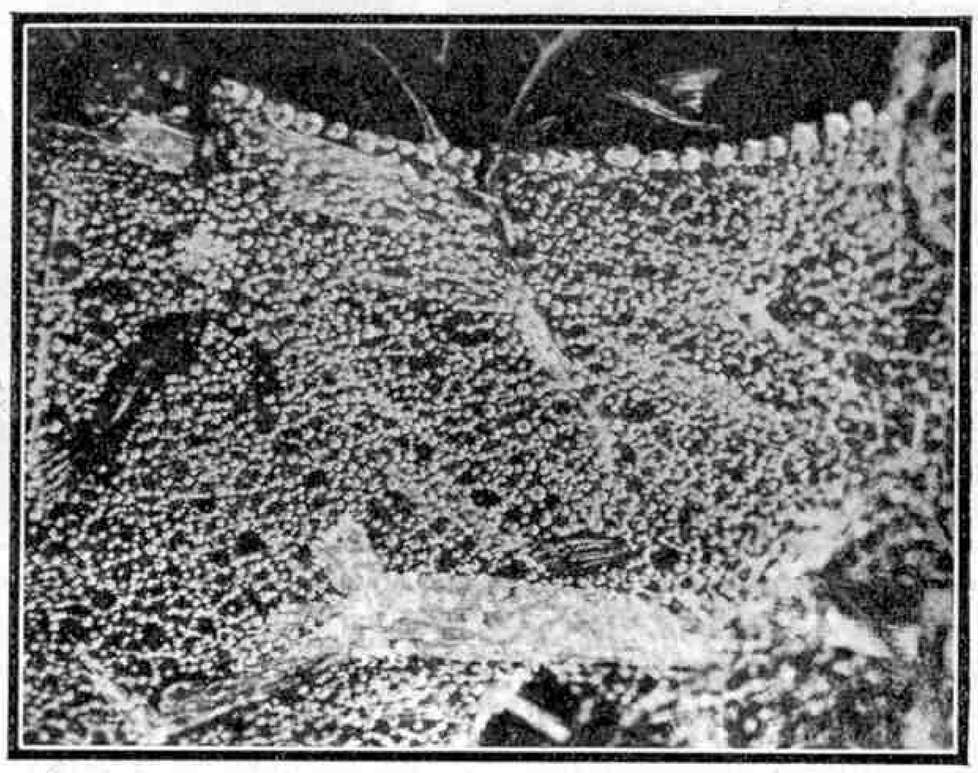
Clouds, Rain and Dew

The Wonderful Story of Water Vapour

By W. Coles Finch, M.Inst.C.E.

WATER vapour from sea and land, under the kindly influence of the Sun's warmth, rises invisibly into the atmosphere and accumulates there until the air is fully saturated, that is it can hold no more. If the air then becomes colder, the water can no longer remain in vapour form, but condenses into minute particles of water in the form of cloud, and by further lowering of the temperature falls as rain. Evaporation under the influence of the direct rays of the Sun is not confined to water surfaces, however, for the ice and snow of colder regions also evaporate to provide their share of rain.

The clouds that we see drifting across the face of the sky represent an incalculable weight of water suspended in the air. A cubic foot of air at 80 deg. F. will retain 11 grains of water invisibly as vapour, but if the temperature falls to zero it will hold only half a grain. Thus, according to the variation in temperature, there is a varying capacity for retaining moisture, and at a certain stage precipitation inevitably takes place.



Web of the field or gossamer spider covered with dew. (Enlarged.)

The minute globules of water that compose cloud, the middle stage between vapour and rain, are only about one three-thousandth of an inch in diameter, and have been expressively named by Professor Tyndall "water dust." At one time they were supposed to be hollow, and for this reason to float in the air; but the secret of their suspension lies in their minuteness. The slightest upward motion of the air will keep them suspended for a considerable time. The particles grow by adhesion of fresh coatings of water as the condensation from the invisible vapour continues, and the larger particles fall and absorb the smaller ones, thus increasing in size until they can no longer remain suspended, but fall as rain.

Beads of dew outlining the web of the garden spider.

Dust motes are essential to the formation of all forms of atmospheric precipitation, and so minute are these motes that 60,000 of them have been found in a cubic inch of air. The dust provided by the breaking up of some 20,000,000 meteorites that annually attempt to reach our Earth is one very important source of supply, and in many ways the most interesting. The bombardment of our Earth by meteorites never ceases, although it is only at night that from time to time they attract our attention by their trail of light. They may have fallen millions of miles, but they are invisible until they come into contact with our atmosphere, and become incandescent by friction as they pass through it. Usually we see them at a height of from 40 to 80 miles. They generally burn out and disappear in the form of cosmic dust at an altitude of 25 miles, but occasionally one reaches the Earth as an aerolite or meteoric stone.

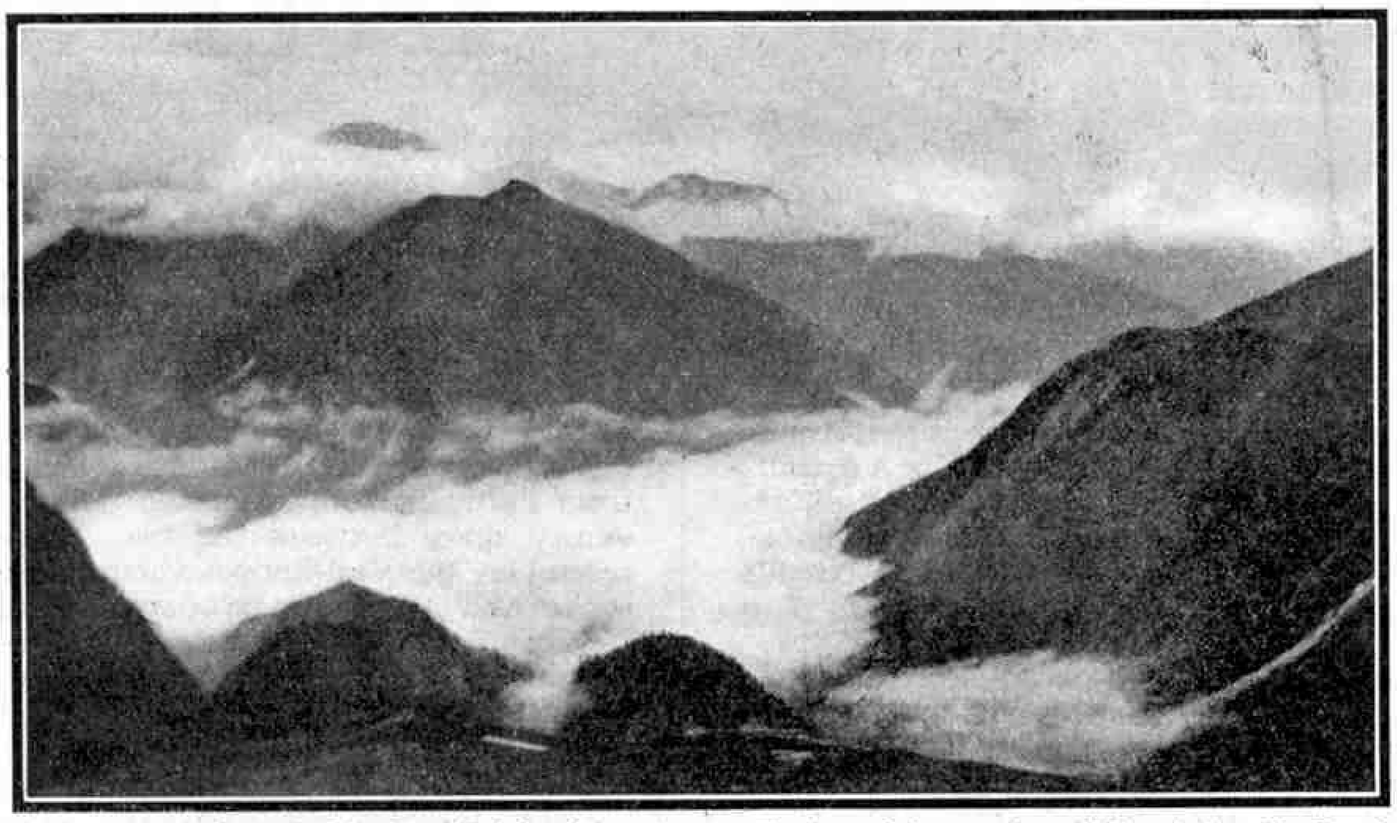
So small are the hollow metallic spheres of cosmic dust that when magnified 1,200 times they are only sufficiently large to be distinguished by their spherical shape from dust from terrestrial sources.

Active volcanoes also are occupied in keeping up this necessary supply of dust motes. The dust ejected during the eruption of Krakatoa in 1883 spread a mantle of dust particles in the air over the whole world, producing a series of gorgeous sunsets. As to more ordinary sources of terrestrial dust, even a puff of smoke from a cigarette contributes to the atmosphere 4,000 millions of separate granules of rain-making dust.

Water vapour never condenses except upon a solid substance, and the dust particles provide the necessary nucleus. In air quite free from dust, water vapour can be cooled far below the dew point without condensation taking place. If a puff of ordinary dust-laden air is admitted, however, each dust mote becomes the centre of a tiny globule of water, and condensation occurs. We may sometimes catch a glimpse of these usually invisible motes as they dance and scintillate with iridescence in a ray of sunshine penetrating a darkened room.

Water is beautiful in all its forms. We may hear it singing in the gentle showers, see it sparkle in the snowbound branches of the trees, glitter in the hoar-frost covered boughs, or glisten in the dewdrop. It forms a golden gauze for the setting Sun or a silvery halo for the midnight Moon, or appears in the varied hues of the rainbow. It dances in the hailstorm, paints with a fairy pencil frost flowers and ferns on the window panes, or covers with a mantle of white the wintry world.

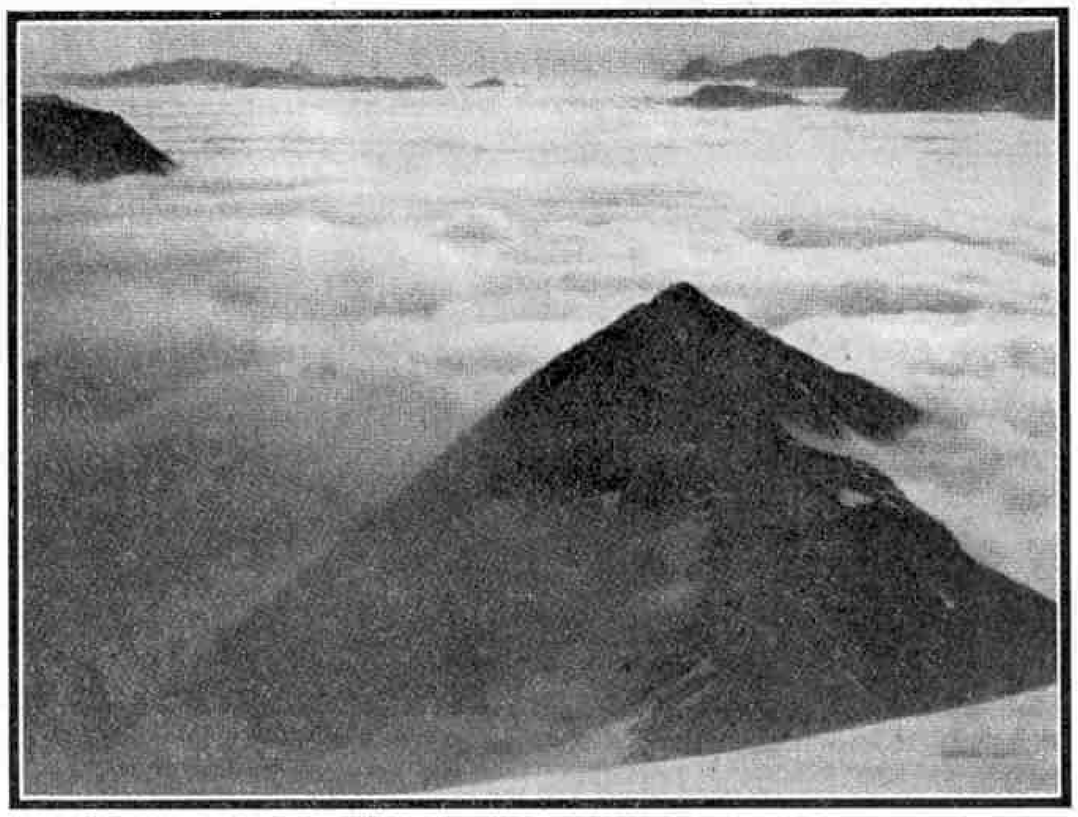
The clouds, too, are very beautiful, but it is a mistake to think that the glorious cloud displays that we so often enjoy are a necessity in order that we may be blessed with rain. That clouds are primarily water carriers must be admitted, but in no branch of her work has Nature done more to give us pleasure than in the formation of beautiful cloud scenes. Ruskin says: "Every essential purpose of the sky might be answered, so far as we know, if once in three days or thereabouts a great ugly black rain-cloud were brought up over the blue sky, and everything well watered, and then all left blue again till next time, with perhaps a film of morning and evening mist for dew. But instead of this there is not a moment or a day in any of our lives when Nature is not producing scene after scene, picture after picture, glory after glory, and working still upon such exquisite and constant principles of the most perfect beauty that it is quite certain it is all done for us and intended for our perpetual pleasure."



Above the clouds; the Alps from Belalp after a storm. Photograph by courtesy of Mrs. Aubrey Le Blond.

Of the serious results of a prolonged drought, disease, famine and death, we have not space to tell. Eastern nations have a rain god, and in Africa the native rain-makers are more highly honoured than kings. In our own country we are familiar with prayers for rain.

One of the most beautiful forms of atmospheric water is dew, which in the form of minute globules of moisture refreshes the thirsty ground. It does not fall in the ordinary sense of the term. After the Sun has set and the supply of heat is cut off, vegetation that has absorbed its rays radiates its heat back into space, and cools rapidly until it becomes lower in temperature than the surrounding air. The result is that the moisture from the lower stratum of air is condensed and forms dew on the vegetation. Dew is not deposited on plants alone, but on all objects that have become cooled by radiation. Plants radiate their heat more freely than other objects, and so receive a greater proportion of moisture in this form. The surface of the Earth is never really cold, heat being radiated from it continuously; and for this reason dew is never formed on bare ground.



Looking down on a sea of cloud in arctic Norway. Photograph by courtesy of Mrs. Aubrey Le Blond.

Dew is not formed in cloudy or windy weather. The clouds prevent the escape of heat into space by radiation. Like grass and foliage they are good radiators, sending back an amount of heat equal to that received; and so the balance of the temperature of the Earth and the air is maintained, and no dew is formed as there is no condensation. The wind, by continually moving the air in contact with the ground, prevents the temperature from falling sufficiently low for the formation of dew.

In parts of the world where rain seldom falls, dew is precipitated heavily, and forms Nature's only means of preserving vegetation in such regions. In the tropics the amount of heat absorbed during the day is very considerable, and at the same time water vapour exists in great quantities owing to the high rate of evaporation. Thus, in conjunction with clear skies, the conditions are complete, and as a result we get dew deposited very freely. In cold, damp climates little dew is deposited, as the frequent presence of clouds prevents it.

One of the most fascinating examples of the manner in which dew is deposited is provided by the web of the spider. As a test of patience and skill "*M.M.*" readers who are amateur photographers cannot do better than endeavour to obtain a picture of a web bepearled by dew, whether it be that of the field or gossamer spider or the attractive net of the garden spider. It is not so simple a matter as it first appears, especially if the aim be to photograph a perfectly unbroken net or web. Even if this is found, and its position lends itself to the task, the atmosphere must be dead calm, as the various strands, radials and spirals, and even the stronger suspension lines that carry the full weight of the net, are so frail that the merest breath of air vibrates the dew-covered net sufficiently to spoil the photograph.

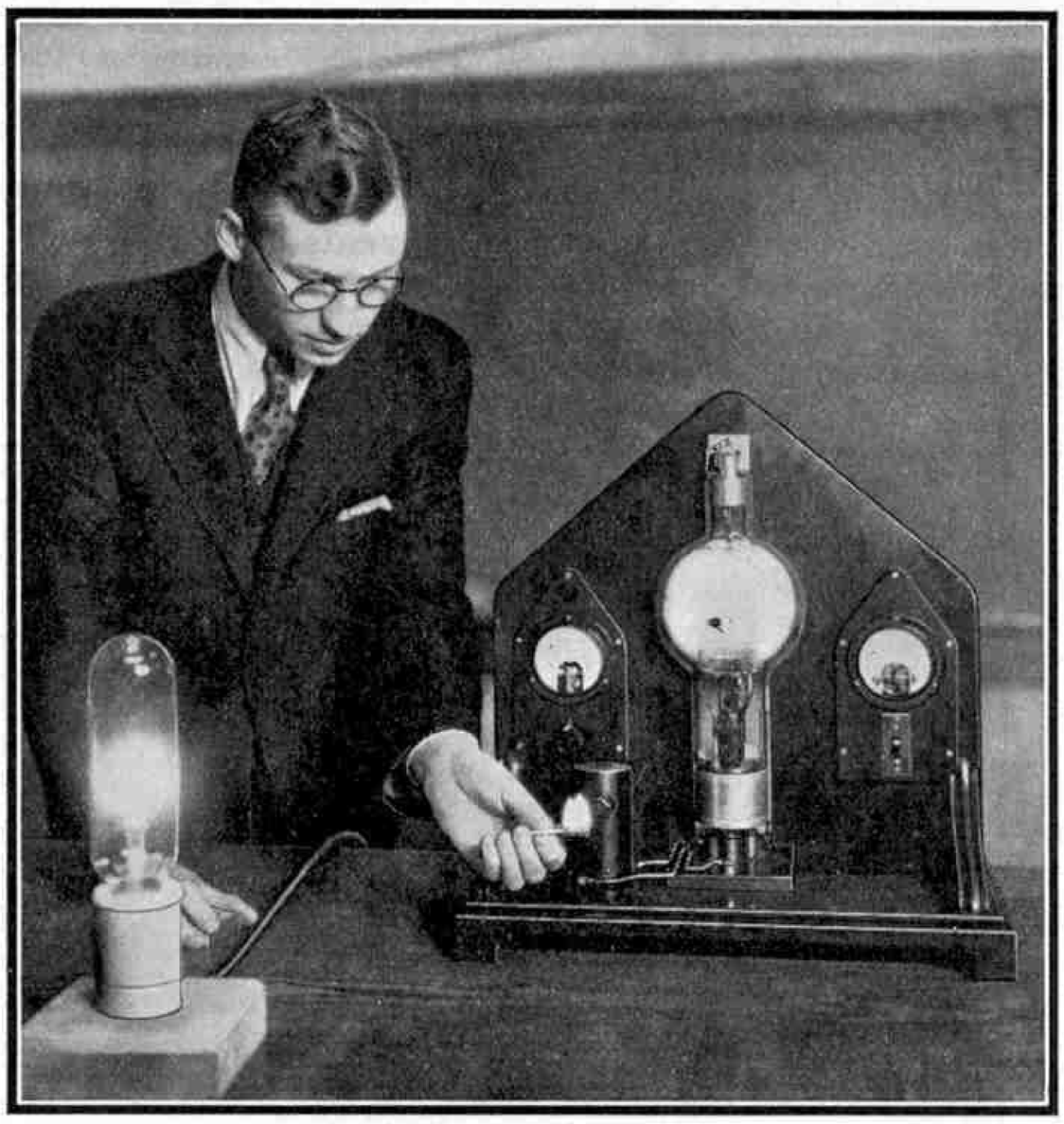
These wonderful creations of the spider are more readily seen during autumn, by reason of the dewy particles then so generously deposited, particularly on the spiral threads. I have frequently noticed that between eight and nine o'clock on an autumn morning is a particularly calm period, when there is no movement in the atmosphere to disturb the net. This is the ideal time to attempt the photograph. If the web selected is slightly coated by hoar-frost photograph it immediately, as the crystals grow so quickly by fresh adhesions of moisture that soon the net collapses under the increasing weight.

By P. A. Tent

THE engineer shown in the illustration on this page is performing the remarkable feat of lighting an electric lamp with a match!

He is not doing this directly, but with the aid of a photo-electric cell that is stirred into action by the light from the flame. The current then generated passes through the control circuits of a thyratron tube, and this in turn allows current to flow through the lamp.

The great variety of uses to which the photo-electric cell, or electric eye, as it is sometimes called, can be put is one of the most remarkable features of modern industry. An interesting and typical instance of its application is found in the automatic painting of lumber, which is best protected from moisture and fungoid growths by spraying it with aluminium paint. A plant that has been designed for this purpose sprays from 60 ft. to 200 ft. of timber per minute, and is entirely automatic, the planks and boards passing through booths in which are sets of spray guns that cover them on all sides with the paint. As each piece of lumber enters the booth, it moves a trip lever that intercepts a beam of light falling on a photo-electric cell, and the circuits in which this is connected are so arranged that the movement brings the spray guns into action. Each board is thoroughly primed with paint, and as it leaves the spraying booth it actuates a second trip mechanism that cuts off light from another photo-electric cell, thus stopping the spraying operations.



Lighting a 1000-watt electric lamp with a match, the light from which brings a photo-electric cell into action. We are indebted to the General Electric Company of New York for this photograph and the lower one on the opposite page.

Rats Shoot Themselves

A still more remarkable use for the electric eye has been discovered in America, where the device has been used to fire a gun at the instant when the quarry crosses the line of fire. So far this photo-electric gun has been used only to destroy rats. It is placed on the rats' favourite promenade in such a position that when one of the creatures passes along the run it intercepts a light beam that normally falls upon the cell. Instantly relays are brought into operation, with the result that the gun is fired and the rat is killed, having as it were pulled the trigger itself!

Some Interesting New Lamps

Among recent electrical inventions is a new form of lamp that is claimed to be more efficient than any other yet introduced. In a sense it may be regarded as a development of the arc lamp, for it has no heated filament, the light coming from metallic vapours that glow when an electric discharge is passed through them. In one form of this invention introduced by the British Thomson-Houston Co. Ltd., and known as the Mazda Mercra lamp, the vapour of mercury is used. The bulb contains also a certain proportion of an inert gas such as argon, in order to enable the arc to be struck on ordinary mains voltage, for the mercury is not volatilised until it is heated. The bulb is prevented from losing heat by enclosing it in a second glass vessel with an empty space between the two. Thus in construction the lamp resembles the well-known vacuum flask. It fits into a standard socket and can readily be adapted to all alternating current circuits.

When one of these lamps is switched on, the bulb is filled with a pale blue glow. As the temperature rises and the pressure of the mercury vapour increases, the glow leaves the walls of the bulb and narrows down into a brilliant discharge in the centre. The light given out is then at a maximum. Its colour is greenish-white, and it is therefore unsuitable for colour matching; while the absence of red light in its composition gives rise to many curious effects. The remarkable sharpness of definition of objects illuminated by it is one of the great advantages of the lamp, and 300-watt lamps of this type are employed in the main avenue of the British Thomson-Houston works at Rugby.

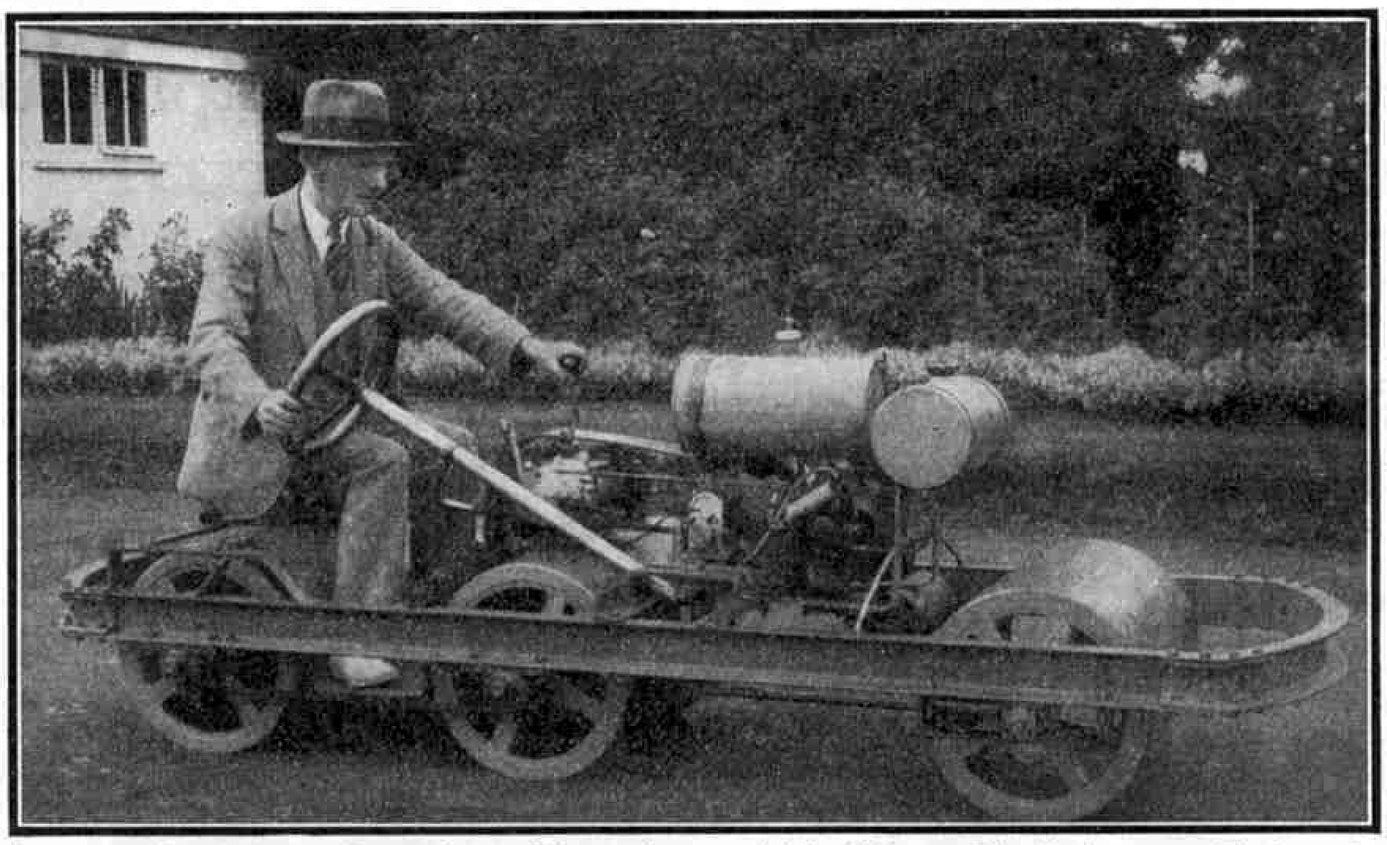
At present the light given by lamps of this type is not quite satisfactory, as it is lacking in the red component necessary for a good white light. They are extremely efficient, however, giving two or three candle power for each watt consumed, whereas gas-filled lamps with tungsten filaments use nearly a watt per candle power.

A promising lighting development is the use of two, or even three, filaments in a bulb, in order to give a wide range in light intensity. For instance, one lamp of this type contains 150-watt and 200-watt filaments, and thus can be used as a 150-watt or a 200-watt lamp by employing each filament separately, or as a 350-watt lamp by passing current through both. The small switch required is contained in the base of the lamp, which is no larger than one containing a single 300-watt filament, although it is really three lamps in one. Many interesting uses for this multiple lamp have been suggested, and it is expected that it will first be used in stores and other buildings where lighting requirements vary from time to time.

Two-filament lamps are well adapted for use in the headlamps of motor cars, and I see that Philips Lamps Ltd., have introduced a new lamp of this kind. It provides a powerful beam for normal use, and a second filament is partially enclosed within a cup so that its light is directed towards the upper surface of the reflector. When meeting traffic, the driver of a car equipped with these lamps can switch off the powerful main light, and the secondary beam then gives him sufficient light without dazzling the drivers of oncoming cars. A special feature of these lamps is that the filaments are supported in a specially-designed shock absorber in order to enable them to withstand road shocks.

Those of my readers who have had as much practice in rolling lawns as I have probably will have realised that an ordinary roller is not ideal for rolling out slight elevations, for it accommodates itself to regular contours of the ground and presses as heavily in a shallow furrow as it does on a slight ridge. The new type of roller shown in one of the accompanying illustrations does not suffer from these imperfections, and with its aid all inequalities of bowling greens, lawns and other stretches of grass can be removed and a level surface obtained.

The secret of the invention lies in the use of three rollers instead of one. These are unequally spaced and their bearings are attached to a rigid framework. As they move over the ground they exert their greatest pressure on slight elevations, and each roller in turn is carried almost clear of the surface where there is a shallow depression. Thus the bumps are completely ironed out, particularly if the green or lawn is rolled in two directions at right angles to each other.

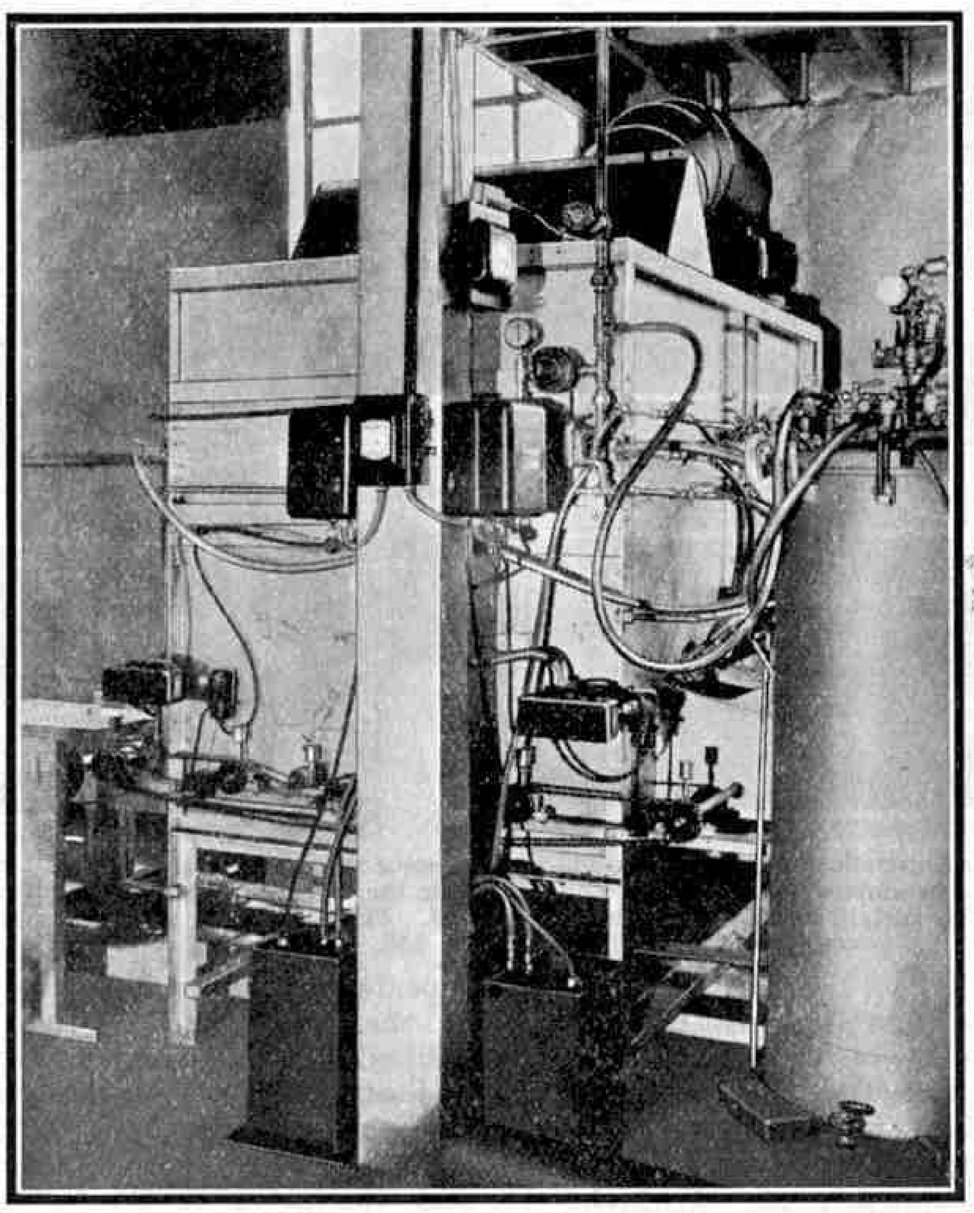


A motor roller that smooths out inequalities on lawns, cricket pitches and bowling greens. Photograph by courtesy of the inventor, A. T. Arnold, Kelvedon.

The roller illustrated is driven by a petrol engine with forward and reverse gears. Rollers of any weight from 10 cwt. to 14 tons may be designed on similar principles. The lighter rollers are suitable for bowling greens, cricket pitches and tennis courts, while those of greater weight are for use on roads.

Building Houses on Sand

It is by now almost a commonplace that engineers are never satisfied to regard any feat as impossible, but it is a little startling to find that they are even prepared to build not only houses, but also much larger and heavier buildings, upon sand. American engineers have discovered that this can be done without incurring risk of disaster, provided that the sand is first prepared by chemical means. Where natural rock below sandy soil is too deep to be reached in building operations, perforated pipes are driven to any desired depth in the ground, and through them a solution of sodium silicate, or water-glass, is forced. When the sand has been completely soaked with this substance, a strong solution of calcium chloride is pumped in, and this re-acts chemically with the sodium silicate to form a "rock" that resembles sandstone. The "rock" seems to be really sand cemented together with calcium silicate, which is insoluble in water. It forms a block of solid material that can be used as a foundation for a building, or for the piles on which huge structures often are erected.



The lumber paint-spraying plant described on the opposite page. The sprays are automatically switched on and off as planks and boards pass through the booth shown in the background.

Another invention of a different character is designed to prevent minor tragedies such as the dripping of cream on to a tablecloth. Even a cream jug with a well-designed spout is occasionally guilty of this crime. An American inventor now claims that the trouble can be prevented by cutting a groove in the lip and down the side of the vessel. Any drops of liquid left in the pouring lip of a vessel designed in this manner do not fall off the edge, but return to the vessel along the groove, being impelled by the action of surface tension. Grooves of this kind can readily be formed in jugs and pitchers of all kinds when these are cast, or can be ground during finishing operations.

A New Way of Timing Watches

I was interested to hear recently of a device by means of which it is possible to measure to one eight-thousandth of a second. This means that a watch can now be timed 1,500 times more accurately than when it could be checked only by observing for a time the fastest moving hand on its dial. If this hand were a seconds hand, the least variation from correct time-keeping that could then be detected was one-fifth of a second per day during an observation extending over 24 hours, or one-fifth of a second per hour when the observation extended only for an hour.

In the new machine, to which the name of Time-Microscope has been given, the hands are not observed, but instead the balance wheel is watched through a stroboscope, similar in action to the Rotoscope described on page 872 of the "*M.M.*" for November last. A rotating mechanism illuminates the balance wheel by means of a succession of momentary flashes of light. Normally these flashes are so timed that the balance wheel appears stationary when oscillating at the correct speed of five times per second; but the interval between the flashes can be varied, and the rate at which a watch gains or loses is found by decreasing or increasing this interval until the balance wheel appears to stand still. A reading of the scale of the instrument then gives the rate of the watch, and this may be found as accurately by watching it through the device for one minute as by timing it for 24 hours in the ordinary manner.

Cinematograph Films in Colour

For many years inventors have been striving to devise satisfactory means of introducing colour photography into the cinema world, but the colour films so far devised have not been very successful, for they are expensive and shades of brown and green are too prominent. Now I learn that work in a laboratory at Bootle, which is not far away from the office and works of Meccano Ltd., has resulted in an invention that promises to revolutionise the film world by making colour films as easy to produce as the black and white films now shown in our picture houses. It is claimed that the special treatment necessary after photography is so simple and rapid that news films in colour of events of importance and interest can be shown in public on the same day. The inventor and his associates are so confident of the efficiency of the new process that they have expressed the belief that black and white films will be abandoned within a few years.

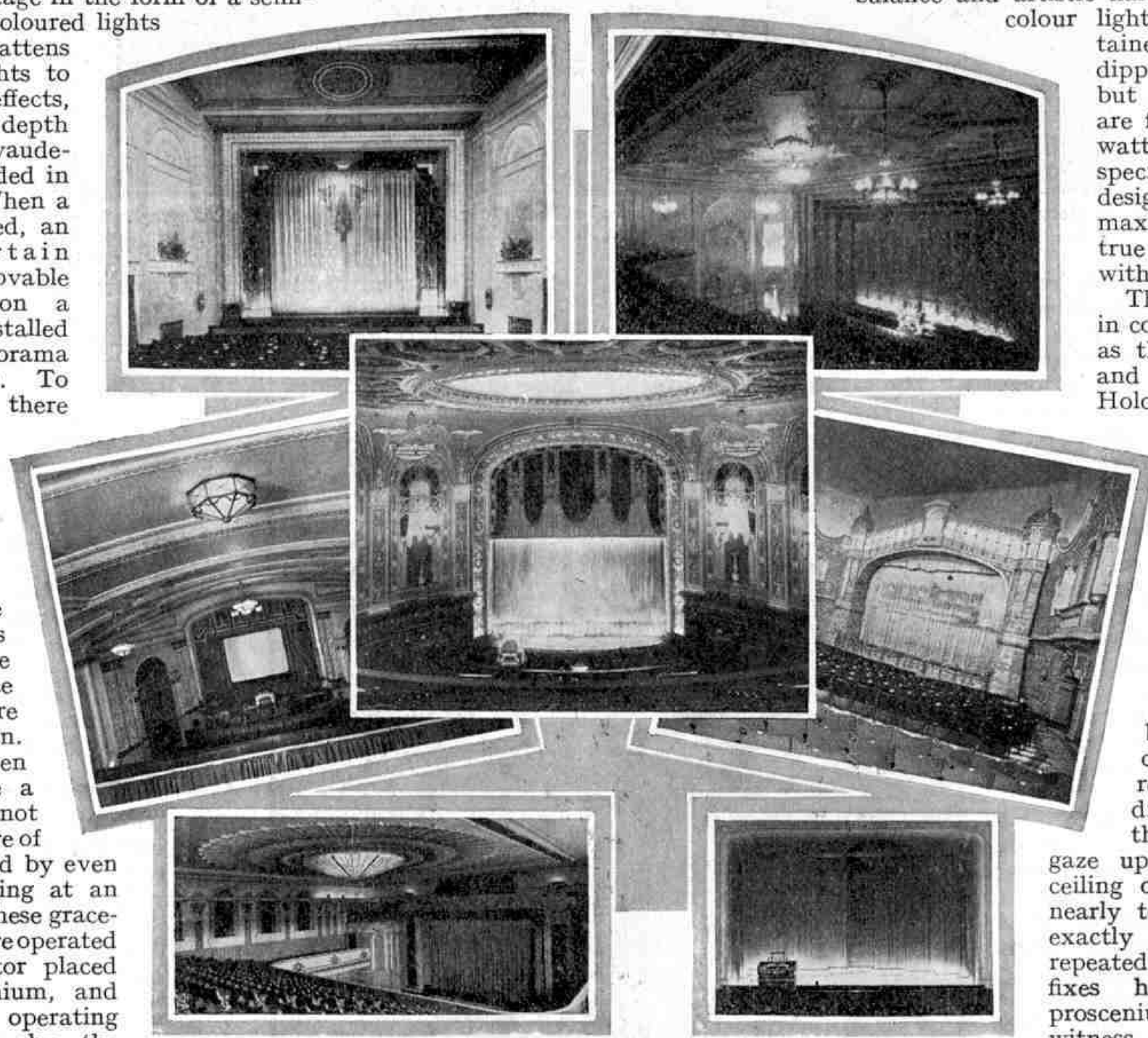
An invention that promises to be even more revolutionary in its own sphere is a motor car engine that requires an electric motor to start it and then derives its power from the atmosphere. This engine is said to be capable of developing 112 m.p.h. at a road speed of 30 m.p.h., and the performance of a car that is now being equipped with it in preparation for an extensive tour of Great Britain will be awaited with interest.

The Modern Cinema Theatre

II.—The Auditorium and Its Equipment

ALTHOUGH the operating box probably is the most fascinating part of a cinema theatre from an engineering point of view, there is a great deal of interest in the auditorium itself, which nowadays contains refinements unheard of only a few years ago. For instance, some cinemas include a fully equipped stage on which vaudeville items can be given when desired. The stage accommodates the picture screen tracks and a beautiful screen cover curtain, and sometimes what is known as a cyclorama, which consists of a stretched white cloth or plaster frame placed at the back of the stage in the form of a semi-circle. Upon this coloured lights are thrown from battens and rows of footlights to give horizon effects, shadowgraphs, and depth to the stage when vaudeville items are included in the programme. When a cyclorama is installed, an additional curtain controller and movable curtain mounted on a curved track is installed to cover the cyclorama when it is not in use. To complete the stage there is sometimes a fire curtain, this being compulsory in certain localities.

Although the screen cover curtain is primarily intended to beautify the auditorium, it serves also to protect the eyes of the audience from the white glare of the vacant screen. Readers who have been to a cinema where a cover curtain is not installed will be aware of the eye strain caused by even a few minutes' gazing at an uncovered screen. These gracefully hung curtains are operated by an electric motor placed behind the proscenium, and controlled from the operating room or elsewhere by the simple pressure of a push-button simultaneously with the dimming or increasing of the theatre lighting.



A composite illustration showing the auditoriums of some modern cinema theatres. In the centre is the Trocadero Super Cinema, London. Note the beautiful lighting effects thrown on the screen curtain and the proscenium surround. Photographs to this article are by courtesy of W. J. Furse and Co. Ltd., Nottingham.

It is only necessary for the operator to press the push-button a few seconds before the curtains require to be closed for this to be accomplished, and the control ensures that the curtains travel smoothly into position, and overlap sufficiently for the screen to be completely covered. Extra control pushes are sometimes fitted in other parts of the cinema, any one of which will give perfect action without interference with others. The controller is also designed to allow for stoppage of the curtains at any determined position of travel to give added effects. A hand-operating device is provided for use in the event of electrical failure. When used in conjunction with a lighting dimmer, the raising or dimming of the light and the opening or closing of the curtains is achieved in one operation. Curtain control apparatus is manufactured by W. J. Furse and Co. Ltd., London, to whom we are indebted for much of the information contained in this article.

Effective auditorium and stage colour lighting is an important and almost indispensable feature of present-day cinema entertainment. Not only can it be used to create "atmosphere" and to emphasise the dramatic values in the action of the film or play, but in itself it provides entertainment of a highly pleasing description, and of almost indefinite duration. The ordinary colour lighting seen in most cinemas is controlled by a dimmer resistance board installed usually in the projection room, and in some cases operated by an electric motor.

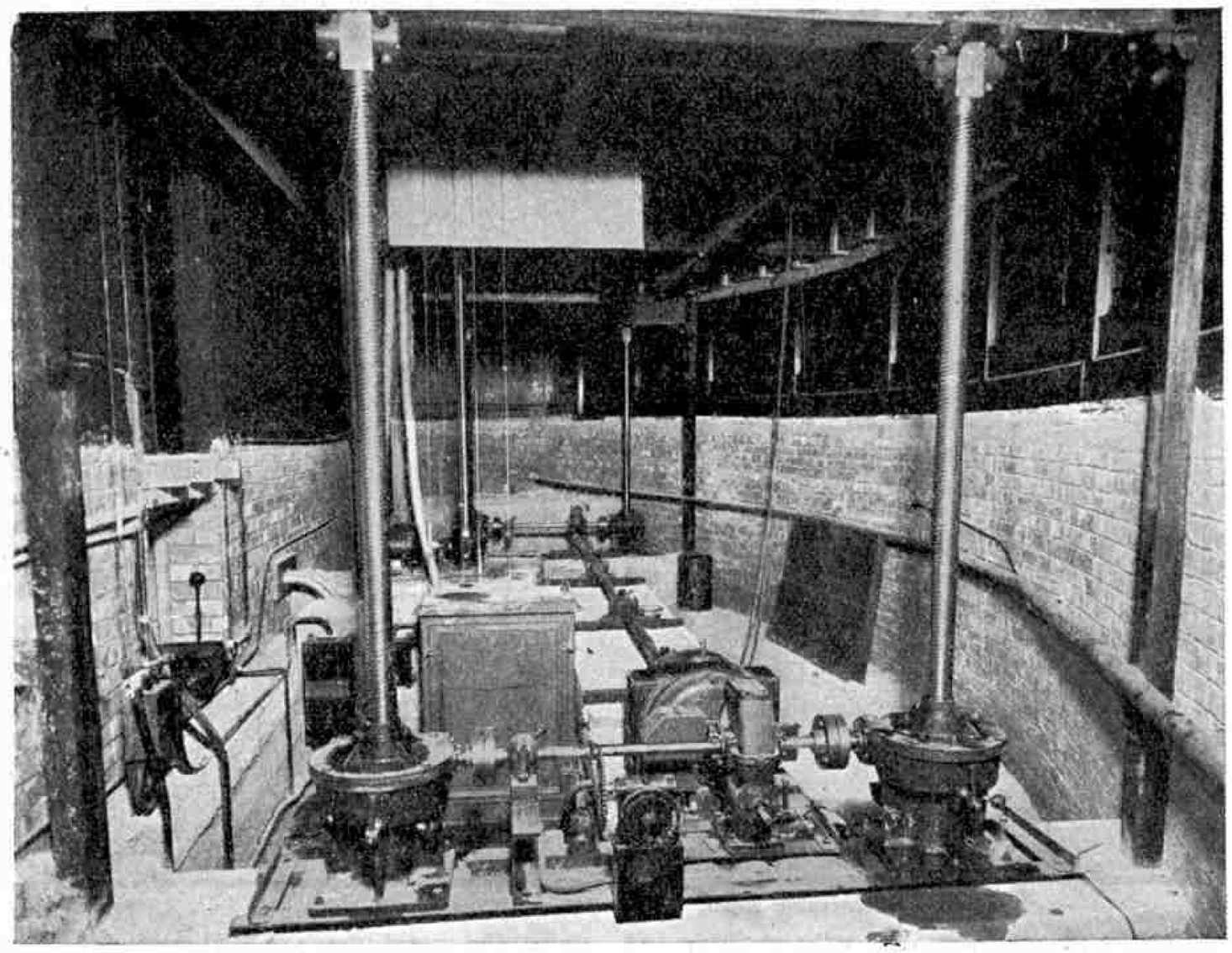
Footlights and battens play a big part in providing effective displays of colour, and when combined with a dimmer control and stage switchboard, keep the general colour scheme in perfect balance and artistic harmony. In the past, colour lighting was usually obtained by electric lamps dipped in coloured lacquer, but to-day colour filters are fitted in front of high wattage lamps housed in special reflectors that are designed to give the maximum efficiency and true colouring, combined with even illumination.

The latest development in colour lighting is known as the Holophane system and was originated by Holophane Ltd., London. With this system a bewildering variety of amazingly beautiful colour effects can be obtained. The Holophane colour lighting system is installed at the Capitol Theatre, Didsbury, Lancashire, a very beautiful modern cinema that has been recently rebuilt after a disastrous fire. At this theatre it is possible to gaze upon one spot on the ceiling of the auditorium for nearly ten minutes before an exactly similar colour hue is repeated. Then, if the visitor fixes his gaze upon the proscenium surround, he will witness such a brilliant and dazzling display of colour contrasts that even when the same colour combination is repeated in nearly ten minutes' time he will fail to recognise it! If the full range of the automatic control mechanism were utilised, and all the available sequences of colour hues run off one after the other, the visitor would have to fix his gaze for 3½ hours on one of the points just mentioned before witnessing exactly the same effect twice over! Rich violets, greens, mauves, and the more subtle shimmering shades such as pearl green, rose du barry, pale salmon, sky blue, etc., follow each other in endless variety, either as single colours or blended with other shades.

A particularly useful and unique feature of this installation is that the organist can control the lighting simply by the pressure of stop keys on the Christie Unit organ console. By this means the intricate colour harmonies, sequences and combinations in the auditorium can all be made to synchronise and blend with each other so as to impress the audience with the mood represented by the music being played. No additional work is entailed for the organist, as the elaborate electrical mechanism is so arranged that at the pressure of a tab or button the control blends the colours to provide results in accordance with the type of music

represented by that tab. The organist at the Capitol Theatre is therefore the sole master of the mood of the lighting, and he is able to make it obey his wishes and express in terms of colour the moods of Chopin, Liszt, Gershwin and Lehar!

Up-to-date cinemas are equipped with special ventilating machinery that extracts the stale air from the auditorium and replaces it with cool fresh air at the rate of hundreds of thousands of cubic feet per hour. The ventilation is carried out by motor-driven fans installed usually in the basement of the building, from where ducts connect with decorative grills provided in the auditorium walls, the openings being placed at such a height that the air flows over the heads of the audience, thus avoiding unpleasant draughts. In some cases the air passes through a water screen and over heating batteries as it enters the building.



An under-stage view of Furse Organ and Orchestra Lifts installed at a large cinema in the north of England.

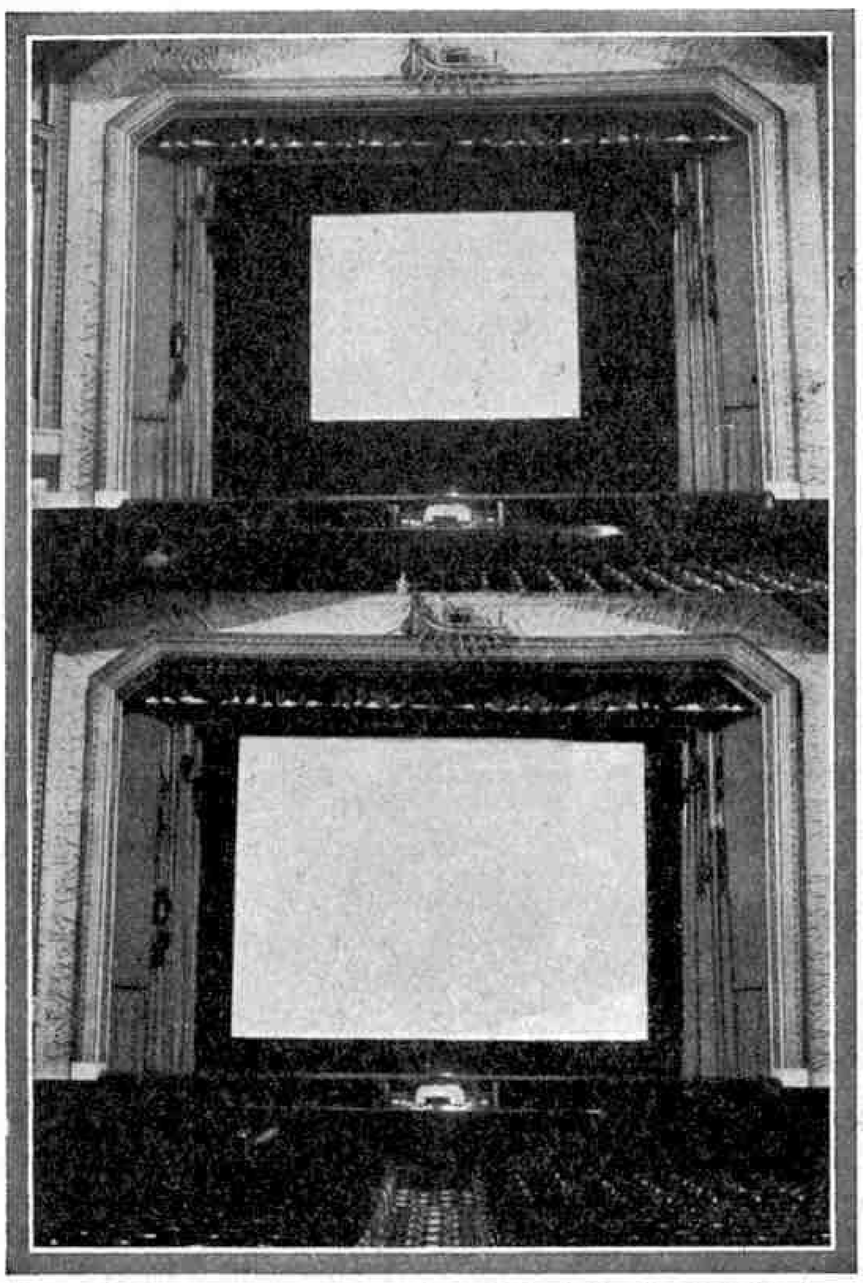
Nowadays a great feature of a cinema entertainment is the musical interlude. The speciality solo performance of the "star" organist, and musical items by a full orchestra, can be made attractive items of the programme, and to do this to the best advantage it is usual to bring the organ console or orchestra up into the sight-line of the audience. In some cinemas this is accomplished by means of "Furse" multi-threaded screw jack console lifts, which are in effect electrically moved platforms that silently raise the organ console and orchestra, complete with performers, to the stage level, enabling flood or spot lights to be effectively thrown upon them. At the conclusion of the musical items the lights are taken off and the platform sinks as silently as it was raised, simultaneously with the opening of the screen curtains.

When at rest at the bottom of its travel the lift and its occupants are in the orchestra pit out of sight of the audience, and when an orchestral item or solo is to be played the organist or conductor simply presses the "up" button and the lift starts and moves until it reaches the top of its travel, where it stops automatically. In this position the artists are in full view of the audience while they play their interlude. The reverse action takes place on the downward journey. If the conductor or organist wishes to stop the lift at any point during its upward or downward journey he can easily do so simply by pressing a stop button, after which he can go either upward or downward at will. Sometimes, when both organ console and orchestra platform lifts are installed, there is a master control on the orchestra platform or vice versa for the other lift. The speed of the lift ranges from 10 ft. to 12 ft. a minute according to the class of lift and the length of travel.

The platform, which is built up of iron framework having an oak floor, is constructed on the cantilever principle and fitted with rollers that run along plain steel guides. The lifting gear itself is self-lubricated, being enclosed in an oil bath, and consequently requiring little attention.

Sometimes the organ console lift is fitted with special lighting reflectors built in round the console platform, which illuminate the console in any colour and can be operated from any position by means of dimmers.

Cinemas, to remain successful, must give patrons the immediate and full benefit of every improvement and advancement in both films and equipment introduced for their better running. Nowadays the giant picture has become popular, and this has brought with it what is known as the Furse Magnascope screen, combined with a variable focus lens on the cinema projector. The former consists of the usual screen frame built up of steel tube adequately braced. Mounted on it are movable black maskings, one at each side, one at the top and one at the bottom. The maskings are adjusted to give a normal small screen of, say, 20 ft. by 15 ft., on which the picture is projected. At appropriate parts of the film, such as very wide scenes, a button is pressed in the operating box. The maskings then automatically glide outward until they arrive at such a position that a screen of, say, 36 ft. by 27 ft. is reached when they automatically stop. Simultaneously with this operation the focal length of the variable lens on the projector is altered, so that the picture size is increased to the new screen size without loss of focus. The effect is really remarkable, as the picture appears to be brought right up to the audience. The maskings are driven by an electric motor through special silent gears.

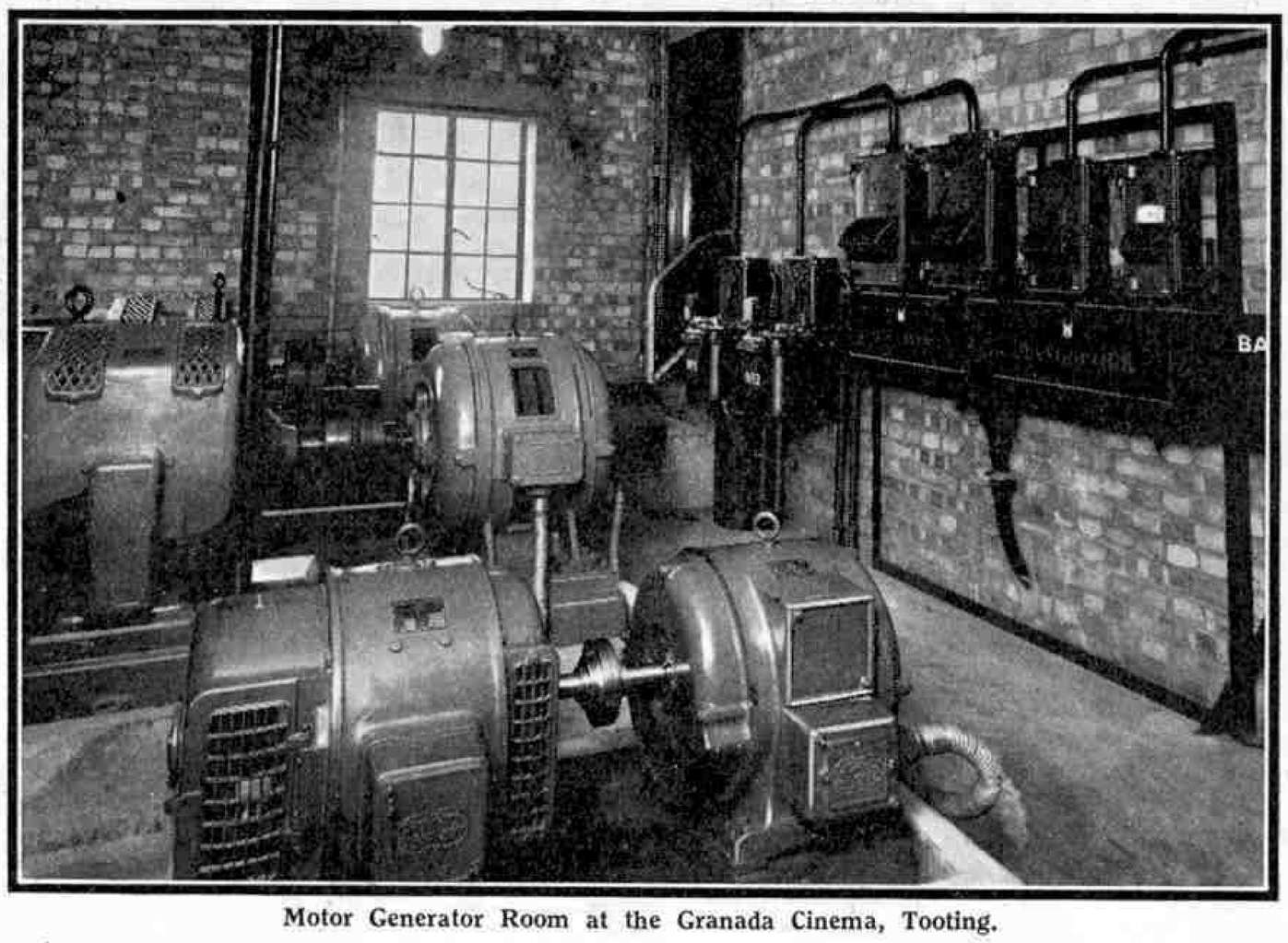


Furse Magnascope screen gear installed at the Capitol Theatre, Didsbury, showing the settings of the masking to give either normal or giant screens.

A further extension of this idea is the Dual Control Furse Magnascope, which has two separate motors, gears and controls, one driving the top and bottom masking and the other the two side maskings. Both motors can be operated simultaneously by means of a master control to give the giant screen effect, but in addition a horizontal strip picture of, say, 36 ft. by 15 ft. and a vertical strip picture of 20 ft. by 27 ft. can be obtained. With this arrangement an adjustable gate on the film projector is necessary.

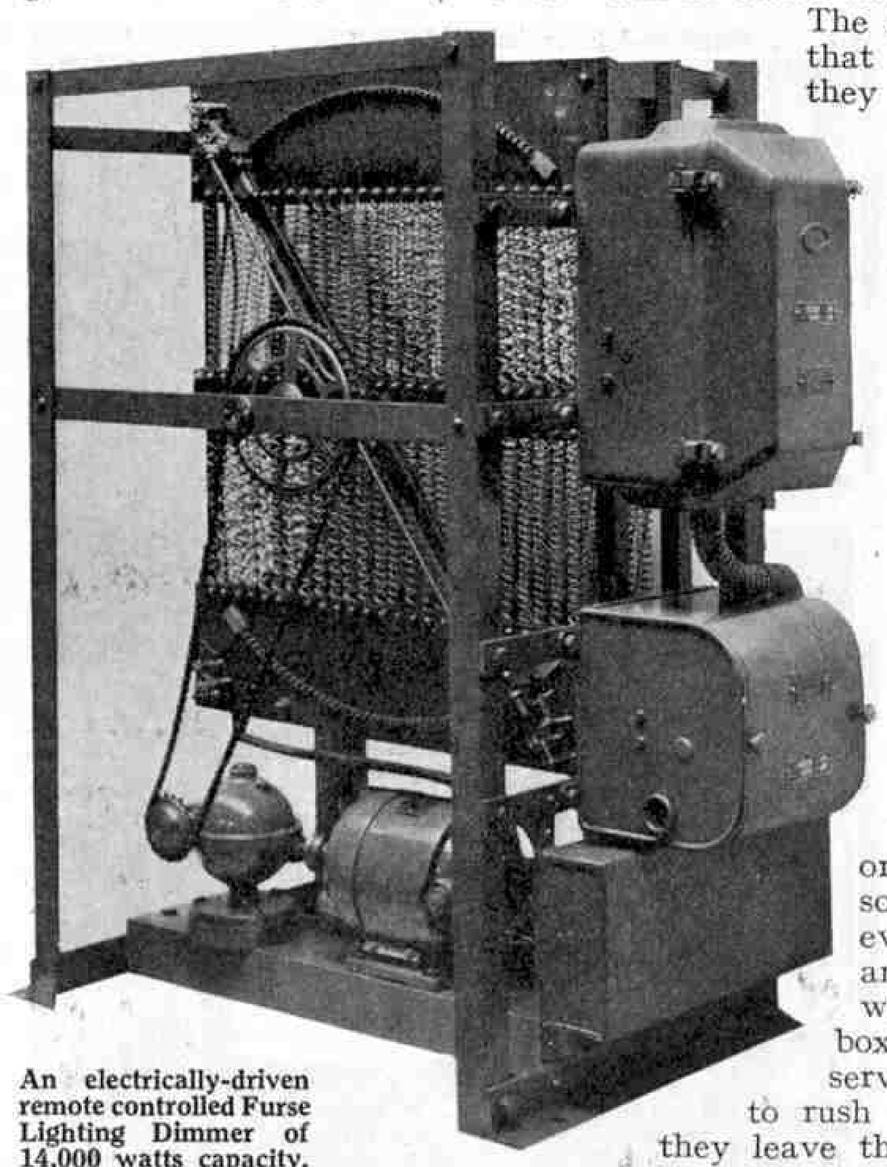
The interior decorations of modern cinemas cost a great deal of money, and in some cases, especially in America, are extremely elaborate. The R.K.O. Roxy Theatre, New York, for instance, has the world's largest chandelier. It is 25 ft. in diameter, and is fitted with electric lamps having a total of 104,000 watts. This beautiful building has a seating capacity of 3,700, but even this big figure is a long way behind the capacity of the Radio City Music Hall, New York, the largest theatre in the world. This giant cinema has a seating capacity of 6,200, and a huge stage that measures 110 ft. by 60 ft. In the centre of this stage is an elevator platform 45 ft. wide and 70 ft. long, divided into three sections that can be raised independently, or all together, so as to form a terraced

stage. When the three sections are at the same level a circular centre portion about 50 ft. in diameter can be made to revolve. The elevating mechanism for the stage itself and also for a separate great orchestra platform are hydraulically driven, the plunger being sunk 54 ft. into solid rock. By this time the reader will have realised that this theatre specialises in having the world's largest things, so that it will not come as a surprise to learn that the screen, the biggest ever erected, has an area of 2,800 sq. ft., and is adjustable by means of an electric motor to any smaller size. On the roof of the theatre is a beautiful garden in which there is real soil and trees 30 ft. in height. The ground area of the theatre is 200 ft. by 284 ft., and the height of the auditorium is 121 ft.



Motor Generator Room at the Granada Cinema, Tooting.

There are many fine cinemas in England, and although they cannot compare in size with the Radio City Music Hall, they are equally magnificent as regards their decorations and projecting equipment. English cinemas as a rule are the last word in comfort, and are decorated with striking furnishings and lovely colour schemes. A splendid example of a modern English cinema theatre is the Capitol, Didsbury, to which reference has already been made. This theatre has one of the largest cinema stages in the country, with a depth of nearly 40 ft., and a centre revolving stage with a diameter of approximately 24 ft. In addition to the stage a unique feature is provided in the form of a floating bridge 24 ft. long by 6 ft. wide, which can be raised or lowered from the flys. This bridge carries one of the three complete orchestras, and is provided with raising and lowering mechanism that enables the bridge and orchestra to be suspended in mid air. By a combination of this bridge and the revolving stage some excellent scenic effects can be obtained. The acting area of the stage is illuminated by Holophane super projectors mounted above the ceiling of the auditorium, the light being thrown through specially concealed openings on to the stage. These projectors have colour screens operated by electrical mechanism, so that light of any desired colour can be obtained by operation of switches on the stage switchboard. The stage is equipped with dimmer light control gear, and has a proscenium opening of 42 ft.



An electrically-driven remote controlled Furse Lighting Dimmer of 14,000 watts capacity.

The following description of a cinema that has recently been built in the south of England will give some idea of the amazingly lovely effects that can be obtained in the auditorium. The vast hall is luxuriously carpeted in pale blue. On entering, row upon row of silver and bronze seats meet the eye, and in the half light of the theatre the general decorative scheme resembles an Aladdin's Cave, an effect obtained by the inclusion in the wall decorations of thousands of coloured pebbles and mother-of-pearl. Enormous butterflies hover over flowers the petals of which are made of mother-of-pearl.

No account of the modern cinema theatre would be complete without mention of that very important person, the chief operator, and his assistants. Some readers may think that a cinema operator has an easy time. This is a mistaken idea, however, for most of them start work at 10 a.m. and do not finish until 10-30 or 11 p.m. They begin their daily work by careful tests for any defects in the projectors and sound mechanism. Then the machines have to be thoroughly cleaned and every moving part of the intricate mechanism well oiled.

At the beginning of the week, or whenever there is a change of programme, the new films as they are received from the previous exhibitor or film distributor have to be carefully examined and any damaged parts mended, great care being taken during the process not to dislodge the sound portions of the film. Perhaps a film may have been exhibited during the previous week on old machines, in which case it is likely that a great deal of mending will be required. An inefficient operator can easily ruin a good film by careless handling, and unless such damage is discovered before the film is again run through a projector, annoying interruptions may be caused by film breakages. The chief operator at a big cinema is usually a qualified electrician, and in addition to having complete charge of the projecting machinery, it is his duty to arrange and attend to the auditorium and stage colour lighting schemes.

At an appointed time daily the machines are "threaded up" with the film ready for the performance. A complete film is in several parts or "reels." Part 1 is put on one of the projectors and Part 2 on the other. While Part 2 is being shown, Part 3 will be threaded on the machine that projected Part 1, so that a continuous "change-over" can be made until the complete film has been projected. The change-overs are carried out so expertly that the audience is unaware that the film they are watching is in several parts and is being shown on separate machines alternately. To facilitate a change-over, some operators arrange a mark on the side of the film close to the end of the part. As soon as the operator observes this mark passing over the upper sprocket of the projector he releases the shutter of his machine, and simultaneously his assistant starts the motor and pulls open the shutter of the other machine.

Before the show actually commences the arc lamp carbons are burned in, so that a good steady arc is available for the start of the performance. New carbons take some little time to burn in before they yield the intense white light necessary for perfect picture projection.

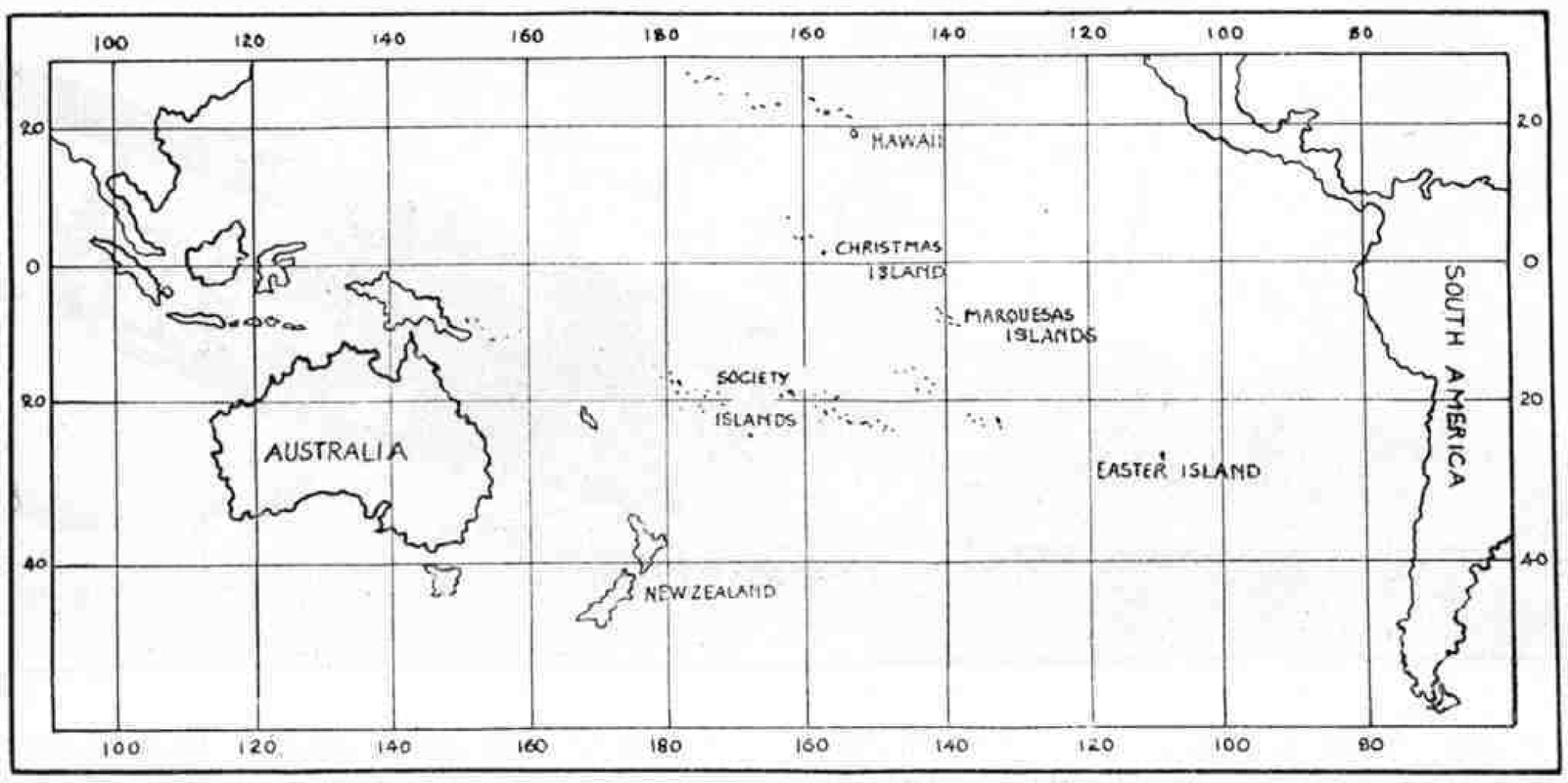
At the end of the week the films have to be returned to the film booking agency, or despatched to another exhibitor. As soon as the show is finished on a Saturday evening the films are taken off the reels and placed in round metal containers, which are then enclosed in steel travelling boxes. Owing to the curtailed railway services on Sundays it is usually necessary to rush the films off to the station as soon as they leave the projectors after the final showing, in order to catch a train that will enable the next exhibitor to have them in good time for the usual Monday inspection.

In this article and the one that appeared last month we have endeavoured to give some idea of the equipment and operation of a modern cinema theatre. Readers will have realised that the present-day operator must be a skilled electrician, for electricity plays an important part in almost every operation connected with cinema work, and an operator must be capable of tackling promptly any emergency, such as the breakdown of the projecting apparatus. There is no well-defined method of entering upon the career of an operator. The most usual plan is to obtain preliminary experience by serving for a period as an assistant at a suburban cinema.

Unsolved Mysteries of Easter Island

Statue Relics of a Forgotten Race

IN the heart of the South Pacific Ocean, some 2,000 miles from the coast of Chile, there is a small, desolate island of volcanic formation that is the scene of some remarkable prehistoric remains, the origin of which is a mystery. The island is almost triangular in shape, about 11 miles long and about four miles wide at the "base," and its three corners are marked by volcanic peaks. Apparently at one time in the distant past the island was wooded, but to-day it is devoid of tree or bush. It lies in a region where the southern trade wind is most violent, and the absence of any natural shelter adds to its inhospitality.



This map of the South Pacific Ocean shows the remoteness of Easter Island, which lies about 2,000 miles off the coast of South America.

When the island was discovered by the Dutch Admiral Roggeveen on Easter Day, 1722, it was inhabited by people of Polynesian race. According to tradition their antecedents had emigrated there a thousand years or so earlier from Rapa Iti, or Little Rapa, one of the Austral group of islands in the eastern part of the South Pacific Ocean. In memory of their native land they named their new home Rapa-Nui, or Great Rapa. This traditional origin of the natives on Easter Island is supported by the fact that they speak the same language as their distant brethren, and possess the same fine stature and other physical characteristics, such as the rather long oval face and the large eyes set close together. After its discovery by the Admiral the island became known to the civilised world as Easter Island, taking this name from the day on which it was discovered.

About 1850 the island was attacked by a party of colonists from Peru. The island king and his subjects hid themselves in the huge crater of Rano-Kaou that overlooks a bay of the island, and is so large that an army could carry out manœuvres in it. This spacious hiding place did not save them, however, and though they bravely defended themselves with lances and stones, the guns of the Peruvians were more deadly. Hundreds of the natives were killed, and the remainder were captured and taken as slaves to Peru, where many of them died in captivity. After a few years in this foreign land the survivors were released and sent back to their lonely island, but smallpox broke out among them and more than half perished from this disease. Since that time the population has continued to decrease. In 1800 the island was taken over by Chile, and it is still governed by that country.

Although the island apparently has been inhabited by the Polynesian natives for 1,000 years or more, it contains remarkable relics of a much older civilisation, of which the natives know nothing. In one part of the island there are remains of stone houses nearly 100 ft. long and about 20 ft. wide, built of large flat stones fitted together without cement. Similar slabs are used for the roofs, the slabs being laid in overlapping courses until there remains an opening only a few feet wide, which is closed by slabs long enough to span the aperture. The walls of the houses are over 5 ft. high and about 5 ft. thick, and are lined on the inside with vertical slabs bearing paintings of geometrical figures and representations of mythical beasts. Many of the lava rocks in the neighbourhood of the houses are carved into crude resemblances of human faces and animals, and are regarded as a form of picture writing. Wooden tablets inscribed with mysterious signs and figures have also been discovered there.

An even greater mystery is presented by the stone platforms situated upon the headlands of the island and on the slope towards the sea. These remarkable works are constructed of large cut stones fitted together without cement, and their immense size may be gathered from the fact that in some cases the platform walls on the seaward side are from 200 ft. to 300 ft. long, nearly 30 ft. high, and about 30 ft. wide, some of the stones being 6 ft. in length.

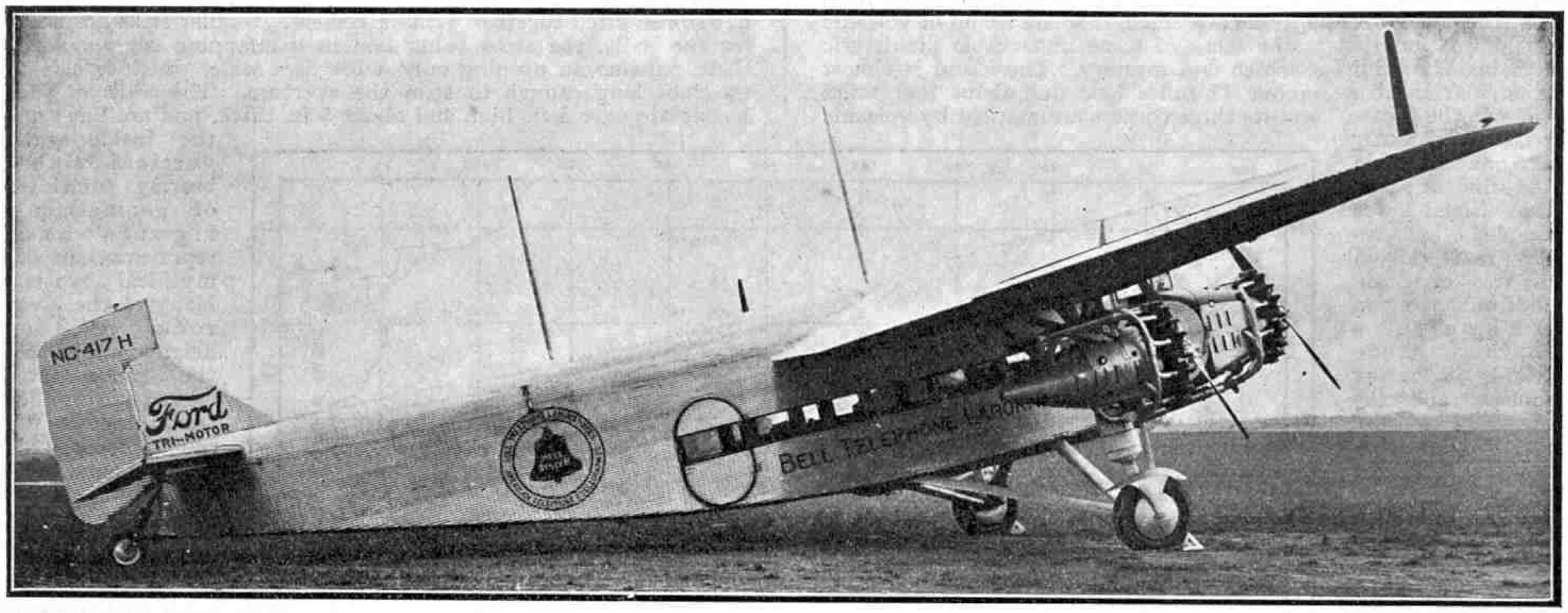
Some of the remarkable prehistoric statues on Easter Island. Reproduced from the Editor's "Book of Natural Wonders" by permission of the publishers, G. G. Harrap and Co. Ltd.

The landward side of the platforms consists of a broad terrace on which at intervals are large stone pedestals that at one time supported giant stone images. On some of the platforms 10 or more of these statues, fallen from their pedestals, now lie in all directions. The statues are carved from the grey lava that is present at the eastern end of the island, and they range in height from 5 ft. to 37 ft., many of them terminating at the hips. The images were originally surmounted by round crowns made of a reddish tuff obtained at a crater about eight miles away from the quarry where the statues were made. Some of these crowns were over 10 ft. in diameter, and the tops of the heads of the images were cut flat to receive them. Several unused crowns still lie in the crater where they were constructed.

The purpose for which so many of these statues were erected upon this small and remote island, the period of history during which they were built, and the identity of their creators, are questions that still remain unanswered. One possible explanation is that in ancient times, when Polynesia was at the height of its glory and its people possessed war canoes capable of weathering the storms of the open sea, the island was a sacred place to which the Polynesians came from great distances to hold religious ceremonies; and that the platforms, with their complements of giant statues, were open-air temples.

Interesting American Aeroplanes

Well Known Civil and Military Types



THIS month we are dealing with four interesting aeroplanes constructed in the United States. They are not the most modern types produced, but are all representative. They are the Boeing P-12, the Douglas 0-25, the Ford "tri-motor" and the Stinson "Detroiter," the first two being military machines, while the others were designed essentially for civil use.

The Boeing P-12 is a single-seat pursuit machine, or as it would be called in the R.A.F., a single-seater fighter, which has for many years been one of the standard types employed in the United States Army Air Corps. The latest version of the P-12 class is the P-12E, which is a single-bay biplane. The wings have a very pronounced forward stagger and are unequal both in span and chord. An interesting feature of the wings is that both upper and lower ones are in one piece, each being constructed around two built-up box spars of wood. They are covered with duralumin sheet. The fuselage is in two sections, the forward part being made of special steel tubing carrying a metal cowling for the engine, while the rear section is of semi-monocoque duralumin construction.

The upper photograph shows the Ford triple-engined cantilever monoplane. The lower illustration shows a Douglas 0-25 observation machine, reproduced by courtesy of the United States Army Air Corps.

The machine is fitted with a 500 h.p. Pratt and Whitney "Wasp" engine that develops 500 h.p., and gives it a speed at sea level of 171 m.p.h., and at 6,000 ft. of 189 m.p.h. This compares well with the Bristol "Bulldog," which is capable of a speed of 170 m.p.h. at an altitude of 10,000 ft. The Boeing machine lands at 60 m.p.h., and is 30 ft. in span and 20 ft. 8 in. in overall length.

The Boeing Airplane Company make both military and civil machines, although the majority of the aeroplanes they produce are for the U.S. Army Air Corps. In 1931 they built 174 military aeroplanes and 13 commercial machines. An important civil contract that they secured in 1932 was for a fleet of new type high-speed, twin-engined, low wing mail and passenger monoplanes, intended for service on the extensive airway network of United Air Lines. These machines carry 10 passengers, two pilots and 400 lb. of mail, and have a maximum speed of 172 m.p.h. and a cruising speed of 153 m.p.h. They are entirely of metal construction, and are provided with retractable landing gear.

The Douglas 0-25, produced in 1930, is also a military machine, but it differs from the Boeing in being a two-seater designed for observation work. It is an

unequal-span single-bay staggered biplane, the wings of which are made of wood and are covered with fabric. The fuselage is a welded steel-tube structure covered with fabric aft of the fireproof bulkhead that separates the engine from the front cockpit. Forward of this bulkhead is an easily removable metal cowling. The machine is equipped with a 600 h.p. Curtiss "Conqueror" 12-cylinder "V"-type water-cooled engine that gives it a maximum speed of 156.6 m.p.h., a cruising speed of 125 m.p.h., and a landing speed of 62 m.p.h. The machine is 40 ft. in span and 30 ft. 4 in. in length. It approximates closely to the Westland "Wapiti" Army co-operation machine which, when fitted with a Hispano-Suiza 12 H.B. engine developing between 540 and 595 h.p., has a speed at ground level of 150 m.p.h.

The Stinson "Detroiter," the first American cabin machine to be provided with an engine starter and wheel brakes. The model illustrated is equipped with a Packard Diesel engine.

The Douglas Aircraft Company, Inc., are devoted almost entirely to the production of military aeroplanes, although an interesting civil amphibian was produced in 1930 and has proved very popular in service. Two important recent products of the firm are a two-seater observation monoplane and a twin-engined monoplane bomber, both of which have wings shaped like those of a gull. A very interesting feature of these monoplanes is that they are both equipped with a special version of the Curtiss "Conqueror" engine that develops 600 h.p. and is cooled with Prestone, a liquid that has a much higher boiling point than water, and thus enables the amount of cooling fluid employed in the engine to be considerably reduced.

The Boeing P-12B, one of the versions of the P-12 single-seat pursuit machine. Photograph by courtesy of the U.S. Army Air Corps.

The first of the two civil machines with which we are dealing in this article is the Ford "tri-motor," or as it would be termed in this country, the Ford triple-engined monoplane. This machine is a high wing cantilever monoplane constructed wholly of metal, and it is interesting to note that in 1930 it set up an official speed record for large commercial aeroplanes by maintaining a speed of 164.4 m.p.h. over a 62½-mile course.

The machine is available in several versions, one having accommodation for 11 passengers, and another and a larger type having seats in the cabin for 14 passengers. The aeroplane is undoubtedly one of the most popular of the larger commercial machines operated over air lines in North, Central and South America. It has been designed solely for commercial purposes, and has a maximum speed of 150 m.p.h., a cruising speed of 120 m.p.h., and a landing speed of 64 m.p.h. The normal cruising range is 560 miles. The aeroplane is powered by three Pratt and Whitney "Wasp" engines, giving a total of 1,260 h.p., but certain other types of engine may be substituted as desired.

In a similar manner to the Armstrong Whitworth "Argosy" machines used by Imperial Airways, the Ford machine is capable of flying with a sufficiently large factor of safety when any one of the engines is shut off. Interesting features of the machine are the substitution of a tail wheel for the tail skid, as is now done in so many American machines, and the provision of independently operated hydraulic brakes on all three wheels. The brakes enable the machine to be manœuvred easily when on the ground without any necessity for a handling crew. This greatly decreases the cost of upkeep and consequently adds to the utility of the machine.

The Ford tri-motor is made by what is known as the Airplane Division of the Ford Motor Company, the factory being the works of the Stout Metal Airplane Company, purchased in August 1925. The works have been considerably enlarged, and during 1929 were capable of producing four complete (Continued on page 135)

Parachutes for Passengers

It is a comparatively simple matter for an aeroplane pilot wearing a parachute to jump from his machine in time of danger and land safely. The same applies also to a passenger in a small open cockpit machine. In large cabin machines it is a different matter, however, for while several trained men can jump from a cabin very quickly, ordinary passengers are apt to be alarmed at the thought of leaping into space, and it is possible for one man to waste so much time in making up his mind to jump that no time remains for the remaining passengers to get clear.

Various methods have been tried to overcome this difficulty, among them being that of using a huge parachute to bring down the machine safely. Successful attempts to land an aeroplane in this manner have been made, but the cost of the necessary apparatus, and also the uncertainty of the method in rough weather, makes it unlikely ever to be universally adopted. It has also been suggested that each passenger should be provided with a parachute, and that in an emergency the pilot should release a catch that would allow the whole of the hinged floor of the cabin to fall away, thus precipitating the occupants into the air. Each passenger would then pull the rip-cord to bring his parachute into action. If this were done, however, it is probable that accidents would occur through passengers colliding with each other before or after the parachutes opened.

The best scheme yet evolved is probably the one mentioned in a brief note on page 24 of last month's issue, dealing with experiments with automatic parachutes carried out in the United States. These parachutes are fitted to special collapsible metal seats, and are put on by means of a few simple straps when the passenger takes his seat in the cabin, or when ordered to do so by the second pilot sent into the cabin by the first pilot of the machine. If the aeroplane got into difficulties the pilot would warn the passengers, and then would pull a lever that would cause two passengers and their metal seats to be projected from the machine. Their parachutes would then automatically come into action. There would be little difficulty in arranging mechanism to fling out all the passengers, two by two, in a multi-passenger machine. During tests that have been made an apparatus of this kind has operated perfectly.

Barnard's Circus in India

During 1933 Captain C. D. Barnard, the famous airman, visited many towns and villages in this country with his aerial "circus." Readers who attended these displays will be interested to learn that Captain Barnard is now giving similar shows in India. His plans are for a tour to last for at least six months, during which time between 60 and 70 different centres will be visited by the eight aeroplanes that make up the circus. Captain Barnard flew to India in his famous Fokker monoplane, the "*Spider*."

The Hawker "Fury," the standard single-seater interceptor fighter used in the R.A.F. Photograph by courtesy of the Hawker Engineering Co. Ltd.

Investigating the Stratosphere

The ascent in a balloon into the stratosphere by Lieutenant Commander T. G. W. Settle, an American aviator, accompanied by Major C. L. Fordeny, does not appear to have produced any noteworthy results. The aviators reached an altitude of more than 58,000 ft., which is higher than that attained by Professor Piccard, but does not reach the record set up by a Russian airman, who recently rose to over 60,000 ft.

French High-Speed Flights

A new French machine, the Dewoitine D.332, recently flew from Paris to Algiers non-stop in only six hours, and the next day it made the return flight in 5 hours 20 minutes. Speeds of 150 and 170 m.p.h. respectively are represented by these times. The machine in which the flights were carried out is equipped with three Hispano-Suiza 9V radial engines each developing 575 h.p. It carried 12 people, consisting of two pilots, a wireless operator, a mechanic and eight passengers.

New Record Claimed for Delayed Drop Parachute Jump

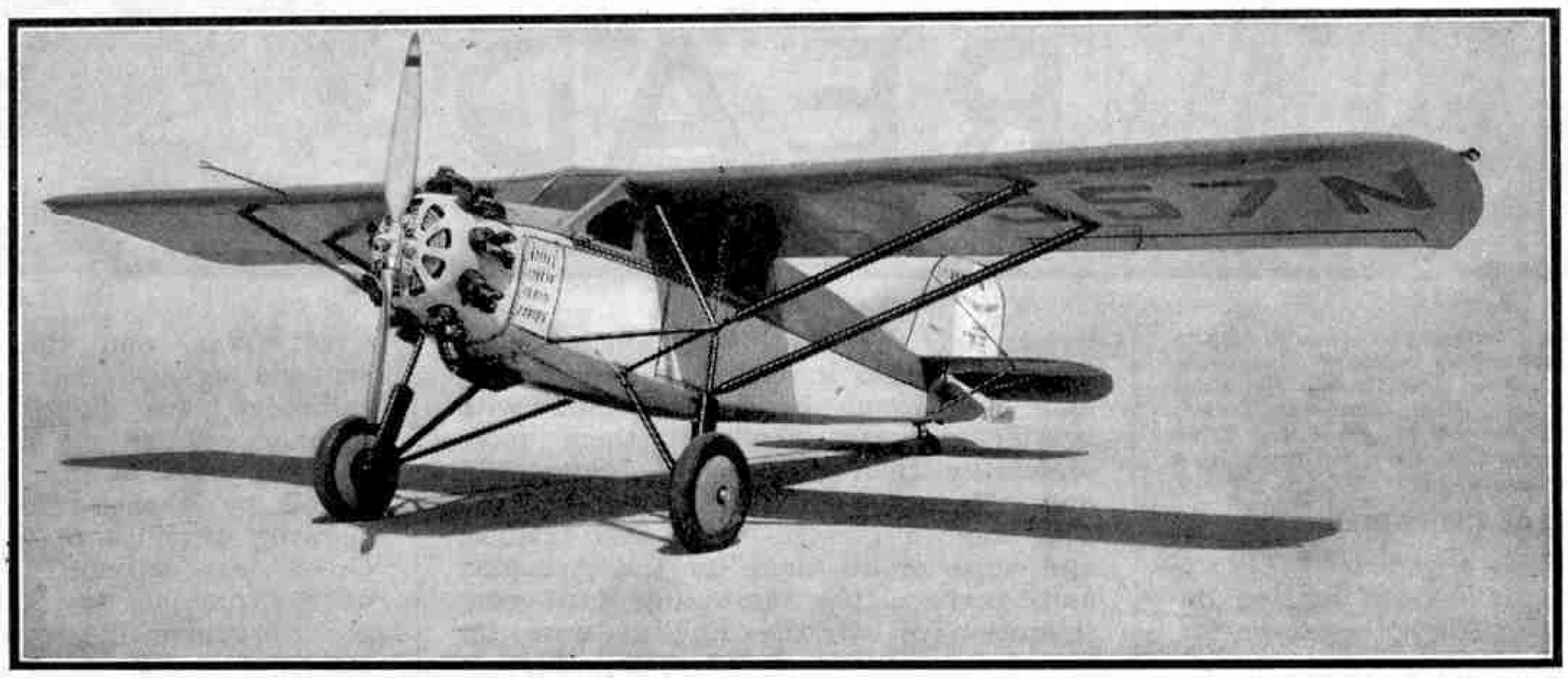
It is claimed that a new record for the delayed drop parachute jump has been set up by a Russian airman named Evseyev, who jumped from an aeroplane flying at an altitude of 23,400 ft. According to reports that have reached this country the airman did not pull the rip cord to open his parachute until he was within 500 ft. of the ground, making a drop of 22,900 ft. The previous record was set up by the British parachutist Mr. John Tranun, who allowed himself to fall for 17,250 ft. before opening his parachute.

A New de Havilland Monoplane

We are now able to publish details of the D.H. "Leopard Moth," the new high wing monoplane produced by the de Havilland Aircraft Co. Ltd. Three experimental machines of this type were flown in the 1933 race for the King's Cup and one of them, piloted by the designer, Captain Geoffrey de Havilland, crossed the winning line first. As previously mentioned in these pages, six of these machines were produced, with the idea of flying them in all kinds of weathers to find any possible bad points that could be put right in the production model, which is intended to replace the "Puss Moth." These aeoplanes have been flown severely since July last, but few modifications have had to be made in the production model.

The new machine resembles the "Puss Moth" in external appearance, although its structural features and the layout of the seating accommodation are different. The "Puss Moth" was intended as a 2-seater, although a second passenger could be

carried on occasions, while the "Leopard Moth" is definitely a 3-seater, the pilot sitting in the front of the cabin and his two passengers side by side behind him. Externally the difference between the two types is that the wings of the new machine taper, and the undercarriage struts run to points on the side of the cabin, and not straight up to the wings. The main structural difference is that the "Puss Moth" was provided with a fuselage of welded steel construction, while the "Leopard Moth" has an all-wood fuselage. This rather revolutionary reversion has been arrived at largely as a result of experience gained on the "Fox Moth." A wooden machine is lighter than one made of metal, and is of course cheaper. Other points in favour of this type of construction were given on page 958 of our issue for December, 1933, in the article on the D.H. "Dragon."



A three-quarter front view of an interesting American high wing monoplane, made by the Ryan Company. The machine illustrated is equipped with a Packard Diesel engine.

The "Leopard Moth" is 24 ft. 6 in. in overall length, and 37 ft. 6 in. in span; but when the wings are folded back the span is only 12 ft. 6 in. The machine has a maximum speed at sea level of 141.5 m.p.h. and is capable of cruising at 120 m.p.h. at an altitude of 1,000 ft. At cruising speed it has a petrol consumption of 5.9 gallons per hour, which is equivalent to 20.4 m.p.g. In still air it has a maximum range of 715 miles.

Air Passengers' Impressions

Every day the aeroplanes of Imperial Airways fly more than 6,000 miles, and during a recent period of six months they carried more than 30,000 passengers Many travellers by air record their impressions, and it is interesting to read some of the accounts that are published in the "*Imperial Airways Gazette.*" One that should reassure those who still consider travel by air a dangerous and alarming undertaking describes the passengers in a machine flying to the Continent: "Some read the morning papers. Others are immersed in the latest novel or an illustrated magazine. One or two are sleeping. Others gaze below fascinated by the passing of the fleeting landscape."

"England," writes another voyager, "stretches like a jig-saw puzzle. The hills of Kent are like the waves of an ocean. Roads, streams, fields, weave themselves into a pattern. The Channel is a sheet of quick-silver—the sky an azure canopy. Now we are over France, its sands glistening like gold. Casinos, hotels, golf courses catch the eye. Past the historic forest of Crecy we fly, and then on mile after mile over the broad, flat breast of France. Cars small as beetles crawl along the straight road. Then red-roofed suburbs of Paris come out to meet us. The Eiffel Tower points its finger at us. We glide down to Le Bourget."

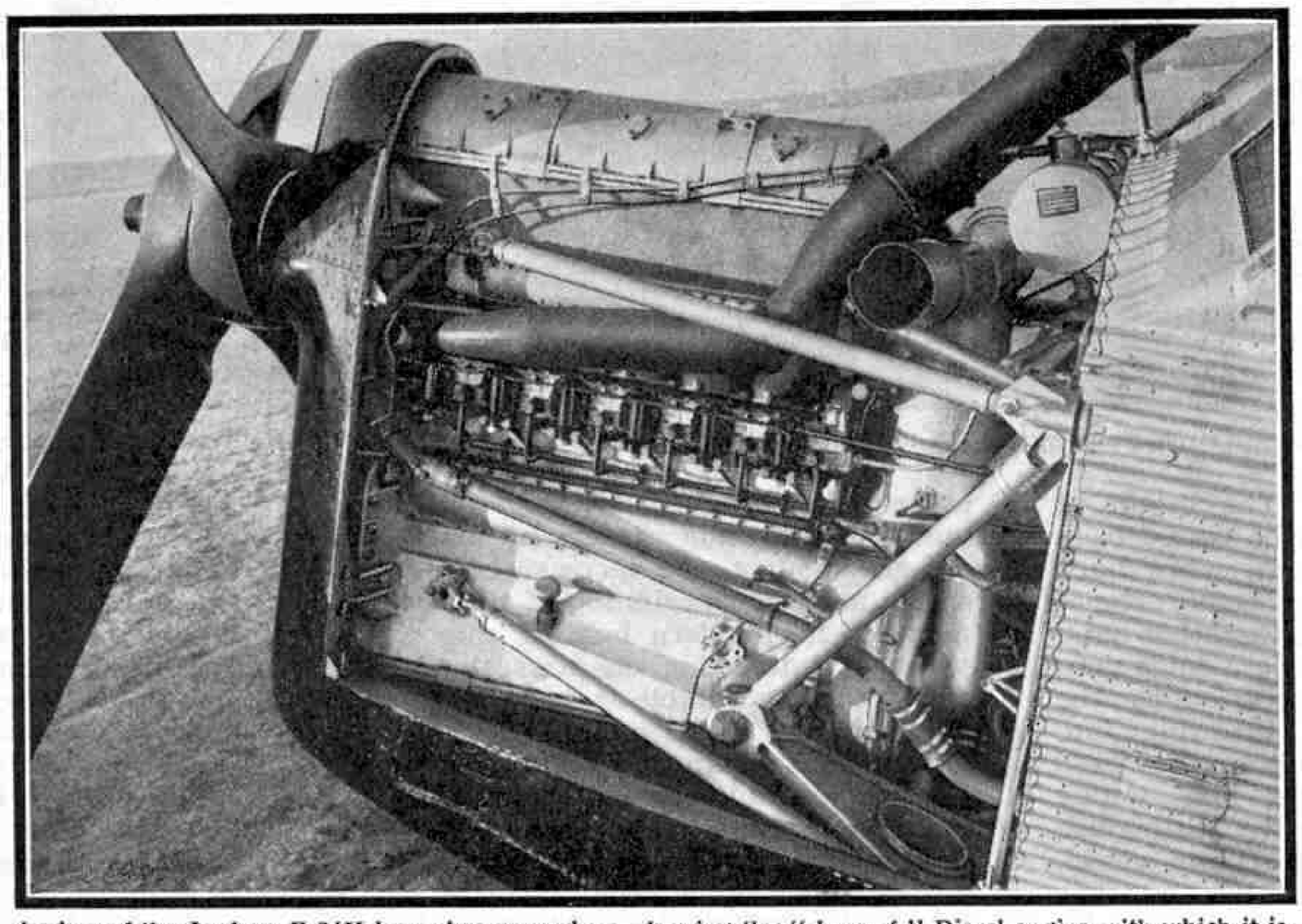
Passengers by the Empire routes find impressions crowding thick and fast upon their minds, for while they are on the ground, as well as when they are up in the air, they see picturesque sights. Watching wild life from the air forms one of the fascinations of a flight across Africa. Here are extracts from passengers' impressions: "The sun is up. The desert is behind. Already game is appearing. The passengers become excited. Just beneath, the veld seems alive. Herds of buck scamper in all directions. One spies ostriches, foxes, hyaena, and innumerable small animals. Swarms of bustards are disturbed by the noise of the machine. Scarcely a minute passes without game appearing on one side or the other.

"'Rhinos!' shouts a voice suddenly. I look down. There are three of the monsters charging through the bush. At the same moment three others appear on the other side of our machine, while herds of giraffes are everywhere.

"Occasionally you are lucky, and in addition to elephants and other big-game, you glimpse lions. One pilot told me of a magnificent view he had of as many as twelve lions, young and old, standing about in the sunshine. The aeroplane was flying low, and the lions, as they watched it, could be seen to lift their heads and snarl angrily."

A night ascent from Cairo is described thus:—

"Stretching across the aerodromes are paraffin flares, but for the rest, the world is dark. We leave the ground as gracefully as a bird. Outside the windows, the ghostly wings and engines are partly illuminated by the moon, and partly by a bluish glow of fiery vapour from the exhausts. Twinkling lights appear now and then from towns and villages bordering the river. Ancient Egypt is asleep."



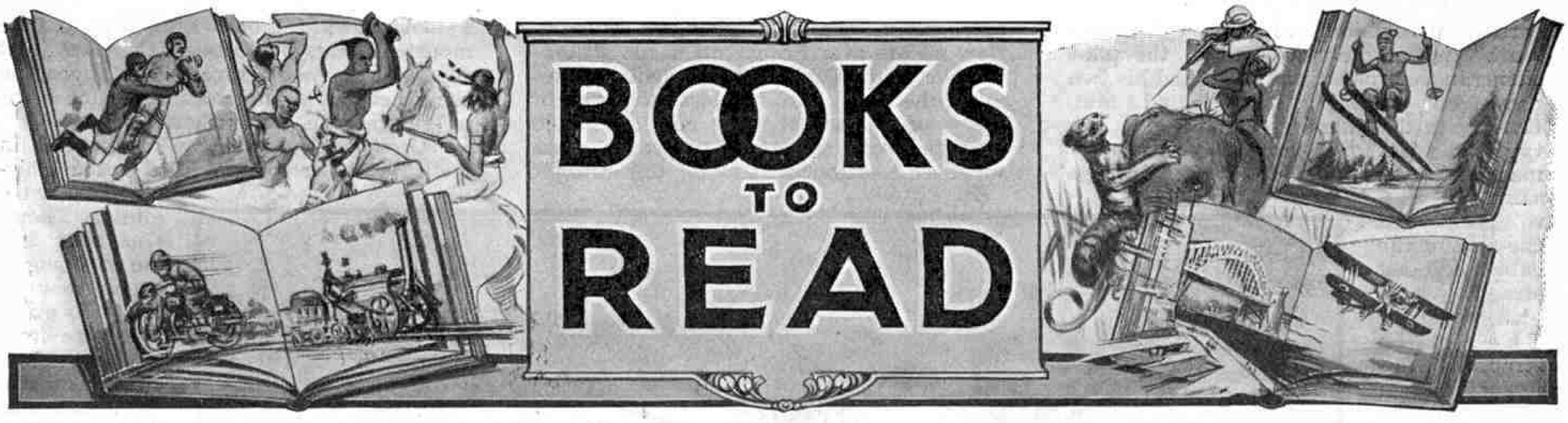
A view of the Junkers F.24K low wing monoplane, showing the "Jumo 4" Diesel engine with which it is equipped. This machine was described on page 66 of our last month's issue. Photograph by courtesy of Junkers Flugzeugwerke, A.G.

60 Vacancies in R.A.F. Reserve

The Air Ministry announce that approximately 60 vacancies exist for entry into the Royal Air Force Reserve during the next few months, for initial training in flying. The vacancies will be filled by direct entrants from civil life. Experience of flying is not necessary as a complete course of flying instruction is given at no cost to the candidate. Applicants, who would be entered into Class A.A. (ii) of the Reserve of Air Force Officers in the rank of Pilot Officer, must not have reached their 25th birthday and must be physically fit and of good education. The initial period of service in the Reserve is five years.

The instructional course consists of 50 hours' flying, which must be carried out in a maximum period of three months. With good weather, however, candidates should be able to complete the course in not more than two months. Within certain limits, flying instruction may be carried out at times convenient to candidates.

Full particulars are given in A.M. Pamphlet 14, which can be obtained on request from The Secretary, Air Ministry (S.7(c)), Adastral House, Kingsway, London, W.C.2.



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

"The Book of the Warship"

By Ellison Hawks. (Harrap. 7/6 net)

So many books have been written on the warship that there is little excuse for a new one unless it has some special feature. "*The Book of the Warship*," by the Editor of the "*M.M.*," fully justifies its existence by reason of the fact that it gives a well-balanced account of the whole history of war vessels, from the times of the Phœnicians to the present day. This gigantic story is told in a fascinating manner, and as we pass from chapter to chapter the fighting ship seems to develop before us.

The warships of the ancients—the Phœnicians, Greeks and Romans—are interesting for their own sake, but are still more so on account of the manner in which they anticipated many modern developments. In ancient times the main offensive naval weapon was the ram, and this persisted, with one break of nearly 300 years, up to the Great War, in which ramming tactics were resorted to on various occasions by destroyers. The origin of modern naval artillery can be traced back to Greek and Roman times, when huge catapults designed to hurl heavy stones were in extensive use. On the other hand one cannot think of any modern equivalent of a plan tried on one occasion by the great Hannibal—that of throwing into enemy galleys pots full of poisonous snakes!

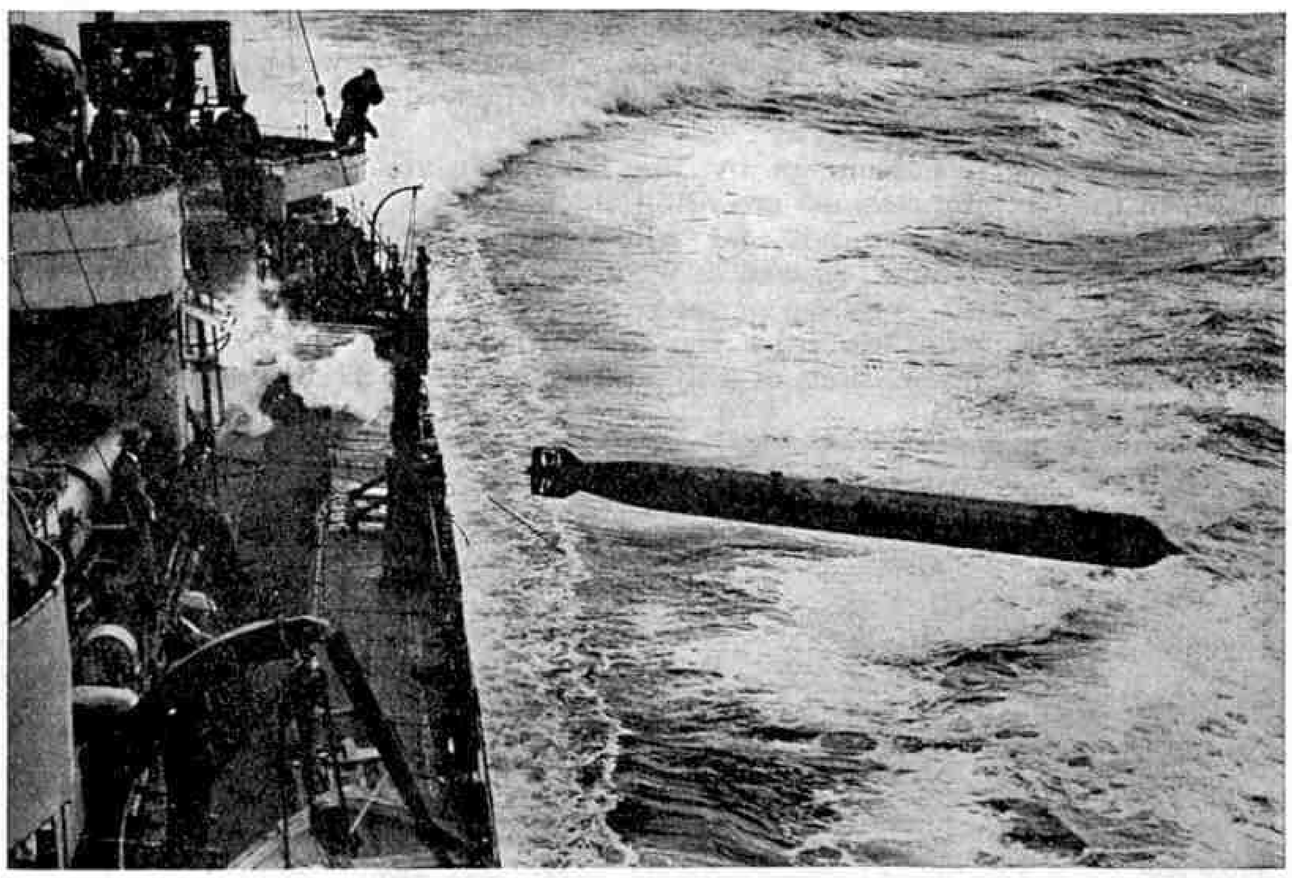
At the beginning of the long sailing ship era there was little to distinguish the warship from the merchant vessel, and the author shows us how, by slow degrees, ships specially designed for fighting purposes were developed, and ultimately became an entirely distinct type. In dealing with the Armada the author not only gives a graphic account of the fighting that took place, but also describes for us in detail the vessels that were engaged. He shows us, for instance, that the widespread impression that most of the Spanish ships were much larger than the English vessels is a mistake. The impression of greater size given by the Spanish ships was due to their great height and their towering forecastles and sterncastles. The English ships were longer on the keel, but much lower, the high castles having been abandoned; and this lower build, combined with greater draught, rendered them more seaworthy than those of the Spaniards, and also much handier to manœuvre. The English gunners were well trained, and superior to those of the Armada; and, perhaps the most important consideration of all, the English were far superior to the enemy in seamanship.

The appearance of the steam warship early in the 19th century, and the subsequent introduction of armour plate as a defence against the increasing power of shells, mark the beginning of the development of the modern fighting ship. In a series of interesting chapters the author traces the remarkable increase in the size and power of naval guns, and gives us a glimpse into the unending struggle between the makers of armour plate and the makers of guns and projectiles. Developments in these directions have been accompanied by a rapid increase in the speed of warships, brought about by the introduction of the steam turbine, the water-tube boiler, and oil fuel.

After tracing the development of the battleship the author proceeds to deal with cruisers, destroyers, aircraft-carriers and other vessels, and devotes a special chapter to the submarine. Then follows one of the most interesting chapters in the whole of the book, dealing with naval personnel, uniforms and flags. The details given in this chapter are of particular value in view of the many misconceptions that exist on these matters. Finally come chapters in which the sea battles of the Great War, and the long and bitter struggle against the German submarine campaign, are described in a thrilling manner.

"*The Book of the Warship*" is illustrated by twenty-three full-page plates, showing warships of all types, from the Greek war trireme to the battleships of the present day. In addition there are thirty-five illustrations in the text, many of which, such as those showing officers' rank badges and the sleeve badges of various other ranks, are of special interest. A coloured frontispiece illustrates the principal flags that are used at sea.

Rev. J. Henry Martin.



A striking photograph of a torpedo being fired from an above-water tube. (From "The Book of the Warship" reviewed on this page.)

"Horsemanship as it is To-day"

By Sarah Bowes-Lyon (Dent. 7/6)

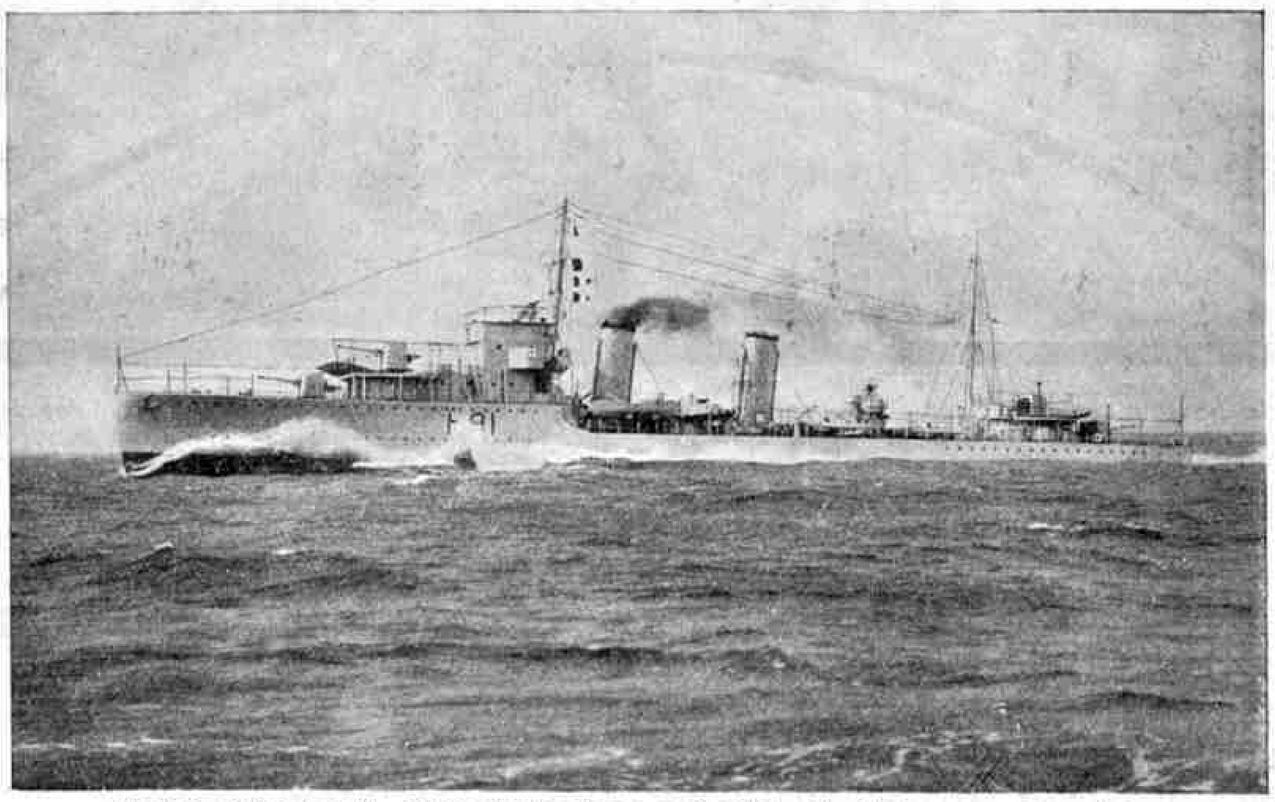
In this delightful book the youthful author (she is only twelve years of age) shows us that she has a knowledge of horses and horsemanship that it would be difficult to equal even among many adults. The book is arranged in two parts. Part I "For Beginners," consists of six chapters dealing with Riding Kit; the Points of a Horse; Saddling; Mounting; the Hands; the Seat; and the Paces. Part II, "For the More Experienced," covers Jumping; Showing; Show Jumping; Riding to Hounds; Stable Management; Kinds, and Colours. The book is produced on unusual lines, each page being a facsimile of the original manuscript. The illustrations—drawings and coloured plates—are also the work of the author, and they demonstrate that she possesses exceptional artistic talent.

Miss Bowes-Lyon's style is delightful. She is equally at home in the free but excellent draughtsmanship of horse and rider in her hunting scenes, as she is in the technical drawings illustrating such subjects as points of the horse, correct seat, and how to hold the reins.

Dealing with this latter subject we are told: "You have often heard about people with good hands, so you won't want them to say you have bad ones. Good hands are naturally gifted, but there is no need to say that one shouldn't have light hands, which with time and practice can grow into good hands. What I mean by light hands is, that you are not always 'pulling' and 'nagging' at your pony's mouth, but can manage him without always 'holding on.'"

The thrill of one's first jump has to be experienced to be realised. "Jumping, the word alone gives a thrill to any child who has ever tasted that grand feeling! Even one who has had many years of experience cannot help having a flicker of pride in his eye as he recalls those days when he came down 'bump' on a Shetland pony's back, saying to himself 'That's my first jump!' and back again to the row of cups on the mantlepiece which, with their gleaming faces, tell of bygone jumping feats! Ah! woebegone reader, who has never tried to jump, who has never felt that thrill as his horse clears! The light shock landing! And the fall—for no one is ashamed when they find themselves in the mud instead of in the saddle!"

The book reveals the young author-artist's keenness about everything relating to horses in general, and to her own mount in particular. It will commend itself not only to those interested in horses and riding, but also as a masterpiece of a young author, to whom it has obviously been a labour of love.



H.M.S. "Bulldog." From "The Book of the Warship" (see opposite page).

Two Good Stories by Vice-Admiral E. R. G. R. Evans

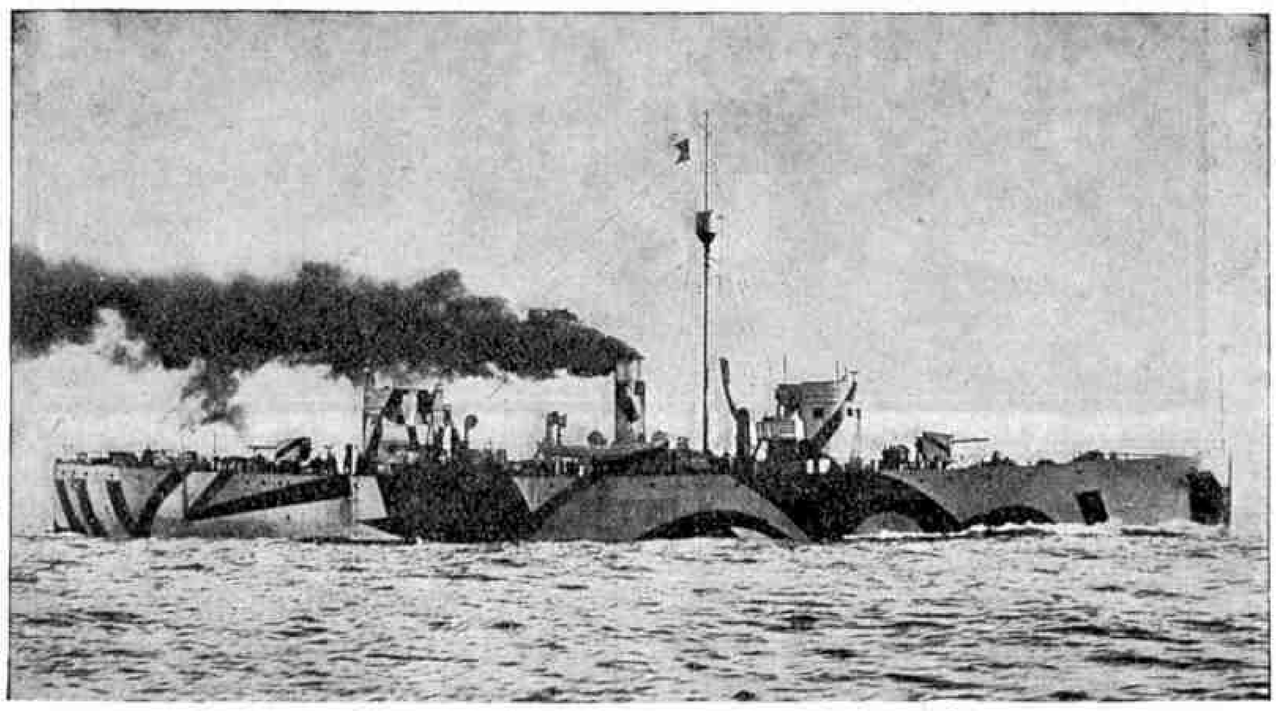
"The Ghostly Galleon"
(Lane. 6/- net)

"The Exile"
(Warne. 6/- net)

One would naturally expect stories by the hero of so many exploits as "Evans of the Broke" to be exciting, and in this respect readers of these two books will not be disappointed. "*The Ghostly Galleon*" is a pirate story of the genuine type. It deals with the thrilling adventures of a company of valiant men who, aboard the fine ship "*Valour*," set out to rid the Caribbean and other seas of the menace of as villainous a gang of pirates as could be imagined. As the result of a series of exciting happenings, Dirk Frobisher, a pot-boy at a Plymouth inn, finds himself aboard "*The Valour*," and finds adventure beyond his wildest dreams. He takes part in fights with the pirates' ships, during which the victory is first with one side and then with the other; is captured by the pirates; discovers the secret of their island headquarters, and finally makes a sensational escape.

The struggle against the pirates is complicated by a mysterious being known as "The Evil" who, never seen, deals out death from time to time with startling suddenness. There is also a mysterious white ship that speeds past like a ghostly vision of silvery light. To give an inkling as to the solution of these mysteries, and of how the pirates were finally crushed, would spoil the book for readers. It is sufficient to say that the story, with its vivid realism and swift and continuous action, carries one along, and it is with regret that one reaches the final page.

In a foreword to "*The Exile*," Vice-Admiral Evans says: "In my own lifetime I have had adventure enough to fill many books, and I have always been conscious of what some people call extraordinary good luck, and others the shielding influence of an unseen hand. Drawing from the experience of my own life, I have let my boy hero win through fight and flight in Glorious Devon, in Napoleon's France, in Belgium, Scandinavia, and Africa, and I have perhaps let his greatest adventures take place in Norway, the country I know and love so well. . . . If it pleases all its readers as much as it seems to have pleased my own boys, it will be well worth publication." These words give an excellent description of the spirit of this book. Noel Howard, at the age of 14, is left a mansion and a fortune on the death of his father, but is swindled out of it by his blackguardly Russian cousin, Ivan. This cousin takes unscrupulous advantage of an unfortunate occurrence to force Noel into exile, and the story traces the boy's adventures from the time he takes refuge in a French smuggling lugger. After a brief but exciting period as a member of the crew of this vessel, Noel finds himself in the clutches of Ivan, but succeeds in making his escape. Travelling steadily northward, with Ivan in pursuit, Noel passes through dangers and hardships of all kinds, and finally reaches Trondhjem where, after being forced to kill Ivan in self-defence, he goes aboard an American ship bound for Jamaica. Even now his adventures are not over, for he narrowly escapes being cooked and eaten by cannibals; but ultimately he reaches home, where all his affairs are settled up satisfactorily. There is not a dull moment in "*The Exile*." Exciting episodes follow fast on one another, especially in the Norwegian period; and there is enough fighting to satisfy the most adventure-loving reader.



H.M. Sloop "Spearmint," in wartime dazzle painting. (See above).

"Printing for Amateurs"
By Arnold Selwyn
(Percival Marshall. 1/6 net)

Printing has much to recommend it as a hobby, for it is not only interesting in itself, but can be turned to useful account in many different directions. Many boys prefer to select a hobby that can be self-supporting, and from this point of view printing must take a prominent place.

In "*Printing for Amateurs*" the author, who has had more than 30 years' experience in the trade, gives practical hints on printing with a modest equipment. His instructions are simply and clearly expressed, and if followed carefully, in conjunction with the numerous illustrations, should enable any enterprising boy to attain sufficient skill to tackle any small printing job, such as those that arise from time to time in connection with the work of a Meccano club, a Scout troop, or a school. The author is clearly an enthusiast in regard to his craft, and in spite of its small size his book will be of great value not only to the amateur, but also to youths who are taking up printing as a career.

List of New Books

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

Jewels of Romance and Renown
by Mary Abbots
(Werner Laurie Ltd., 8/6)

Modern Watch Repairing and Adjusting
(N.A.G. Press Ltd.

Amateur Pilot
by The Earl of Cardigan
(Putnams, 7/6)

A British Railway Behind the Scenes
by J. W. Williamson
(Ernest Benn, 5/-)

Wireless for Beginners
by C. L. Boltz
(Harrap, 3/6)

Pioneering in the Prairie West
by W. C. Pollard
(Stockwell Ltd., 3/6)

The Carpenter's Tool Chest
by Thomas Hibben (Routledge, 5/-

The Treasure of San Jacinto
by F. Riley (Nelson, 3/6)

The Romance of Research
(Bailliere, Tindall & Cox, 5/-

The Romance of Treasure Trove
by Charles R. Beard (Sampson, Low, 10/6)

H.R.H. A Pictorial Biography
by Edgar Middleton (The Bodley Head, 5/-)

The Wonder Book of Machinery
by H. Golding (Ward Lock, 5/-)

Popular Scientific Recreations
by Prof. A. M. Low (Ward Lock, 6/-)

King Richard's Land
by L. A. G. Strong (Dent & Sons, 5/-)

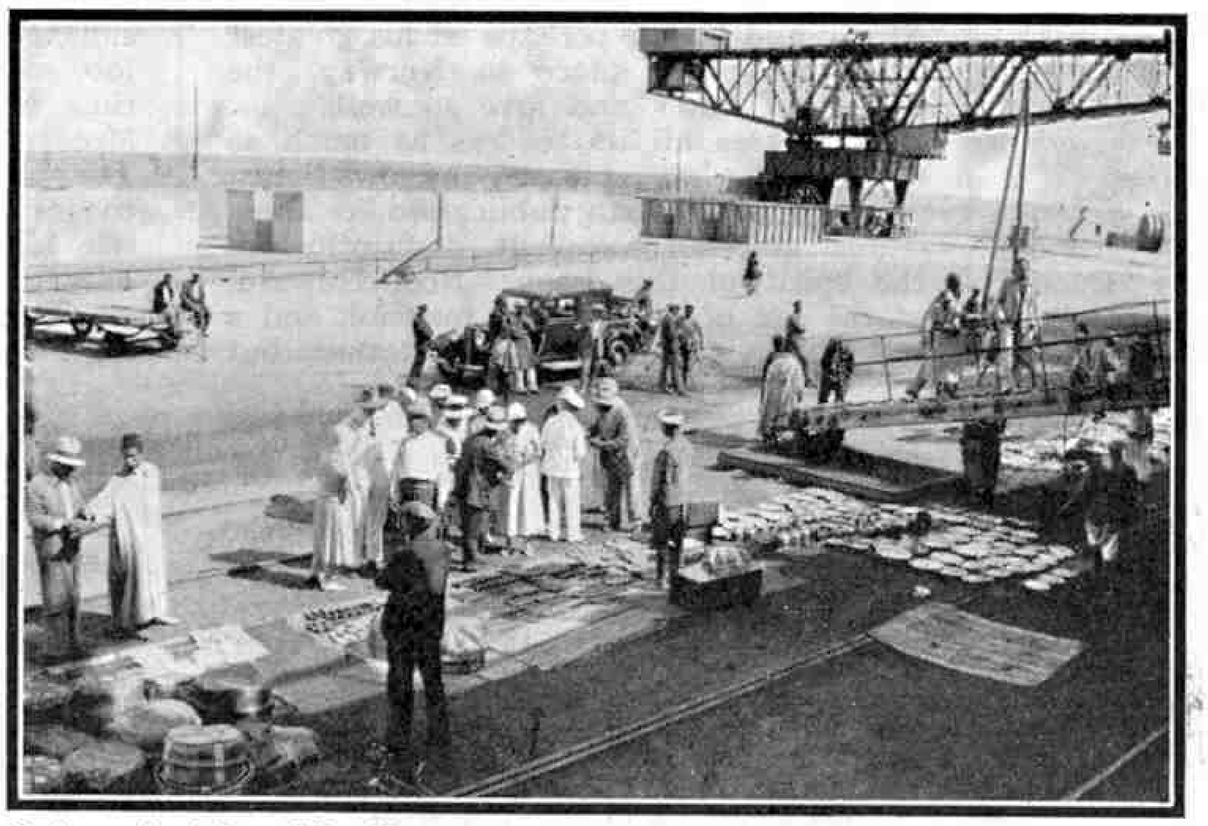
Watermills and Windmills
by W. Coles Finch (C. W. Daniel Co., 15/-)

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.

The Port of Casablanca

The vessel in which I travelled when returning from a holiday abroad called at Casablanca, in French Morocco. We arrived at dawn, and I decided to go for a stroll along the quay before breakfast. The city seemed to me to be typically North African, with its white flat-roofed buildings, and streets through which passed quaintly dressed natives. From the quay I had a good view of the surrounding port. Around me were excellent buildings and warehouses, including a giant grain elevator. The chief export is phosphate, for use in the manufacture of fertilizers, and this is brought to the port by rail and either stored in warehouses or shipped immediately.

On my way back to the ship, I passed through what seemed to be a fish market, where Arabs were chattering and arguing with each other. This was interesting, but gradually I took the place of the fish as the chief centre of interest, and therefore decided not to stay.


Native curio dealers of Casablanca on the quay alongside which a visiting ship is berthed. Photograph by J. Dimmer, Southampton.

Later in the day I accompanied several fellow passengers on a visit to the city itself. The port owes its modernisation and development to the French, and its modern buildings, some of which were still under construction, are owned by French firms. Naturally we were greatly interested in the native quarter, but we did not stay long in it, the peculiar aromas encountered causing us to retrace our steps to more agreeable surroundings. As we returned to the ship we passed the Sultan's Palace, a beautiful building with large gardens in which men were sweeping the paths and working on the flower beds. On the quay we found crowds of natives displaying goods of all kinds to the passengers, and the scene was one of bustle and activity.

We left Casablanca at midday, passing a breakwater in course of construction on the way out. The giant blocksetting crane shown in the accompanying photograph was employed in this work, and as I watched it I marvelled at the industry that had transformed a small fishing town into a fine modern port, the importance of which is steadily increasing. J. DIMMER (Southampton).

A Scottish Silver Fox Ranch

I have been greatly interested in the introduction into Scotland of the silver fox, and during a recent holiday was glad to have an opportunity of visiting the Shire Ranch, near Culroy, Ayrshire, in order to see the remarkable creatures reared there. The two large enclosures in which the foxes are kept are surrounded by high fences of strong wire netting. One enclosure is used as a run for the cubs, and in the other are several small runs and breeding hutches. There is also an observation tower from which the foxes are carefully watched. Great care is taken to prevent infection of the animals with disease of any kind. No dogs are allowed near the ranch, and the walls of the hutches are periodically scorched in order to destroy any germs that may be lurking there.

The morning meal of the foxes consists of bread and milk, and in the afternoon they are given a mixture of rabbit, tripe, cabbage, and brown and white bread, all minced together. While watching preparations at feeding time I touched one of the metal dishes employed, and was then told that the foxes refuse to eat food from dishes on which they detect the scent of a stranger. The creatures are exceedingly shy and timid, and if one of them is injured, the men on the ranch have to attend to its hurts, because it will not allow itself to be touched by a veterinary surgeon with whom it is not familiar.

The ranch was began a year or two ago with a few foxes brought from Canada, and at the time of my visit there were 47 foxes and 47 cubs. The creatures are killed painlessly, and their pelts are worth from £12 each.

I. GRAHAM (Kilmarnock).

A Station Without Rails

The G.W.R. station at Dartmouth is perhaps the only one in the country that was never intended to have railway lines. It could not well be provided with these, because the street is in front, and the river behind. Actually it is the ferry station for the steamer that crosses the Dart from Kingswear, but its interior resembles that of an ordinary railway station. It is provided with a nameboard of the usual type, as can be seen from the accompanying photograph.

A railway station in which there are no rails ! Photograph by R. Wood, Manchester.

The ferry service is operated by "*The Mew*" of London, which is a small steamer registered for plying "on smooth water, on rivers and canals." Nevertheless, it is possible to be sea-sick while crossing! The vessel has a crew of five and is registered to carry 543 passengers, but fewer people are allowed on board when motor lorries and cars are carried across the stream.

Although the 12.0 train from Paddington is called the "*Torbay Express*," it finishes its journey at Kingswear, and thus passengers for Torbay have the unusual experience of ending their journeys at a railway station without rails!

R. Wood (Manchester).

Landmarks of the Zulu War

I live and work on my father's farm near the coast of Zululand, and from time to time have visited places of historic interest in connection with the campaign against the Zulus 55 years ago.

A few miles away is Port Durnford, a wide bay where troops and supplies were landed to be taken by ox wagon to Fort Chelmsford, the site of which can still be seen. On our farm and the one adjoining it are trenches dug on hills from which commanding views are obtained of the stretch of country between these two places, and it is clear that these mark posts on the line of communication. A British florin dated 1879 was recently unearthed in one of these trenches. A hill on our neighbour's farm is called Fort Napoleon, after the Prince Imperial, son of the French Emperor Napoleon III, who lost his life in this campaign, although this disaster occurred a long way from there.

Port Durnford was not used until towards the end of the campaign, for the first columns of British troops entered Zululand from Natal by crossing the Tugela River. The advance column first destroyed the royal kraal, or native village, at Gingindhlovu, where to-day there is a thriving township, and then moved on towards Eshowe. An attack on this column while in camp at Inyezani was beaten back with heavy loss to the Zulus, and Eshowe was reached safely. The little force remained there for some months to protect the surrounding country, and was eventually relieved after the final overthrow of the Zulus at Ulundi by the main army under Lord Chelmsford. The relieving force had to fight a way through a native army of about 15,000 men. The British losses were slight and those who were killed are buried in the pretty little cemetery at Gingindhlovu.

Eshowe is now a beautiful little town, and contains an interesting military fort built at the close of the Zulu War. Surrounding the town is the Hlinza forest, and a road that has been driven through this passes under a curious tree that has grown in the form of an arch extending from one side of the highway to the other.

E. R. Füsslein (Mtunzini, Zululand).

A wonderfully decorated tazia displayed during the celebration of the Moharram festival in Poona, India. Photograph by M. Samson, Poona.

A Famous Mohammedan Festival

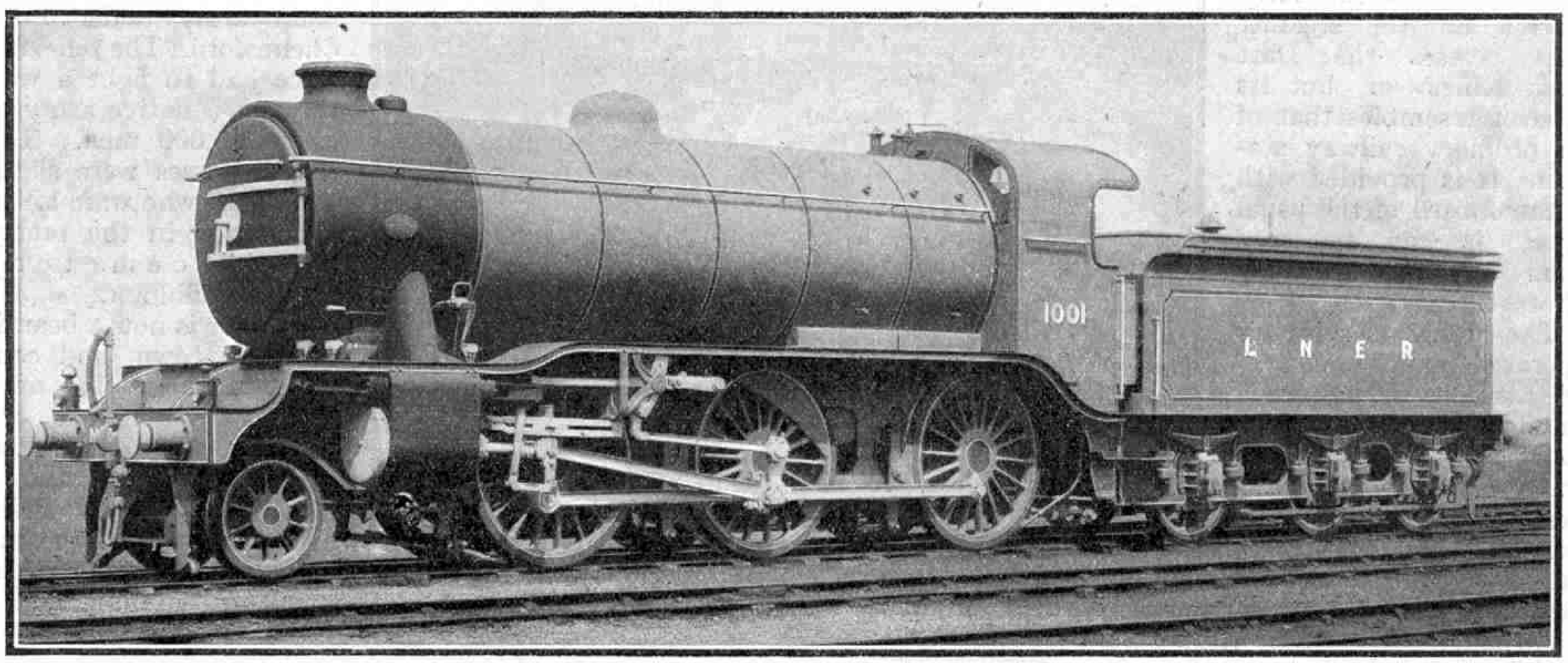
Every year during May, Indian Mohammedans celebrate the Moharram festival in memory of Hosein and Hassan, sons of Ali, cousin of Mohammed the prophet, who were slain in civil strife in the early years of the Mohammedan era. The 10th of Moharram, the first month in the Mohammedan year, has ever since been devoted to this festival, and every year, as the time for the celebration approaches, the richer Mohammedans build expensive tazias in preparation for it. These have bamboo frameworks and are beautifully decorated with coloured paper, covered with oriental designs, and richly ornamented. The accompanying photograph shows a splendid tazia that was built for the celebrations in Poona of this festival, and behind it can be seen part of another of these structures.

When they are ready, the tazias are placed for a few days where people can see them. Finally one evening they are taken out in procession, large crowds following them, beating drums and shouting "Hosein! Hassan!" This continues until after midnight. Next morning the procession recommences and the tazias are carried through the streets for the greater part of the day. Late in the evening they are taken down to the river, and there with much ceremony are thrown into the water, thus bringing the interesting festival to a close.

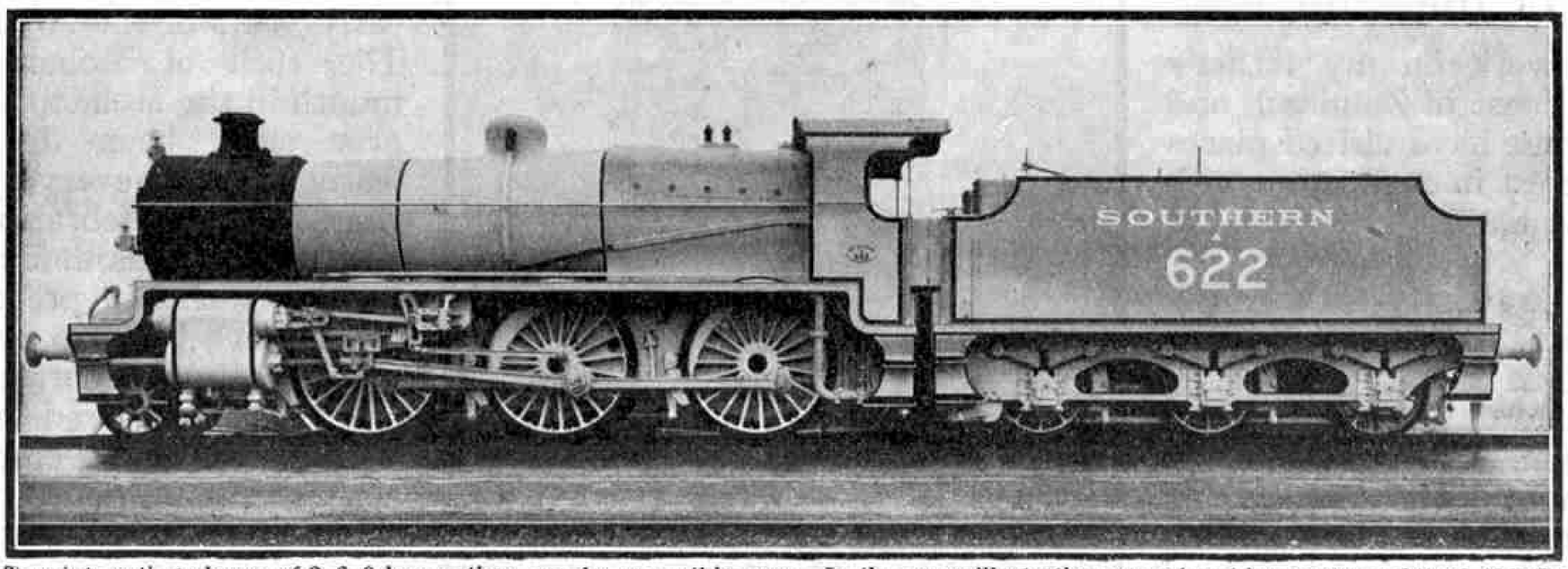
M. Samson (Poona, India).

The "Mogul" Locomotive in Great Britain

1.—Its Origin and Early Development



A FEATURE of the locomotive practice of the four great British railway groups is the extensive use that is made of locomotives of the "Mogul" or 2–6–0 wheel arrangement. This in itself would arouse no comment, but the fact that the type was formerly little employed, and has only recently attained any great popularity, makes it of special interest. Possibly the American origin of the type caused it to be left alone by the locomotive engineers in this country, and the fact that the earliest "Moguls" in England were not very successful may have accounted for a certain amount of prejudice. It is probable, however, that the desire for a simpler engine was the main cause of the neglect. Preference was given to the 0–6–0 wheel type, which dated back to Hackworth's "*Royal George*" of 1827, and which had given splendid service, and of course still continues to do so.



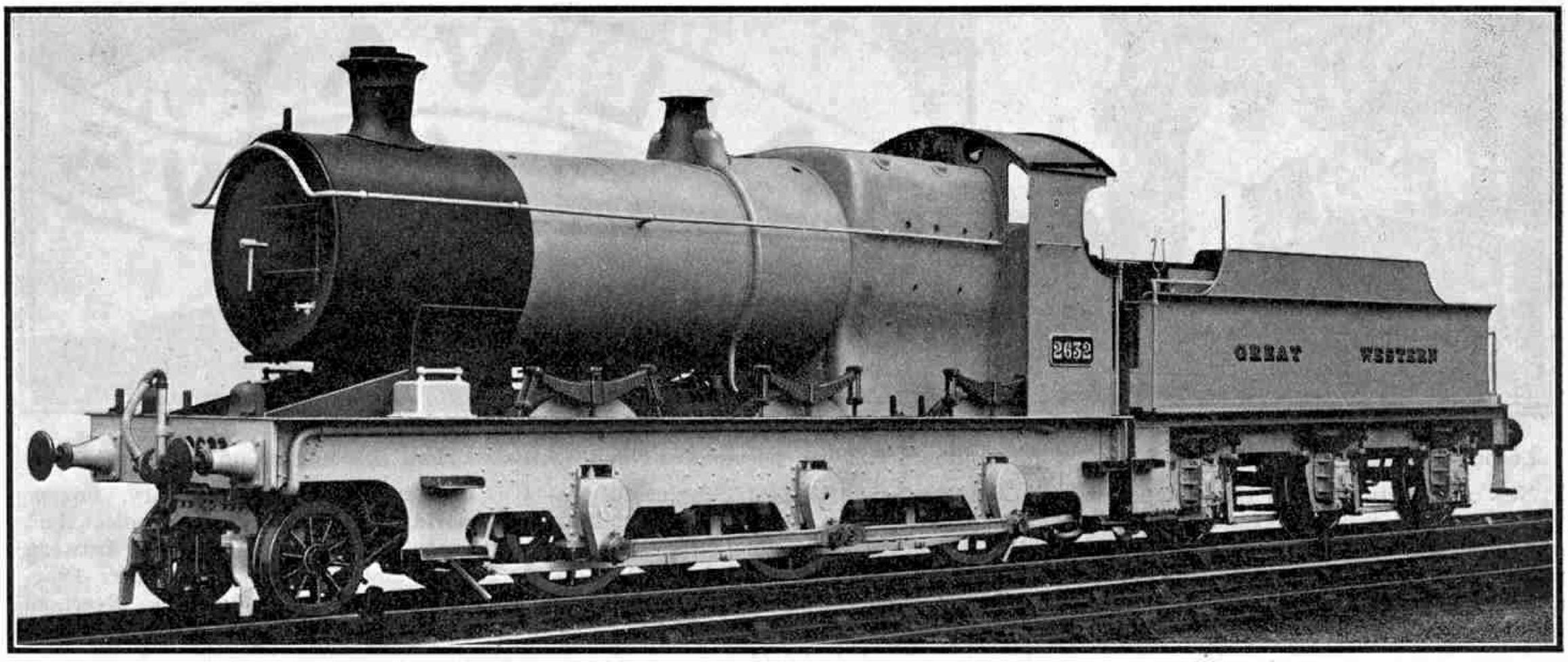
Two interesting classes of 2–6–0 locomotives are shown on this page. In the upper illustration, reproduced by courtesy of the L.N.E.R., appears one of the Great Northern "1000" class with three cylinders, from which the present L.N.E.R. "K3" locomotives have been developed. The engine in the lower picture is one of those built to the same design as the reconstructed "River" class on the S.R. Their driving wheels have a diameter of six ft., so that they are particularly suitable for passenger work, on which they are chiefly employed. Photograph by courtesy of the S.R.

While the development of the "Mogul" as a popular type in Great Britain is thus of comparatively recent date, the first examples of this wheel arrangement were put into service on the former Great Eastern Railway as far back as 1879. They were built by Neilson & Company of Glasgow to the total number of 15. Mr. W. Adams, who at that time was in charge of the G.E.R. locomotive department, was responsible for the design, but certain modifications were introduced by Mr. Massey Bromley, who succeeded him. These modifications involved the use of various American features, for Mr. Bromley had then recently visited that country and apparently had been much impressed by the locomotive practice he saw there. Thus these "Moguls" were given cylindrical sand-boxes mounted on the boiler between the chimney and the dome, and outside cylinders with the valves on top, operated through the medium of rocking shafts by Stephenson link motion placed between the frames. They also had quite large cabs with a side window, but this feature had been introduced previously by Mr. Adams in his "Ironclad" 4–4–0's of 1876-77. The leading pony truck of these Great Eastern "Moguls" was a copy of the one in use at that time on the Pennsylvania Railroad.

These engines were not entirely satisfactory and had only a short life, being broken up in 1885-87. They were employed chiefly on coal trains between Peterborough and London. After their withdrawal, and until the incorporation of the Great Eastern Railway in the L.N.E.R. group, no 2–6–0 locomotives ran over the metals of that system.

No further locomotives of this wheel arrangement were put into service until 1895, when Beyer Peacock & Co. Ltd. constructed a 2–6–0 for the former Midland and South Western Junction Railway, now part of the G.W.R. A further one was added in the following year. These were small engines, with driving wheels only 4 ft. in diameter, and no other members of the class were built. By reason of their working on a relatively obscure line they had not much chance of distinguishing themselves, and little is known of them.

The next variety of 2–6–0 locomotives to be noted were not "Moguls" in the usually accepted sense of the word, for although this implies a six-coupled locomotive with a two-wheeled leading truck, the use of outside cylinders is also understood. These were inside cylinder engines, and in their latest form are illustrated on page 129 by No. 2632 of the G.W.R. They are interesting because



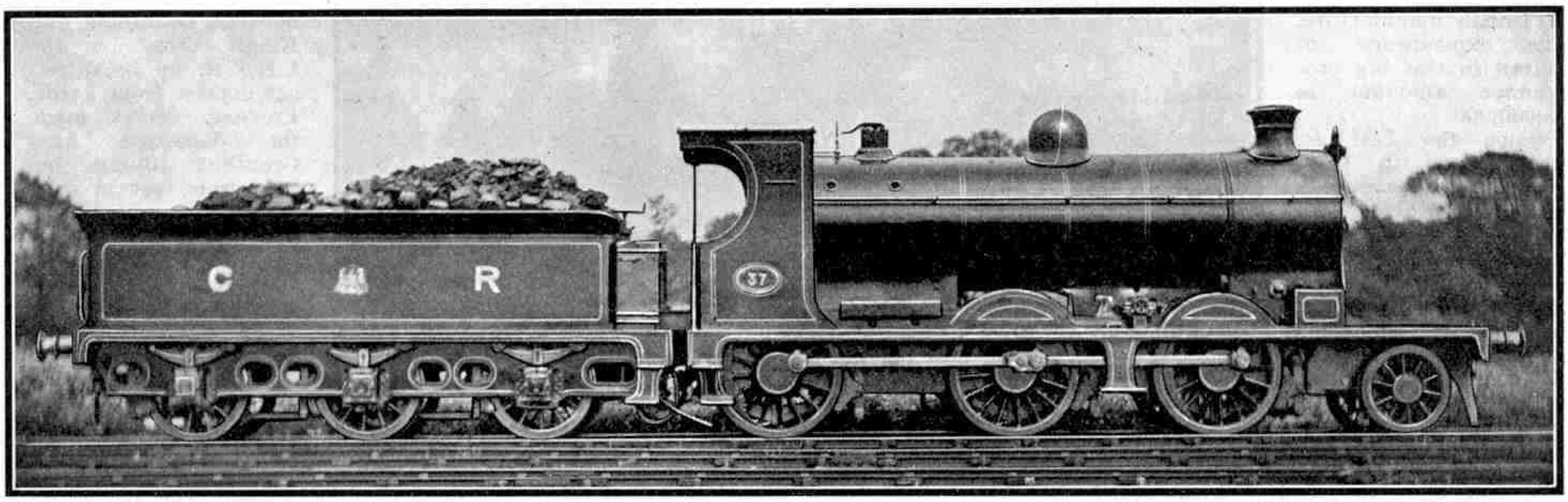
One of the G.W.R. "Aberdare" 2–6–0's, so called because of their construction for the Aberdare coal traffic. These, with their outside frames and inside cylinders, form an interesting variation of the type as compared with the true "Mogul" which is also found in large numbers on that line. Photograph by courtesy of the G.W.R.

they were really developed from two similar engines of the 4–6–0 wheel arrangement.

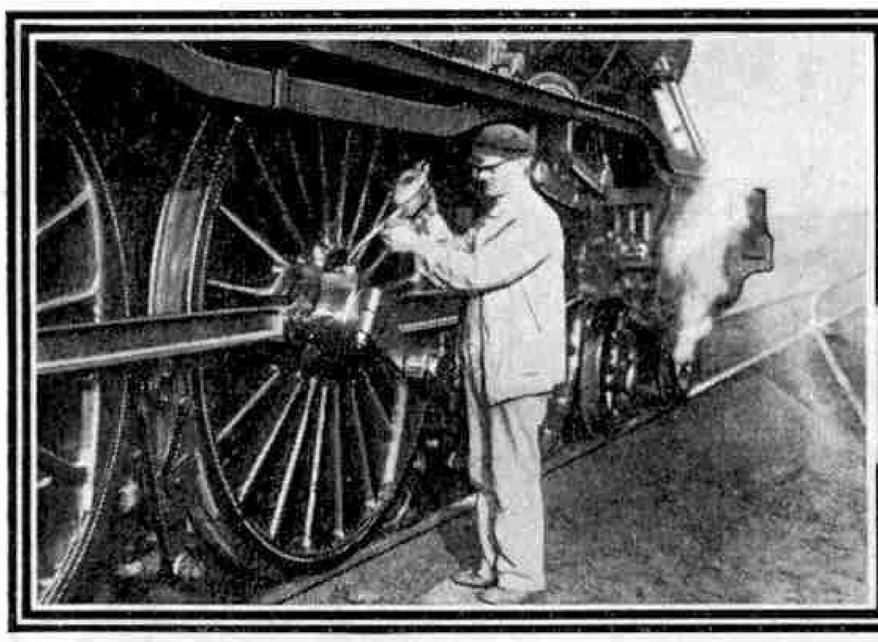
The first of these engines was No. 36, and was turned out from Swindon in 1896 for heavy goods and mineral traffic. It had a curious appearance, for it had outside frames for the driving wheels, as shown by No. 2632, and in addition the four-wheeled bogie, also with outside frames, had wheels of Mansell pattern with wooden centres. It had a raised fire-box, with a rather wide grate that rested on the main frames; and it was unusually powerful for that time. In 1899 was built another 4–6–0, No. 2601, that had a domeless parallel boiler and Belpaire type fire-box with a wide grate and a combustion chamber extending into the boiler barrel. Like No. 36, it had outside frames to the driving wheels, but the bogie had inside frames and spoked wheels. This engine had a sand-box mounted on the boiler behind the chimney, and was notable for the length of its piston stroke, which was 28 in. In nine similar engines the bogie was replaced by a two-wheeled truck, and the frames were shortened, with the result that the 2–6–0 wheel arrangement was arrived at.

These nine locomotives were known as "Krugers." No. 36 was broken up in 1905, but No. 2601 was fitted with a leading pony truck and was therefore brought into line with the "Krugers." In 1900 Mr. Dean, their designer, produced a rather smaller engine, No. 33, with double frames and the same wheel arrangement. In this the piston stroke was reduced to the more usual figure of 26 in., and until the famous "Kings" appeared in 1927, a stroke of 28 in. was not employed on any new engines by the G.W.R., although an even longer stroke, 30 in., made its appearance on many G.W.R. engines with two outside cylinders. This smaller engine was multiplied until 71 were running, and the 10 "Krugers" were afterwards rebuilt and assimilated to the class. These 81 engines are generally known as the "Aberdares," as they have been identified particularly with the South Wales coal traffic, although of course they are to be found in other districts. Their numbers run from 2600 to 2680, the original No. 33 having been renumbered 2600.

In the meantime, however, an exceptionally interesting situation had occurred. In 1899 a locomotive "famine" was experienced in this country, and the various building firms were so busy that they could not undertake any more orders for some time. In consequence the Midland, Great Northern and Great Central railways were compelled to place orders abroad, so that in that year the Baldwin Locomotive Works and the American Locomotive Company delivered 80 genuine "Moguls" to this country. The Midland had 40 of them, the Great Northern 30, and the Great Central 10. They were of typical American design, though slight variations were made for each railway. They had outside cylinders with valves on top, operated by inside valve gear, and double-window cabs; and some of them had tenders carried on two four-wheeled bogies. The Baldwin engines had sand-boxes between the chimney and the dome, and all had extended smoke-boxes of cylindrical form resting on a saddle. They were not popular with the men, who said that they were heavier on fuel and lubricants than the corresponding engines with which they worked in company. At all events their life was short, and they had disappeared after some 15 or 16 years. According to American standards they were not large engines, but they approximated in size to the English goods engines of that period.



Caledonian Railway No. 37, a Scottish version of the 2–6–0 introduced by Mr. J. F. McIntosh. Some similar engines were built for the former Glasgow and South Western Railway, and both classes were developed from previous 0–6–0 engines. The engine illustrated is a typical product of the Caledonian Railway and exhibits features that for many years were characteristic of that company's practice. Photograph by courtesy of the L.M.S.R.



Locomotive Building on the L.M.S.R.

New construction during 1933 comprised two "Pacific" express locomotives, built at Crewe; forty 4-6-0 express locomotives of the "Baby Scot" class, 30 of which were built at Crewe and 10 at Derby; forty 2–6–4 tank engines, built at Derby; and four 2–6–0 "Mogul" tender engines for the N.C.C., Ireland, that were built at Derby. An order for forty 2–6–0 "Moguls" was put in hand at Crewe and about half the engines were turned out by the end of the year, the remainder being still under construction.

The works and rolling stock programme for 1934 includes 232 locomotives and 159 locomotive boilers; 674 carriages; and 5,365 wagons. In addition, the company will renew 500 miles of permanent way, requiring 80,000 tons of rails, all of which will be of British manufacture. The expenditure involved in this big programme amounts to £8,400,000.

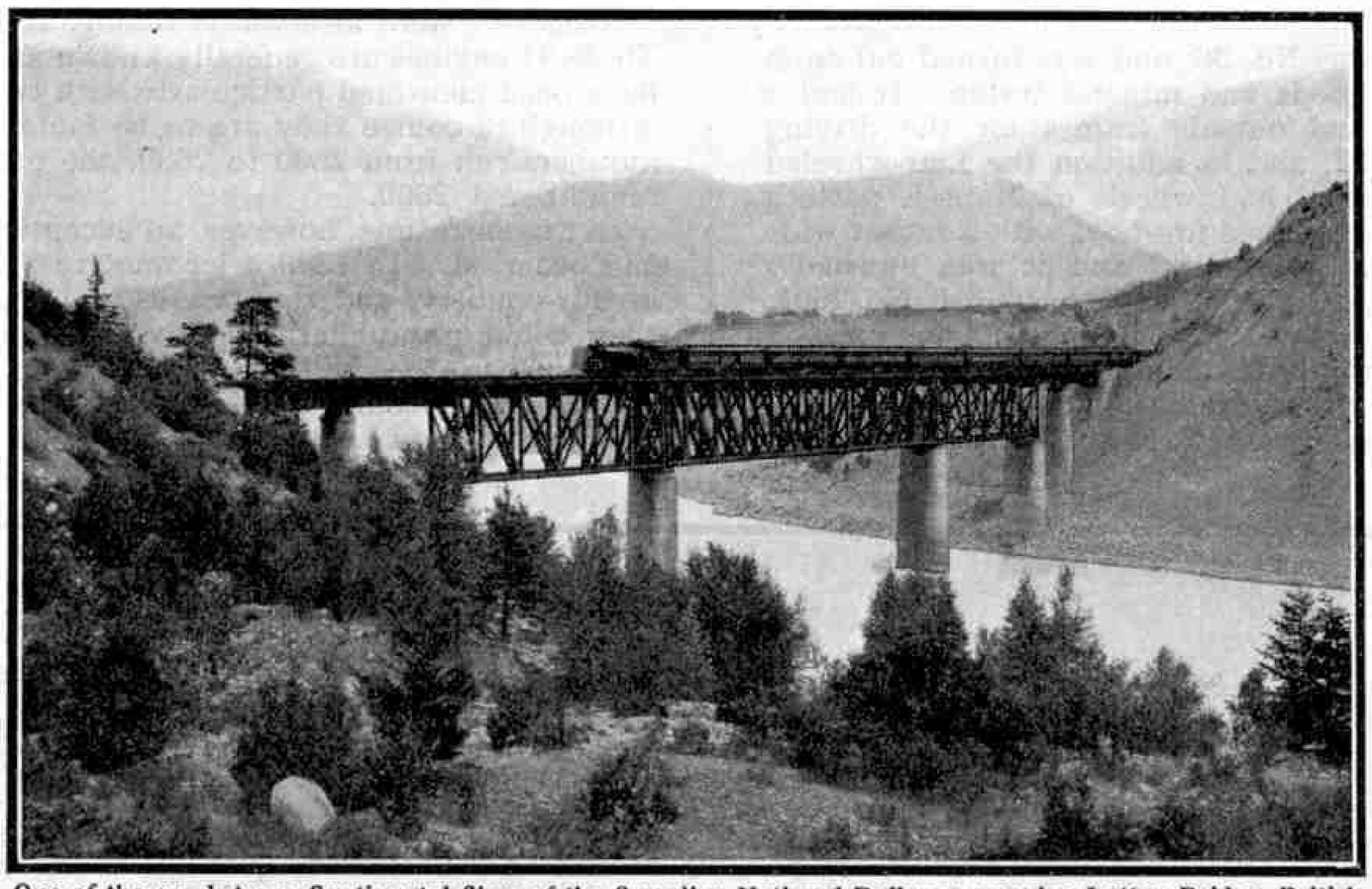
Since the L.M.S.R. was formed in 1923, great strides have been made in improving locomotive efficiency. While 2,500 new locomotives have been added, 4,800 have been withdrawn from service; and the number of different types of locomotive has been reduced from 393 to 204. Superheating has been largely extended. These changes have resulted in heavier trains being hauled at higher speeds, with reduced coal consumption and repair cost per mile.

A new series of 2–6–4 passenger tank engines is on order at Derby. These engines will have three cylinders and be numbered from 2500 upward. The 4–6–0 "Baby Scot" locomotive No. 5971 now carries the name "*Croxteth*," which was formerly borne by the "Claughton" class engine that it replaced.

Since 1st January, the two "Pacific" locomotives—No. 6200, "*The Princess Royal*," and No. 6201, "*Princess Elizabeth*"—have been allocated to the daily working of "*The Royal Scot*" expresses between Euston and Glasgow, one engine taking the up train, and the other the down, and making the through journey of 401¼ miles each day. On the first day of the new working the up train arrived at Euston an hour late, owing to dense fog.

Southern Railway Locomotive News

Further 2–6–0 "Mogul" engines of the "N" two-cylinder class have been built at Ashford works. The latest series of 15, just completed, are numbered from 1400 to 1414. The engines have a larger tender with a water capacity of 4,000 gallons in place of the one carrying 3,500 gallons previously fitted to engines of this class. Commencing with No. 1407, the new engines have been built with left-hand drive instead of right-hand drive, which until now has been the standard practice on Eastern section engines. Henceforward left-hand drive will be standard on the Eastern section as on the other sections of the Southern Railway.



One of the crack trans-Continental fliers of the Canadian National Railways crossing Lytton Bridge, British Columbia. This bridge is situated where the railway crosses the junction of the North Thomson and Fraser Rivers. Photograph by courtesy of the Canadian National Railways.

An Exhibition Train

The railway companies are co-operating in a new form of business enterprise by which a train exhibiting British goods is to make a three-months' tour of a great part of England. The train will be made up of 17 corridor coaches, 15 of which will be adapted for the display of goods. There will also be a reception coach and a coach carrying electric light and power plant. The train will start out from Birmingham on 14th March next and in the course of its tour will be open for exhibition at more than 60 important centres, including London, Norwich, Lincoln, Manchester, Liverpool, Cardiff, Plymouth, Bournemouth, and Folkestone. When travelling, the exhibition train will be hauled by a locomotive of the company over whose system it is passing.

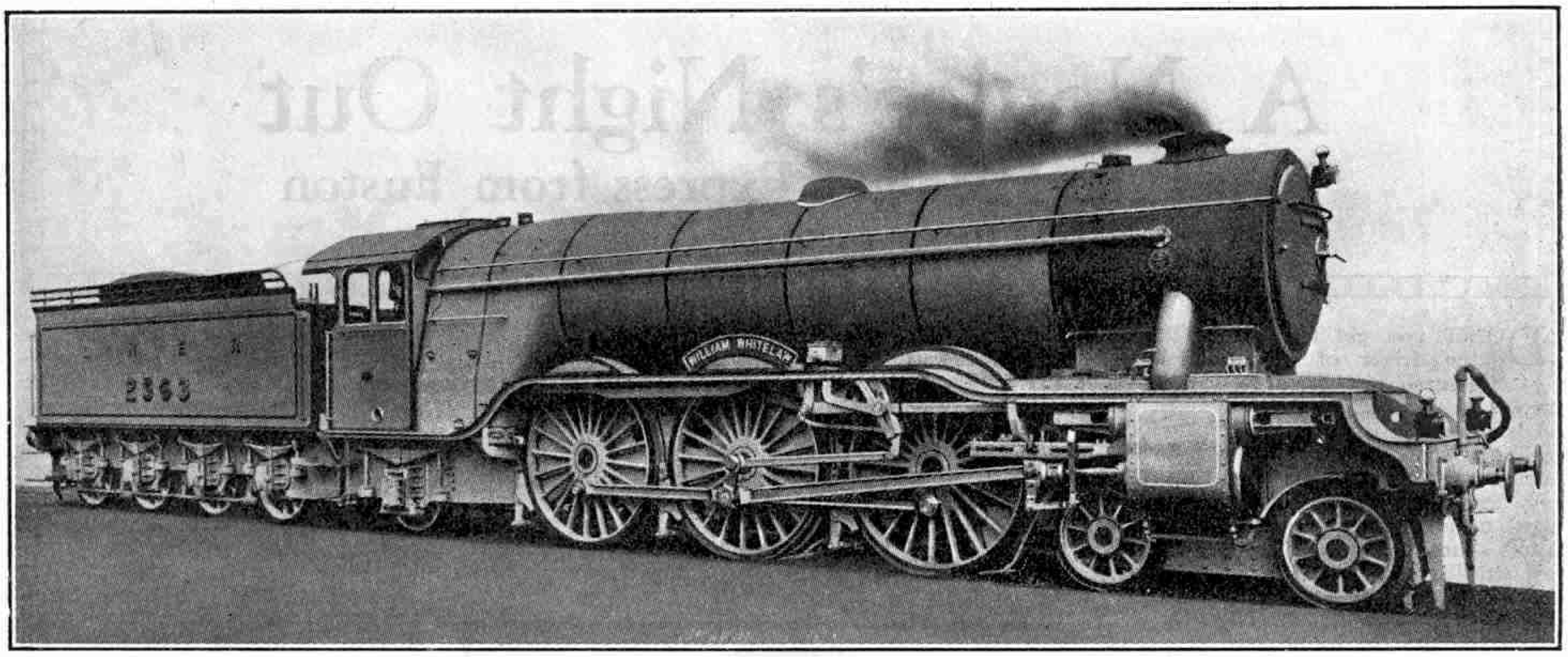
More Speeding-up on the L.N.E.R.

Commencing on 1st January, further important improvements were effected in the L.N.E.R. train services between London and the Eastern Counties. Practically every train between Liverpool Street and Clacton, Frinton and Walton-on-the-Naze has been speeded up, and accelerations and additions have also been made in the East Anglian and Southend services. This general speeding-up has been made possible by the bringing into use before the end of last year of the widened lines from Gidea Park to Shenfield and the burrowing junction that there communicates with the Southend branch. The suburban services beyond Gidea Park to Brentwood and Shenfield have also been considerably improved.

An exceptionally fast run was made recently between Grantham and King's Cross by the L.N.E.R. up breakfast-car express from Leeds. Previous delays made the departure from Grantham 10 min. behind time, yet in spite of the very tight schedule that allows only 100 min. for the 105½ miles from Grantham to London, the arrival at King's Cross was only 3 min. 40 sec. late, no less than 6 min. 20 sec. having been regained by the engine. The average speed from start to stop was 67.6 m.p.h., but between Huntingdon and Finsbury Park it was well over 70 m.p.h. A maximum speed of 92 m.p.h. was attained near Essendine. The locomotive responsible for this fine effort was "Pacific" No. 2544, "*Lemberg*," with Driver C. Molsen in charge. The load behind the tender amounted to 350 tons.

"*The Brighton Belle*"

The name of the Southern Railway's luxurious all-Pullman electric express which, like that of its steam-drawn predecessor, has hitherto been "*The Southern Belle*," has now been changed to "*The Brighton Belle*." As the train travels only between London and Brighton, making three return trips each day, the new title will certainly give to passengers a more definite indication of the route and destination of the train than was afforded by the original title.



The Tour of "*The Royal Scot*"

Within a few days of its return to England from its tour of the North American Continent, the famous L.M.S.R. train "*The Royal Scot*" was given an official welcome at Euston Station, London. Afterwards the train was opened to the public and in the course of three days, more than 33,000 people inspected it.

Since 1st January, "*The Royal Scot*" has been making a triumphal tour of England and Scotland and has been placed on exhibition at some of the principal centres on the L.M.S.R. Among the places visited have been Birmingham, Northampton, Crewe, Manchester, Liverpool, Preston, Carlisle, Glasgow, Edinburgh, Leeds, Bradford, Derby, Nottingham and Leicester. The train has been shown at these centres in the exact form in which it toured Canada and the United States, the engine, "*Royal Scot*," being complete with electric headlight and warning bell. A new name-plate has been fitted, however, which in addition to the name, bears the following inscription: "This locomotive with "*The Royal Scot*" train was exhibited at the Century of Progress Exposition, Chicago 1933, and made a tour of the Dominion of Canada and the United States of America. The engine and train covered 11,194 miles over the railroads of the North American Continent and was inspected by 3,021,601 people. W. Gilbertson—Driver. J. Jackson—Fireman. T. Blackett—Fireman. W. C. Woods, Fitter."

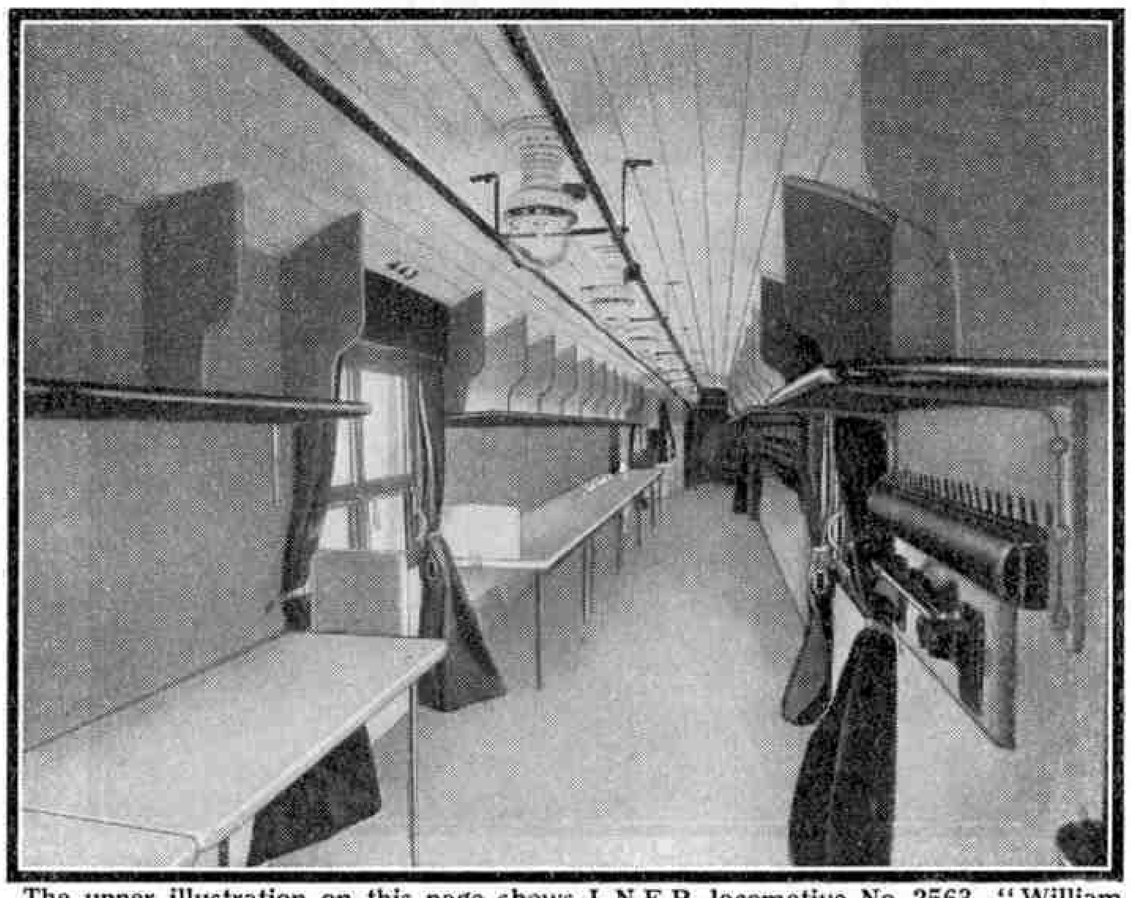
100,000 Steel Sleepers for the G.W.R.

For their 1934 relaying programme the G.W.R. have ordered 100,000 steel sleepers (weighing 10,500 tons); 10,000 tons of chairs; and 30,000 tons of steel rails.

The company already have some 400,000 steel sleepers in use, equal to 185 miles of track, and the new order will add a further 47 miles to this latter figure.

Oil-Electric Units on British Railways

Oil-electric traction continues to claim an increasing place in railway working, and two interesting units are at present being tried out on British railways. For several weeks past an "English Electric" rail car has been working on the Watford and St. Albans branch of the L.M.S.R.



The upper illustration on this page shows L.N.E.R. locomotive No. 2563, "William Whitelaw," one of the Gresley "Pacifics." Below is seen the interior of a mail van, showing its sorting tables and letter racks.

It is fitted with a 200 h.p. Diesel-electric engine that provides sufficient power to propel not only the rail car itself, but also a trailer coach coupled to it.

The other experimental unit is of considerably greater power. It is an 880 h.p. Armstrong-Whitworth 2–6–2 oil-electric locomotive specially built for main-line service and capable of taking either goods or passenger trains. With the latter it can run at a maximum of 70 m.p.h. After undergoing varied tests on both passenger and goods trains on the L.N.E.R. between Newcastle and Edinburgh and on the Carlisle line, it has been put into regular passenger train working between Newcastle and Berwick, where its fuel consumption and general performance will be carefully watched.

The Late Mr. G. J. Churchward

The death on 19th December last of Mr. G. J. Churchward removed one of the most outstanding figures in the exceptionally distinguished line of chief locomotive engineers of the G.W.R. It will be remembered that he was knocked down and killed by a passing express within a few yards of his home at Swindon.

Mr. Churchward first went to Swindon upon the amalgamation of the South Devon and Cornwall Railways with the G.W.R. in 1876, and steadily advanced from one responsible post to another until, in 1902, he became chief mechanical engineer in succession to Mr. Wm. Dean. He then set about the standardisation of boilers, engine parts and types, and introduced many improvements that made the locomotives of the G.W.R. second to none in efficiency. Among the most distinctive features introduced by him were large steam and exhaust passages, long travel piston valves, and the automatic "jumper" blast pipe. His most notable achievement was the building in 1908 of the first British "Pacific" locomotive, "*The Great Bear*," an illustration and description of which appeared in last month's "*M.M.*" Mr. Churchward retired from the service of the G.W.R. in 1921 and was succeeded by Mr. C. B. Collett, the present "chief" at Swindon.

High Speed in Germany

Throughout the winter the "*Flying Hamburger*" rail car is running to its 77.4 m.p.h. schedule and covering the distance of 178.1 miles between Berlin and Hamburg in 138 min. The non-stop steam service has been accelerated and the time has been cut to 154 min., demanding an average speed of 69.4 m.p.h. This is surpassed only by the "*Cheltenham Flyer*" of the G.W.R. with its average of 71.4 m.p.h.

Readers will remember that the power unit of the "*Flying Hamburger*" consists of two 410 h.p. Maybach Diesel engines.

A Novice's Night Out

Firing the Midnight Express from Euston

By "Ixion"

"DON'T you get nervous. I'll put you right," said Fred, the driver of the midnight express from Euston. I assured him I wasn't, but perhaps my actions betrayed me. I had the feeling common to all of us when we embark on some adventure the result of which is uncertain. The same feeling a schoolboy has when he's about to be found out and is not quite sure of the punishment. I was about to start on my first express run, having been called upon to deputise at short notice for the regular fireman. What a change from the usual shunting job!

I paid extra special care to the work of preparing the engine, wondering all the time if I had forgotten anything. I carefully made the fire up to be sure of a good start. My responsibility was to keep 250 lb. of steam in the boiler of the "Royal Scot" engine; to ensure there was sufficient water in the boiler; to pick up water from the troughs; and to do several other little jobs while the driver worked the "*Night Scot*," weighing 400 tons, from Euston to Crewe in 2 hours 57 minutes—an average of 55 miles an hour.

The reason for the remark of Fred's was that a locomotive inspector had announced his intention of riding with us to watch the running of the train. Mustn't make any mistakes now, I thought, with visions of what would happen to me if by any fault of mine we lost time.

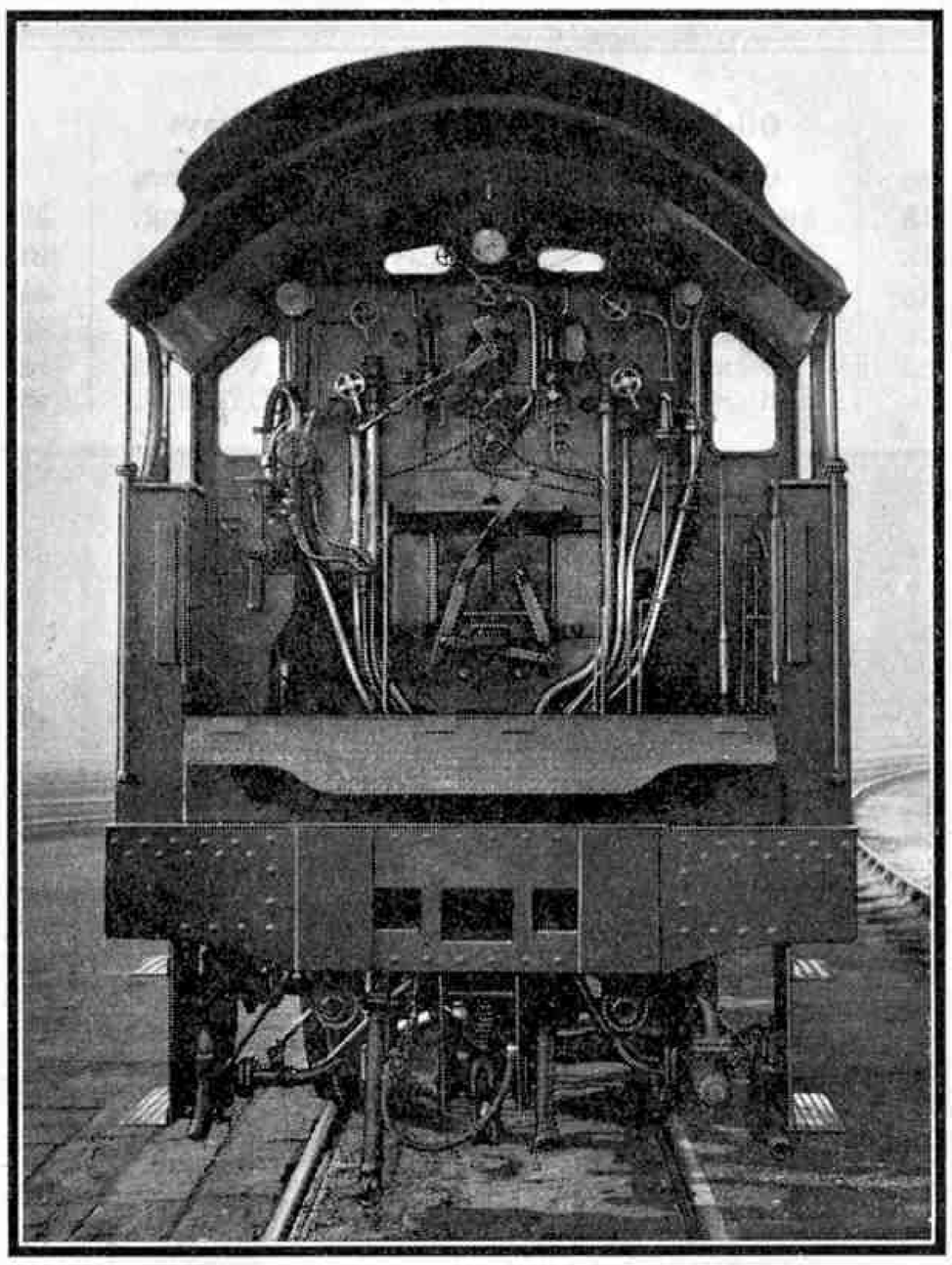
"Give me the tip when we're near the troughs, Fred."

"I'll look after you, don't you worry," was his answer. He must have been in my position once himself.

Two minutes to go. I felt I knew what it was like waiting zero hour in the trenches. I increased the steam jet to brighten the fire, still wondering if I had done all that was necessary. I ran over the various items in my mind—lamps on, heating pipes coupled up and turned on, fire irons secure, coal-pick handy. Nothing forgotten. Open damper to ashpan a little wider, and the steam begins to escape from the safety-valve. There's the green light from the guard; "*Right!*" and off we go. The beats of the engine now get awfully jumbled; six beats per revolution seem quite unorthodox. Under the bridges we commence to climb the one mile bank at about 15 miles an hour.

Time to feed the fire, so I pick up the shovel full of coal, and swing it. *Crash!* I hit the side of the fire-hole door and the coal goes all over the footplate. I certainly haven't got the knack of firing. Next time—ah, that's better! Three towards the front, one up each side, and three at the back of the box. Must remember to fire even and level; no heaps in the middle of the box. Brush up the coal I've dropped. A glance at the steam gauge. Good heavens! it's back 15 lb. already, and we've hardly travelled 400 yards! I console myself by thinking the fire has not yet brightened up. I feel like grabbing the shovel to fill up the firebox, but no; Fred and the inspector seem to take things calmly, and Fred's smiling as if to say she's alright. I'll break up some lumps to make out I'm not worrying. Past Euston No. 4; under the girders and Park Street Bridge. Now things get better, and the fire assumes a white-hot appearance. The needle begins to move towards 250 lb.; our speed increases to about 25 m.p.h. Another meal for the fire, nicely to the bull's-eye each time, and as we approach Camden Shed *bang* goes the safety-valve. Too early to put water in the boiler, so we'll show the chaps at the shed what I can do.

Now it's time for the injector to start working. Open the tank valves—one in the boiler and one in the corner of the cab. A little adjustment, and a singing noise indicates that it's working. Can I keep the engine up in steam while constantly replacing the water that is being evaporated? A wave of the hand from Fred means more food for the monster. Speech is now almost an impossibility; the noise from the engine seems to increase every minute. Entering Primrose Hill Tunnel our speed reaches about 40, and the sound of the six beats is lost in the roar from the chimney. All that beautiful steam I spent so much trouble in making is being left in the tunnel; what a shame! Another wave of the hand. What, already? Still, "ours not to reason why." *Crash!* Again I hit the side of the firehole, but there is some excuse now. I have yet to acquire my "sea legs," to balance myself against the swaying and pitching of the engine. I hope the inspector doesn't mind me treading on his toes. I do my best to look sorry. He's moved his feet, I see. I sweep up the coal I drop, and get most of the dust in my face as the draught comes up the cracks in the floor-boards. I'll use the hose next time first, and sweep up only the lumps.



A view of the footplate and cab fittings of a "Royal Scot" locomotive. This shows the fire-hole doors, the pressure gauge in the centre below the roof, and the injectors mounted one behind each step below the footplate. Photograph courtesy of the L.M.S.R.

What puzzles me is that the gauge is still just under the 250 mark, and we are really moving now. Can it be that I'm not feeding the fire right? It's too early yet to be sure, so I'll give her another lot, and no misses this time! Good! Eight nice ones. I feed her regularly now—sometimes six, sometimes eight—at intervals of one to three minutes, although to me it seems almost continuous. By the time I put the shovel down, break a few lumps, and give a quick look to see if the injector is still working, it's time to fire again. I begin to think I shall not be able to stay the distance—and we've not done five miles yet!

Another little tunnel, and just afterwards, with a shriek of the whistle, we tear through Willesden, and leave the houses behind. It's too black to see ahead; the signals I don't know, except that ours should be on the extreme left, except at junctions. However, I know we shall quickly get to Bushey—distances seem short when you cover a mile in a minute or just over—and at Bushey we pick up water. I keep my eye on Fred, and soon he points to the dip handle. I stand by.

"Right!"

Down goes the dip. I notice we have used nearly 1,500 gallons of water since leaving Euston. The pointer rises to 3,000 almost immediately, and I attempt to pull up the dip. What's stopping me? Something is holding it! I shall overflow the tank if I don't get the dip up. *Come up!* It moves slightly—but too late; a fountain of water shoots up at the back of the tender and blots out the train. I hope the passengers have the windows closed! I win at last, but only after wasting as much water as

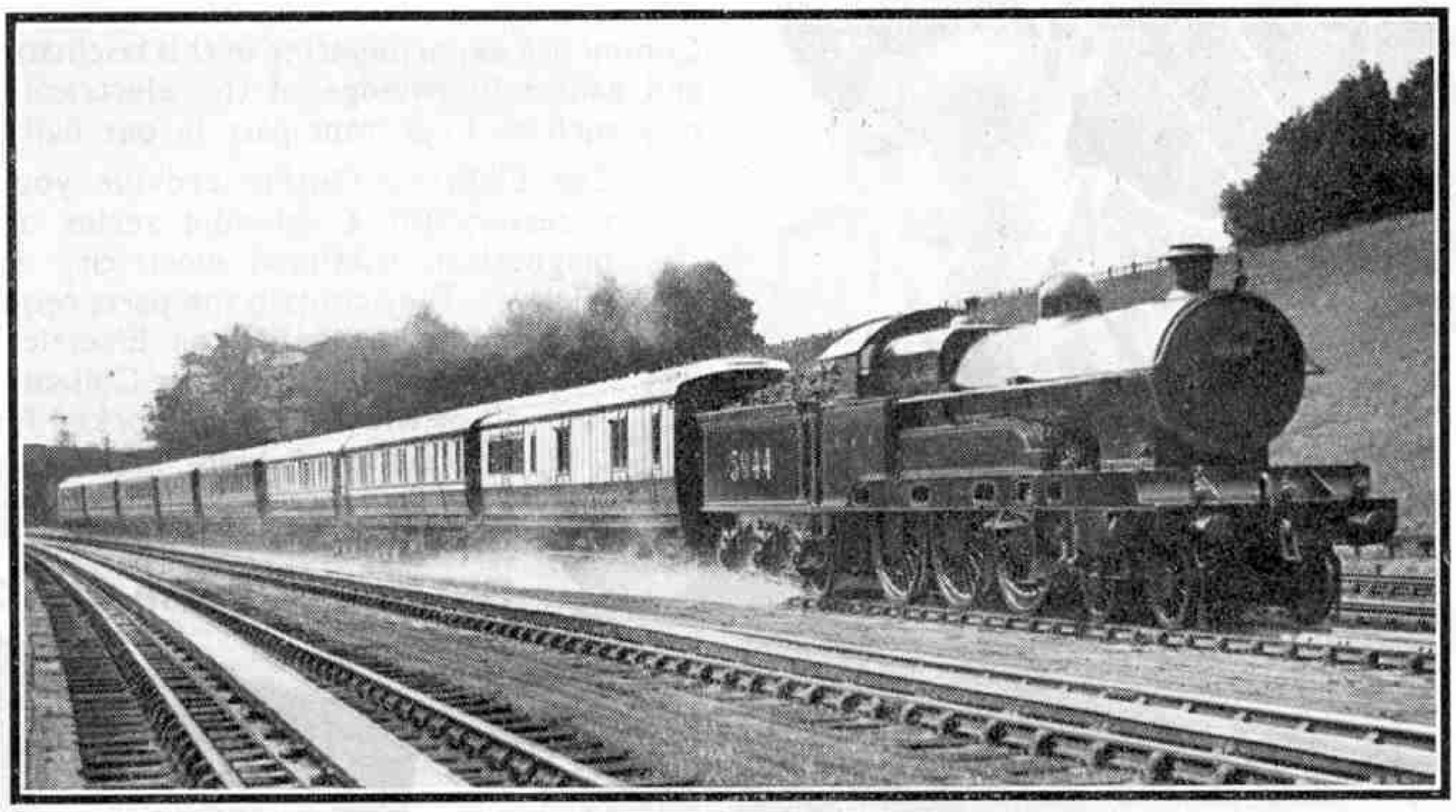
I pick up. I shall know next time; I don't intend to be caught like that again! I find out later that the pressure of the water holds the scoop in the trough.

But the worst is yet to come. Water from the back of the tender now appears at the shovelling plate, and it's difficult to pick up coal without picking up water as well. It certainly doesn't do the fire any good, and I see the gauge drops back nearer to 200 than 250. Still, there is plenty of water in the boiler; I can afford to cut down the supply a little, and she may come round.

We tear through Watford tunnel shortly after. What a roar! The damp rail in the tunnel makes the engine slip. Fred shuts off sharp for a moment in a shower of sparks. I'm not gaining yet; the steam gauge is still where it was. That spurs me on to greater efforts. King's Langley, Boxmoor, Berkhamsted—on into the night. Tring, after a gradual climb of 31 miles from London; down the bank now, towards Cheddington, the speed increases to what seems double. The noise is terrific; the sound of the train is flung back from the chalk walls of the long cutting—80 m.p.h. we must be going now. The engine looks like some gigantic hare with ears laid flat; the glare of the fire, the hiss of the steam from the pistons, the roar and rattle—it seems more like 180 m.p.h.!

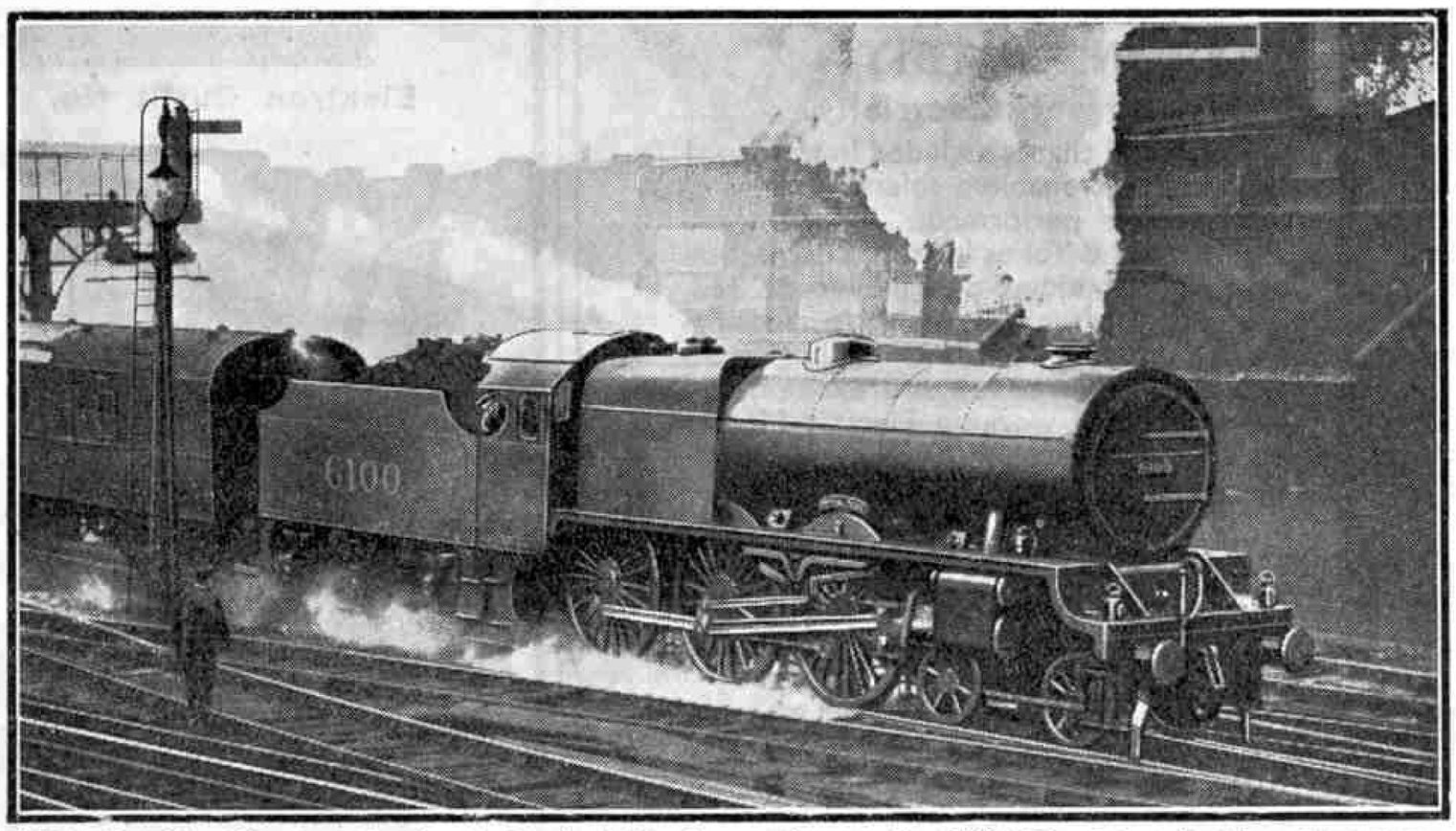
Cheddington is soon passed. A sudden longing for a drink of some sort. Haven't I some tea in a bottle? It's a job on the swaying engine to transfer it to my parched throat. Never did cold tea taste so good. The inspector doesn't want it. He doesn't know how good it is. Well, all the more for me! I'm back to nearly 200 lb. of steam now; something must really be done. Let's see if we can see by holding the shovel in the firehole door. So *that's* what's wrong! Not enough along each side. I must fire a little heavier along the sides. I pick up the shovel in a do-or-die attitude, and make sure she does get some along the sides. Then I break up some lumps and give her another lot. I feel like covering the "clock" up. I've cut the feed to the boiler down as much as I dare. But look! She's gained a pound or two; another nice firing, in the middle of which I sit on the inspector's lap. I wish she wouldn't sway so much!

Now, what's the game? Fred shuts the door tight and covers his face with his handkerchief, the inspector does the same, and yells to me, "Leighton Tunnel!" I just get my handkerchief up to cover my face as there is a terrific *Whoof!* and we hit a solid wall of air at 70 miles an hour. Coal dust flies everywhere; it's uncomfortable down your neck! Next time I shall water the coal and the footplate. Look, 245 lb. of steam again; that's better, I can increase the boiler feed to make up what I lost. A shriek from the whistle and we fly through Bletchley. Wolverton, where the coaches of our train were made, is soon reached, and then stand by for Castlethorpe troughs. "Right!"



Picking up water at Bushey Troughs. Additional interest is given to this photograph by the fact that the train shown is the Royal Train, as indicated by the four headlamps on the locomotive. The engine is one of the original "Claughtons" that are gradually being replaced by "Baby Scots" bearing the same numbers and names.

Down goes the dip for another 2,000 - gallon drink, but I don't intend to get caught this time, so wind it back till the surface of the water is only skimmed; 3,500, and not a drop over. I silently congratulate myself. More on the fire; what an appetite for coal—like a schoolboy's for cream buns! "Sorry!" I say, as I again sit on the inspector. He crosses to the driver's side, fed up with me falling on to him, I expect. Still, my seat is not much good to me; by the time my trousers have cooled to enable me to sit down, it's time to fire again. Roade, and we're a minute before time. Another cutting that re-echoes the noise of the train and we shoot through Blisworth like a scalded cat. A grinding from the wheels; I'm flung from one side to the other; a roar—that's Weedon, that was! Again the gauge drops back nearly to 200 lb.; again I wonder what to do. Another good firing up the sides and cut down the feed. More on the fire, a long blast on the whistle, and we enter the famous Kilsby Tunnel, which with its two huge air-shafts seems like three.



"The Royal Scot" express leaving Euston hauled by the well-known No. 6100 "Royal Scot." The safety valves are just blowing off and the steam sanding gear is in operation to assist adhesion, for the locomotive with a train of over 400 tons has to face a gradient of 1 in 70 immediately after the start.

Either it's me or it's the engine that's wrong; she's not shaping well. Come on, old girl, don't turn round on me now! I address the quivering mass of metal. Lights in the sky—what the dickens! Yes, white lights, high up! Oh, it's Hillmorton wireless station masts, the highest in the country—but lights before the eyes is a bad sign! Shut off steam here for Rugby; now's the chance to get things up to the mark. We approach a host of red lights; Fred gently applies the brake, and speed slackens as we glide through the great junction. I feel a lot better now the needle is on 250 lb. mark, and fill the boiler up while I have the chance. Mustn't waste steam—not when I have to work so hard to make it! In lap; Fred opens out. Newbold troughs; another 2,000 gallons is scooped up, and none is wasted.

After Nuneaton come the collieries, with their pithead gear faintly showing against the dark sky. Things seem to have settled down. I keep the pressure up and act more or less automatically. Tamworth, Lichfield, and Rugeley are passed, picking up water again at Hademore troughs. I'm not so rough on the inspector now. I only sit on his lap once from Rugby to Crewe. Another tunnel by Milford and Brocton, and after the factory lights of Stafford appear in the distance the (*Continued on page 175*)

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The Story of Artificial Silk—(*Cont. from p. 111*)

from this process the yarn should not be over twisted, while the loose, projecting hairs or fibres have to be burned off or "gassed" by passing the thread with great rapidity through a flame of gas from a bunsen burner.

As the fibres of the best cotton grown do not exceed 2 in. in length, and are commonly nearer 1½ in., it will be apparent that they must be properly twisted in order to make a thread at all. Moreover, in almost all cases the yarn is doubled two or more ends together before it can be successfully gassed. On the other hand, silk and rayon are in the first instance ejected in absolutely untwisted streams of gum which, for ordinary manufacturing purposes, require only a minimum of "throwing" or spinning.

This then is the key to the fundamental difference between a mercerised yarn and an artificial silk or rayon thread. The former is built up of short hairy fibres which, although disposed to cohere, must of necessity be twisted and doubled, and thus the very processes that go to the making of a cotton thread tend to diminish its lustre under mercerising. The brilliance of the continuous filament of raw silk, on the other hand, is but slightly modified by the few turns to which it is subjected.

In contrasting mercerised cotton and rayon reference has been made to the fact that both natural silk and rayon are in the first instance ejected in absolutely untwisted streams of gum. The manner in which this is effected in rayon will be fully explained at a later stage, but before resuming the story of artificial silk production it will be useful to have some knowledge of the natural filament it is intended to imitate.

Silk in its natural state is the fibrous substance ejected by the silkworm when it is preparing to undergo the change from caterpillar to chrysalis. When it has come to maturity, that is in little over a month, the larva begins to spin around itself a cocoon of this brilliant gum. From two tubular, many-coiled glands in its head it ejects two filaments or streams of a viscous liquid named fibroin, which lie together and are enveloped in a gummy substance known as sericin. These form a single thread, which is solidified at once when exposed to the air; and this thread, which takes about four days to spin, is usually about 1,400 yds. in length.

In China it used to be common practice to begin reeling from the cocoon as soon as the silkworm had finished spinning, and this stage could be discovered easily by rattling the silken ball. It was believed that by this means a more brilliant filament could be obtained.

In the ordinary course the larva is killed by heating the cocoon to about 70° or 80°C. after which a number of the cocoons are plunged into hot water to soften the gummy material. When the silk swells, the ends of the filaments are caught by suitably-shaped brushes, and after short lengths have been unwound by hand these are collected together and drawn through slots or guides to the swift of a reeling machine which, while making a hank of raw silk, unwinds the remainder of the cocoons.

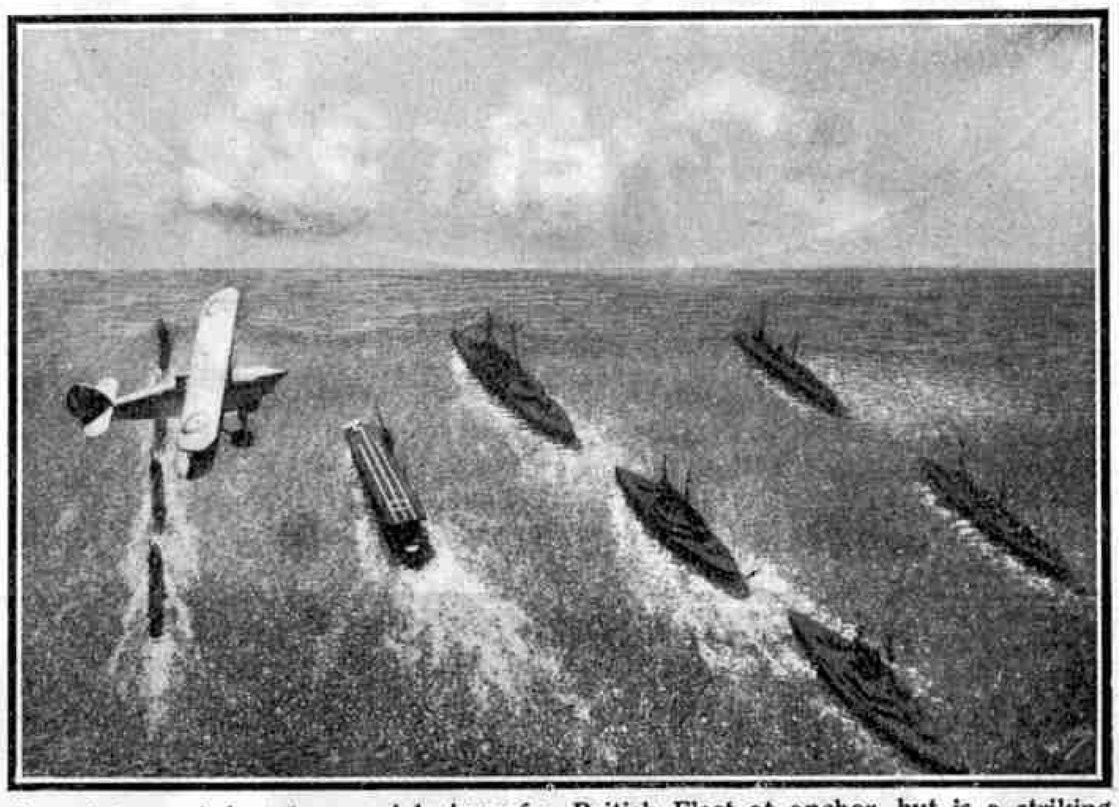
Exploring in the Mendips—(*Cont. from p. 105*)

of the closing years of the old Stone Age. The skeleton of one of these early inhabitants was discovered in 1903 in a cleft a little way from the entrance. It is believed that he lived from 10,000 to 12,000 years ago, and some of his bones have been left in the position in which they were found, in order to mark the spot. Near here was unearthed the only specimen yet discovered in England of a curious baton-shaped article of which many examples have been found in cave dwellings in France.

On penetrating farther into the caves a lofty chamber called the Fonts is discovered, in which is a series of beautifully-formed basins, arranged like gigantic steps, over which water flows in a magnificent cascade. Then comes the Swiss Village, where wonderful stalactites and stalagmites are to be seen on all sides, the reflections of these and of the roof in the clear water in the great limestone basins of the floor giving rise to many remarkable effects. Other halls and chambers are known by such names as Aladdin's Cave, the Fairy Grotto and the Diamond Chamber. The last-named is perhaps the most impressive of these great halls, for it is very lofty and its roof is superbly coloured.

Like practically every system of this kind in the world, Gough's Caves possess a capacious cavern that reminds visitors of a cathedral. This is known as St. Paul's, and is an immense chamber with a dome-shaped roof. King Solomon's Temple, another wonderful hall, is remarkable for a group of magnificent stalagmites known as the Pillars. One of these Pillars is 11 ft. in height and is perfectly symmetrical in form, and its surface is beautifully fretted, as if carved by a sculptor. Two large stone curtains formed by columns of stalactites descending from the roof of the hall are known respectively as the Archangel's Wings and the Organ Pipes, and these add to the wonderful effect obtained when the lamps in the cave itself are turned off and only King Solomon's Temple is illuminated.

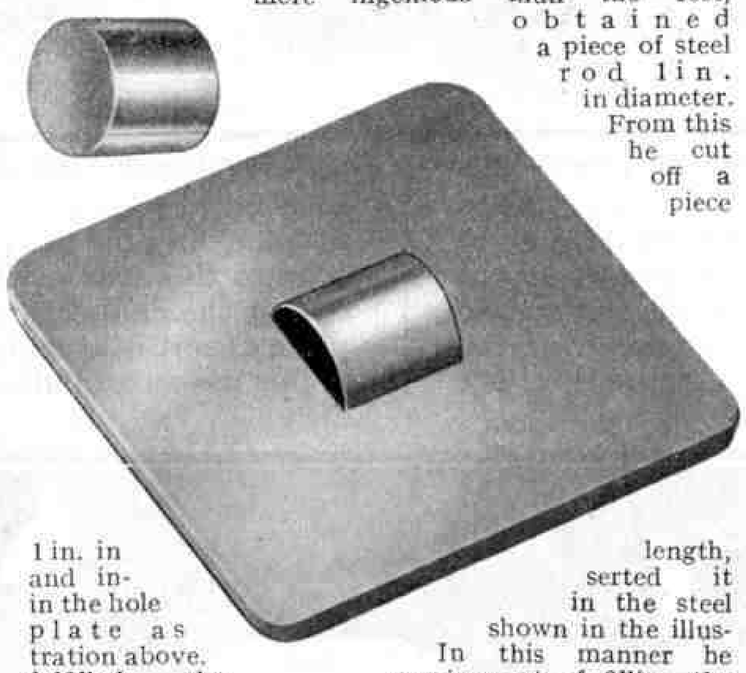
Near St. Paul's is a remarkable spectacle that at first glance suggests a frozen river. The "ice" is really a mass of white stalagmite that has a diamond-like sparkle in the electric light in which it is bathed. A "frozen fall" in the course of this underground marvel is equally impressive, the columns of limestone hanging from its bank suggesting icicles; and a similar fall close by conveys so well the impression of a winter scene at a great waterfall that it has been named Niagara Falls. Both formations are very beautiful and greatly impress visitors to the Caves.



Our photograph is not an aerial view of a British Fleet at anchor, but is a striking illustration of the realistic effect secured by an ingenious reader using a "Skybird" model aeroplane and a number of models in the new "Ship" series produced by our advertisers, A. J. Holladay & Co. Ltd. A particularly interesting feature of the "Skybird" models is that their scale is designed to fit in with Hornby Railway displays. The two series make a unique combination.

An Engineering Problem

We give herewith the solution of the engineering problem that appeared on page 66 of last month's issue. One of the apprentices, more ingenious than the rest, obtained a piece of steel rod 1 in. in diameter. From this he cut off a piece 1 in. in length, and inserted it in the hole in the steel plate as shown in the illustration above. In this manner he fulfilled the requirement of filling the square hole in the plate with a round piece of metal.



Great Ports of the World—(*Cont. from p. 102*)

towns; the metallurgical centres of Sheffield and Chesterfield, and such important manufacturing centres as Derby, Birmingham, the Black Country and the Potteries. These few references are sufficient to indicate the very varied nature of the trade of the port. The record of the port has been one of success from the time of its opening 40 years ago, and although the volume of traffic during the past year or two has reflected the world depression in trade, the total tonnage for the year 1931 reached the impressive figure of 5,898,298, the gross revenue being £1,276,110.

The principal item on the import side is of course raw cotton, the annual imports of which are valued at nearly £18,000,000, more than three times the value of any other imported commodity. Oil and wheat come next, and other substantial imports are road vehicles, copper and paper. On the export side cotton piece goods head the list, the total annual exports being valued at nearly £11,000,000, nearly three times greater than the next highest export. This is machinery, of which about £4,000,000 worth is shipped annually. Cotton yarn, woollen and worsted tissues, chemical products and iron and steel manufactures are chief among the many other commodities that are shipped from the port. This heavy traffic to and from the port is expedited by the Ship Canal Company's railways connecting with the Cheshire Lines, L.M.S., L.N.E.R. and G.W. railways, and by the direct communication between the Ship Canal and other inland navigations.

Regular steamship services are maintained between Manchester and the Canadian ports of Montreal, Quebec, St. Johns, Halifax, Victoria and Vancouver; and with the North Atlantic, Southern and Pacific ports of the United States. Other regular services link up Manchester with South America, South and East Africa, India, the Persian Gulf, and Mediterranean and other Continental ports.

How to Get More Fun—(*C. from p. 163*)

squared edge. Another point to be remembered is that the locomotive should never be pushed along the track by hand when the spring is run down.

The crank pins, and in the case of outside cylinder engines the piston rods, crossheads and slide bars where fitted should also be lubricated, but it is not necessary to flood these parts with oil as is often done. Excess of oil is flung off these swiftly-moving parts, and quickly finds its way on to the wheels and rails. Oil is best for piston rods, but grease, such as the Meccano Graphite Grease, is better for crank pins, as it stays where it is put, and does not leak over the surface of the coupling and connecting rods and so give the engine an untidy appearance.

It is useless to expect the engine to haul a good load if the tender and vehicles composing the train are not in a free running condition. New rolling stock is apt to be stiff, especially when pressed tinplate wheels are used. Each axle, where it passes through the wheels and through the frame of the vehicle, should therefore have a drop of oil applied to it. The wheels should also be spun round to make sure that the side frames are not pressing inward against them, and thus hindering their free rotation. This condition sometimes arises as a result of packing, but it may be cured by gently easing outward the bearing or frame in question.

No. 1 and No. 2 Special Tenders, and also the bogies of No. 2 Special Pullmans, are provided with axle boxes that are packed with grease before the vehicles are fitted with wheels. All that is necessary, therefore, is to make sure that the wheels spin freely. The couplings of the various components of a set also should be examined in order to see that they pivot freely. Any stiffness here should be dealt with by means of a drop of oil or a little graphite grease, as a stiff coupling is a possible cause of derailments on curves. This precaution is particularly necessary in the case of long bogie vehicles.

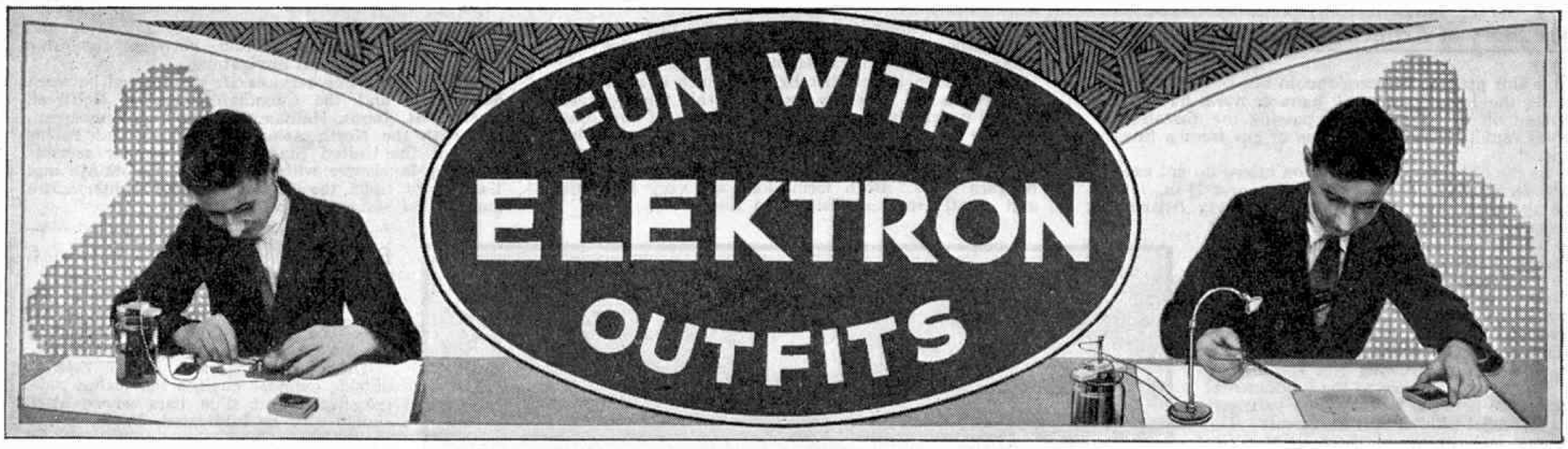
American Aeroplanes—(*Cont. from page 121*)

three-engined monoplanes every week. The most interesting production of the factory is a large transport monoplane that is claimed to incorporate many interesting features not hitherto in use in the United States. The machine was produced in 1932, and as it is still in its experimental stages full details cannot yet be given.

The Stinson "Detroiter" is a high wing commercial monoplane equipped with a single engine and capable of seating six in a commodious cabin. The construction is somewhat on Fokker principles, the machine being provided with a wooden wing covered with fabric, and a welded steel-tube fuselage. It is interesting to note that the "Detroiter" was the first American machine that had incorporated in its design a completely enclosed cabin, an engine starter, wheel brakes, and sound-proof cabin that can be heated if necessary.

The "Detroiter" is 46 ft. 8½ in. in span and 32 ft. 8 in. in length, and is normally fitted with a Wright "Whirlwind" engine developing 300 h.p. This gives a maximum speed of 135 m.p.h., a cruising speed of 115 m.p.h., and a landing speed of 56 m.p.h. The photograph of the machine published with this article shows it equipped with the Packard Diesel engine, the first Diesel air-cooled radial aero engine ever produced. This interesting engine was fully described on page 778 of our issue for October, 1930. It is of the 9-cylinder type and is rated at 225 h.p. at a speed of 950 r.p.m. The Diesel engine is particularly suitable for use in aeroplanes as it practically eliminates all danger from fire, the fuel employed being non-inflammable until it has been atomised into a very fine spray. It cannot be ignited by a lighted match and a cloth saturated in it will only burn like a wick. The fuel will, in fact, put out a fire if poured on it!

The Stinson Aircraft Corporation was founded by the late Mr. E. A. Stinson, one of the earliest pilots in the United States, who learned to fly in 1911. It is claimed that Mr. Stinson has taught more men to fly than any other instructor, while he also worked for 10 years as a test pilot. The company make a number of other machines in addition to the "Detroiter," varying in size from a four-seater cabin machine to a big three-engined 10-passenger monoplane with a span of 66 ft., and a maximum speed of 142 m.p.h. The firm specialise in civil machines and does not, in fact, build any for military purposes. In 1930 they built and delivered more aeroplanes than all the other American cabin aeroplane manufacturers combined.



GENERATING ELECTRICITY FROM MAGNETISM

OF all electrical experiments those illustrating the connection between magnetism and electricity are the most fascinating, for the giant dynamos at work in large power stations and the electric motors employed in factories and workshops depend upon this connection for their action. Many experiments described in the Elektron Manuals show how magnetism and electricity are related to each other, but others of a very attractive kind can be carried out with the contents of Elektron Outfits.

An interesting experiment can be performed with the aid of a Magnet Coil and a smaller coil of about the same diameter made by wrapping No. 35 Gauge E.S.C.C. Copper Wire round a cylindrical former of the required size. From a length of 3 ft. of wire eight turns are made, leaving straight portions of equal length at the ends. The insulation is removed from the tips of the wires, and they are joined to lengths of connection wire passing over the Bracket of the Elektron Stand and connected to Terminals on the Circular Base, as shown in Fig. 1. This leaves the coil suspended from the Stand and free to swing backward and forward. Its height is adjusted to bring it into the position shown in the illustration, when it will be immediately opposite the end of the Magnet Coil, which is placed on any convenient support in order to lift it clear of the table.

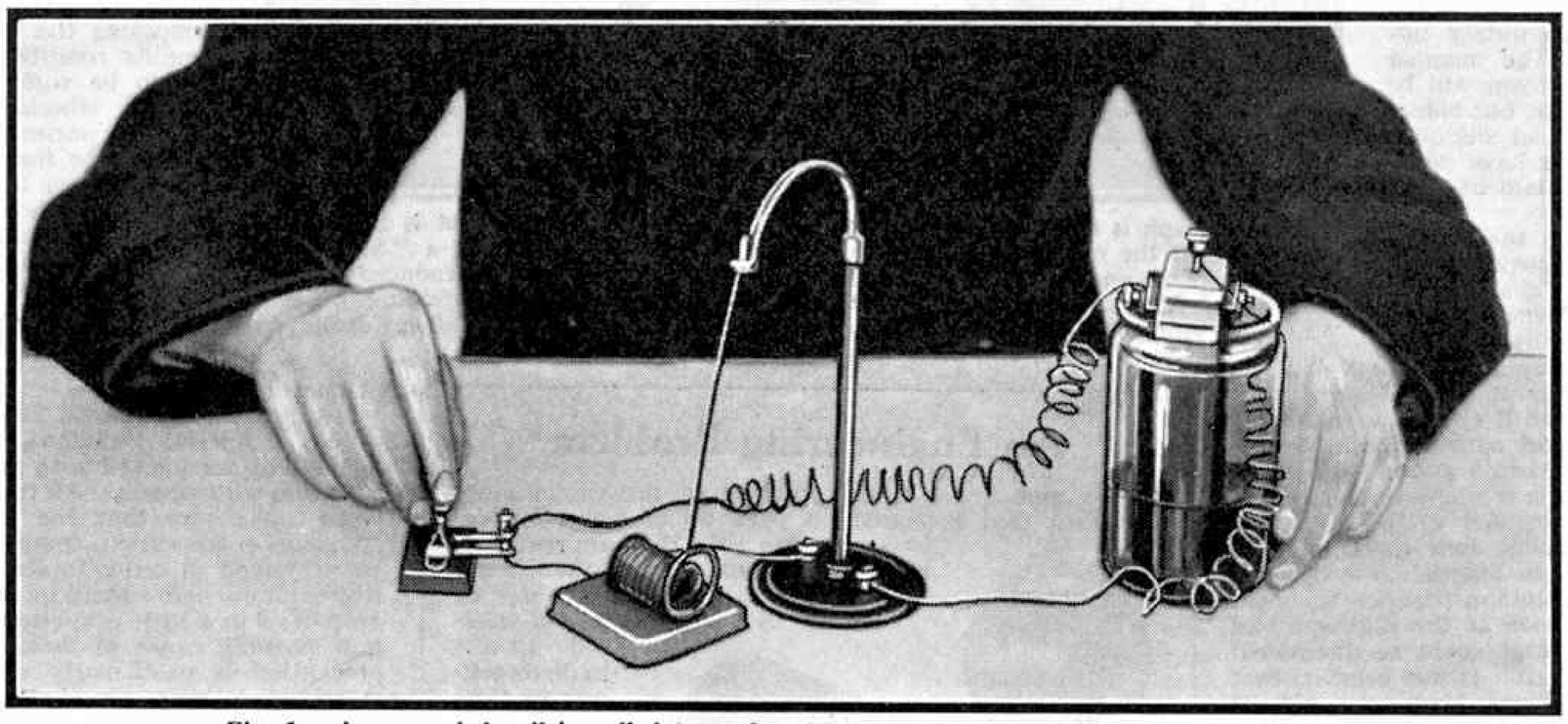


Fig. 1. A suspended coil is pulled towards a Magnet Coil through which current passes.

The electrical connections are then made. One pole of the Bichromate Cell is joined to a Terminal on the Circular Base, and the other is connected to one of the Switch Terminals. The second Terminal on the Switch is joined to one end of the Magnet Coil, and the remaining end to the second Terminal on the Circular Base.

The illustration makes the course of the wiring clear, and it will be seen that closing the Switch causes current to pass through both coils. The suspended coil then immediately swings rapidly toward the Magnet Coil, or away from it, and the movement is reversed when the wires connected to its ends are interchanged.

In this experiment the two coils attract or repel each other because the passage of current transforms them into electromagnets. If the current flows the same way round the two coils, their north poles point in the same direction. Opposite poles then face each other and attraction therefore follows. Reversing the current in one of the coils brings similar poles opposite, and the two then repel each other. The effect of the Magnet Coil can be increased by placing a Magnet Core inside it, for this concentrates the lines of magnetic force that come into existence as soon as the current is switched on.

The substitution of a piece of soft iron for the small coil converts this device into a useful indicator of the kind fitted to electric bell systems. The electrical connections are simpler, for now the poles of the Bichromate Cell have to be joined only to the ends of the Magnet Coil, the Switch being included in one of the connections. On passing current through the Coil the piece of soft iron swings towards it, for it is magnetically attracted.

For use as an indicator, a device of this kind is placed in each of the circuits of an electric bell system. As soon as the switch in any one circuit is closed, current flows through the windings of the appropriate coil and the piece of soft iron is attracted. Small squares of thin card, usually marked with coloured designs, are attached to the suspended pieces of soft iron in order to make their movement easily visible, and numbers or names are marked on the glass cover of the box containing the indicators in order to show which switch has been pressed.

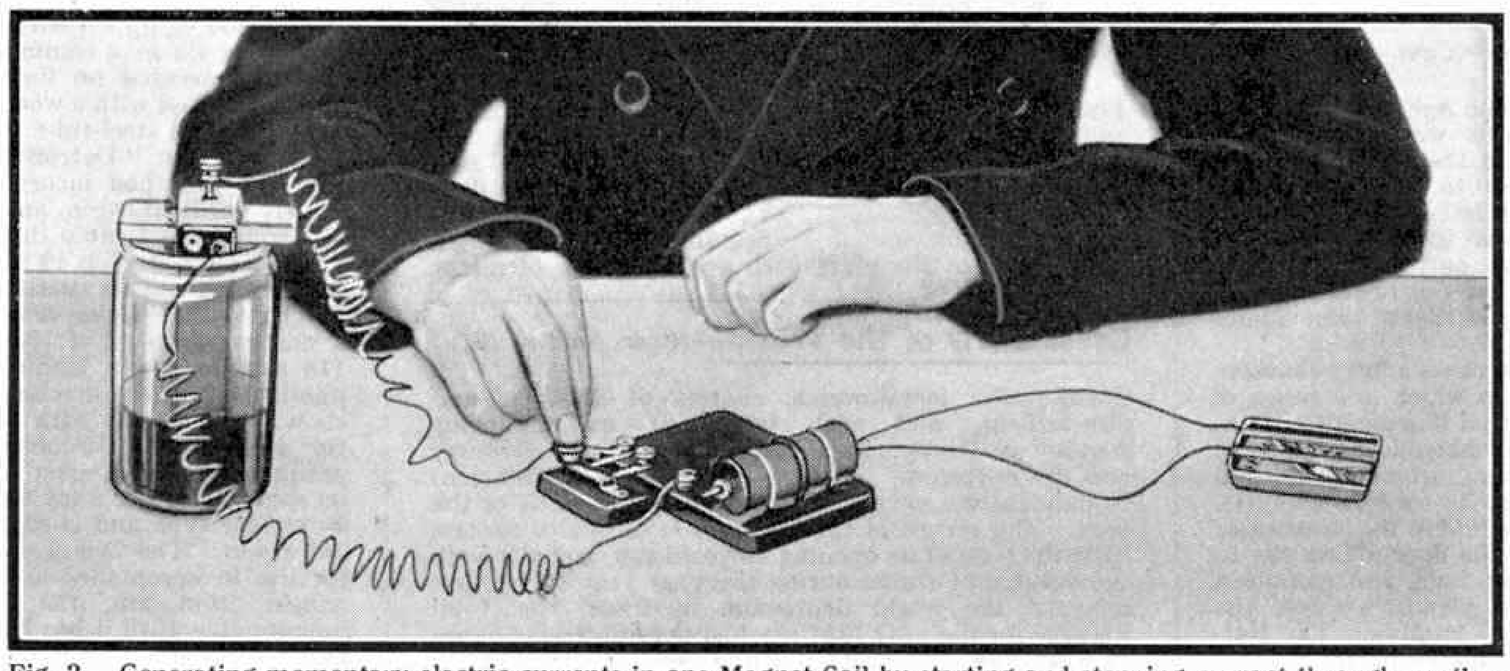


Fig. 2. Generating momentary electric currents in one Magnet Coil by starting and stopping current through another Coil. The currents excited in this manner cause the Compass Needle to deviate from its normal position.

The experiment with the two Magnet Coils that has been described shows how magnetism is produced from electricity. It is even more fascinating to realise how electricity can again be generated from this magnetism. There are many ways of demonstrating this, but a simple and convenient one can be carried out with the arrangement shown in Fig. 2. In this two Magnet Coils, each fitted with a Magnet Core, are placed end to end on the Universal Base, and are kept in position by means of stout thread or elastic bands. The ends of the windings (Continued on page 175)

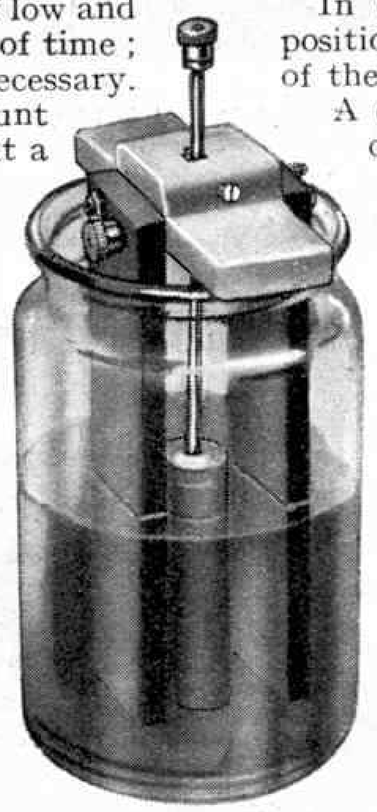
The Elektron Bichromate Cell

A Safe and Convenient Source of Current

IN experiments with electricity the first requirement of course is a source of current, and for experiments of the type carried out with the contents of the Elektron Outfits this current is best obtained from a voltaic cell. The Elektron Bichromate Cell is an excellent example of this type. It gives a direct current of low and safe voltage and can be made to last a reasonable length of time; and it is easily assembled and as readily recharged when necessary.

The voltaic cell was invented about 140 years ago by Count Alessandro Volta, a famous Italian scientist, who found that a weak current passed through a wire joining discs of copper and zinc separated by a disc of flannel soaked in acid. Later he built a pile of these discs, arranging them in the succession copper, flannel, zinc, and then obtained a more powerful current through a wire connecting the first copper disc with the last zinc disc.

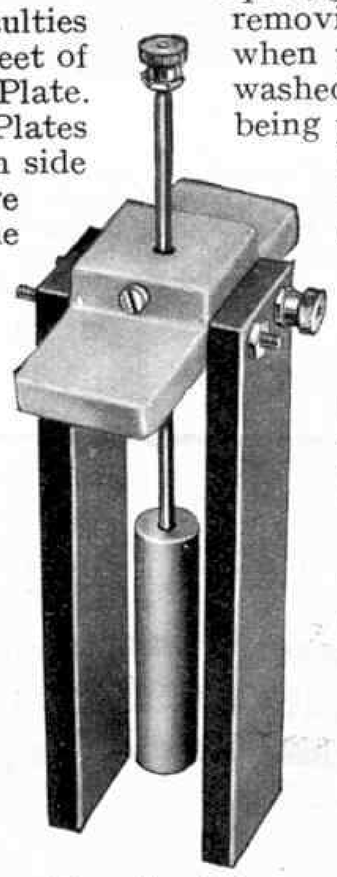
This source of electricity was known as Volta's pile, and it was soon replaced by the more convenient device known as the voltaic cell, made by placing copper and zinc plates in dilute acid. A simple cell of this kind can be made from the Copper and Zinc plates in Elektron Outfits, which are placed in a glass or earthenware vessel containing dilute sulphuric acid of the strength employed in accumulators. Unfortunately, owing to transport regulations, acid cannot be included. The necessary sulphuric acid can be purchased in the quantity required for a few pence from any chemist, or it can be obtained at a garage or other place where accumulators are charged. The Copper and Zinc Plates are provided with holes through which bolts can be passed and secured in position by means of nuts, and terminals can then be run on the shanks of the bolts in order to enable wires to be attached. This cell is illustrated on page 1 of the Elektron Manual No. 2.



The Elektron Bichromate Cell with the Zinc Rod lowered into the solution ready for use.

As a source of electric current for experimental work the simple cell has two disadvantages. One is that the Zinc Plate quickly dissolves; and the other is that current is only given for a short time, owing to polarisation, or the formation on the Copper Plate of a layer of the gas hydrogen, which prevents the metal from making contact with the acid.

In the Elektron Bichromate Cell the first of these difficulties is overcome by using a solid Zinc Rod instead of a thin sheet of this metal, and substituting Carbon Plates for the Copper Plate. A porcelain Cell Mounting supports these, the Carbon Plates being fitted on two Threaded Rods passing through it from side to side, and secured by means of hexagonal nuts, which are firmly screwed down in order to make good contact. The Zinc Rod fits on one end of the Electroscope Rod, which is passed through the central hole of the Cell Mounting, and should be screwed down tightly. It can be raised or lowered as desired, and fixed in any required position by means of a set screw.



How the Carbon Plates and the Zinc Rod are assembled on the Cell Mounting.

The sizes of the parts used in making the Elektron Bichromate Cell have been carefully calculated to enable them to fit into a small glass jar, about five in. in height and of proportionate width. A 1 lb. jam jar is a suitable container. This is only half filled with the liquid employed, so that when the Zinc Rod is raised to its greatest height it is preserved from rapid solution in the acid.

In order to overcome the second of the two difficulties previously mentioned, Bichromate of Potash is dissolved in the acid used in the Cell. The hydrogen that otherwise would cause polarisation is converted into water by this chemical, thus ensuring a continuous flow of current. The solution is prepared by dissolving ½ oz. of the Bichromate of Potash in 4 oz. of water. This quantity of the chemical is only one-sixth of the amount included in the Outfit and thus ample allowance is made for renewals. The red crystals dissolve very readily if they are first crushed, an operation that can be carried out by simply pressing them firmly with a flat piece of hard wood, and stirring also hastens the process.

When the Bichromate of Potash is dissolved, 1 oz. of dilute sulphuric acid is added to the red liquid. Acid of accumulator strength is used, and as already explained, this can be purchased from a chemist or at a garage. The mixture should be made with the glass jar standing in the sink, or other place where no harm can be done if the liquid is accidentally spilled, and the acid should be added to the solution, and not vice versa.

In order to complete the Cell the Mounting is placed in position and the screw holding the Zinc Rod above the surface of the liquid is slackened in order to allow this to be lowered. A current then flows through wires or coils with their ends connected to the Terminals on the Carbon Plates on the Zinc Rods. These Terminals are described as the poles of the cell, and the current flows from the Carbon Plates through the external wiring to the Zinc Rod. The Carbon Plates form the positive pole of the cell and the Zinc Rod forms the negative pole.

A cell prepared in this manner gives current at about 2 volts steadily for a considerable time without special attention. It will give the best service if care is taken to raise the Zinc Rod out of the liquid when current is not required; and if there are long intervals of inaction a little water should be added from time to time to maintain the original level and the Carbon Plates should be rinsed in order to free them from any crystals that form on them, for these would spoil their contact with the acid liquid. It is a good plan to keep the cell in a small box of wood or strong cardboard and to pack shavings or paper round it. This diminishes the risk of spilling the liquid by accident.

When the Elektron Bichromate Cell shows signs of exhaustion its activity can easily be renewed. For this purpose it is placed in a sink and the Cell Mounting, with the attached Plates and Zinc Rod, is lifted out and rinsed with water. The liquid, which is now much darker in colour, is then carefully poured away down the sink and the jar is washed out before being recharged with Bichromate of Potash solution and dilute sulphuric acid, as already explained. The Cell Mounting is replaced, and after the outside of the jar has been carefully dried the Cell is again ready for use.

Since the Carbon Plates and the Zinc Rod are wetted by the acid liquid, great care should always be taken to prevent splashing when removing them from the jar. They should only be lifted out when the Cell is standing in a sink, and should be thoroughly washed with water before being laid aside while new solution is being prepared. If a little acid is spilled by accident, no harm will be done if it is immediately washed away with water. This plan is not effective if the acid falls on cloth or fabric of any kind, however, for the liquid spreads along the fibres. The place affected should then be moistened with ammonia immediately in order to neutralise the acid and prevent damage.

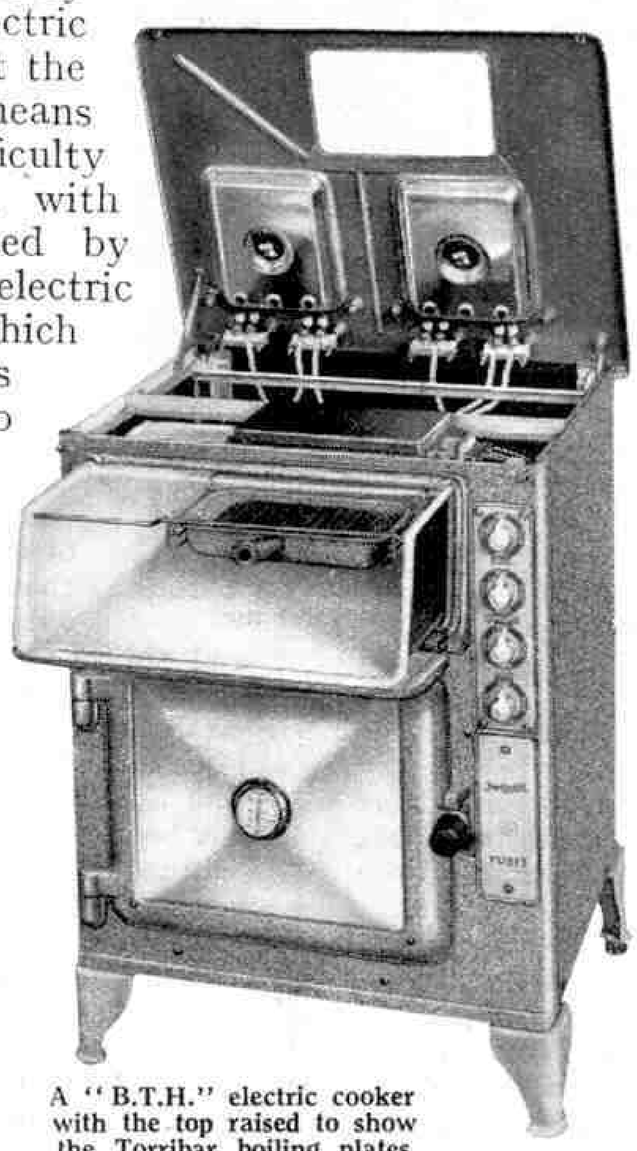
It is very often an advantage to make use of a stronger current than that provided with a Bichromate Cell. All that is necessary for this purpose is to fit up a second Bichromate Cell from the Cell Mounting, two Carbon Plates and the Zinc Rod, with the necessary Electroscope Rod, Bolts, Nuts and Terminals, all of which can be obtained separately. The two Cells can then be connected in two different ways. In one of these the two positive poles are connected together, and the two negative poles also are joined. The effect of this is to transform the two Cells into the equivalent of a single large Cell, and this arrangement gives a larger current, but one having the same voltage as a single Cell. Cells connected in this manner are said to be in parallel.

The second method of combining two Bichromate Cells is to place them in series. For this purpose the negative pole of one Cell is connected to the positive pole of the other, and the wires through which current is led to the electrical appliance in use are connected to the remaining Terminals. In this case the voltages of the two Cells are added together.

Elektron Outfit owners need not hesitate to make use of two Bichromate Cells in series, except with their lamps, and they will find it very interesting to compare the working of the Elektron Bell and other appliances when supplied with current from two cells with their behaviour when a single Cell is employed.

II.—HEATING AND COOKING

LAST month we told the story of the electric lamp, in which a filament is made to glow brightly by raising it to a very high temperature by passing an electric current through it. Electric heaters depend on the same principle, but the use for this purpose of wires heated by means of electric currents involves a great difficulty that is not encountered in connection with electric lamps. This difficulty is caused by the presence of air. The filament of an electric lamp is enclosed in a glass vessel from which the air is pumped out, and which contains only a proportion of an inert gas that has no chemical action on the hot wire. On the other hand, the conducting wires of electric heaters must generally be freely exposed if the full benefit is to be obtained from their radiations. The wire employed therefore must be of a metal or alloy that is not readily oxidised when strongly heated in air.



A "B.T.H." electric cooker with the top raised to show the Torribar boiling plates. Photographs by courtesy of the British Thomson-Houston Co. Ltd.

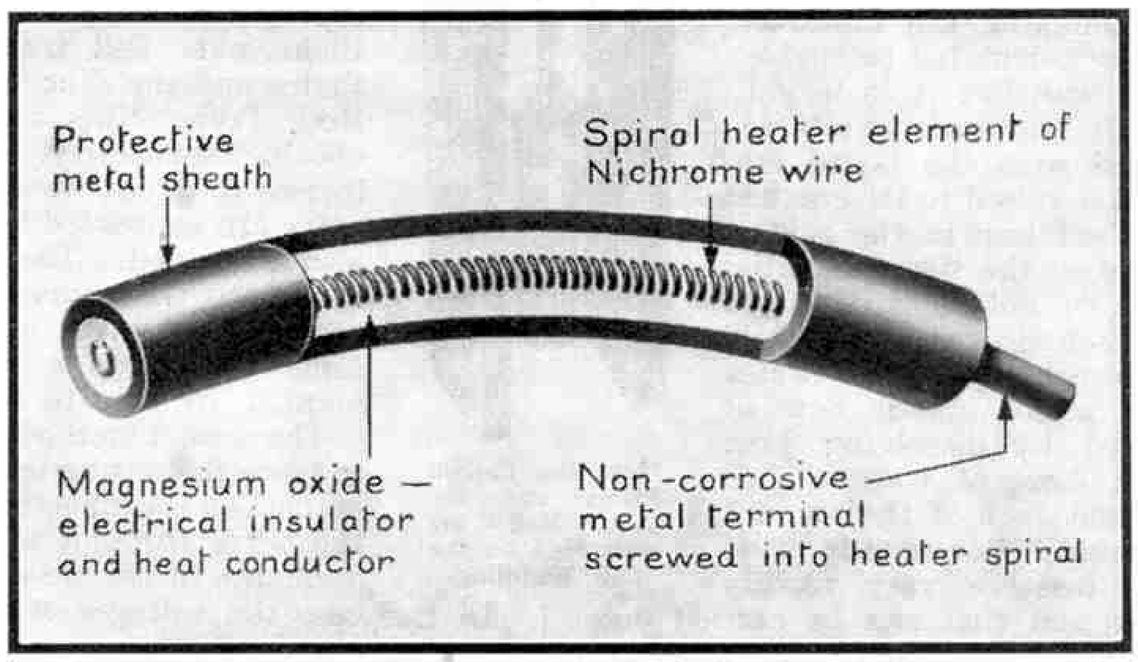
Continual experiments have been made since electrical heating was first introduced in order to find the best material of which to make the wires of electrical heaters, and to-day an alloy containing 80 per cent. of nickel and 20 per cent. of chromium has become practically standard for this purpose. It does not become coated with a layer of oxide, as copper wire would do in similar conditions, and thus there is no scaling and loss of material. It is therefore suitable for use in domestic household appliances such as electric fires, cookers and toasters, and is employed also in the construction of furnaces and other forms of industrial electrical apparatus.

This alloy of nickel and chromium is tough and ductile, and can readily be formed into the spirals from which the heating elements of electrical appliances usually are made. It does not change its properties very greatly when raised to a high temperature and kept there for a considerable length of time, and in this respect it is superior to many metals that otherwise might be suitable, but are liable to become brittle in these conditions. It is often used at a working temperature of 1,000°C., and its life is then practically indefinite, but it can safely be employed at a temperature of about 1,150°C. These temperatures of course are much below that of the filament of a modern gas-filled electric lamp, which is about 2,630°C., but the presence of air makes it difficult to use higher temperatures with complete absence of scaling, and such temperatures are not necessary when heat, and not light, is required.

Many readers no doubt are familiar with the general design of heaters, in which the spiral resistance wires are mounted in grooves in fireclay moulds, metallic reflectors of various shapes being used to direct the heat. In toasters and other small electric appliances no mounting is necessary, the wires being stretched directly over a frame of insulating material.

An interesting application of a nickel-chromium alloy is the Torribar heating element manufactured by the British Thomson-Houston Co. Ltd. for use in a large range of domestic electrical appliances. In this element the wire spiral is not exposed, as it is in ordinary electric fires and toasters, but is enclosed in a tube of stainless steel.

In making a Torribar element, the length of heating spiral required is provided with solid nickel terminals screwed into its ends. It is then placed inside the steel tube, one end of which is completely closed by a terminal, while the other remains open. The tube is then passed through a machine that makes indentations in it at regular intervals, and these have the effect of centralising the spiral of wire and fixing it in the required position.



Sectional view of part of a Torribar heating element.

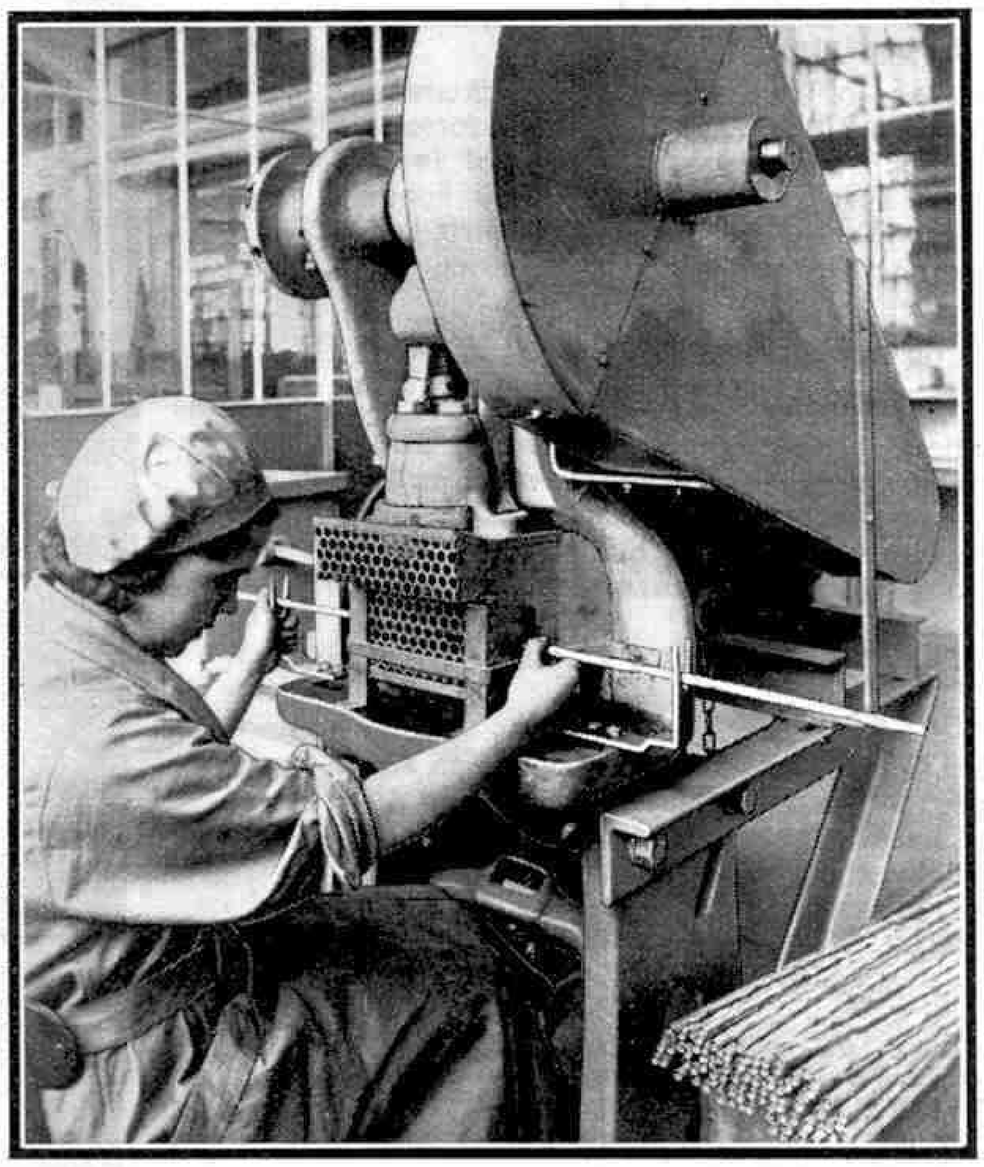
The tubes are now stood on their closed ends in a machine in which they are kept vibrating continuously by means of a series of blows from light hammers, while dry crystalline magnesium

oxide is poured into them. The powder fills the space between the spiral and its steel sheath and the shaking causes it to settle down and to become firmly packed. Electrically, magnesium oxide is an insulator, and therefore a current passed through the spiral cannot leak through it to the steel tube. It conducts heat very well indeed, however, and when the temperature of the spiral rises on passing electric current through it, the heat developed passes rapidly across the magnesium oxide to the steel tube, which soon glows with a red heat.

Fitting the terminals and ferrules to Torribar heating elements for use in electrical appliances.

When each tube has been completely filled with magnesium oxide its ends are securely sealed by means of washers held in place by pressing the ends of the tubes themselves on to them. Then it is passed through what is known as a swaging machine, which smooths out the indentations previously made and reduces the diameter of the tube, with the result that the magnesium oxide is further compressed, to ensure efficient contact between the nickel-chromium wire on the one hand and the stainless steel tube on the other. The element is then bent to the shape required for its special purpose and its ends are cut off to expose the terminals, to which suitable leads are connected.

It will be seen that the nickel-chromium wire in the Torribar element is not in contact with the air, but is as effectively sealed off as is the filament of an electric lamp. It is also well protected from mechanical damage, and no harm can follow the spilling over it of liquids, a type of accident that may easily occur with an electric cooker. Thus the element is safe to use as well as highly efficient and reliable. It is particularly valuable in the making of immersion heaters. These heaters are simply plunged into the liquid to be heated, and as all the necessary electrical connections are made directly to the heating element, they may be used to raise the temperature of liquids in tumblers or any other suitable vessels.



Making the indentations in the stainless steel tubes that centralise the heating spirals and keep them in position.

The Torribar element is well adapted for use in electric cookers, and the illustrations on this page show electric cookers to which it is fitted in process of construction in the works of the British Thomson-Houston Co. Ltd., to whom we are indebted for much of our information. The central feature of a cooker of this type is a removable oven, around which heating elements are placed. Above the oven is the grill chamber, and above that are the hob, which carries plates on which liquids in pans can be boiled, and the top surface of the grill, which is used for simmering and operations requiring gentle heating.

The first step in the production of cookers is the preparation of the castings and punched steel metal parts that are required. These are carefully designed and produced by means of tools specially made with great accuracy in order to ensure that the products are of standard size and can be assembled without difficulty. The sheet metal parts of which the ovens and grill chambers are composed are fitted together and assembled by means of spot welding, after which most of the metal parts are given a coating of vitreous or glassy enamel. This enamel cannot be applied with success to metal that is not perfectly clean, and the parts to be coated therefore are sand-blasted, or dipped in dilute acid, in order to remove scale and dirt before being sprayed.

The enamel is similar in appearance to coloured glass, and for use it is ground to a very fine powder and mixed with water into a smooth creamy liquid. After the first coating is applied, the parts pass through a dry oven and then through an electric furnace in which the temperature is sufficiently high to fuse the glassy particles together into a very hard protective coating. Parts that are on the outside when the cooker is completed are given further coatings of white or mottled grey enamel.

In the meantime the sections that require machining are being prepared and the necessary heating elements are being built up. All is then ready for the final assembly, which is a continuous operation carried out on a roller conveyor. Each cooker begins its progress along the assembly line in the form of a box built up of enamelled steel sheets, on the inside of which the oven-heating elements are fitted, while material that conducts heat only with great difficulty is packed tightly on its outer surfaces in order to (Continued on page 175)

KEMEX

CHEMICAL EXPERIMENTS

The contents of the Kemex Chemical Outfits provide many hours of fascinating fun. With the apparatus and materials contained in them a boy can make dyes, inks and soaps; test foodstuffs for impurities; analyse air and water; grow crystals; write with electricity; make invisible inks and a chemical garden; prepare gases, and perform a host of other interesting chemical experiments.

The Outfits include everything necessary, and the hundreds of experiments that may be made are described in a simple manner in a well-illustrated Manual.

PRODUCT of MECCANO LIMITED LIVERPOOL

No. 1 KEMEX OUTFIT

130 Experiments

This Outfit contains a supply of specially selected chemicals, together with a length of Magnesium Ribbon, sufficient to perform 130 attractive and varied experiments. The apparatus provided in the Outfit includes Test Tubes and a Test Tube Holder, a Glass Funnel, Filter Papers, and Glass Delivery Tubes, with a simple Spirit Lamp that makes the Outfit completely self-contained. Price **7/6**

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250 Experiments

This Outfit includes the whole of the contents of the No. 1 Outfit, and further chemicals that increase the range of experiments up to 250. The additional apparatus includes a porcelain Evaporating Dish, Special Test Tubes to withstand high temperatures, a Test Tube Stand, and the Kemex Retort Stand and Ring, with Wire Gauze. Price **15/-**

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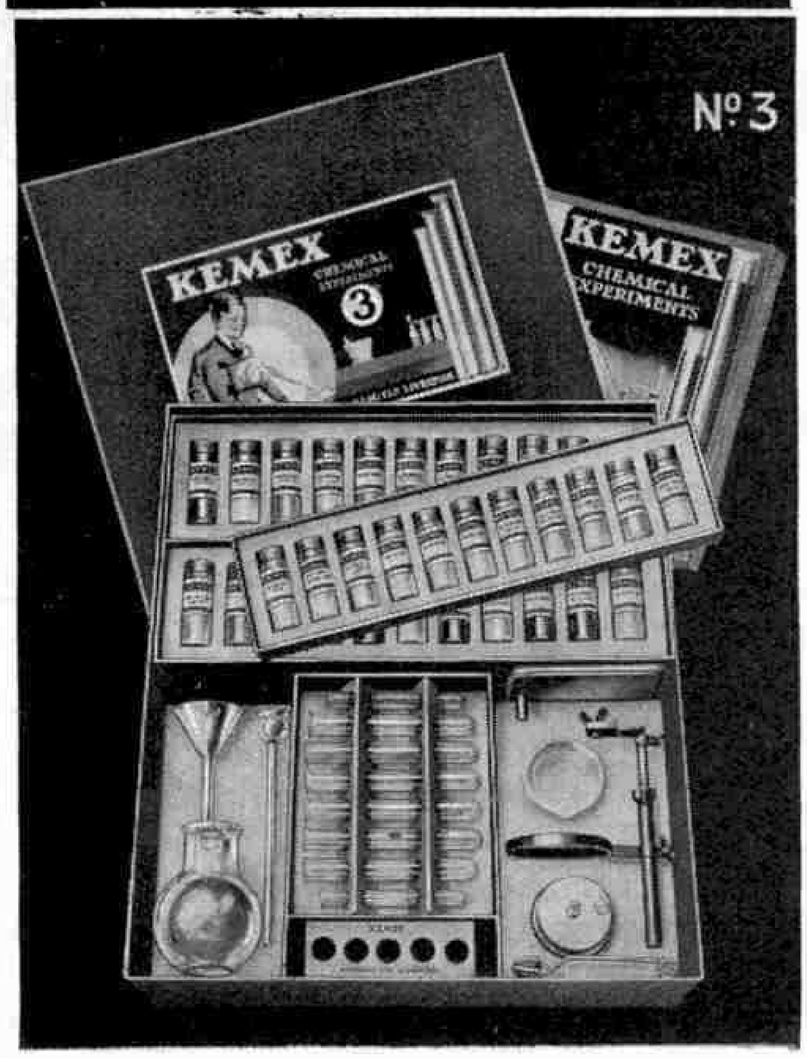

The apparatus included in Kemex Outfits and refills of Kemex chemicals can be obtained separately. Ask your dealer for the leaflet giving a list of Kemex parts and their prices, or write for a copy to the address given below.

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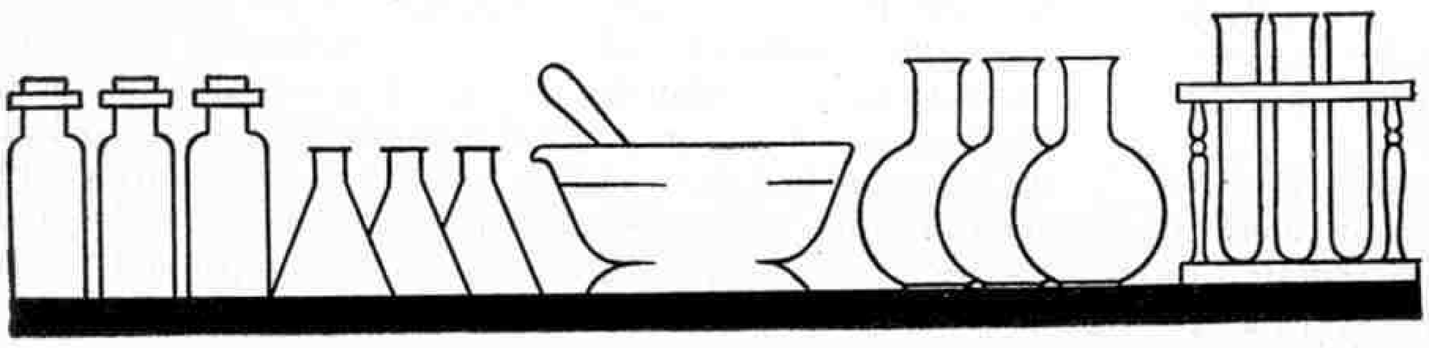
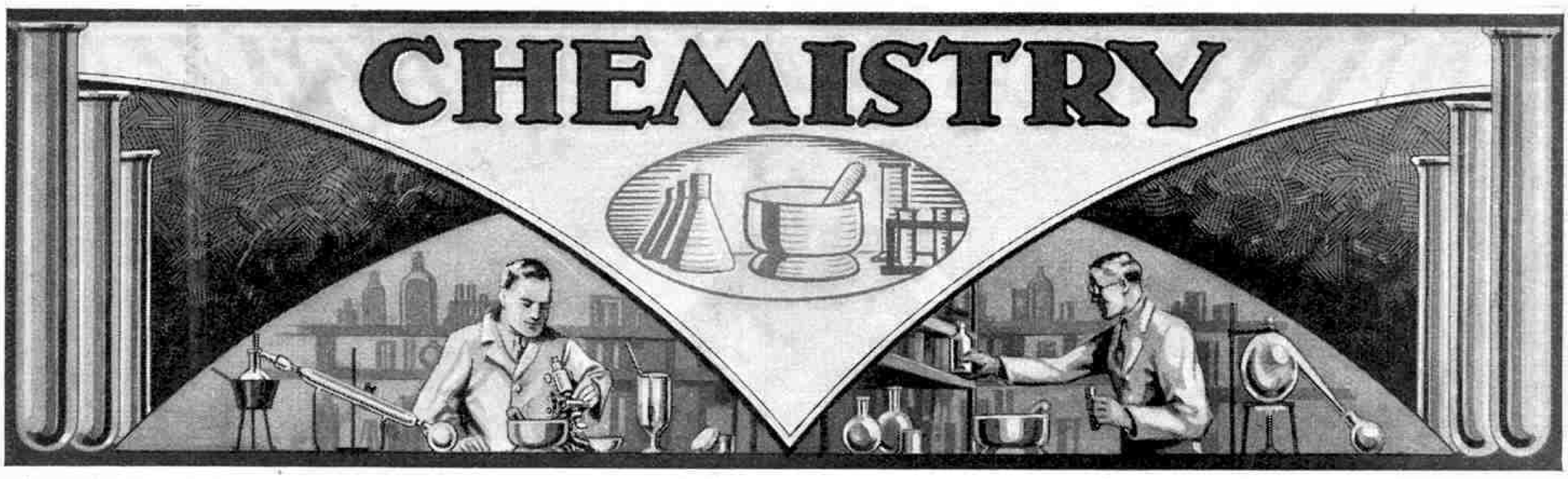




GOLD—THE NOBLEST OF METALS

IT is curious to find that rank seems to have played a part even in chemistry. Certain chemical elements are distinguished as noble, and they have earned this description by their reluctance to associate or combine with other elements, which are regarded as common. For instance, the colourless gases helium, neon and argon, which lurked unsuspected in the atmosphere until about 40 years ago, have been described as noble gases because as yet no means of making them enter into union with even the most active of other chemical elements has been discovered. Gold, platinum and silver have been regarded as noble metals because they do not tarnish or rust when exposed to the air, and the alchemists thought gold to be the noblest of all metals because in addition it resists the attack of all ordinary acids.

The lofty indifference of gold to other elements helped to make this metal familiar to man, for as a result it is always found in the earth in the free state, and not disguised in the form of ores or compounds, as is the case with such metals as aluminium and iron. It is not easy to realise the existence of the glittering white metal aluminium in clay, nor can the red and yellow ores of iron be recognised as sources of this metal by anyone unfamiliar with iron mining. It is impossible to miss the presence of gold when looking at the quartz from which the precious metal is extracted, however, for its glitter immediately attracts the eye. Very little effort also is needed to detect it in gold-bearing sands, for when these are washed with water the glittering specks of the metal sink to the bottom of the pans containing the liquid, while the sand itself, which is much lighter, is readily washed away.

An Australian gold mine, showing the tanks in which the tailings are treated with potassium cyanide. Photograph by courtesy of the High Commissioner of Australia.

For these reasons gold has been known from very early times. It was of little use except for ornamentation, but was very highly prized for this purpose, and its malleability led to its use in coinage. It is curious to reflect that gold, which does not rust away, is too soft to make tools or weapons, or for employment in engineering; while iron, man's greatest ally among the metals, rusts so readily that the annual loss due to this cause is enormous.

In view of the early importance of gold, it is not surprising to find many references to it in the Bible. One of the most interesting of these occurs in the second chapter of Genesis, where mention is made of "the whole land of Havilah, where there is gold." The Biblical reference to gold that has had the most lasting effect concerns the mines from which Solomon obtained the gold used for ornamenting his Temple. This gold came from the Land of Ophir, and for centuries explorers searched Arabia, Ethiopia, and South Africa in the hope of finding the fabulously rich mines that yielded King Solomon's treasure. Many believe that the Zimbabwe ruins in Southern Rhodesia were the source of this gold. These ruins tell us of a great gold-mining venture of the past. The people who built them and worked the mines appear to have been overcome by unexpected enemies, for ore awaiting smelting was found in the remains of the buildings, and other indications show that the life of the community was suddenly brought to a standstill.

There are many other old workings throughout Rhodesia. From time to time prospectors still set out into remote parts of the country to look for King Solomon's Mines, and only a few months ago one of these hardy adventurers returned to claim that he had discovered their exact position.

At various times almost every country in the world has been the scene of a romantic search for gold. Centuries ago Great Britain and Ireland were scoured for it, and articles made of Irish gold have been found during exploration of buried ruins of ancient Eastern cities. Even to-day gold is mined to a very small extent in Wales, but in our own times the chief sources of the metal have been Australia and South Africa, Canada, Yukon and Alaska. Gold rushes have occurred recently in Kenya and other places, but the greater part of the world's gold is obtained by crushing ore dug out of the deep mines of the Rand in South Africa, and from similar workings in Canada, Australia and other countries.

Although gold deservedly ranks as a noble metal on account of its resistance to the rusting action of the atmosphere and to the attack of acids and other chemical agents, the ingenuity of the chemist has found ways to overcome its reluctance to combine with other elements. The metal is insoluble in strong nitric acid, and the jeweller actually places a drop of this liquid on ornaments and jewellery in order to detect the substitution of brass for gold, for its action on brass is very violent, a blue liquid being formed and brown fumes being given off. The strongest hydrochloric acid also has no action on gold, but when this liquid is mixed with strong nitric acid in the proportion of three or four of the former to one of the latter, a piece of gold placed in the mixture dissolves to form one of the rare compounds of the metal. It seems a little unfair that two acids should be let loose at once upon gold! The secret of the combination is that the green irritating gas chlorine is set free, and it is this that unites with the gold. *Continued on page 175*)

MAKING SUGAR AND GUM FROM STARCH

WHENEVER starch is mentioned we think immediately of a white substance that is bought in packets and used for stiffening collars and other linen articles; that we should eat this substance is one of the last ideas that would occur to us. Yet in reality we consume enormous quantities of starch, for it is one of the chief constituents of bread, rice, tapioca, potatoes, and countless other things that we eat regularly. There is no difficulty in proving that this is the case. For instance, in the case of a potato all that is necessary is to allow a drop of tincture of iodine to fall on a freshly-cut surface. A blue stain appears immediately, and this is a proof of the presence of starch, for it is due to the formation of a compound of starch with iodine. Boiling rice and similar foodstuffs with water produces a liquid that also gives this blue colour when a drop of iodine solution is added to it.

The foodstuffs we have mentioned are more appetising than starch from a packet, partly because they contain also other substances, and partly because they are boiled or baked; yet the starch is the important feature. If we are to make use of this substance as a food, however, it must be changed in some manner to enable us to absorb it easily. We cannot take it up directly, for it does not dissolve in cold water. Solutions can be made only by boiling it with water, the effect of which is to burst the granules of starch. It is scarcely possible to do this with foodstuffs, but fortunately our digestive systems, by means of wonderful chemical changes, transform the starch in substances that we eat into sugars that are absorbed without difficulty.

An interesting experiment enables us to reproduce in a test tube chemical actions similar to those that take place when we eat starchy foods. A small quantity of starch is boiled with water in order to give a clear solution, and three or four drops of dilute hydrochloric acid are then added. The boiling is continued for two or three minutes, after which the solution is allowed to cool. A little of a dilute solution of Copper Sulphate is then added, followed by sufficient caustic soda to form a blue solution. If the liquid is warmed again a brilliant red powder makes its appearance in the tube.

A Remarkable Colour Change

This strikingly-coloured new substance is cuprous oxide, a compound of the metal copper with oxygen. It differs from the black Copper Oxide, familiar to owners of Kemex Outfits, in having a smaller proportion of oxygen; and it is remarkable that a small change in the proportion of the elements in these two oxides should be accompanied by such a decided change of colour. It is even more remarkable to find that, sometimes, cuprous oxide is bright orange yellow in colour. If a precipitate of this colour is formed in the experiment we have just dealt with, however, it becomes red on standing or on further heating, and it is interesting to note the gradual change in colour that then takes place.

The precipitation of cuprous oxide in this experiment is due to the production of grape sugar. Starch itself does not bring about this change, and in our experiment this substance has been changed into cane sugar, and this in turn transformed into grape sugar. Boiling the starch solution with half a measure of Sodium Bisulphate brings about the same result.

We can now understand what happens when we eat starchy foods. In this case the change is due to the action of ferments in the saliva and in the gastric juices. These work much more slowly than the hot dilute acid used in our experiments, but the final result of their efforts is the complete transformation of the starch into sugars that are readily soluble in water, and therefore are easily absorbed into the system.

Strong Gum made from Starch

Starch is a very complex chemical, for which many surprising uses have been found. One purpose for which it may be used is the production of a strong gum. In order to make this a teaspoonful of crushed starch is heated gently in one of the special heat-resisting test tubes included in Kemex Outfits 2 and 3, or in an ordinary test tube that has been thoroughly dried. The tube should be held well above the flame of the Spirit Lamp, and rotated steadily in order to ensure that the starch is heated slowly and evenly.

The heating is continued until the starch has turned light brown in colour throughout, and the tube is then allowed to cool and the residue examined. It is a gummy mass, and the addition of a few drops of water gives a brownish liquid that feels sticky and has a sweet taste. Sufficient water to dissolve the whole of this brown material is then added, and the result is a strong gum that can be used with confidence.

The chemist's name for the brown substance obtained in this experiment is dextrin. An interesting experiment can be made by adding a little of the solution to a drop of tincture of iodine. A red coloration is then obtained, and this test enables us to distinguish between starch and dextrin, for, as we have already seen, a blue compound is formed in similar conditions when starch is present.

Curiously enough, dextrin is formed also by the action of acids on starch. For this purpose a few drops of dilute hydrochloric acid are added to a starch solution, and the tube containing the liquid is dipped in water heated nearly to boiling point and kept there for 10 seconds. The liquid is then allowed to cool, and on testing with tincture of iodine will be found to give a red colour, showing that the starch has been transformed into dextrin. In

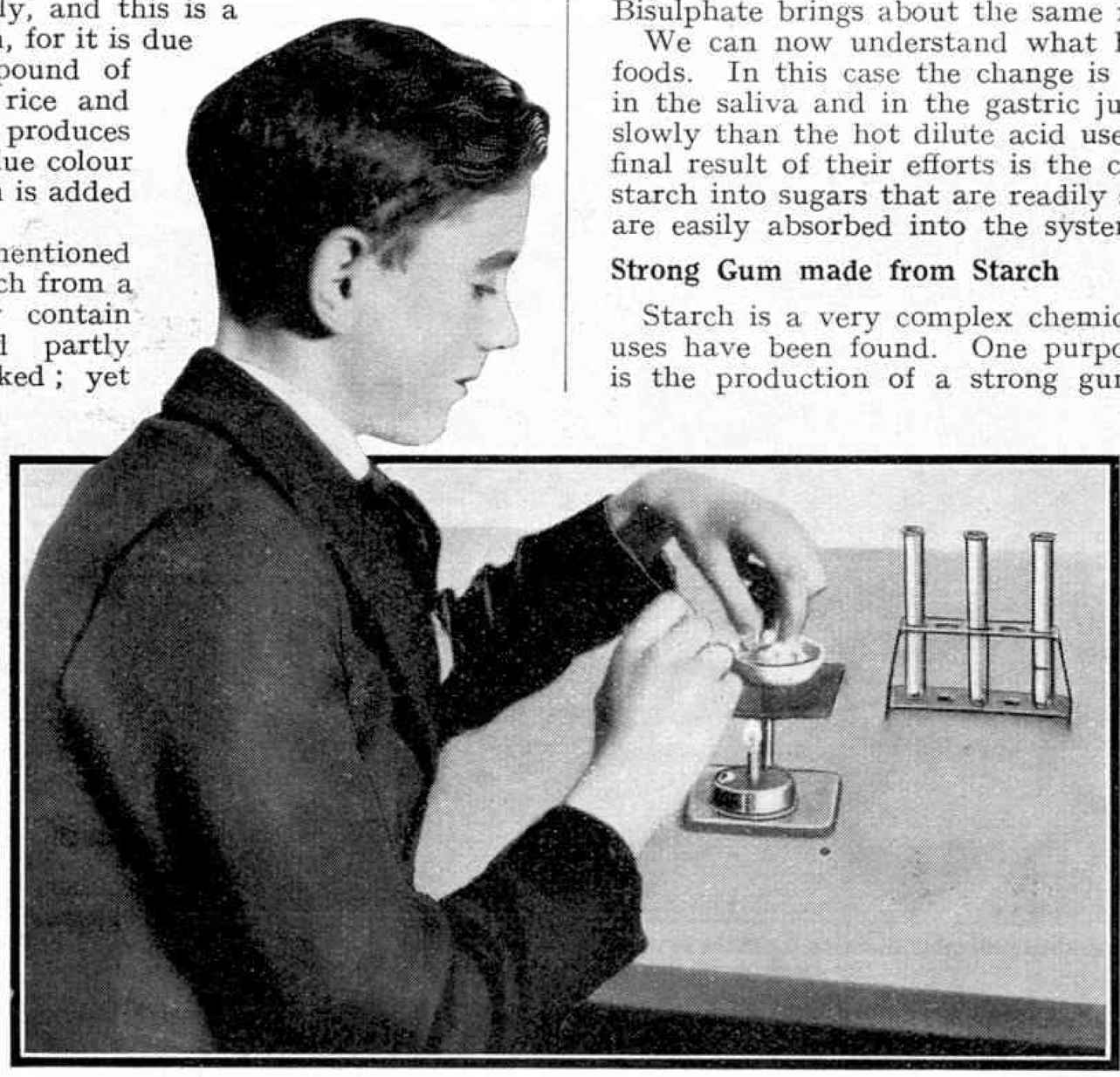


Fig. 1. The first step in making soap. The fat in suet is being melted out before boiling with caustic soda, as explained in the accompanying article.

this experiment, if the tube is allowed to remain in the hot water for longer than 10 seconds, the dextrin itself will be changed by the action of the dilute hydrochloric acid, for its production is an intermediate stage in the transformation of starch into sugar.

Sugars are easily extracted from fruits and from other sources such as beetroot, for they are very widely distributed in nature. In order to obtain sugar from beetroot, this is sliced or reduced to shreds with the aid of a grater, and the fragments are boiled with water in the wide-necked flask, as shown in Fig. 2. After boiling for about five minutes a small quantity of the solution is poured off and allowed to cool. It is then tasted, when its sweetness distinctly shows the presence of sugar. In this case cane sugar is produced, and the solution does not cause the separation of a red precipitate when boiled with alkaline Copper Sulphate.

In this experiment the boiling of the main volume of the liquid should be continued for nearly 15 minutes, and the liquid filtered in order to separate it from the remains of the beetroot. The solution can then be evaporated to obtain crystals. If a syrup only is obtained, adding a few fragments of sugar will induce crystallisation.

A solution of another sugar can easily be obtained by pressing grape juice through filter paper, or by pouring boiling water over raisins in a cup. In each case the brilliant red precipitate of cuprous oxide is produced when the solution is boiled with Copper Sulphate and caustic soda solutions, showing that grape sugar is present. This substance actually derives its name from its occurrence in ripe grapes.

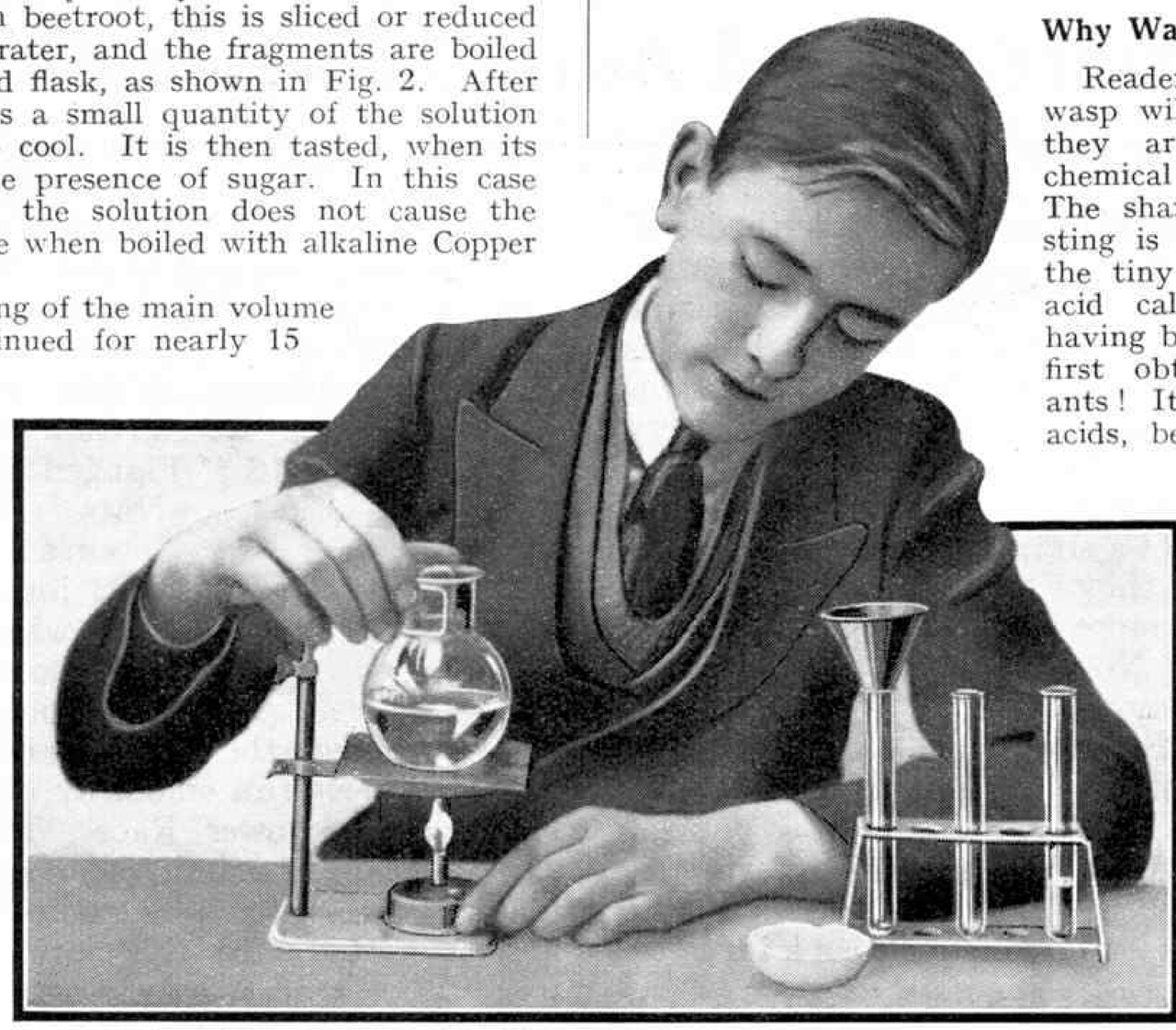


Fig. 2. Making sugar by boiling shredded beetroot with water. The liquid is filtered and then evaporated until the sugar crystallises.

How to Make Soap

The fats form a second class of foodstuffs, and these are remarkable for their close association with soap, which is far from being eatable! Soaps actually are made from various oils and fats, and Kemex enthusiasts can easily make a small cake of crude soap from mutton suet.

About a tablespoonful of grated suet is required, and if possible this should be fresh suet, not the prepared variety, which usually contains a small proportion of starch in the form of rice flour. The suet is placed in a muslin bag which is dipped in boiling water in order to melt out the fat. This part of the experiment can be carried out in an evaporating dish, as shown in Fig. 1, the glass rod being used to press the bag gently and thus to squeeze out the fat, which runs through the material of the bag to form an oil floating on the hot liquid, leaving the skin and membranes of the suet behind.

The next step is to pour the oil into the wide-necked flask, and to add to it caustic soda solution, prepared by boiling about a quarter of the quantity of Calcium Oxide contained in the Kemex Outfit with three times its bulk of washing soda crystals and a little water. The mixture is boiled with the caustic soda until no oily drops remain on the surface of the liquid, showing that the fat has been decomposed. The liquid is then allowed to cool a little and poured into the evaporating basin or a small cup. About a tablespoonful of salt is then stirred into it. The effect of this is to displace an oil, and on leaving the liquid to stand this separates out as a surface layer, which on further cooling becomes a solid cake.

On examination the new substance is found to have a slippery feel when handled, and to lather freely with water. It is actually crude soap, and after a dip in cold water to remove salt, can be used for washing purposes.

The explanation of the changes that have taken place during this experiment is that the fat contains an acid, called stearic acid, which with the caustic soda forms sodium stearate, and this is the chemical name of our soap. The acid itself can be obtained by adding hydrochloric acid to a strong solution of part of the soap and boiling. On cooling a white solid is seen. Although this is different in appearance from the more familiar chemicals of this class, which are liquids, and is insoluble in water, it is a real acid, and again forms a soap when boiled with caustic soda.

Why Wasp Stings are Painful

Readers who have been stung by a wasp will be surprised to learn that they are already familiar with a chemical that resembles stearic acid. The sharp pain that follows such a sting is caused by the injection into the tiny wound of a quantity of an acid called formic acid, the name having been given to it because it was first obtained by distilling stinging ants! It is one of a series called fatty acids, because certain members, such as the stearic acid we have made, are found in fats. Another member of this series that is more familiar than formic acid is acetic acid, which is the constituent of vinegar that gives this liquid its characteristic tart flavour.

The stearic acid in suet is combined with a well-known chemical, the presence of which would be entirely unsuspected by those who have no knowledge of chemistry. This is glycerine, the colourless, syrupy liquid with a sweet taste that forms part of many cough mixtures. Glycerine is present in all fats, and in oils, such as palm oil, that resemble fats; and when soap is made from these it is set free and can be separated and purified by distillation.

Although it is a pleasant oily substance, glycerine is changed into a substance with an acrid and irritating smell, similar to that of badly burned fat, when a few drops of it are heated either alone or with a measure of Sodium Bisulphate; and the chemist uses this test in order to make sure that any sweet oily liquid supposed to be glycerine really is that substance. Another interesting test for glycerine consists of making a borax bead in the manner described in the Kemex Manuals, and dipping this into the liquid. The flame is coloured green when the bead is again heated.

Glycerine and Sodium Borate (Borax) can be used in a further experiment in which there is a striking colour change. The borax is dissolved in water in a test tube and two or three drops of Phenolphthalein solution added. The solution becomes pink, but the colour disappears when glycerine is added drop by drop, returning again on warming.

Let us turn now to an entirely different type of experiment in which materials used in the home are concerned. About half a teaspoonful of dry cloves is crushed and placed in a test tube about one-third full of water. The tube is fitted with a cork carrying a large right angle delivery tube dipping into a second dry test tube standing in cold water in a basin, and supported on the universal stand, as shown in Fig. 3, or held in the test tube holder at a convenient angle. The water containing the crushed cloves is boiled gently for about five minutes, a small flame being used in order to avoid the spurting of liquid into the delivery tube. The receiving test tube is then found to contain water, together with tiny drops of oil of cloves extracted by the action of boiling water, and distilled with the steam.

Fig. 3. Distilling a scented oil from dried cloves.

All The Fun of The Fair

Pleasure Ground Attractions in Meccano

THE models of fairground attractions described and illustrated in this article are particularly interesting examples of the adaptability of the Meccano System. A fair is, strictly speaking, a miscellaneous market held at more or less long intervals, and was originally a holiday or saint's festival. From very early times a prominent feature of these fairs was a series of side shows of various kinds. At first these shows were of a simple character, but gradually they developed and became more thrilling and elaborate. Nowadays, in this country at any rate, the term "fair" is used to describe a collection of shows and entertainments, without any commercial aspect.

One of the most popular features of the fairground has always been the round-about. This began as a creaking contraption from which were suspended a few small wooden horses which, with their load of children, were rotated slowly by the vigorous efforts of the man in charge. The modern roundabout is a very different affair. It is a huge structure operated by steam or electrical power, and its horses, ostriches, or switchback cars go round at a very high speed to the accompaniment of a blaring mechanical organ.

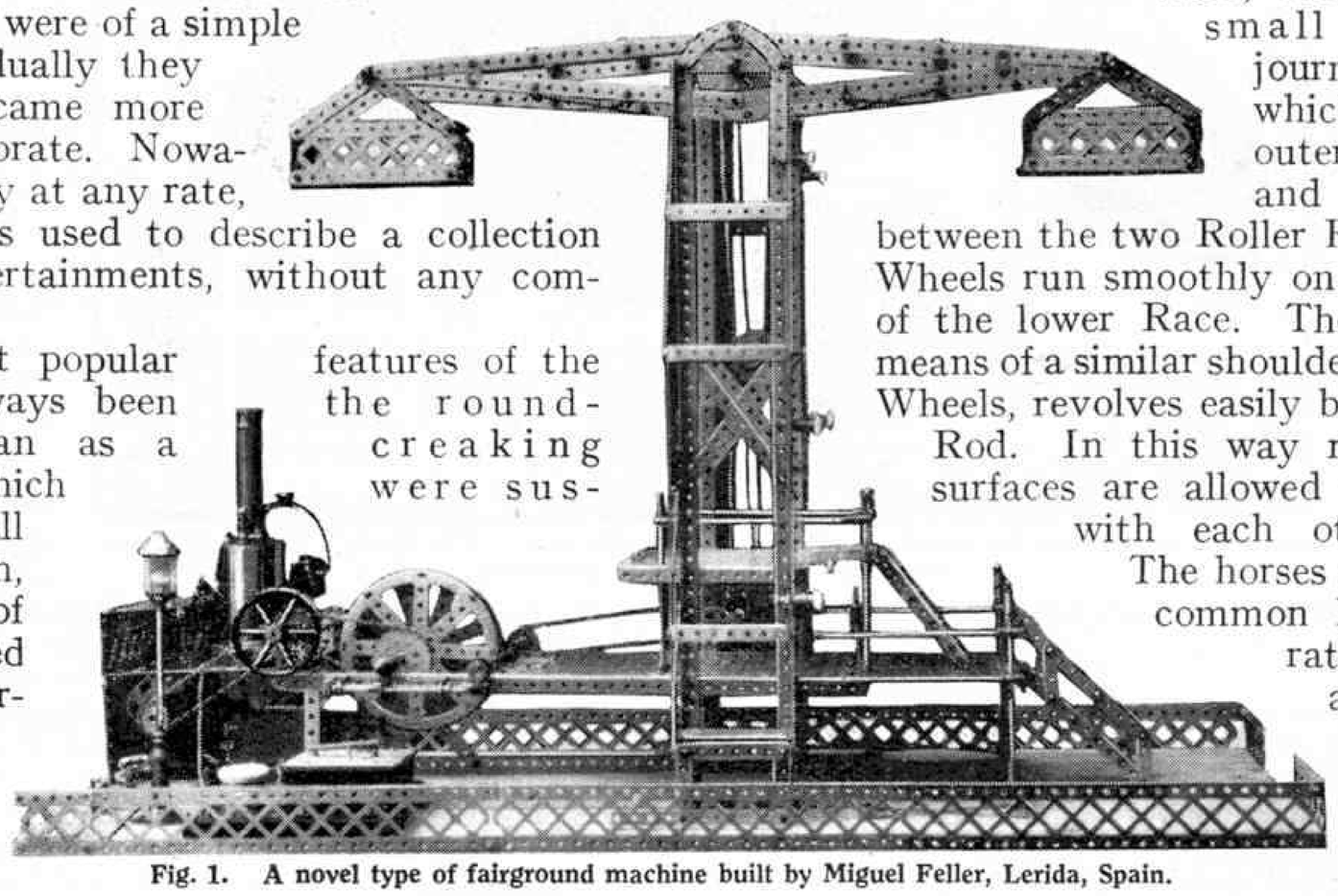


Fig. 1. A novel type of fairground machine built by Miguel Feller, Lerida, Spain.

The Meccano Roundabout illustrated in Fig. 2 reproduces faithfully the various movements of a present-day roundabout, with its rotating superstructure, revolving cars, and leaping horses. Its appearance when in operation is strikingly realistic and very fascinating. The whole structure rotates on Roller Bearings by means of a Meccano Electric Motor, and simultaneously four radial shafts are caused to revolve. These shafts impart to the model cars and horses the motions that they make in the prototype machine. Two of the shafts are fitted with Single Throw Eccentrics that cause the horses to gallop, while the other two shafts turn vertical spindles that in turn make the cars revolve about their axes at a fairly high speed.

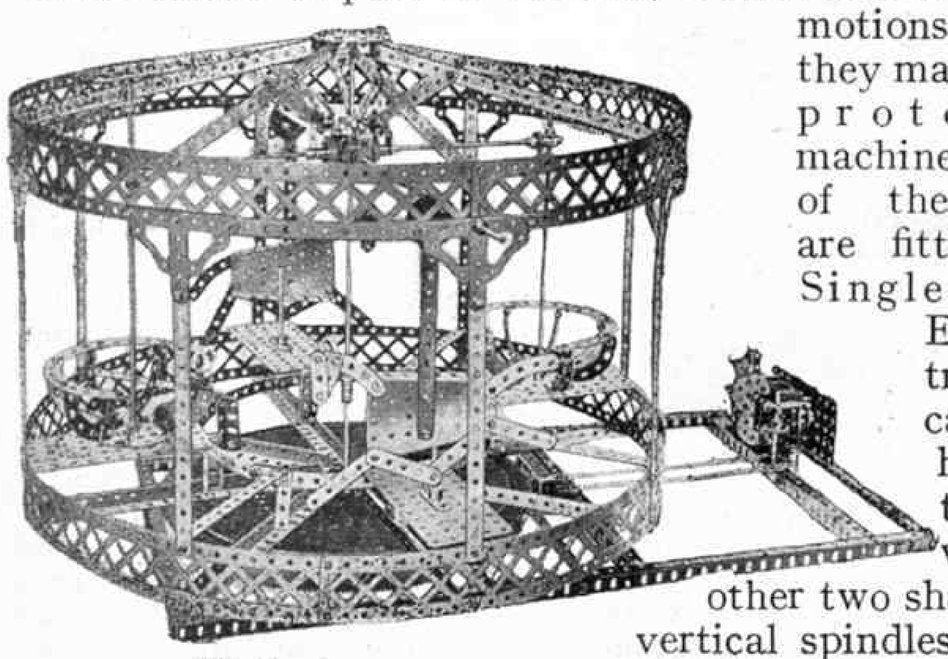


Fig. 2.
A fine Meccano model Roundabout.

The large Geared Roller Bearing on which the whole of the superstructure rotates is designed as a complete unit (Part No. 167). It is suitable for incorporation in many different models, and it comprises two large Geared Roller Races, each about 12 in. in diameter, a Ring Frame, 16 ¾" Flanged Wheels, 16 Pivot Bolts with Nuts, and a special Pinion. The small Flanged Wheels are journalled on the Pivot Bolts, which are secured round the outer edge of the Ring Frame, and the latter is inserted between the two Roller Races, so that the Flanged Wheels run smoothly on a shoulder near the edge of the lower Race. The upper Roller Race, by means of a similar shoulder resting on the ¾" Flanged Wheels, revolves easily but steadily about an Axle Rod. In this way no points in the moving surfaces are allowed to be in sliding contact with each other.

The horses on the roundabout are no common hacks. Indeed, they are rather remarkable creatures, and the fact that they bear only a slight general resemblance to the animals whose name they are given will, unless our experience of roundabouts is at fault, make them all the more suitable for incorporation in this model. The body of each horse consists of a Sector Plate, and is provided with a tail (a 2½" large radius Curved trip) and four 2½" Strips representing legs. The passenger is expected to sit astride the horse immediately behind the supporting Strip. During "rush hours" no doubt an extra passenger could be squeezed in between the front of the supporting Strip and the horse's neck! The gracefully arched but rather ill-nourished neck may be distinguished from the tail by the fact that it bears a shapely head (two 1½" Strips) surmounted by a Flat Bracket with which the poor beast must do his best to hear! Much fun may be obtained by adjusting the angles of the neck, tail, and legs to represent the characteristic trotting and galloping attitudes.

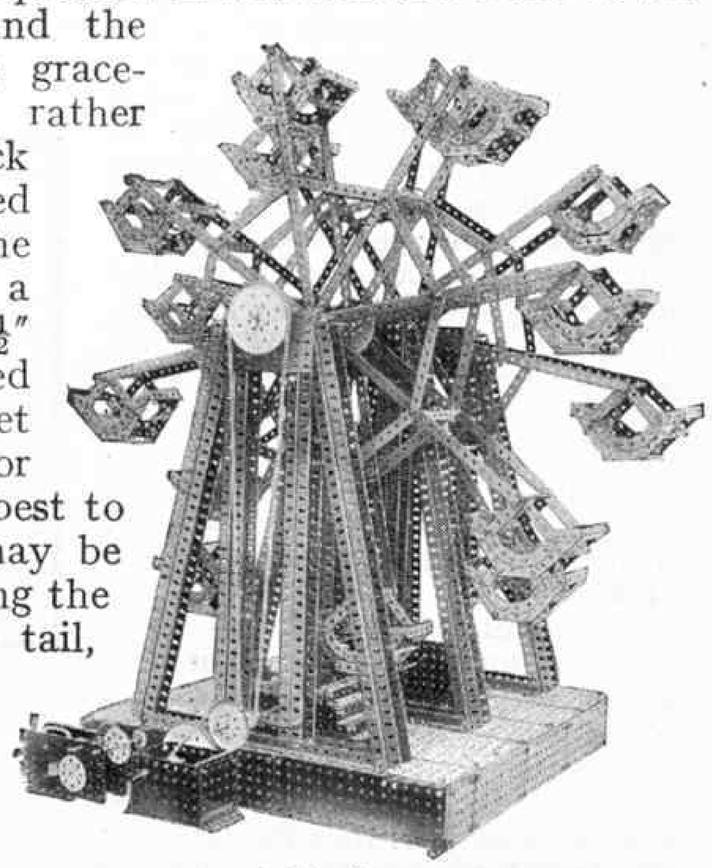


Fig. 3.
The super model Revolving Flyboats.

Each of the horses is carried on a $5\frac{1}{2}''$ Strip bolted to a Single Throw Eccentric, which imparts a realistic leaping motion to the animal.

The operation of the Roundabout is entirely automatic, and once the Motor has been started the model will work continuously without any attention. The realism of its appearance is greatly enhanced if the roof, floor and central part are filled in with suitably coloured cardboard.

Full constructional details of this fine model are contained in Special Instruction Leaflet No. 8. Readers who build the model should take care that all bearings are oiled at frequent intervals, particular attention being paid in this respect to the Geared Roller Bearing. If this is done the model should work almost noiselessly and without any signs of shaking or rattling. The gearing has been arranged so that the Roundabout will operate at a speed proportional to that of its prototype, but if a greater speed is required it is only necessary to make a slight alteration to the gearing, as the Electric Motor has an ample reserve of power.

Boys who have a sufficient number of parts will be able to improve the model in various ways that will readily occur to them. For instance, the revolving platform might be filled in with Flat Plates, and steps might be arranged around its sides.

A very enjoyable ride is to be had in a car of such a machine as the revolving flyboats, a model of which is shown in Fig. 3. It is an exhilarating experience to step into one of the cars and be carried high into the air, and then as the car descends to see the ground apparently coming up to meet it! In the model illustrated the arms revolve in opposite directions and carry the cars at their extreme ends. As the wheel rotates, the combined weight of the cars and the passengers make the cars remain always in a vertical position. The landing platform is sturdily built, and includes most of the details found on the actual machine. It considerably enhances the appearance of the model and makes it look very real.

The mechanism for rotating the wheel is simple. The drive is taken from a six-volt Meccano Electric Motor screwed to the base. On one end of the $11\frac{1}{2}''$ Rod on which the wheel revolves is a 2″ Sprocket Wheel connected by a length of Sprocket Chain to a 1″ Sprocket secured to a short Rod carrying a 3″ Sprocket. The Rod of the 3″ Sprocket is journalled in the centre holes of the Angle Girder in the vertical standard, and held in position by means of Collars. In motion this model presents a most interesting sight, and is well worth the time and trouble involved in building it.

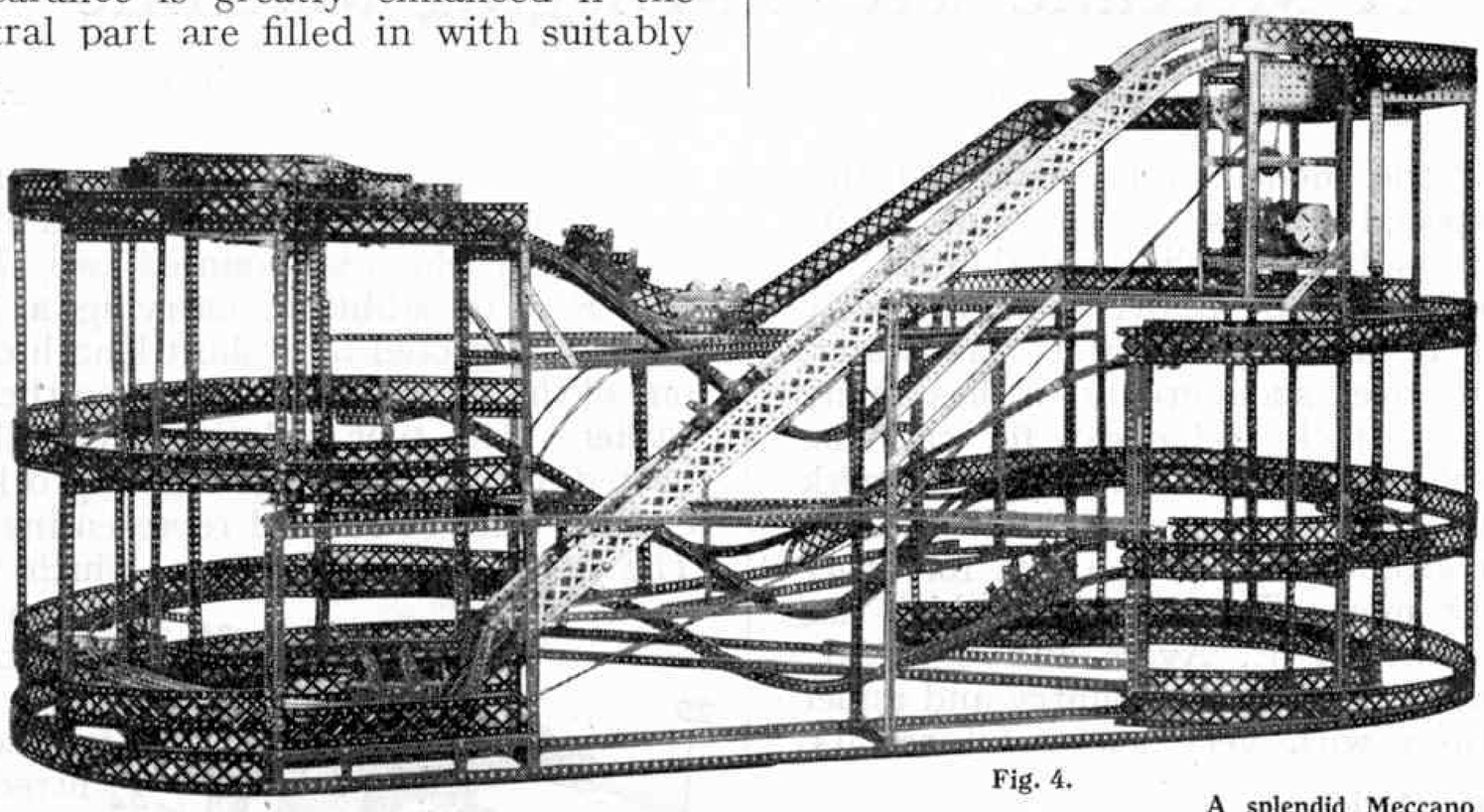
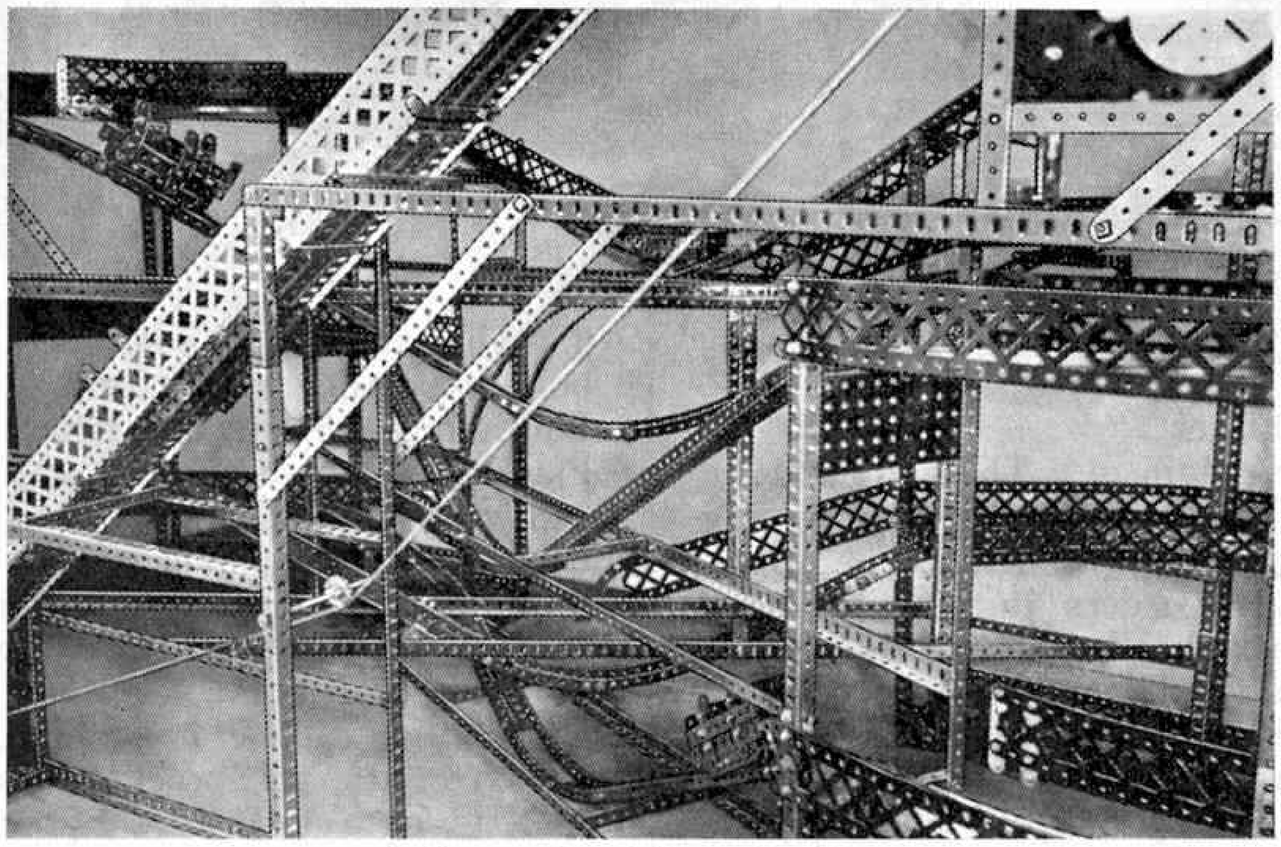


Fig. 4.
A splendid Meccano scenic railway built by Paul Mareuse, Paris.

A model of the ever-popular scenic railway is illustrated in Fig. 4. It was built by Paul Mareuse, of Paris. The structure is roughly in the shape of a figure eight, and has three tiers, each of which is enclosed with Braced Girders that represent railings, and give the model an appearance of great solidity. The model might be made to look very like the actual machine, however, by fitting diagonal girders to the frame. Lack of such girders, although not a serious matter in a model, would be exceedingly dangerous in actual practice.

The cars are fitted with Hornby Train Wheels, and run on rails. In the upper part of the structure the rails are made from Strips bent to shape and secured to the frame, but at the landing platform these are replaced by Hornby Curved Rails. The cars are hoisted to the top of the incline by means of a Sprocket Chain conveyor fitted with wire claws spaced at intervals along the Chain. The claws engage the backs of the cars and haul them to the top of the slope, where they are released and allowed to run back round the track. The Chain is driven by a Meccano Electric Motor, the necessary gearing being obtained by using a $\frac{1}{2}''$ Pinion to drive a 95-teeth Gear Wheel, the drive then being taken to the conveyor by means of Sprocket Chain and Sprockets. The appearance of the model might be improved in various ways as, for instance, by fitting steps and an embarking platform.



A close-up view of the scenic railway.

Another type of pleasure ground machine is represented by the model shown in Fig. 1, built by Miguel Feller, of Lerida, Spain. In this a large arm is rotated, carrying with it the cars, which are pivoted to the ends of the arms and remain vertical while revolving. The model is driven by a Meccano Electric Motor, the speed of which is reduced by means of Sprocket Wheels.

The Month's New Model

A Meccano Trench-Digging Machine

THE prototype of the model to be described this month is of special interest on account of its originality and its labour-saving capabilities. It is of course only possible to use it over comparatively soft ground, but where it is necessary to lay water, electric, or gas mains over such ground it has many advantages. It is also quick and cheap for carrying out large drainage schemes, and in this type of work the track units with which it is fitted make it possible for it to operate on ground that is too soft for other machines, or even for men. The machine, which has been designed and built by E. Ayers and Co. Ltd., has been tested in many parts of the country and under a variety of conditions with very successful results.

Building the Meccano Model

The main frames are constructed first, and are shown in Figs. 1 and 2. Each side consists of a channel section girder built up from two 24½″ Angle Girders, and both sides are connected together at one end by double 3½″ Flat Girders 2. A 3½″ channel section girder 3 is also fitted, and is used later for carrying the steering mechanism. The end carrying this girder is also fitted with doubled 4½″ Strips 4 carrying at their extremities 1½″ Angle Girders. The Bolts securing these short Angle Girders in position have Washers placed under their heads. Three 3½″ Strips are secured across the gap between the two Girders, forming a seat for the driver. A foot rest is also provided, and this is built up from three 2½″×½″ Double Angle Strips coupled together by two 1½″ Strips. The complete rest is suspended from the Strips 4 by four 1½″ Strips, one Washer being placed on each securing Bolt between the short Strips and the Strips 4.

The main frames are now complete, and the driving track is fitted. The two sides of the track framework, each of which consists of two 4½″ Strips, are coupled together by means of two 1½″×½″ Double Angle Strips. The two centre holes of the frame carry a 3½″ Rod on which is mounted two 1″ Sprocket Wheels, the Rod being prevented from lateral movement by two Collars. The complete frame is mounted so that it is free to swing on the 4½″ Rod that is supported in the end holes of two Trunnions bolted to the main frames of the model. Two further Collars prevent the track frame from moving sideways. Each end of the frame carries a 2″ Rod on which is mounted two 1½″ Sprocket Wheels, one Rod in addition, carrying a 1″ Sprocket Wheel that is connected by a short length of Sprocket Chain to one of the 1″ Sprocket Wheels on the 3½″ Rod mentioned earlier. The four 1½″ Sprocket Wheels are now connected together in pairs by Sprocket Chain, the two endless belts so formed representing the driving tracks. The drive from the motor, which will be fitted later, is taken to the remaining 1″ Sprocket Wheel on the 3½″ Rod.

The steering tracks are now fitted, and are supported in 1″ Triangular Plates that are bolted to the girders 5 and 6. The girder 5 is composed of two 5½″ Angle Girders bolted together in the form of a channel section girder. Each end of 5 and 6 is fitted with three 1″ Triangular Plates, and these support a 2″ Rod fitted at its upper end with a Collar and at its lower end with a Large Fork Piece. Two Washers are placed between the Fork Piece and its respective Triangular Plate. The Fork Piece carries a 1″ Threaded Rod 7 together with two Flat Brackets, one to each lug. A 2½″ Strip is attached pivotally to each Flat Bracket, and each pair carries at its extremity 1″ Sprocket Wheels. The endless track consists of a length of Sprocket Chain passed round the two Sprockets.

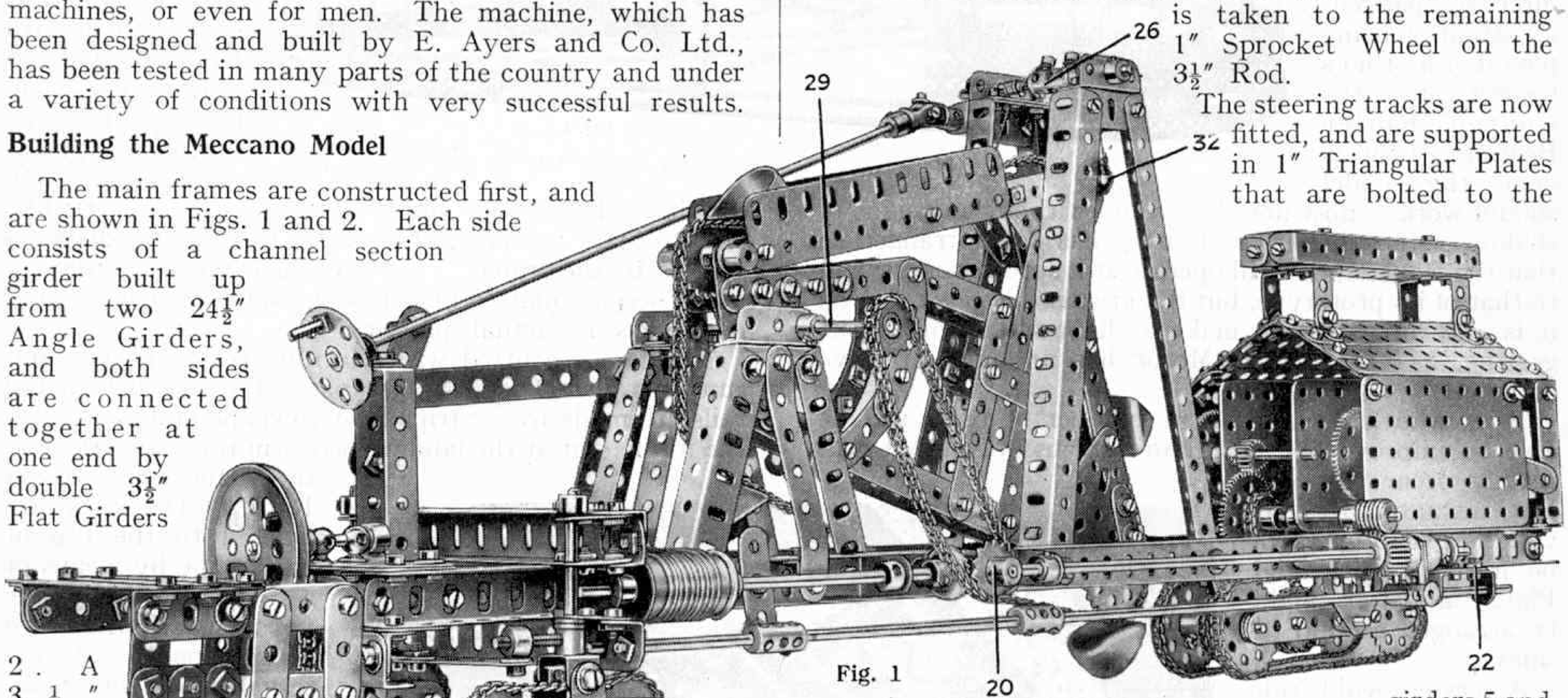


Fig. 1

The Threaded Rods 7 and 8 are next connected, this being done by fitting a Collar on each and securing a Strip five in. long between them. This strip is built up from two 3″ Strips overlapping two holes, the two ends of the complete link being pivotally attached to the Collars. The Threaded Rod 8 carries, in addition to a Collar, a Threaded Boss by means of which a Flat Bracket is fixed to the Rod. A Hinge is locknutted to this Flat Bracket, and also bolted securely to a 2″ Strip the free end of which is pivotally attached by means of a ⅜″ Bolt to a Coupling 9. This is mounted on a 2″ Rod journalled in the plain bore of a Handrail Support, a

Collar being used for spacing purposes between the Coupling and Handrail Support. The opposite end of the Rod carries four Washers and a 1″ Sprocket Wheel, the Washers being used for spacing purposes between the Sprocket and its supporting Girder. A short length of Sprocket Chain connects the Sprocket Wheel with a ¾″ Sprocket Wheel on the steering column 10, which consists of a 2½″ Rod journalled in two Handrail Supports. The steering wheel is represented by a 2″ Pulley Wheel which may be fitted with a length of Spring Cord in order to improve its appearance at the rim.

The power unit is now fitted. This consists of a Meccano No. 6 Electric Motor bolted down to the transverse Strips 1. A 1½″ Strip 11 is secured to one side of the reversing switch of the Motor, and this will protrude from the side of the bonnet when this is fitted later. A ½″ Pinion on the motor armature shaft engages with a 57-teeth Gear that is fitted, together with a second ½″ Pinion, on a 2½″ Rod. This second Pinion drives a 57-teeth Gear that in turn drives a similar Gear 12 through a third ½″ Pinion 13. The Gear 12 is mounted on a 3½″ Rod that carries a ¾″ Sprocket Wheel and a Worm 14. The 1″ Sprocket Wheel drives the front driving track by means of a short length of Sprocket Chain. The use of the Worm 14 will be described later.

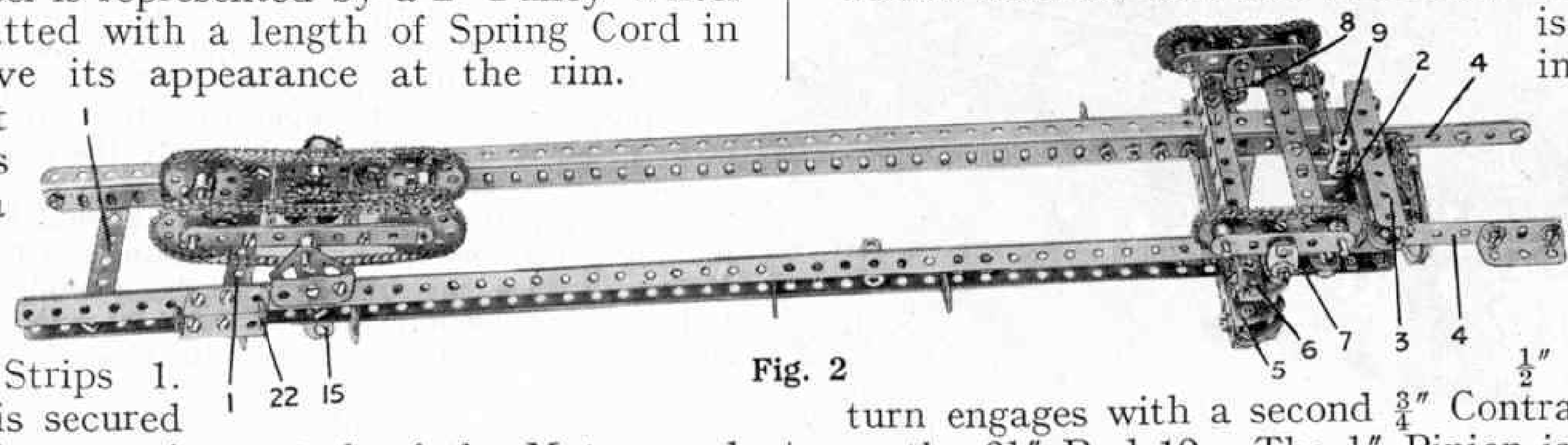


Fig. 2

The bonnet unit, Fig. 4, consists of three separate units, the bonnet proper, the radiator and the petrol tank. Each side of the top of the bonnet consists of four 5½″ Strips joined together by two 2″ Strips, the two complete sides being coupled by two bent Flat Brackets. A 4½″×2½″ Flat Plate is now secured to each side of the pointed top, as shown in the illustration, by means of Flat Brackets, which are bent to the required shape after being fitted.

The radiator frame consists of two 2½″ Angle Girders connected together at the bottom by a 3½″ Angle Girder and at the top by a 3½″ Strip. This frame is attached to the lower edges of the bonnet top by two Flat Brackets, and the triangular space remaining between the radiator and bonnet is filled in by two 1½″ Strips and a Corner Bracket, the 1½″ Strip being extended by Flat Brackets. The radiator tubes are represented by 2″ Rods, Couplings and Collars being used to secure them in place to the lower 3½″ Angle Girder.

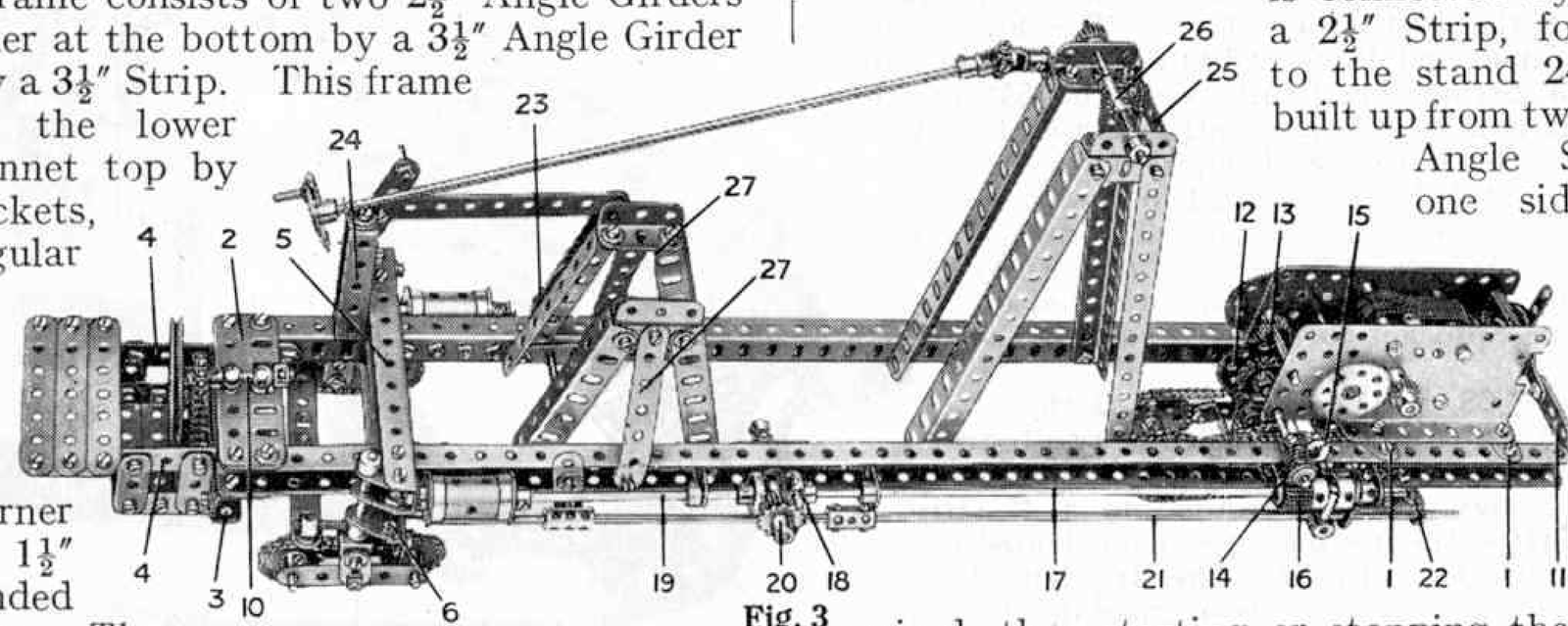


Fig. 3

The petrol tank is built up from four 5½″×½″ Double Angle Strips, and the rectangular trough so formed rests on two 5½″ Strips bolted to the top of the radiator by means of 1″×1″ and ½″×½″ Angle Brackets. The Double Angle Strips are attached to the 5½″ Strips by means of four ¾″ Bolts, as it is impossible to get the Nuts on to ordinary Bolts inside the finished petrol tank.

The complete radiator is secured to the frame of the model by the 3½″ Angle Girder of the radiator, and also by the ½″×½″ Angle Brackets 15, Figs. 2 and 3.

The next thing to be considered is the clutch and transmission for the dredger buckets and the endless belt for depositing the excavated earth to one side of the trench. The Worm 14 engages with a ½″ diameter ½″ face Pinion 16 that is secured in one end of a Socket Coupling, the other end of which is occupied by one half of a Dog Clutch. The remaining half of the Dog Clutch is gripped on an 11½″ Rod 17, on which the Pinion member 16 is free to rotate. The Rod 17, which is mounted in bearings consisting of three 1″×1″ Angle Brackets, carries the ¾″ Contrate Wheel 18, which meshes with a ½″ Pinion that in turn engages with a second ¾″ Contrate Gear mounted on the 6½″ Rod 19. The ½″ Pinion is secured together with a ¾″ Sprocket Wheel 20, on a 2″ Rod that is supported in the bosses of two Double Arm Cranks, it being free to revolve in these.

The free end of the Rod 19 is fitted with a drum, consisting of a Sleeve Piece and two ¾″ Flanged Wheels, which is connected by 10 lengths of Spring Cord to a similar drum on the opposite side of the frame (see Figs. 1 and 3). This second drum is mounted on a 2″ Rod that is free to revolve in the end holes of two 1″×1″ Angle Brackets bolted to the main frame.

The clutch member, attached to the Pinion 16, is operated by a claw composed of a Coupling and two 1″ Rods, the complete part being secured rigidly to a long rod 21. This long rod, which is built up from one 11½″ and one 8″ Rod, is journalled at one end in the bracket 22, Fig. 2, and at the other end in a 1½″ Strip bolted to the 5½″ Angle Girder 6. A Coupling, fixed on the rod 21, is attached pivotally to a Double Arm Crank that is mounted on a transverse 4½″ Rod. This Rod is fitted with a Crank 23, extended by means of a 3″ Strip that is connected by a 4½″ Strip and a 2½″ Strip, forming a handle, to the stand 24. This stand is built up from two 2½″×2½″ Double Angle Strips bolted to one side of the main frames. It will now be seen that, by actuating the 2½″ Strip, the clutch, fitted to the Pinion 16, is engaged or disengaged as required, thus starting or stopping the endless belt and digger machinery when fitted later.

The frame for carrying the cord controlling the digging arm is built up from four 7½″ Angle Girders bolted at their lower ends to the inside of the main frames. At the top they are joined together in pairs by means of "T" shaped girders, each of which is constructed from two 1½″ Angle Girders. The two sides of the frame are then coupled together by a 2″ Strip 25.

The upper flanges of the "T" girders are fitted at their centre holes with a 3½″ Rod on which is secured a Coupling 26. The Rod also carries a ½″ Pinion that is in constant mesh with a Worm mounted on a 2″ Rod, carried in the two end holes of a 1½″×½″ Double Angle

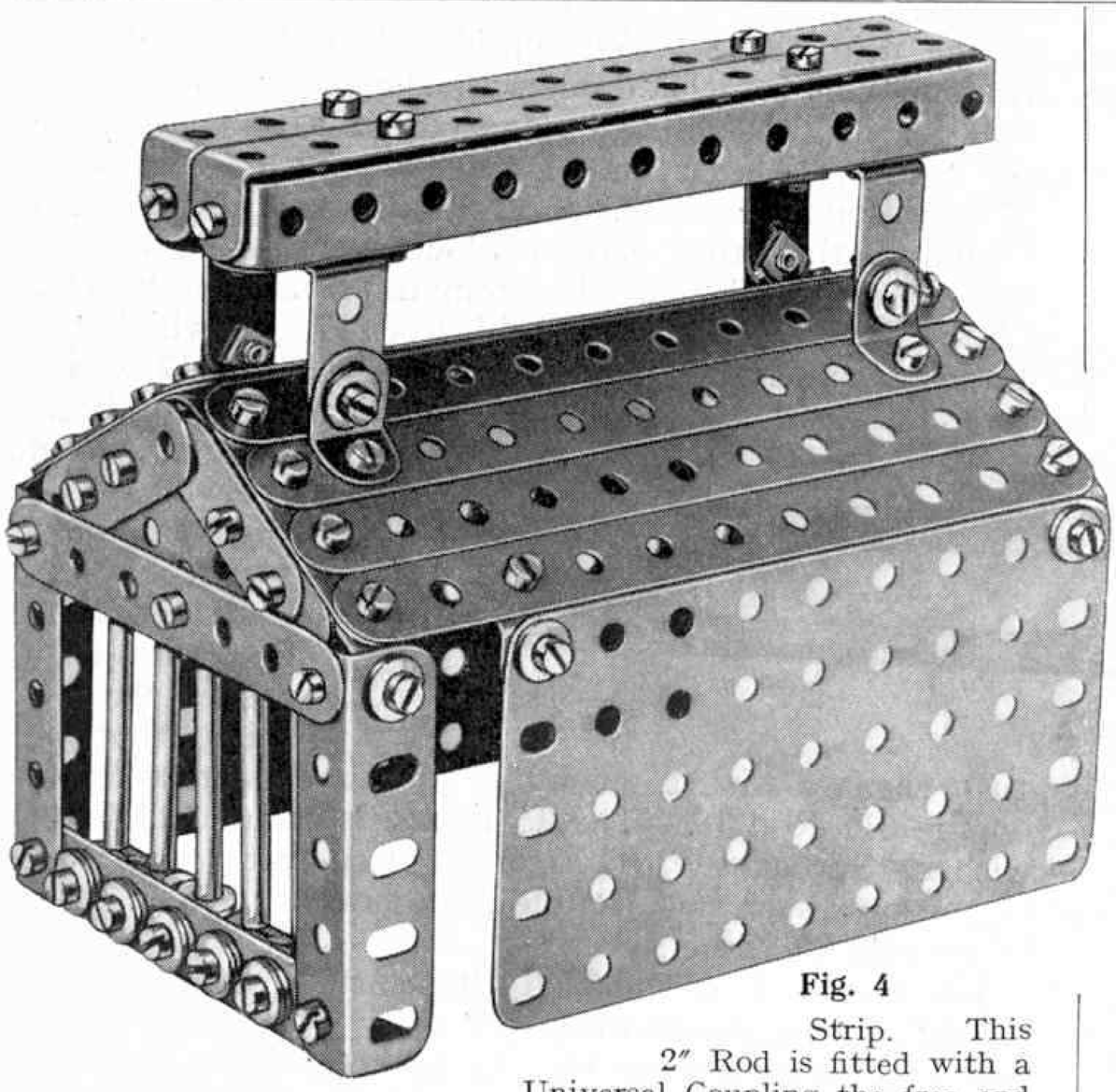


Fig. 4

Strip. This 2″ Rod is fitted with a Universal Coupling the free end of which carries an 11½″ Rod journalled in the round hole of a ½″ × ½″ Angle Bracket bolted to the top of the stand 24. A handle, consisting of a Bush Wheel and Threaded Pin, is fitted to the end of the long Rod to facilitate turning. This mechanism will be used later for raising and lowering the digging arm.

The structure that carries the digging arm pivot is composed of four 3½″ Angle Girders joined together in pairs at the top by "T" girders in a similar manner to the larger frame described previously. The two sides are prevented from moving laterally by means of 3½″ Strips 27, the lower ends of which are secured to the main frames by ½″ × ½″ Angle Brackets.

The machine is now complete with the exception of the digger arm, and for this Fig. 6 should be referred to. The upper edge of each side of the arm consists of a 7½″ Strip to which is bolted a 5½″ Flat Girder. One end of the Strip carries a 5½″ Strip and the other end a 2½″ Strip, both corners being fitted with Cranks, one of which carries the Flat Brackets 32. The lower end of the 5½″ Strip carries a 2½″ Triangular Plate and a Crank, the Strip overlapping the Plate three holes. The lower edge of the frame is now fitted, and this consists of an 8″ strip built up from a 5½″ and a 3″ Strip. The join between this 5½″ and the 2½″ Strip, to which it is attached, also carries a Crank. When the frames of the two sides have been completed they are joined together by means of four 1½″ Rods secured in the bosses of the Cranks fitted to the corners of the frame. The two lower Rods carry 2″ Sprocket Wheels and the two upper Rods 1″ Sprocket Wheels, and Collars are placed on each Rod on the opposite side of the Sprocket to the boss so that the wheels all lie centrally.

A ¾″ Sprocket Wheel 28, which drives one of the 2″ Sprockets, is carried on a 5″ Rod 29 journalled in two bearings each built up from two Flat Brackets arranged in the form of a triangle. These bearings are each secured to a 4″ strip, composed of two 2½″ Strips, the free end of which is bolted to a long curved strip 30 and a 4½″ Strip 31. The strip 30 is built up from two 2½″ large radius Curved Strips overlapping two holes. The Strip 31 is fitted with three 3½″ Strips arranged as shown in the illustration, the upper strip being secured to the frame, at its upper end, by means of a Flat Bracket and a 1½″ Strip. At its lower end it is held in a channel formed from two 1½″ Strips bolted to the two lower 3½″ Strips mentioned earlier.

A length of chain is now passed round the four Sprocket Wheels carried on the frame, and to this are secured five Dredger Buckets, representing the digger buckets of the actual machine.

The digger arm is now complete, and is mounted on the model by passing the two ends of the Rod 29 through the centre holes of the "T" girders of the smaller of the two vertical frames. Two Collars are then fitted to prevent side movement of the frame, and a ¾″ Sprocket Wheel is nipped on the long end of the Rod as shown in Fig. 1. This Sprocket is connected to the Sprocket 20 by a suitable length of Sprocket Chain. The Brackets 32 are now connected to the Coupling 26 by two lengths of Cord, Set-Screws in two tapped holes of the Coupling being used for this purpose. Thus by operating the handle, situated on the column 24, it is possible to regulate the depth of cut while the machine is in motion.

Before operating the machine oil should be applied to all the moving parts, and the Sprocket Chain, and the grease cups of the Motor, if these are fitted, must be attended to. The Meccano Lubricating Oil will be found to be most satisfactory for lubricating the model, and Meccano Graphite Grease should be forced into the grease cups.

The model is only suitable for digging in fairly loose material such as gravel and loose earth, but if a more solid discharge belt is used, sand will be found to be most satisfactory. In starting a trench, the bucket arm is lowered until about ¼″ of slack cord is wound off the drum after the bucket arm touches the ground. The endless belt of buckets and also the discharge belt are now set in motion, and as the ground is cleared at the point of contact of the buckets, so the entire machine is moved forward. It is advisable to stop the buckets while a new digging position is found, as the travelling movement of the model is very rapid.

It may be found that the buckets discharge the excavated material clear of the endless belt. This may easily be rectified by fitting small Flat Plates or pieces of cardboard at the necessary points. It may also be found necessary to fit a short chute to one side of the discharging belt so that the waste material is thrown well clear of the trench.

It will be observed that there are only five buckets fitted to the endless belt of Sprocket Chain, whereas many more could be fitted, digging being speeded up in consequence. These extra buckets may be fitted if so desired, but since the model illustrated is intended to come within the limits of a No. 7 Outfit, only five were fitted this being the number included in the Outfit. If more buckets are fitted, however, it will be necessary to speed up the discharge belt.

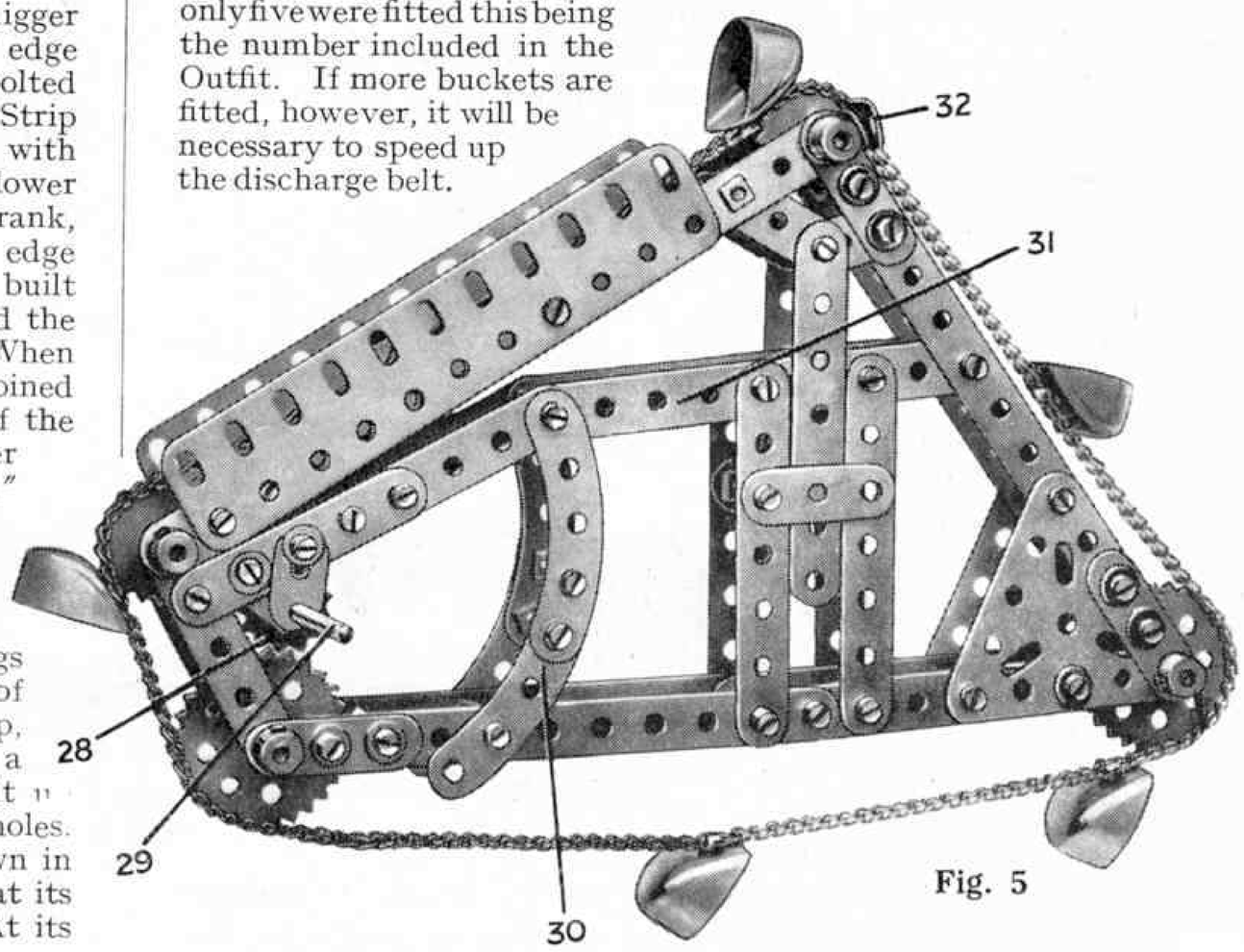
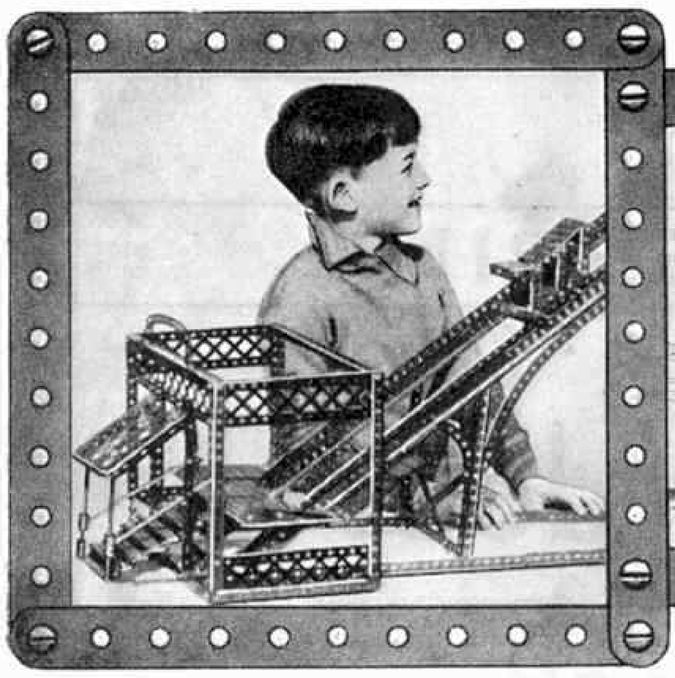


Fig. 5

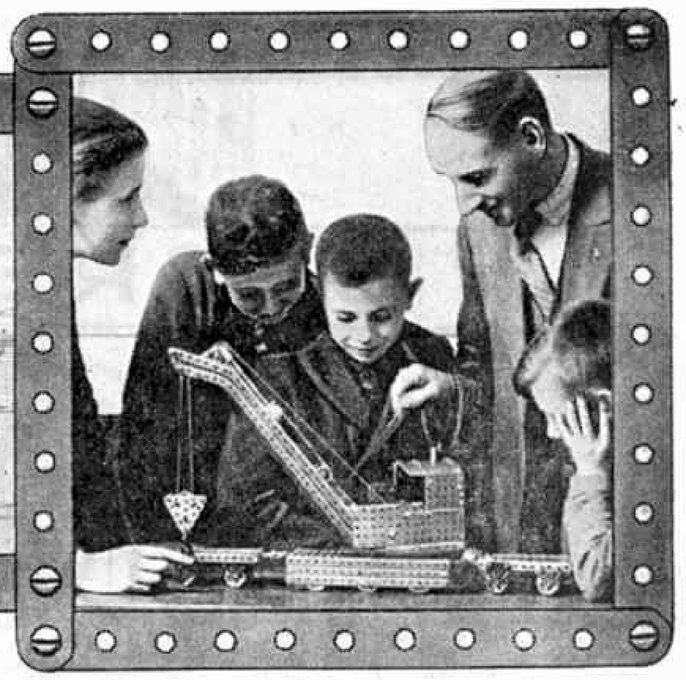
Parts required to build this Meccano Model

2	of No.	1b	7	of No.	9b	1	of No.	14	1	of No.	25a	2	of No.	53a	8′	of No.	94
14	„ „	2	2	„ „	9d	2	„ „	15a	4	„ „	26	85″	„ „	58	2	„ „	95
12	„ „	2a	2	„ „	9e	2	„ „	16	3	„ „	27a	24	„ „	59	4	„ „	95a
14	„ „	3	4	„ „	9f	5	„ „	16a	2	„ „	29	9	„ „	62	10	„ „	96
5	„ „	4	27	„ „	10	1	„ „	16b	2	„ „	39	3	„ „	62b	5	„ „	96a
11	„ „	5	1	„ „	11	10	„ „	17	253	„ „	37	7	„ „	63	2	„ „	103
10	„ „	6	11	„ „	12	5	„ „	18a	29	„ „	37a	1	„ „	64	2	„ „	103d
14	„ „	6a	7	„ „	12a	6	„ „	18b	166	„ „	38	2	„ „	76	1	„ „	103h
4	„ „	7	4	„ „	12b	1	„ „	20a	4	„ „	48	6	„ „	77	4	„ „	111
4	„ „	8b	3	„ „	13	4	„ „	20b	5	„ „	48a	2	„ „	82	8	„ „	111a
3	„ „	9	1	„ „	13a	1	„ „	24	4	„ „	48d	4	„ „	90	12	„ „	111c

1 of No. 114
2 „ „ 115
2 „ „ 116
2 „ „ 126
5 „ „ 131
3 „ „ 133
3 „ „ 136
1 „ „ 140
1 „ „ 144
2 „ „ 163
1 „ „ 171
1 E6 Electric Motor



WITH THE MODELBUILDERS



MECCANO TRANSFORMERS

Meccano Transformers provide a convenient means of utilising mains alternating current supply for operating models driven by Meccano Electric Motors. It must be noted, however, that Transformers can be used only with alternating current, and any attempt to use them with direct current will result in serious damage to the Transformer. The function of the Meccano Transformers is to transform mains alternating current down to a voltage suitable for Meccano Motors. The nature of the current remains unchanged, however; that is to say it is still alternating. An important feature in regard to transformers is their economy in operation. The Meccano Transformers give current for from 20 to 25 hours per B.O.T. unit.

There are now six different types of Transformers in the Meccano range, three of these being for use with 6-volt Motors and Trains, and three for 20-volt working. Each type has individual features that make it suitable for special purposes.

TYPES T6 AND T20

These two Transformers are similar in design, type T6 being for 6-volt working and type T20 for 20-volt working. The output of the T6 Transformer is 25 VA at 9 volts continuous rating, this voltage being correct for 6-volt Motors when operating from alternating current. The T20 gives an output of 20 VA at 20 volts. The Transformers have a 6-stud speed controller, giving five speeds. When on the stud at the extreme left the switch lever is in the "off" position. The next stud provides maximum current, and the remaining four are connected to coils of resistance wire, the stud on the extreme right being for slowest running. In starting a motor or train the lever is moved over to the extreme right, so that the motor momentarily receives the maximum current through its windings, and this impulse ensures an immediate start. The lever is then moved back again to the left, and the motor gradually picks up speed as the lever passes from stud to stud. The panel carrying the regulator is fitted also with two plug sockets for the output lead, and a length of twin flex, complete with plugs and sockets, is supplied with each Transformer. A fuse unit that gives protection against short circuit or overload is also included.

TYPES T6A AND T20A

The special feature of these Transformers is the two electrically isolated secondary windings giving different output voltages. The Transformers have a 6-stud resistance regulator mounted on the front, and at the side a small panel with three pairs of plug sockets for output. The first secondary of the T6A type gives an output of 21 VA at 9 volts, and is connected to the first and second pairs of sockets, the first pair being subject to control by the 6-stud speed regulator. The other secondary has an output of 19 VA at 3.5 volts, and is connected to the third pair of sockets. The purpose of this winding is to supply current for electric lamps that may be arranged in different positions on a model or a Hornby layout to add interest to its operation. As many as 18 lamps can be illuminated at once from this circuit.

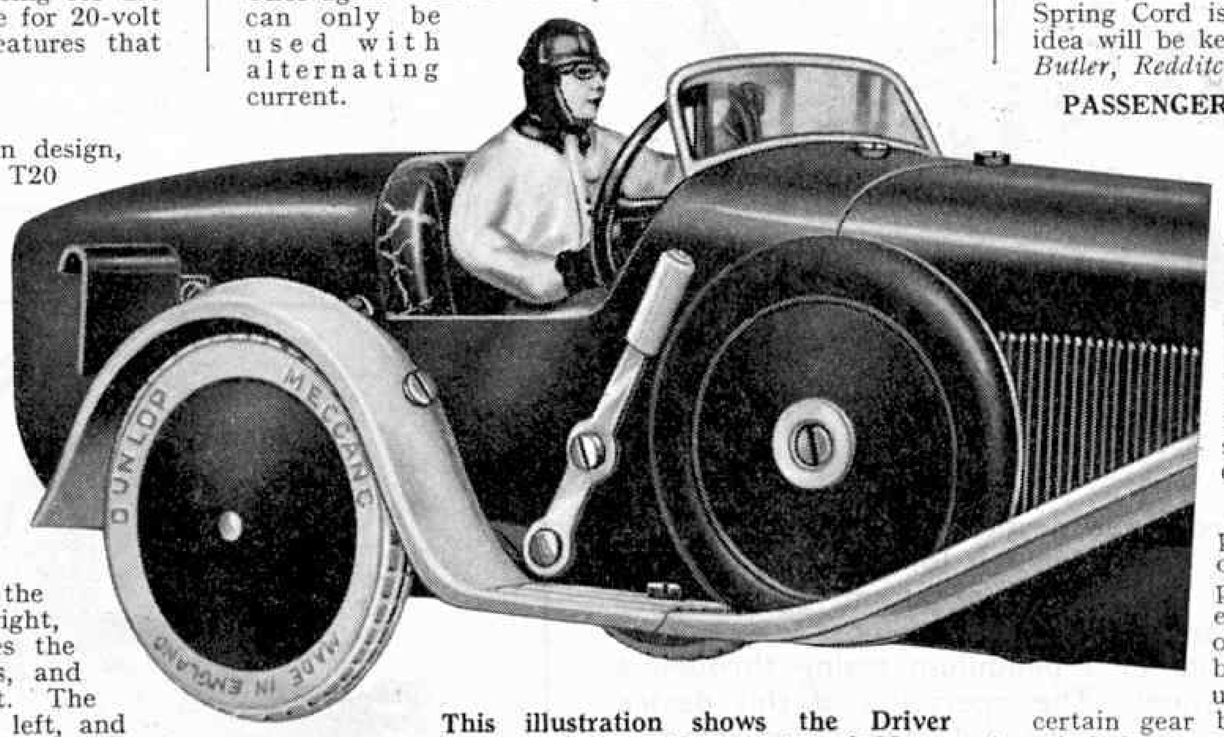
The output of the first secondary winding of the type T20A Transformer is 20 VA at 20 volts continuous rating. The first and second pairs of sockets are connected to this circuit, and the first pair is subject to control by the 6-stud regulator. The third pair of sockets is connected to the other secondary winding, and has an output of 15 VA at 3.5 volts. In this case 14 lamps may be lighted at the same time. A flexible output lead and fuse unit is supplied with each of these Transformers.

It will be seen that the T6A and T20A Transformers are of special utility in models that are fitted with lamps as well as an Electric Motor, as the lamps can remain fully lighted while the Motor is slowed down or stopped. Special care should be taken to guard against connecting the lamps to the wrong sockets and thus burning them out.

TYPES T6M AND T20M

The simplest Transformers in the Meccano range are the types T6M and T20M. These are not provided with a resistance controller, and they are fitted with terminals for output. The T6M Transformer has an output of 25 VA at 9 volts, and the T20M gives 20 VA at 20 volts. They are intended to be used with an external speed regulator, such as the Meccano resistance controller that is supplied with Hornby Electric Train Sets. These Transformers can of course be used without a speed regulator where it is not required to vary the speed of a motor.

All Meccano Transformers are available for all standard supply voltages and frequencies. The voltage and the frequency of the current with which they are to be used must be stated when ordering. The correct figures may be obtained from the meter, or if there is any doubt, from the supply authority. Once again it must be emphasised that Transformers can only be used with alternating current.



This illustration shows the Driver in position in a Meccano No. 2 Motor Car, and also the Imitation Spare Wheel Cover.

MOTOR CAR DRIVER

The illustration above shows the Driver (No. A1100) in position in a model built with a No. 2 Motor Car Outfit. This attractive figure is specially designed for fitting into the driving seat, and the latest type seat is perforated for fixing it. The figure is clad in the white overalls of a racing driver and has helmet and goggles. The hands are so placed that when the Driver is in position they appear to be holding the steering wheel, but allow slight clearance so that the wheel itself can be manipulated for taking corners.

To bolt the figure in position a special nut, supplied for the purpose, is slipped into a slot and the bolt inserted from under the seat.

SPARE WHEEL COVER

Many modern cars carry the spare wheel in a neat circular cover, which protects the wheel and the tyre, and gives a smarter appearance to the car. An Imitation Spare Wheel Cover is now included in the range of No. 2 Motor Car parts, and replaces the Spare Wheel previously contained in the Outfits. The part is shown mounted in position in the accompanying illustration, and it will be seen that this closely resembles the covers used in actual practice. The parts greatly enhance the appearance of the complete models and are obtainable in colours to match the cars.

INSPECTION LAMPS

The model-builder sometimes finds that he has to carry out an intricate operation in an awkward position in a model, and when the parts requiring attention are inside a complicated structure it may be difficult to see them. In such cases the illumination of the inside of the structure would greatly assist matters, and no doubt many readers have often wished for a light small enough to be inserted in awkward positions without being in the way. The pea-lamps included in the Motor Car Lighting Set are very suitable for this purpose. They are supplied attached to a length of flex, and on account of their small size can be inserted almost anywhere in a model. In connecting up the pea-lamps it is advisable to guard against overloading them, to prevent the possibility of the filament burning out. If a 3-volt battery is used there will be no danger of this, but it should be remembered that the standard flash lamp battery gives an output of 4½ volts.

WHEEL SEGMENT.—Wheel segments for building up flat-rimmed wheels of various diameters would probably be of utility in certain models, especially where flat belts are used for driving purposes. In most cases, however, ordinary Pulleys can be utilised instead, and as a rule an endless belt of Cord or Spring Cord is more satisfactory than belting. The idea will be kept in mind, however. (*Reply to W. D. Butler, Redditch.*)

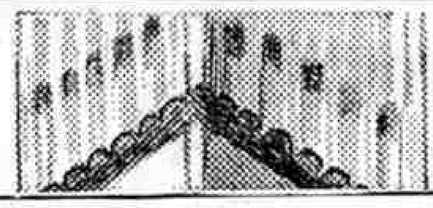
PASSENGERS FOR MOTOR CARS.—The production of passengers for fitting into the Cars built with the Motor Car Constructor Outfits might be popular with some constructors, but it is doubtful if there would be sufficient demand for the parts to warrant their manufacture. The Drivers at present included are in racing kit, and passengers would have to be similarly clothed to represent mechanics. The suggestion, and your proposal for drivers and passengers for touring cars, will be given consideration. (*Reply to D. A. Hart, Gt. Baddow, Essex.*)

SLIDING COUPLING.—The proposed part would resemble a Socket Coupling of greater length than the existing part, and with longer slots cut in the ends to receive the Set Screws of Collars or Pinions, etc. The Set Screws would be free to slide in the slots. A sliding unit such as this might be of utility in certain gear boxes, and the idea will be kept in mind, but we would point out that there are several methods of making a sliding coupling from parts already in the Meccano range.

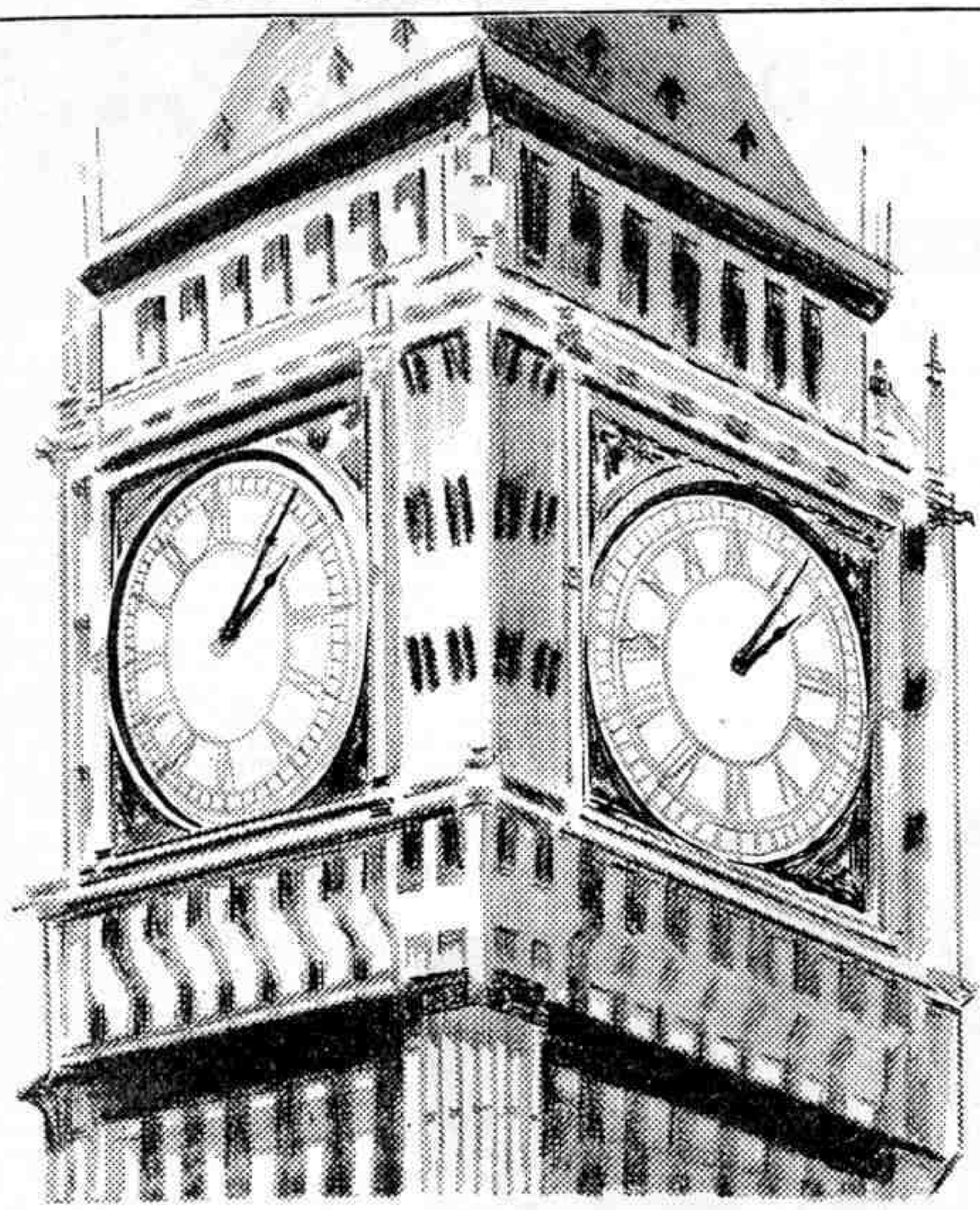
The existing Socket Coupling can be used where a slight sliding movement is required, such as in a friction clutch. The slot at present provided at each end of the Coupling allows sufficient movement of the Set Screw to disengage the frictional surfaces, but at the same time prevents the part carrying the Set Screw from rotating independently. If it is required to slide 57-teeth Gear Wheels or other similarly perforated parts, a Bush Wheel can be mounted on the Rod and provided with Threaded Pins that engage holes in the sliding Wheel. (*Reply to R. Richards, South Shields.*)

DIFFERENTIAL GEAR.—A special unit for constructing a differential gear would have limited applications in the Meccano system, and the built-up differential can be used in almost every case instead. The suggested part would consist of a Pulley Wheel or Sprocket with four large holes cut away to take Pinions rotating idly on Axle Rods attached to the Wheel and arranged radially from the centre. A Contrate would be placed on each side of the Wheel to engage the Pinions, and the drive from the Motor would be taken up by the Pulley or Sprocket. Belt or chain drive is not usual practice in motor car transmission, and if a Gear were substituted for the Pulley it would give a considerable reduction ratio, which in most cases would be unnecessary. Although the idea is ingenious, we are unable to consider the production of such parts. (*Reply to J. Willis, Wellington, N.Z.*)

GEAR RATIO OF 4 : 1.—The present range of Meccano Gears and Pinions gives ratios of 1 : 1, 2 : 1, 3 : 1, 5 : 1 and 7 : 1, and by means of various combinations of gearing, almost any required ratio can be obtained. A 4 : 1 reduction gear can be produced by using two sets of 2 : 1 gearing, obtainable by meshing a ¾" Pinion with a 50-teeth Gear. Special gearing to give a 4 : 1 ratio would make for compactness and we will not lose sight of the suggestion. (*Reply to O. M. Hart, Hornsey.*)



SECRETS OF ENGINEERING



How does a Clock keep Time?

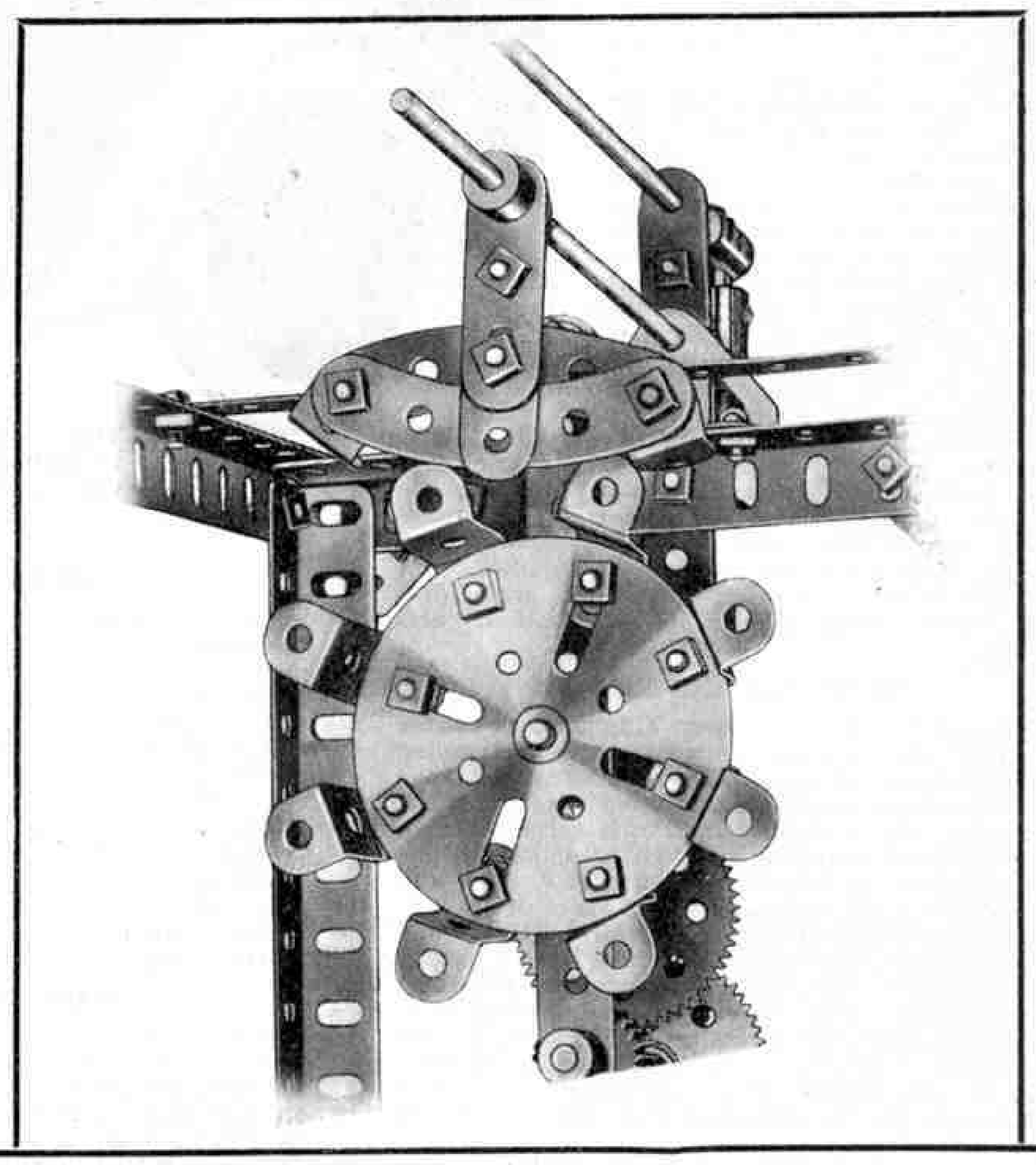
Full instructions for building a complete Meccano Grandfather Clock are contained in the special Instruction Leaflet No. 14A, obtainable from any Meccano dealer price 2d., or direct from Meccano Ltd., Binns Road, Liverpool 13.
Price 2d. post free.

Every modern clock, from the smallest household type to great turret clocks like "*Big Ben*," depends for its accurate time-keeping upon some form of regulating mechanism. Many types of such mechanisms have been devised, but the most widely used and the most reliable consists of a pendulum acting through a pallet and an escapement wheel. The operation of this device is based on the property possessed by a pendulum of always swinging at a constant rate, and thus providing a regulating influence that is transmitted to the clock movement.

The lower illustration on this page shows how perfectly this ingenious arrangement can be reproduced in Meccano. This is the mechanism that is incorporated in the well-known Meccano Grandfather Clock, and it enables the clock to keep excellent time. This clock is a splendid example of Meccano model-building, and it presents a very striking and attractive appearance when fitted into its case, which is 7 ft. in height.

PRICES OF MECCANO OUTFITS

Outfit	Builds	Price	Outfit	Builds	Price
No. X1	70 models	1/3	No. 3	687 models	27/6
No. X2	96 ,,	2/-	No. 4	753 ,,	52/6
No. 000	162 ,,	2/6	No. 5 (Carton) ...	798 ,,	70/-
No. 00	189 ,,	3/6	No. 5 (Cabinet) ...	798 ,,	100/-
No. 0	343 ,,	5/-	No. 6 (Carton) ...	844 ,,	125/-
No. 1	573 ,,	10/-	No. 6 (Cabinet) ...	844 ,,	155/-
No. 2	629 ,,	16/-	No. 7 (Cabinet) ...	889 ,,	415/-



MECCANO

MECCANO LTD. BINNS ROAD LIVERPOOL 13

Can You Make a Meccano Toy?

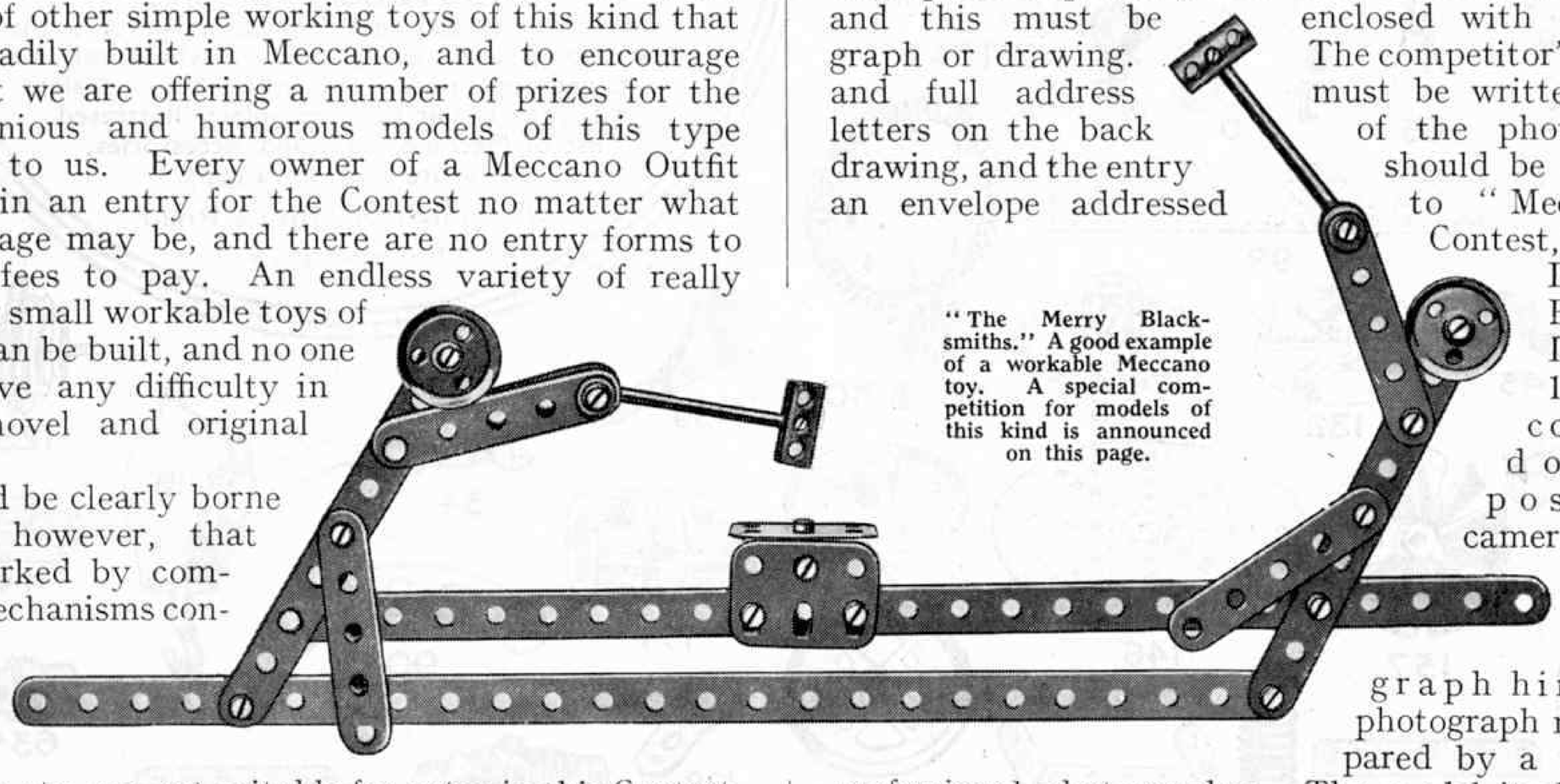
Big Prizes for Simple Models

The illustration on this page shows an amusing toy that can easily be built up from simple Meccano parts. It consists of two figures that represent blacksmiths, and by pulling and pushing on the ends of the Strips to which the figures are pivoted they can be made to swing their hammers so that they strike the anvil. There are hundreds of other simple working toys of this kind that can be readily built in Meccano, and to encourage experiment we are offering a number of prizes for the most ingenious and humorous models of this type submitted to us. Every owner of a Meccano Outfit may send in an entry for the Contest no matter what his or her age may be, and there are no entry forms to fill in or fees to pay. An endless variety of really fascinating small workable toys of this kind can be built, and no one should have any difficulty in finding a novel and original subject.

It should be clearly borne in mind, however, that models worked by complicated mechanisms consisting of Gear Wheels, Worms and Motors, etc., are not suitable for entry in this Contest. The movement of the model should be effected by some very simple method such as pulling on a string, or in a manner similar to the blacksmith model illustrated on this page. A suitable toy might consist of two boxers, with pivoted arms and legs attached to strings so arranged that by pulling them the boxers could be made to fight each other in realistic fashion. Another interesting model would be a human face, the ears, eyes and mouth of which could be made to move by means of levers or cords.

All models submitted must be workable ; models that are not made to work will not be eligible for prizes.

The prizes to be awarded for the best models sent in are listed at the foot of this page. In judging the entries particular attention will be given to those models that are the most amusing in operation. There are no restrictions as to the number of parts that may be used, but models that include a lot of unnecessary parts will not have much chance of success. The Meccano boy's ingenuity is best displayed in the construction of simple models from a small number of parts. It is a comparatively easy matter to make a fine model with intricate mechanism when a large variety of parts are available, but much skill and patience is needed to construct a simple working model from a limited selection of pieces. Success in this competition, therefore, will be a testimonial to a competitor's model-building skill.



"The Merry Blacksmiths." A good example of a workable Meccano toy. A special competition for models of this kind is announced on this page.

It should be noted that *the actual model must not be sent.* A good photograph or drawing is all that is required. Competitors must also prepare a short description explaining how their models are operated, and this must be enclosed with the photograph or drawing. The competitor's age, name and full address must be written in block letters on the back of the photograph or drawing, and the entry should be enclosed in an envelope addressed to "Meccano Toy Contest," Meccano Ltd., Binns Road, Liverpool 13. If the competitor does not possess a camera and is unable to obtain a photograph himself, the photograph may be prepared by a friend or a professional photographer. The model itself, however, must be the competitor's own unaided work.

Entries will be divided into two Sections—(A) for competitors of all ages living in the British Isles ; (B) for competitors of all ages living overseas. The letter A or B should be written on the entry to indicate the Section for which it is eligible. A separate set of prizes as listed at the foot of this page will be awarded in each Section. Two or three models may be sent in if desired, but when more than one is sent they should all be included in the same envelope. No competitor can win more than one prize, and if two or more models are sent they will be judged on their joint merits. Readers living in Gt. Britain and Ireland must forward their entries not later than 31st March, 1934. In order to give Overseas entrants plenty of time in which to build their models and forward them, we have extended the closing date for Section B to 31st May, 1934.

It is a condition of the Contest that photographs or drawings of prizewinning models become the property of Meccano Ltd. Unsuccessful entries however will be returned to the senders, provided that a stamped addressed envelope is sent for that purpose.

All prizewinners in this Contest will be notified personally as soon as possible after the closing dates, and lists of prizewinners will be published in a future issue of the "*M.M.*"

"Meccano Toy" Competition

The Prizes

A separate and complete set of prizes will be awarded in each of the Sections A and B as follows :—

First Prize, Meccano or Hornby Goods value £3-3s.
Second Prize, Meccano or Hornby Goods value £2-2s.
Third Prize, Meccano or Hornby Goods value £1-1s.
Six Prizes of Meccano or Hornby Goods value 10/-.
Six Prizes of Meccano or Hornby Goods value 5/-.
Twelve Consolation Prizes of "Famous Trains" by C. J. Allen.
Certificates of Merit will also be awarded in each Section.

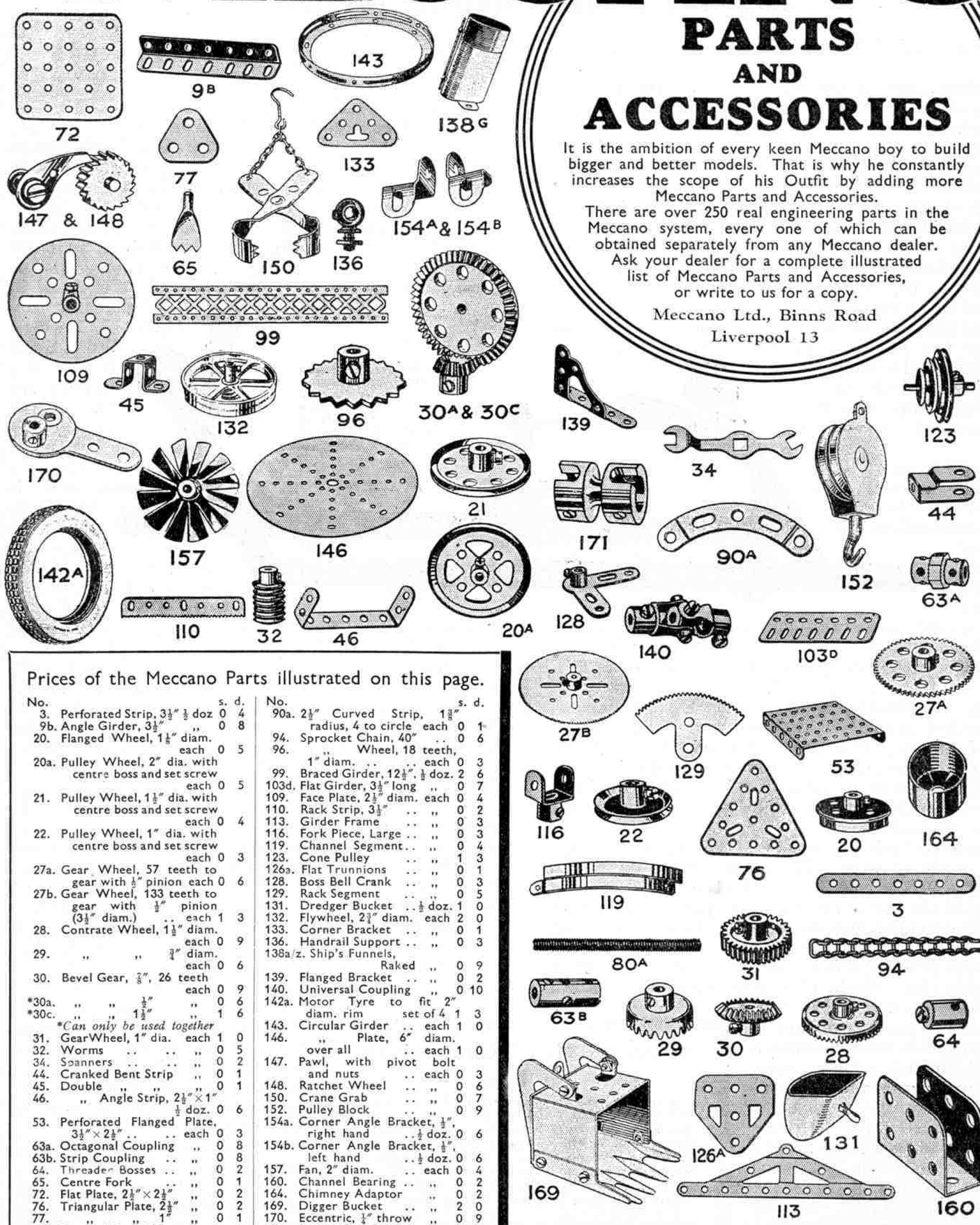
MECCANO

PARTS AND ACCESSORIES

It is the ambition of every keen Meccano boy to build bigger and better models. That is why he constantly increases the scope of his Outfit by adding more Meccano Parts and Accessories.

There are over 250 real engineering parts in the Meccano system, every one of which can be obtained separately from any Meccano dealer. Ask your dealer for a complete illustrated list of Meccano Parts and Accessories, or write to us for a copy.

Meccano Ltd., Binns Road
Liverpool 13



Prices of the Meccano Parts illustrated on this page.

No.		s.	d.
3.	Perforated Strip, 3½″ ½ doz	0	4
9b.	Angle Girder, 3½″ ,,	0	8
20.	Flanged Wheel, 1⅛″ diam. each	0	5
20a.	Pulley Wheel, 2″ dia. with centre boss and set screw each	0	5
21.	Pulley Wheel, 1½″ dia. with centre boss and set screw each	0	4
22.	Pulley Wheel, 1″ dia. with centre boss and set screw each	0	3
27a.	Gear Wheel, 57 teeth to gear with ½″ pinion each	0	6
27b.	Gear Wheel, 133 teeth to gear with ½″ pinion (3½″ diam.) .. each	1	3
28.	Contrate Wheel, 1½″ diam. each	0	9
29.	,, ,, ¾″ diam. each	0	6
30.	Bevel Gear, ⅞″, 26 teeth each	0	9
*30a.	,, ,, ½″ ,,	0	6
*30c.	,, ,, 1½″ ,,	1	6
	Can only be used together		
31.	GearWheel, 1″ dia. each	1	0
32.	Worms .. .. ,,	0	5
34.	Spanners .. .. ,,	0	2
44.	Cranked Bent Strip ,,	0	1
45.	Double ,, ,, ,,	0	1
46.	,, Angle Strip, 2½″×1″ ½ doz.	0	6
53.	Perforated Flanged Plate, 3½″×2½″ .. .. each	0	3
63a.	Octagonal Coupling ,,	0	8
63b.	Strip Coupling .. ,,	0	8
64.	Threaded Bosses .. ,,	0	2
65.	Centre Fork .. ,,	0	1
72.	Flat Plate, 2½″×2½″ ,,	0	2
76.	Triangular Plate, 2½″ ,,	0	2
77.	,, ,, 1″ ,,	0	1
80a.	Screwed Rod, 3½″ ,,	0	3

No.		s.	d.
90a.	2½″ Curved Strip, 1⅜″ radius, 4 to circle each	0	1
94.	Sprocket Chain, 40″ ..	0	6
96.	,, Wheel, 18 teeth, 1″ diam. .. .. each	0	3
99.	Braced Girder, 12½″, ½ doz.	2	6
103d.	Flat Girder, 3½″ long ,,	0	7
109.	Face Plate, 2½″ diam. each	0	4
110.	Rack Strip, 3½″ .. ,,	0	2
113.	Girder Frame .. ,,	0	3
116.	Fork Piece, Large .. ,,	0	3
119.	Channel Segment .. ,,	0	4
123.	Cone Pulley .. ,,	1	3
126a.	Flat Trunnions .. ,,	0	1
128.	Boss Bell Crank .. ,,	0	3
129.	Rack Segment .. ,,	0	5
131.	Dredger Bucket .. ½ doz.	1	0
132.	Flywheel, 2¾″ diam. each	2	0
133.	Corner Bracket .. ,,	0	1
136.	Handrail Support .. ,,	0	3
138a/z.	Ship's Funnels, Raked ,,	0	9
139.	Flanged Bracket .. ,,	0	2
140.	Universal Coupling ,,	0	10
142a.	Motor Tyre to fit 2″ diam. rim set of 4	1	3
143.	Circular Girder .. each	1	0
146.	,, Plate, 6″ diam. over all .. each	1	0
147.	Pawl, with pivot bolt and nuts .. each	0	3
148.	Ratchet Wheel .. ,,	0	6
150.	Crane Grab .. ,,	0	7
152.	Pulley Block .. ,,	0	9
154a.	Corner Angle Bracket, ½″, right hand .. ½ doz.	0	6
154b.	Corner Angle Bracket, ½″, left hand .. ½ doz.	0	6
157.	Fan, 2″ diam. .. each	0	4
160.	Channel Bearing .. ,,	0	2
164.	Chimney Adaptor ,,	0	2
169.	Digger Bucket .. ,,	2	0
170.	Eccentric, ½″ throw ,,	0	9
171.	Socket Couplings .. ,,	0	9

Model-Building Contest Results

By Frank Hornby

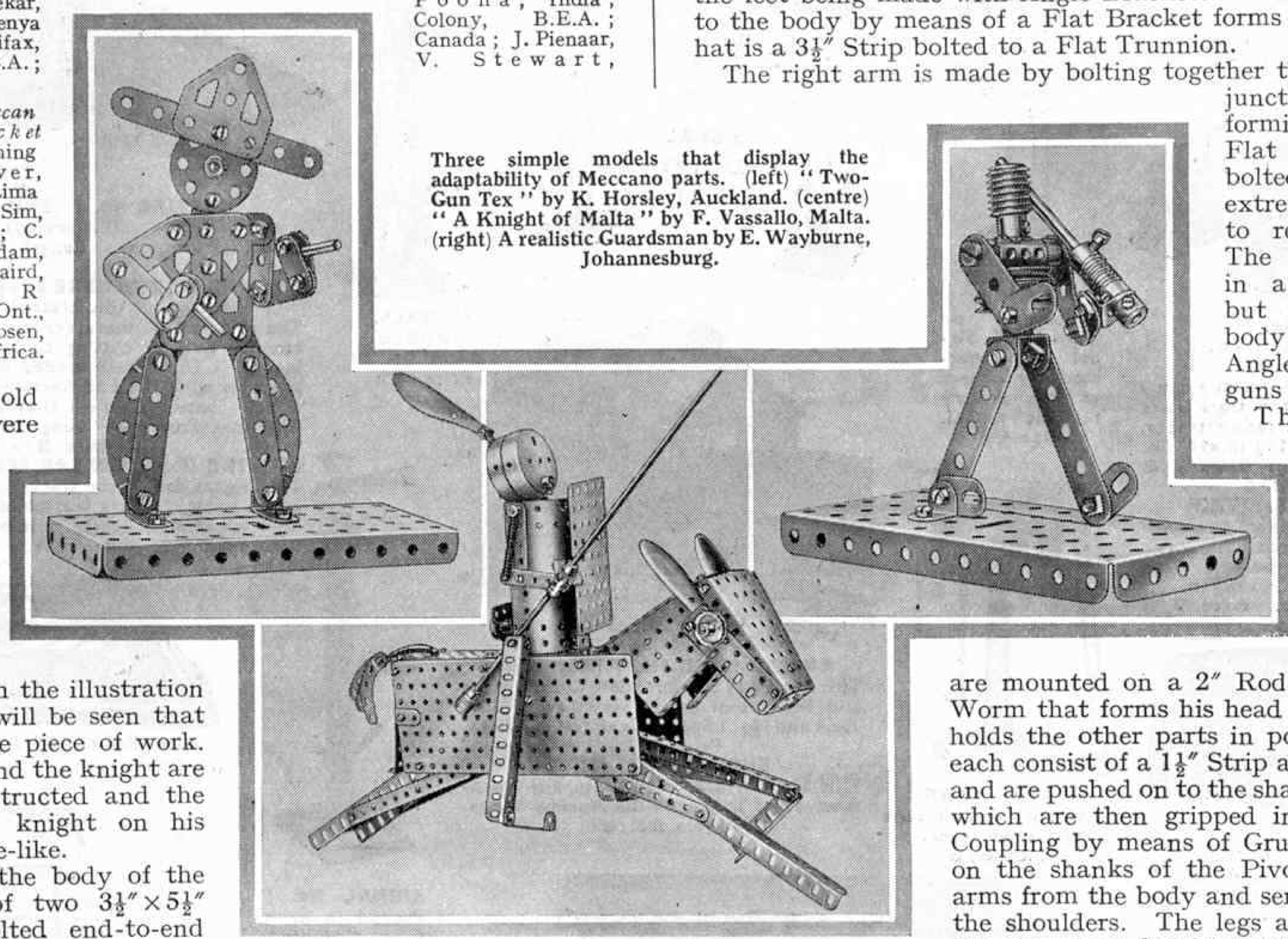
"Meccanitian" Competition (Overseas Section)

This month I have pleasure in announcing the names of prizewinners in the Overseas Section of the "Meccanitian" Contest. The complete list is as follows:—

FIRST PRIZE, Meccano or Hornby Goods value £2-2s.: F. Vassallo, Sliema, Malta.
SECOND PRIZE, Goods value £1-1s.: K. Horsley, Herne Bay, Auckland, N.Z.
THIRD PRIZE, Goods value 10/6: E. Wayburne, Johannesburg, S.A.

TEN PRIZES of Meccano or Hornby Goods value 5/-: E. Wilkinson, Durban, S. Africa; R. Piper, Eglinton, N.S.W.; N. Venimore, Wellington, N.Z.; L. Huls, Amersfoort, Holland; A. Fulcher, Te Kuiti, N.Z.; D. Davjekar, Poona, India; B. Cowen, Kitale, Kenya Colony, B.E.A.; P. Whalley, Halifax, Canada; J. Pienaar, Johannesburg, S.A.; V. Stewart, Ontario, Canada.

PRIZES of "*Meccano Engineer's Pocket Books*": A. Worthington, Vancouver, Canada; T. De Lima Bombay, India; P. Sim, Christchurch, N.Z.; C. Lagendijk, Schiedam, Holland; J. Baird, Ranfurly, N.Z.; R Begg, Hamilton, Ont., Canada; I. Ellebsen, Plumstead, S. Africa.



Three simple models that display the adaptability of Meccano parts. (left) "Two-Gun Tex" by K. Horsley, Auckland. (centre) "A Knight of Malta" by F. Vassallo, Malta. (right) A realistic Guardsman by E. Wayburne, Johannesburg.

The "days of old when knights were bold" are conjured up by the splendid model that won First Prize. The model represents the "Knight of Malta," and from the illustration on this page it will be seen that it is a really fine piece of work. Both the horse and the knight are realistically constructed and the position of the knight on his steed is quite life-like.

Each side of the body of the horse consists of two $3\frac{1}{2}'' \times 5\frac{1}{2}''$ Flat Plates, bolted end-to-end with an overlap of four holes. Angle Girders are bolted along the upper edge of each Plate, and to these are bolted two $2\frac{1}{2}'' \times 4\frac{1}{2}''$ Flat Plates, which form the horse's back. The sides are spaced apart at the bottom by a $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip, and a $2\frac{1}{2}'' \times 3\frac{1}{2}''$ Flanged Plate is secured to one end of the box thus formed and held in place by a $2\frac{1}{2}'' \times 1''$ Double Angle Strip. The long, lean legs are made from Angle Girders and $5\frac{1}{2}''$ Strips, and are placed at such angles as to give the appearance of galloping.

The horse's neck, which is rather too broad and thick, is made from two Sector Plates, spaced apart by a $2\frac{1}{2}'' \times 3\frac{1}{2}''$ Flat Plate, the latter being bolted to the flanges of the Sector Plates. Another Sector Plate and two $3\frac{1}{2}''$ Flat Girders bolted to the ends of the Sector Plates that form the neck complete the horse's head, across the end of which a $1\frac{1}{2}''$ Flat Girder is bolted to represent the nose. The eyes are 1" Fast Pulleys secured to the ends of a Rod that passes through the head, and two Propeller Blades represent the animal's ears.

The knight is a boiler to which are bolted legs consisting of two $5\frac{1}{2}''$ Angle Girders, fitted with $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips for feet. Two Boiler Ends form the knight's head and a Propeller Blade makes a realistic feather. The head is held in place by means of a Rod that passes through the Boiler and a Double Bracket bolted to the rim of one of the Boiler Ends.

In his right hand the knight carries a lance consisting of an $11\frac{1}{2}''$ Rod and a 5" Rod connected by a Coupling, with a Worm on the butt end. The Coupling enables the lance to be bolted to the end of the arm. A 1" Sprocket Wheel secured to the lance forms a hand guard and a $2\frac{1}{2}'' \times 4\frac{1}{2}''$ Flat Plate represents the knight's shield. The saddle is a $1'' \times 2\frac{1}{2}''$ Double Angle Strip and a $1\frac{1}{2}''$ and a $2\frac{1}{2}''$ Strip, and the saddle pommel is a $\frac{3}{4}''$ Flanged Wheel.

Second Prize was won with a model of "*Two-Gun Tex*" the Bandit. The bandit's body consists of two Flat Trunnions, bolted together with an overlap of two holes. To the corners of the lower Flat Trunnion are bolted two Flat Brackets, by means of which the legs are held in place. Each of these consists of a $2\frac{1}{2}''$ Strip, to which is bolted a $2\frac{1}{2}''$ Curved Strip that forms his "chaps," the feet being made with Angle Brackets. A Bush Wheel bolted to the body by means of a Flat Bracket forms the head, and the hat is a $3\frac{1}{2}''$ Strip bolted to a Flat Trunnion.

The right arm is made by bolting together two $1\frac{1}{2}''$ Strips, the junction of the two forming the elbow. Two Flat Brackets are then bolted to the lower extremity of the arm to represent a hand. The left arm is made in a similar manner, but is secured to the body by means of an Angle Bracket. The guns are 1" Rods.

The Third Prize model represents a Guardsman. His body consists of three 1" loose Pulleys, a Coupling and a large Fork Piece, which are mounted on a 2" Rod and capped by a Worm that forms his head and bearskin, and holds the other parts in position. The arms each consist of a $1\frac{1}{2}''$ Strip and a Flat Bracket, and are pushed on to the shanks of Pivot Bolts, which are then gripped in the ends of the Coupling by means of Grub Screws. Collars on the shanks of the Pivot Bolts space the arms from the body and serve also to broaden the shoulders. The legs are $2\frac{1}{2}''$ Strips with Flat Brackets bolted to their lower ends to form the feet. Over the left shoulder the figure carries a rifle consisting of a 3" Rod, three Collars and nine Washers. A Set Screw in place of the Grub Screw in the upper Collar forms the trigger. The baseplate of the model is a $2\frac{1}{2}'' \times 5\frac{1}{2}''$ Flanged Plate, to which the figure is secured and the legs arranged in such positions that the Guardsman appears to be marching in regulation fashion with his chest thrown forward and his right arm swinging at his side.

One of the most humorous models entered in the Contest represents two hungry diners sitting at a table, on which are salt and pepper canisters reproduced by Buffers. Nuts and Bolts placed in a Contrate Wheel for a dish provide a plentiful but unpalatable repast!

"Most Useful Parts" Voting Contest

The Meccano parts that received the highest number of votes in this Contest are as follows:—(1) Flat Bracket; 189 votes. (2) Double Bracket; 120 votes. (3) Threaded Pin; 48 votes. (4) Corner Bracket; 36 votes. As several competitors succeeded in placing the four selected parts in the order given above, the First, Second and Third Prizes were combined and divided equally between them, each receiving goods value 18/6. The remaining prizes were awarded to competitors whose entries were nearest correct in order of merit.

The list of principal prizewinners is as follows:—

MECCANO OR HORNBY GOODS value 18/6: D. Howe, Bedford; D. Head, Beckenham, Kent; R. Message, Dartford, Kent; T. Plant, London, N.8.

FIVE PRIZES of Meccano or Hornby Goods value 5/-: C. Allard, Hayes; G. Ranson, Cowes; P. Kay, Oldham; J. Carter, Capetown; C. Vermande, Baarn.

HORNBY SERIES

HORNBY ACCESSORIES

GAUGE O

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

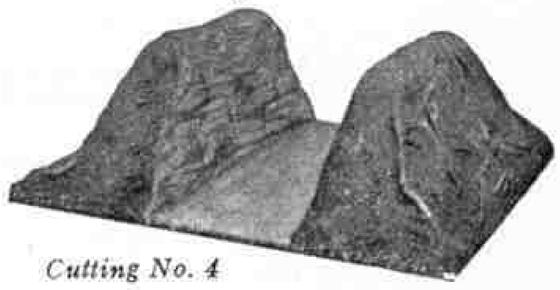
A selection of Hornby Accessories is illustrated below. Your dealer will be pleased to show you the full range.

TUNNEL No. 0 (Straight)
Length 6 in., width 6⅛ in.
Price **1/6**

TUNNEL No. 1 (Straight)
Length 7 11/16 in. Width 6¼ in. (as illustrated).
Price **2/-**

TUNNEL No. 2 (Straight)
Length 15⅝ in. Width 9¼ in. Price **4/-**

STATION No. 2
Excellent model, beautifully designed. Built up in three detachable sections. Length 2 ft. 9 in., breadth 6 in., height 7 in. Price **10/-**

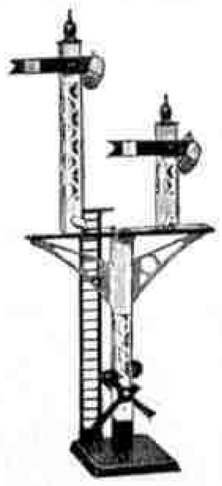


Cutting No. 4

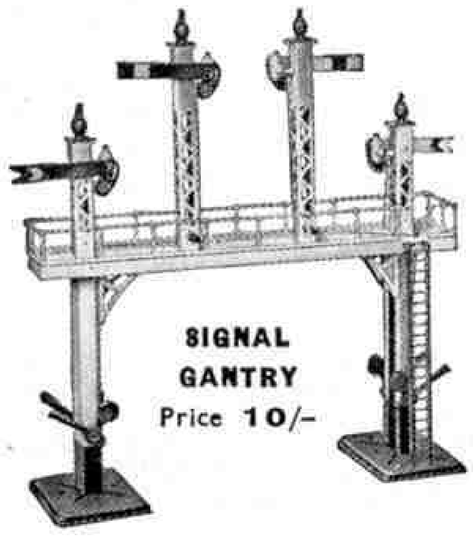
CUTTING No. 4 (STRAIGHT)
This is a double cutting, mounted on a base over which the railway track is laid.
Base measurement: Length 15⅝ in., width 15 in. Price **6/-**

TUNNEL No. 5 (LEFT-HAND CURVED)
(as illustrated)
This tunnel is in the form of a small hill, through which the track runs obliquely. For 2 ft. radius tracks.
Base measurement: 15⅞ in.x14¾ in.
Length of track 17¼ in. Price **7/6**

TUNNEL No. 6 (RIGHT-HAND, CURVED)
Similar to No. 5 Tunnel, but with track in the reverse position. For 2 ft. radius tracks only. Base measurement 15⅞ in.x14¾ in.
Length of track 17¼ in. Price **7/6**



JUNCTION SIGNAL
"Home" or "Distant," Signal arms operated by levers at base. A very realistic model.
Price **6/-**



SIGNAL GANTRY
Price **10/-**

SIGNALS, DOUBLE ARM No. 2
Price each **3/-**

Two No. 1 and one No. 2 Cuttings are illustrated here.

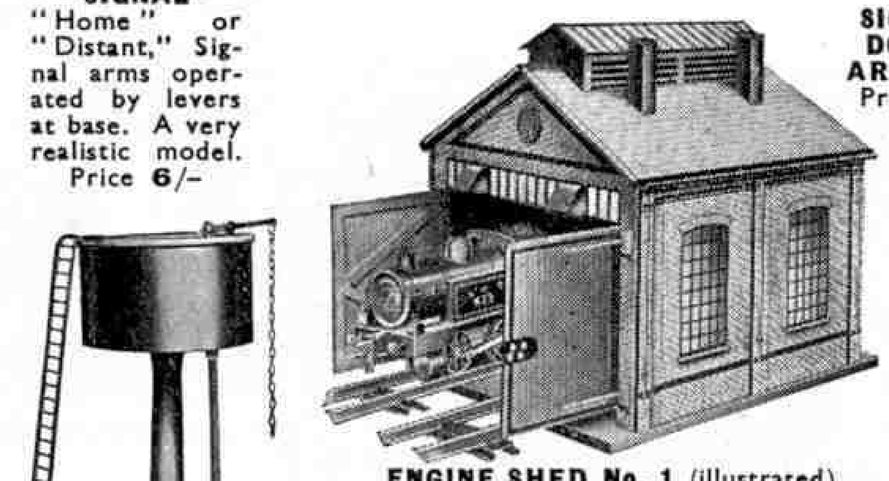
CUTTING No. 1 (END SECTION)
(illustrated)
Base measurement: Length 7 11/16 in., width 6 in.
Price, per pair **3/-**

CUTTING No. 2 (CENTRE SECTION, STRAIGHT)
(illustrated)
The addition of these centre sections enables a Hornby Railway cutting to be extended to any length. They are intended to be used in conjunction with the End Sections (Cutting No. 1), between which they are fitted.
Base measurement: Length 10¼ in., width 6 in.
Price **2/-**

CUTTING No. 3 (CENTRE SECTION, CURVED)
This is used for curved tracks in the same manner as the straight centre section, described above, is used for straight tracks. It is suitable for both 1 ft. and 2 ft. radius tracks. Price **2/-**

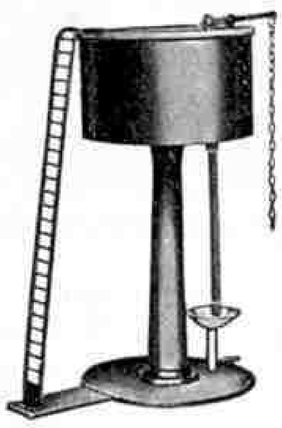
TUNNEL No. 3 (Curved)
Length 13 in. Price **4/6**

TUNNEL No. 4 (Curved)
(as illustrated)
Length 20 in. For 2 ft. radius tracks only. Price **5/6**

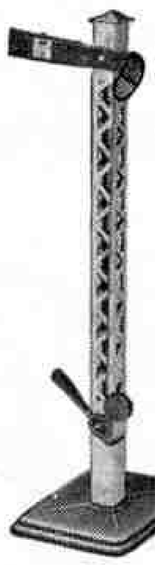


ENGINE SHED No. 1 (illustrated)
This Shed will accommodate Locomotives and Tenders of the M Series and No. 1 Tank and No. 1 Special Tank Locomotives.
Price **15/-**

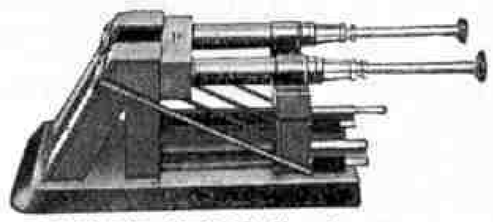
ENGINE SHED No. 2
This Shed will accommodate any Locomotive and Tender in the Hornby Series.
Price **22/6**



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



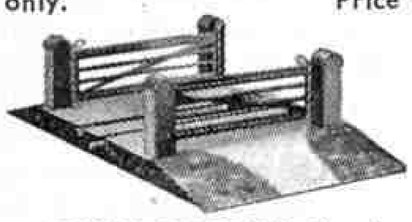
SIGNAL No. 1
Packed in pairs (one "Home," one "Distant").
Price, per pair **3/-**



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

SIGNAL CABIN No. 1
Finished in colours. Price **2/9**

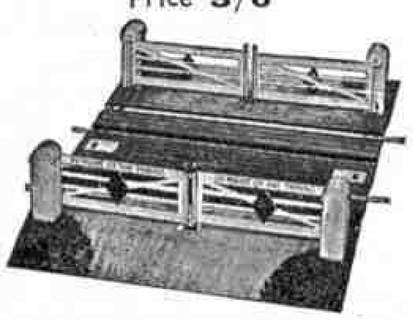
SIGNAL CABIN No. 2 (illustrated)
Dimensions: Height 6½ in., width 3½ in., length 6½ in. Roof and back open to allow Lever Frame to be fitted inside cabin if desired. Price **4/6**



LEVEL CROSSING No. 1
Suitable for a single track only and has gauge O rails in position.
Price **3/6**

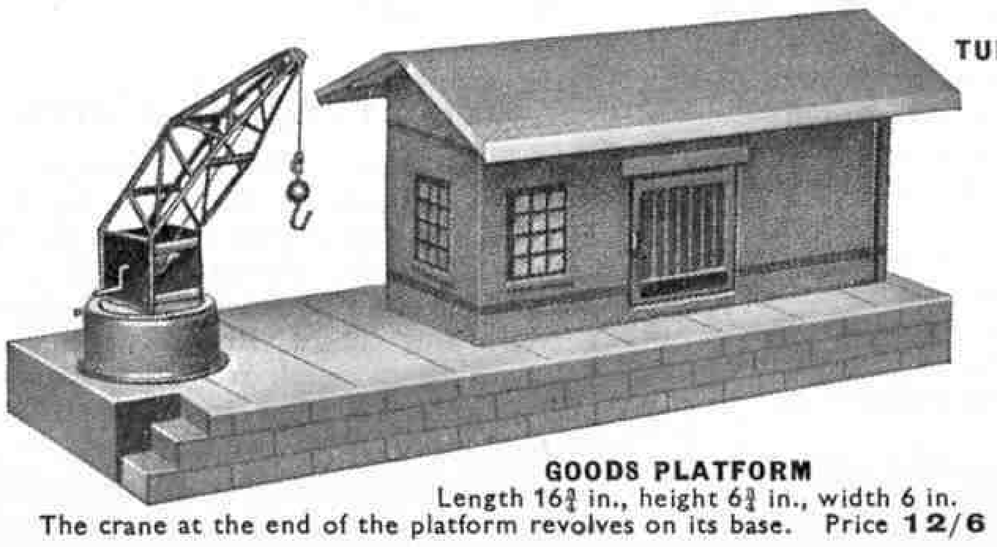
STATION No. 1
Length 16¾ in., width 6 in., height 6 in. This Station is a well-made model, richly finished in bright colours. By placing several of these Stations at intervals along the track, and using the Railway Station No. 2 as the main terminus, a very realistic effect is given to a miniature railway layout. Price **6/-**

TURNTABLE No. 2
Price **4/6**



LEVEL CROSSING No. 2
Measures 13½x10¼ in., with two tracks of gauge O rails in position. Price **5/6**

LEVEL CROSSING No. E2 (Electrical)
Similar to Level Crossing No. 2 excepting that a third rail is fitted in each of the two tracks.
Price **7/6**



GOODS PLATFORM
Length 16¾ in., height 6¾ in., width 6 in.
The crane at the end of the platform revolves on its base. Price **12/6**

No. 1 FOOTBRIDGE, WITHOUT SIGNALS
Price **4/-**

No. 1A FOOTBRIDGE, COMPLETE WITH SIGNALS Price **4/9**

No. 2 FOOTBRIDGE, COMPLETE WITH DETACHABLE SIGNALS
(as illustrated). Price **7/6**

Signals only (for Footbridge No. 2)
Price, per pair **3/9**

MECCANO LIMITED — BINNS ROAD — LIVERPOOL 13

The Secret of the Guild

The news that reaches me week by week from Meccano clubs suggests that members are already acting upon the suggestion I made last month that they should recognise the 15th year of the Guild by making special efforts to spread its influence among their friends, for most clubs report satisfactory increases in membership, and a growing enthusiasm for club activities of all kinds.

I have often been asked what is the real secret of the remarkable success of the Meccano club movement. I think it is to be found in the fact that a Meccano club provides splendid opportunities for keen boys who are eager to learn how things work by the best of all possible methods—that of actually making models for themselves. It is the eagerness of members that gives the best opportunity for the development of club life, and the chief aims of Leaders must always be to direct their interest into the right channels. As far as possible, therefore, programmes should be modelled in accordance with members' own wishes, the Leader checking misdirected energy and encouraging all ambitions that promise fruitful results, and every effort should be directed towards making the most of the keenness and enthusiasm that mark all their efforts.

Merit Medallions in 1934

In accordance with my usual custom, I give on this page the names of members of Meccano clubs who have been awarded Merit Medallions during the past twelve months. The wide distribution of these awards is evidence of the keen interest taken in Meccano club activities in all parts of the world.

There are many clubs that have not been adequately represented in the lists of winners of Merit Medallions published in recent years. I hope that during 1934 the Leaders of these clubs will make greater use of this award, the highest in the Guild, and that a record number of Guild members will become qualified for inclusion in the list before its next annual appearance. In every club two Merit Medallions are available each session, and they are presented in recognition of any form of good work on behalf of a club. The Leader's nomination is all that is required, and the Medallions make ideal awards for special activities and also for continued successes in minor club events.

Merit Medallions Awarded in 1933

SOUTH CROYDON & PURLEY—A. Jones. DAGENHAM—S. Pashley, L. Hurley, I. Bond, E. Butcher, F. Wood, L. Guthrie, D. Pashley, S. Mullins. CHERTSEY—G. Stevens, A. Foster, P. Bryant. STATIONERS' SCHOOL—G. Wrapson, L. A. G. Cunnington. LAINDON—R. Charlick, A. Farthing. WEALDSTONE METHODIST—P. Drew, D. Slinn. BARTON-ON-HUMBER—P. Thompson. EXETER—S. D. Elworth, T. Gorman, N. Tillyer, J. Rattenbury, D. Legg, H. Isaac, P. Yeo. WEMBLEY—D. Wenman, A. G. Brampton. HARLESDEN METHODIST—J. Ford, A. Durrant. MIDDLESBROUGH—H. Garnett, L. Shepherd. KENDAL—S. Coutts, A. Woodburne, A. Thompson. KING'S LYNN—G. D. V. Dey, R. E. Sharp. HOLY TRINITY (BARNSBURY)—S. Letchford, M. Thorpe, B. Cockins, A. Head, P. Gilroy, G. Gerhold, H. Boys, F. Bedwell, S. Liversidge, T. Adams. ESTON SCOUTS—C. Moore, E. Jones. ST. COLUMBA'S (SUNDERLAND)—R. Dunn, R. Brooks. GATE HOUSE SCHOOL (INGATESTONE)—G. Roebuck. MORISON MEMORIAL (CLYDEBANK)—G. Moir, D. McGregor. HARWICH—J. Duffy, R. Summers, R. Marsh. OLD CHARLTON—D. Picton. MARY SWANWICK (CHESTERFIELD)—F. W. Cooper, F. Adams. KING EDWARD GRAMMAR SCHOOL (BIRMINGHAM)—E. H. Petford. REGENT STREET SELECTIVE SCHOOL (HEYWOOD)—W. Jones. COLFE'S GRAMMAR SCHOOL—H. H. Renyard, H. Fowler. MILLWALL CENTRAL SCHOOL—C. J. Shaw, J. R. Taylor. NEW BRADWELL—R. Bellchambers, F. Baxter.

OVERSEAS CLUB MEMBERS

AUSTRALIA: MELBOURNE—L. S. Osborne, R. Willard. SYDNEY—J. Butler, G. Devine, R. J. Hoseason. VICTORIA—L. Ison. SOUTH AFRICA: MALVERN—Miss M. Nicholson, G. Ross, A. Robert. BEREA—D. S. Rosenburg, P. Epstein. TURFFONTEIN—K. Tanner. WESTERN PROVINCE PREPARATORY SCHOOL—P. K. Wiener, B. B. Strickland. FRANCE: DERRIL—M. Doat, R. Gillard, P. Anglards. NEW ZEALAND: WELLINGTON—E. J. Barnsley, J. D. Satterly. ASHBURTON—G. Bishop, R. McQuarters. HOLLAND: MAASTRICHT—F. L. Bingen. NORWAY: SANDEFJORD—J. Jacobsen.

Capabilities of Meccano Boys

The rapid manner in which members of clubs conducted in this manner develop initiative and resource is always surprising to those who do not know the capabilities of Meccano boys. This is often shown when engineers or others interested in mechanical work, are invited to Exhibitions, for they are invariably astonished by the wealth of detail in the models on view, and by the fidelity with which these reproduce real engineering structures and machines.

The skill and the ingenuity of club members are demonstrated also in the novel types of Model-building Contests that are popular in many clubs. The "Packet" Contest is one of these. In this, each entrant is given a package of Meccano parts and is required to produce a Meccano model in a specified time. Whenever a contest of this kind is held, some model is produced that is outstanding in its realism, or is provided with a simple but highly effective movement.

Some club members have even proved capable model-builders when relying only on their sense of touch, and Blindfold Model-building Contests actually have been arranged in several clubs. The type of model to be built in such Contests should be very simple, and the handicap imposed on competitors is so great that events of this kind are best treated as a means of introducing humour into the club programme.

Coming Events

The end of the present session is a favourite time for the Exhibitions, Concerts and Open Meetings that give parents and friends of members, and others interested in Meccano model-building, opportunities of seeing something of club life. Every effort should be made to ensure that wide publicity is given to events of this kind, and I hope that the advantages of an announcement in these pages will not be overlooked by club Leaders. I shall be very pleased to include notice of any Exhibition of which the details reach me in good time, and in order to avoid disappointment, these details should be forwarded immediately if they are to appear in the March or April issues. The information given should include the date and place of the event, and the opening times and admission charges.

An attractive Exhibition organised by the Transvaal Meccano Clubs Union will be held on 3rd March in the Parktown Boys' High School, Wellington Road, Johannesburg. Meccano enthusiasts and all interested in model-building and model railway operation will be cordially welcomed and are invited to write for full details of the event, and of the competitions arranged in connection with it, to Mr. E. Sykes, P.O. Box 8, Cleveland, Johannesburg.

Proposed Clubs

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

BELFAST—Mr. J. T. Parker, c/o Robb & Co. Ltd., 1/15, Castle Street, Belfast.

HORLEY—Mr. H. Wilson, Burstow School, Horley, Surrey.

GIDEA PARK—J. Thompson, 115, Carlton Road, Gidea Park, Essex.

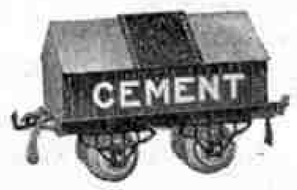
HORNBY ROLLING STOCK

Hornby Rolling Stock includes almost every type in use on the big railways, and a selection of the splendid range available is illustrated on this page. The various items are modelled on realistic lines, strongly built and beautifully enamelled.

Ask your dealer to show you the full range of Hornby Rolling Stock.

WAGON, MO. Price **7**d.

*** CATTLE TRUCK No. 1**
Fitted with sliding doors. Very realistic design. Price **3/-**



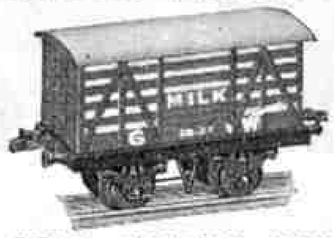
CEMENT WAGON
The door at the top opens. Finished in bright red. Price **2/9**

CRAWFORD'S BISCUIT VAN
Finished in red, with opening doors. Price **3/-**

TIMBER WAGON No. 1
Beautifully finished. Price **1/6**

BITUMEN TANK WAGON "COLAS"
Finished in blue. Price **5/3**

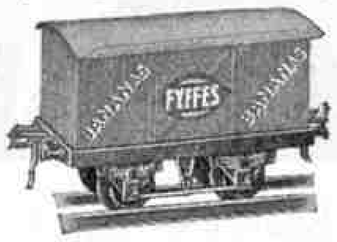
SECCOTINE VAN
Finished in blue, with opening doors. Price **3/-**



MILK TRAFFIC VAN No. 0
Supplied with G.W. Railway lettering only. Price **2/6**

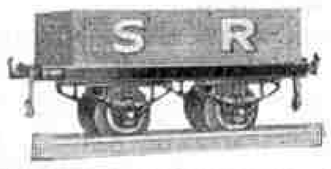
*** GUNPOWDER VAN**
Finished in red, with opening doors. Price **3/-**

MILK TRAFFIC VAN No.1
Fitted with sliding doors. Complete with milk cans. Price **3/-**



BANANA VAN
An attractive model, finished in yellow and green. Price **3/-**

*** REFRIGERATOR VAN**
Fitted with opening doors. Price **3/-**



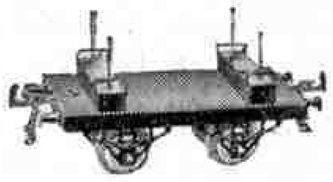
***WAGON, HORNBY No. 1**
Price **1/9**

ROTARY TIPPING WAGON
Finished in orange. Price **2/6**

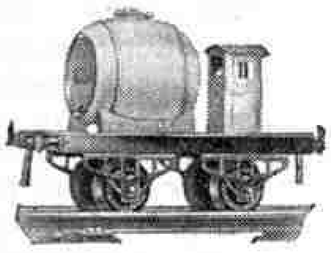
COAL WAGON
This is similar to Hornby Wagon No. 1. It is fitted with embossed representation of coal. Price **2/3**

*** OPEN WAGON "B"**
Similar to Hornby Wagon No. 1 but fitted with centre tarpaulin supporting rail. Price **2/-**

CRANE TRUCK
Finished in brown and blue. Price **3/6**



LUMBER WAGON No. 1
Fitted with bolsters and stanchions. Price **1/9**

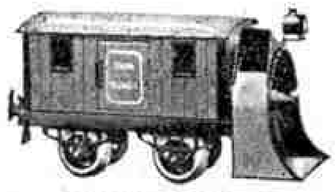


WINE WAGON, SINGLE BARREL
A model of the single-barrel type of wine wagon used in France. Finished in red and green. Price **3/6**

BRAKE VAN (French Type) Lettered "Nord." Opening doors. Price **4/-**

PETROL TANK WAGON "B.P."
Finished in cream enamel. Price **2/6**

GAS CYLINDER WAGON
Finished in red, lettered gold. Price **2/6**

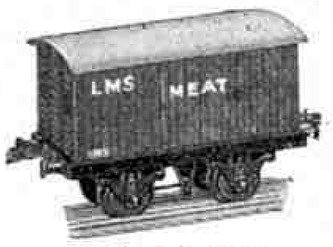


SNOW PLOUGH
With revolving plough driven from front axle. Price **5/6**

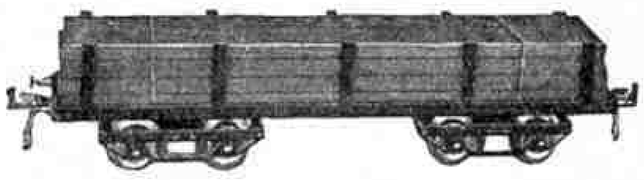
SIDE TIPPING WAGON
Lettered "Robert Hudson Ltd." Price **2/-**

LUMBER WAGON No. 2
Fitted with bolsters and stanchions for log transport. Suitable for 2-ft. radius rails only. Price **3/6**

BARREL WAGON
This is a model of a type of wagon used in France and other European countries. Price **2/9**



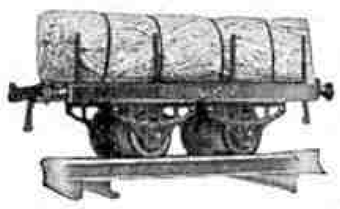
MEAT VAN
Supplied with L.M.S. Railway lettering only. Price **2/6**



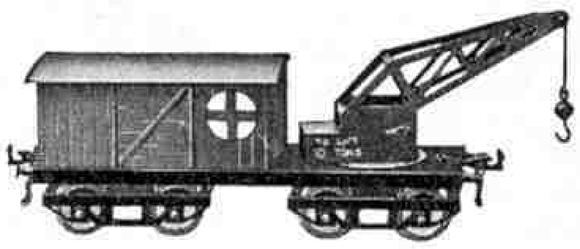
TIMBER WAGON No. 2
Finished in green and red. Suitable for 2-ft. radius rails only. Price **3/-**

MITROPA COACH No. 3
Lettered "Mitropa," with either "Spiesewagen" or "Schlafwagen" in gold. Finished in red enamel with white roof. Price **14/-**

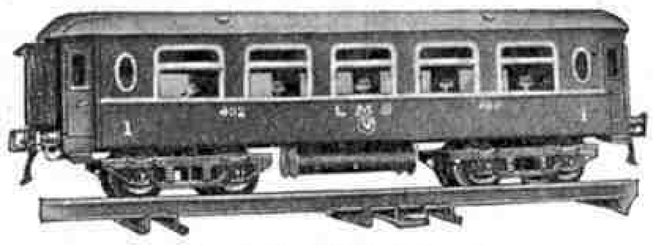
COVERED WAGON (French Type)
This wagon is fitted with frame and sheet. French type lettered "Nord." Price **3/-**



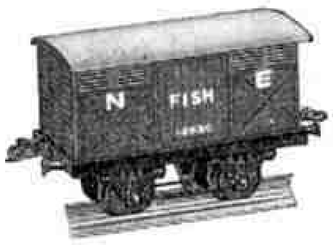
FIBRE WAGON
This is a model of a type of wagon used in France and other European countries. Price **1/9**



***BREAKDOWN VAN AND CRANE**
Finished in brown and blue, with opening doors. Suitable for 2-ft. radius rails only. Price **6/3**

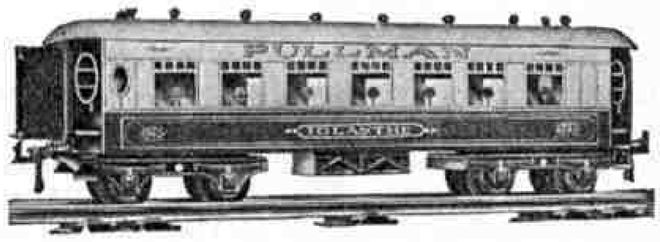


No. 2 SALOON COACH
Two types are available: L.M.S. (as illustrated) enamelled maroon, and L.N.E.R. enamelled brown. Suitable for 2-ft. radius rails only. Price **11/6**



FISH VAN
Supplied with L.N.E. Railway lettering only. Price **2/6**

MITROPA COACH No. 0
Finished in red with white roof. Lettered "Mitropa," with either "Speisewagen" or "Schlafwagen" in gold. Price **1/6**

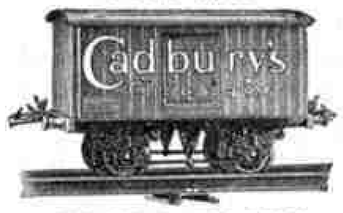


HORNBY No. 2 SPECIAL PULLMAN COACH
As supplied with No. 2 Special and No. 3 Pullman Train Sets. Suitable for 2-ft. radius rails only. Price **15/-**

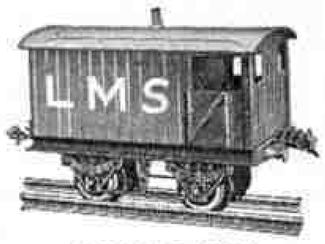
OIL TANK WAGON "MOBILOIL"
Finished in battleship grey. Price **2/6**

PETROL TANK WAGON "SHELL"
Finished in red. Price **2/6**

OIL TANK WAGON "CASTROL"
Finished green with lettering in red. Price **2/6**



CHOCOLATE VAN "CADBURY'S"
Beautifully finished in blue with orange roof. Price **3/-**

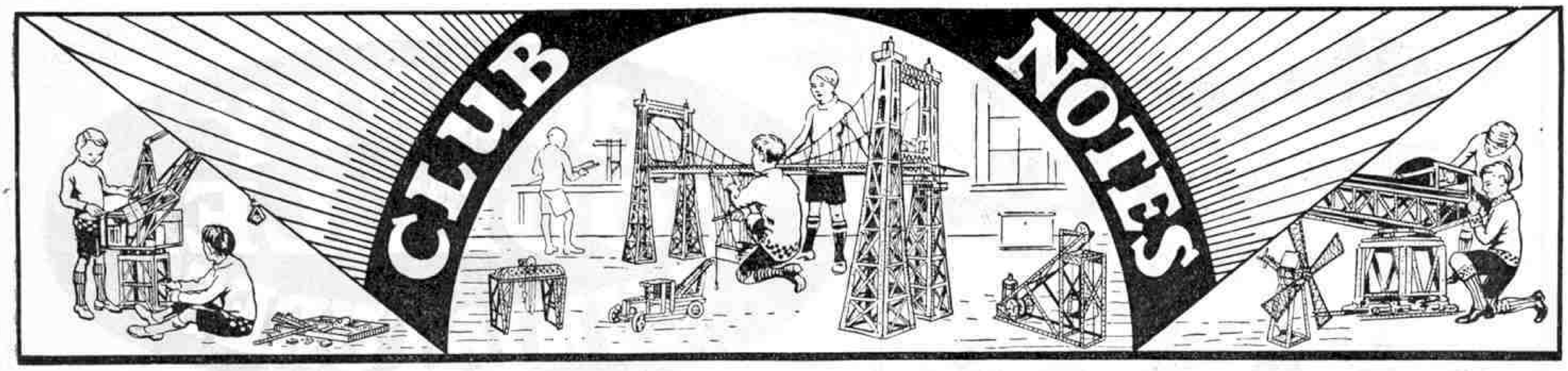


BRAKE VAN
Finished in grey, with opening doors. Obtainable with L.M.S. or G.W. lettering. Price **3/6**

MILK TANK WAGON "UNITED DAIRIES"
Finished in blue and white. Price **6/-**

**In L.M.S., L.N.E.R., G.W., or S.R. lettering.*

Manufactured by MECCANO LIMITED, BINNS ROAD, LIVERPOOL 13



St. Peter's (Wolverhampton) M.C.—Model-building and Hornby Train Evenings have been varied by Electrical Nights, at which members have carried out experimental work with telephone systems and wireless outfits. Fine models recently constructed by members have included representations of the M.G. Magna Sports Car and an Austin Racer. The club celebrated its birthday with a very jolly party. Club roll: 10. *Secretary:* V. Biddulph, c/o Westminster Bank, Lichfield Street, Wolverhampton.

John Gulson Senior Boys' School (Coventry) M.C.—An interesting feature is the greater skill shown by members in model-building, the average marks gained having recently increased very largely. In this club it is the practice to apportion a special week every two months to Games and recreations, and the most exciting event of the last week spent in this manner was a great Table Tennis Tournament. Members continue to be busy on work in preparation for the Exhibition. Club roll: 17. *Secretary:* H. Ludgate, 46, Fynford Road, Radford, Coventry.

Braintree County High School M.C.—Particularly attractive Lectures have been given by members of the School Staff on "*Explosives*" and "*Fencing*," the latter Lecture being illustrated by means of weapons and fencing costumes. "Packet" Model-building Contests are a feature of club work, competitors being allowed 20 minutes in which to build a model from a packet of parts received. Other Model-building work has included preparations for the Exhibition, the central feature of which is to be a saw-mill. Club roll: 22. *Secretary:* M. K. Miles, 1, Wordsworth Road, Bocking, Braintree.

Longdendale M.C.—Discussions on models built by members are helpful in raising the standard of Model-building generally, and it is expected that the models displayed at the club's Exhibition will show a great improvement as a result. A Lecture on "*Electricity*" has been given by the secretary, and other meetings have been devoted to the development of a good Hornby train layout for use at the Exhibition. Club roll: 11. *Secretary:* V. Morris, 54-56, Hadfield Road, Hadfield, Manchester.

Thorney Abbey M.C.—Members of this new club are very keen and are doing promising work. Special attention is being paid at first to Model-building, and Cranes of different types, Motor Omnibuses and Aeroplanes have been constructed at the special meetings arranged for this purpose. The aeroplane models were kindly judged by Mr. Carter, an engineer, who selected a Night Bomber, built by the secretary, as the best. Club roll: 9. *Secretary:* G. K. Popely, 9, Council Houses, Thorney, Nr. Peterborough.

Abington M.C.—Excellent progress is being made under the Leadership of Mr. J. Williamson. A Junior Section has been formed for members under 12 years of age, and this step is expected to help to keep up membership. Model-building Evenings, a Surprise Night, and a Firework Display have been held, and a successful programme of indoor games meetings has been arranged, when Table Tennis, Draughts, Chess and Blow Football have been played. Club roll: 22. *Secretary:* S. Cocking, 4, King Edward Road, Northampton.

Regent Street Selective School (Heywood) M.C.—A special feature has been made of Lantern Lectures, and those recently given have included Lectures on "*Indoor Games*," by Mr. G. N. Chaplin, Leader of the club; "*The Art of the Blacksmith*," by Mr. A. Hobson; and "*A Tour Through North Wales*," by Mr. J. P. Lunt, President of the club. Other meetings have included a Draughts Match between members of the club and the rest of the school, and a Concert and Exhibition of models. The items at the Concert were presented by members and the display concluded with a Boxing Match that aroused great enthusiasm. Club roll: 102. *Secretary:* W. Jones, 123, Lynden Lea, Bury Street, Heywood, Lancs.

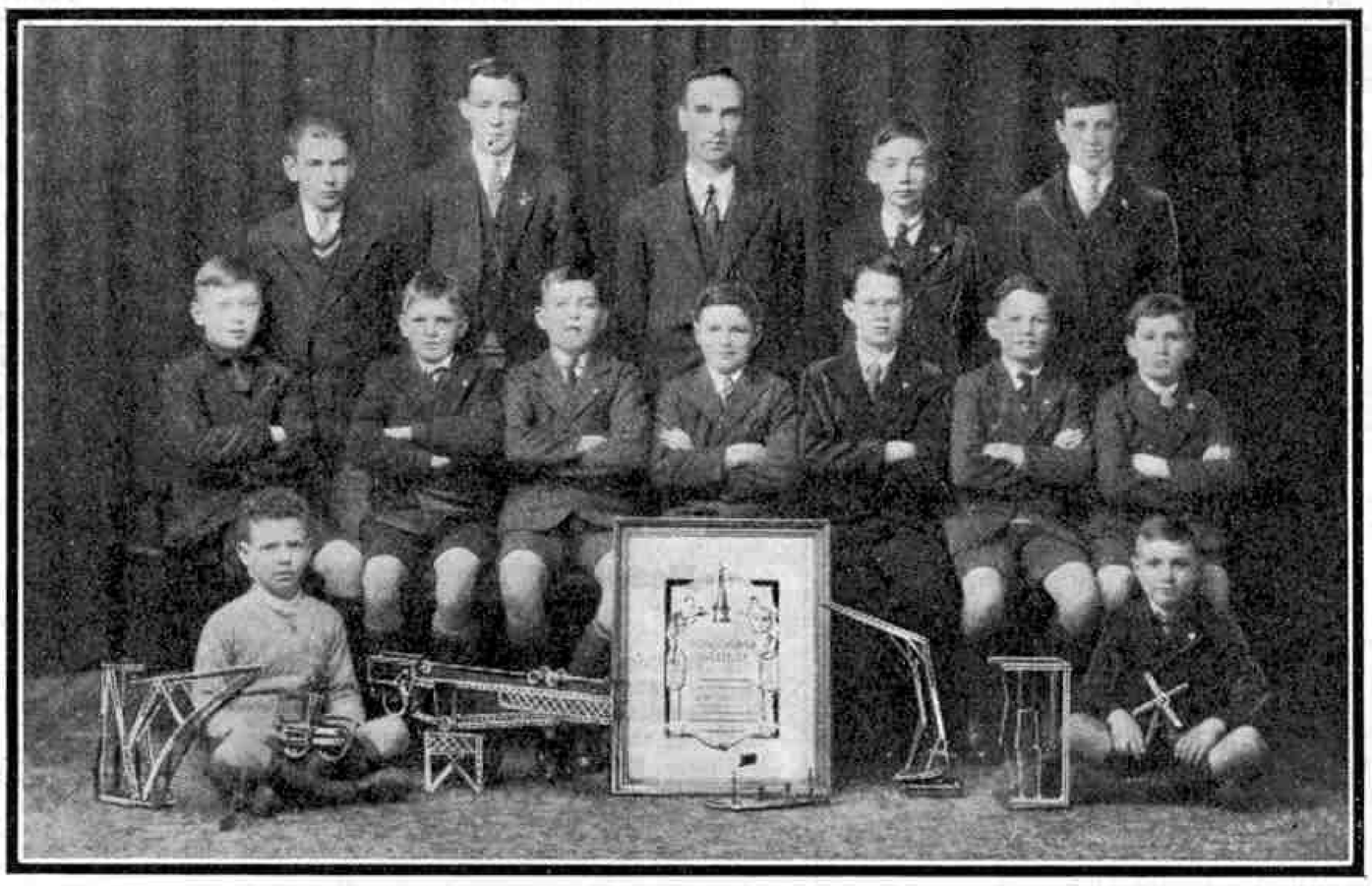
Bridport Grammar School M.C.—The facilities provided by the club include a Library, and a store of Meccano Parts available for loan to members. Full use is made of these, and the system is to be extended. A special meeting was devoted to a Lantern Lecture on "*How the 'Daily Express' is Produced*." The Lecturer was a member of the school staff who has had journalistic experience, and slides were kindly loaned by "*The Daily Express*." Club roll: 33. *Secretary:* E. Wilkins, "Colwil," Allington Park, Bridport.

Middlesbrough M.C.—A new feature in club work is Exhibit Night, when members bring items likely to be of interest to other members. Articles shown and explained at the first meeting of this kind included a sword stick, specimens of bayonets, many foreign coins and a map of the local water supply. The circulating plant at the local baths has been inspected, and a Lecture on "*Aircraft*" has been given. Games Nights, Section Entertainments, and Discussions and Debates also have been held, and special interest was taken in carol singing practice in preparation for the Christmas party. A Senior Section has been formed. Club roll: 40. *Secretary:* L. Weighell, 42, Bishopton Road, Middlesbrough.

Hornsea M.C.—Splendid use continues to be made of Lantern Lectures, Cinematograph Entertainments and Games in maintaining interest. The subjects dealt with in the Lantern Lectures include practical topics, such as Photography and Wireless. A Visit was paid to a Box Making Factory, where members were greatly interested in the processes carried out. Club roll: 77. *Secretary:* L. Chapman, Red Roofs, Southorpe Road, Hornsea.

Harlesden Methodist M.C.—Special interest was taken in a "*Surprise Evening*" arranged by Mr. Weightman, Leader of the Club. It took the form of a demonstration of an original designing machine capable of producing a surprising variety of patterns. Model-building continues to occupy members, who have built a Trawler, complete with deck fittings, a powerful Searchlight, an Oil Tanker, a Scammell Tractor and many other attractive models. Talks on his journeys round the world have been given by Mr. Smedley, Assistant Leader. In one of these talks he gave a fascinating account of the railways of the world. Club roll: 11. *Secretary:* J. A. Ford, 139, Wakeman Road, Kensal Rise, London.

Worcester Y.M.C.A. M.C.—The models entered in the first Model-building Contest were judged by Mr. A. Walker, of Messrs. Heenan and Froude Ltd., who expressed admiration for the initiative and practical sense displayed by members in constructing models of a Railway Breakdown Crane, the subject of the Contest. A series of Model-building Contests on similar lines has been arranged. A Library has been started, and members are making preparations for a Concert. *Secretary:* R. G. Price, 60, Bath Road, Worcester.



A group of members of the Marlborough Mont Albert (Victoria) M.C., with Mr. J. Coutts, the Leader, in the middle of the back row. This enterprising Australian club was affiliated in February, 1933. Members are keen model-builders and have been remarkably successful in winning prizes in contests organised in connection with hobbies exhibitions and similar events.

AUSTRALIA

Melbourne M.C.—A splendid display of models was given at a Hobbies Exhibition at the Carnegie Methodist Church. One of the most attractive models represented a Gold Mine, with the winding gear at work and other machines in operation. Visits were paid to the Annual Display of the Footscray Technical School, the Meadmore Railway Exhibition and the Hobbies Display of the Scotch College. Ordinary meetings have included Reading Nights, Model-building Evenings, and a Lecture and Demonstration by Mr. Nash, of the Vacuum Oil Company, on "*The Oil Industry*." Members of the Kew and Mont Albert Clubs were welcome visitors at this Lecture. Club roll: 15. *Secretary:* L. Ison, 8, Hayes Street, Northcote, N.16, Victoria, Australia.

INDIA

Kognolkar M.C.—Recent activities have included a Model-building Competition, in which members were allowed to submit models of any type, and a Swimming Contest. Games Contests with other clubs are held regularly, and as far as possible these are carried on outdoors. There are many places of interest within easy reach of Headquarters, and full advantage is taken of the opportunities of arranging excursions. Club roll: 9. *Secretary:* R. M. Kognolkar, Nowgong, C.I. India.

NEW ZEALAND

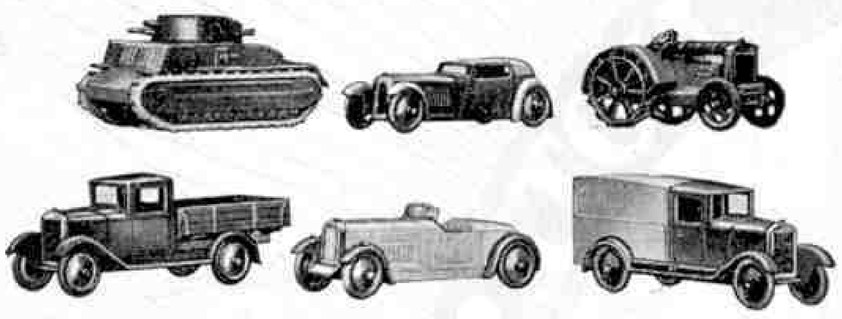
Wellington Boys' Institute M.C.—The first copy of the club's Magazine has now been produced. A special effort is being made to encourage good attendance, and a prize is to be awarded to the member with the best record. Recent events have included a Cinematograph Entertainment, the proceeds of which were on behalf of club funds, and a Lecture by Mr. J. E. Barnsley, Leader of the Club, that was followed by a supper. Great interest in the club's activities has been aroused by the appearance in a local evening newspaper of a photograph of the club room during a Model-building meeting. Club roll: 25. *Secretary:* A. Abel, 17, Helen St., Brooklyn, Wellington, S.W.1, New Zealand.

NORWAY

Sandefjord M.C.—Model-building operations have included the construction of models of a large Crane 5 ft. in height, and a Streamlined Rail Car. Excellent models were submitted in a Competition, in which first prize was awarded to the builder of a well-constructed Windmill. At other meetings talks have been given on "*The Invention of the Steam Engine*" and "*Whale Fishing Developments in Sandefjord*." An orchestra has been formed, and its members perform regularly at club meetings. Club roll: 6. *Secretary:* T. Jacobsen, Jernbanealleen 5, Sandefjord, Norway.

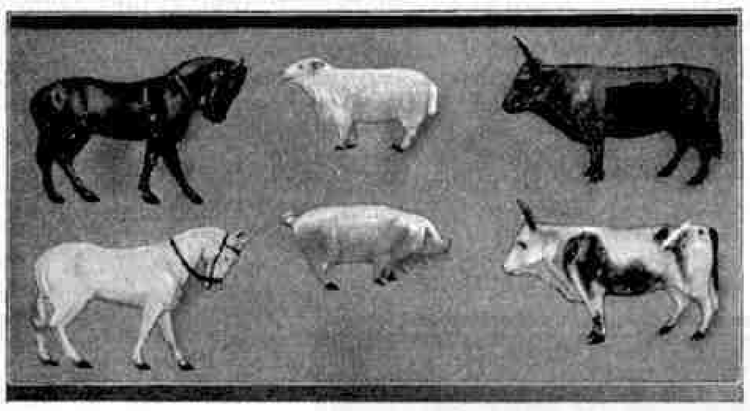
Club Not Yet Affiliated

Philadelphia (Durham) M.C.—Preliminary meetings have been successfully arranged, many excellent models being produced by members. Interest is being shown in other activities, and fretwork has been introduced. An Exhibition also has been planned. New members are required and the secretary will be pleased to hear from Meccano boys wishing to join. *Secretary:* J. D. Pow, Rose & Crown Hotel, Philadelphia, Co. Durham.



Modelled Miniatures No. 22. Motor Vehicles
Price, per set, **4/-**

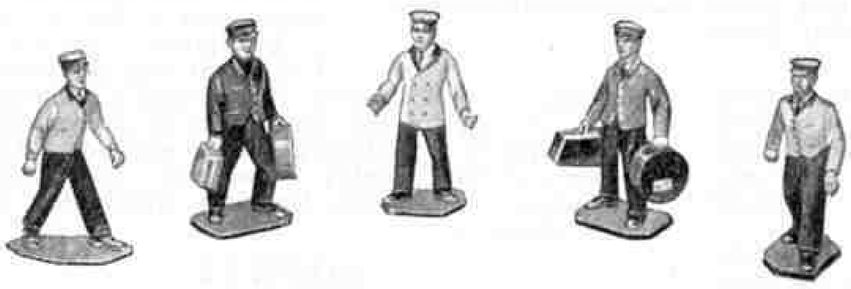
Modelled Miniatures No. 1. Station Staff
Price, per set, **1/6**



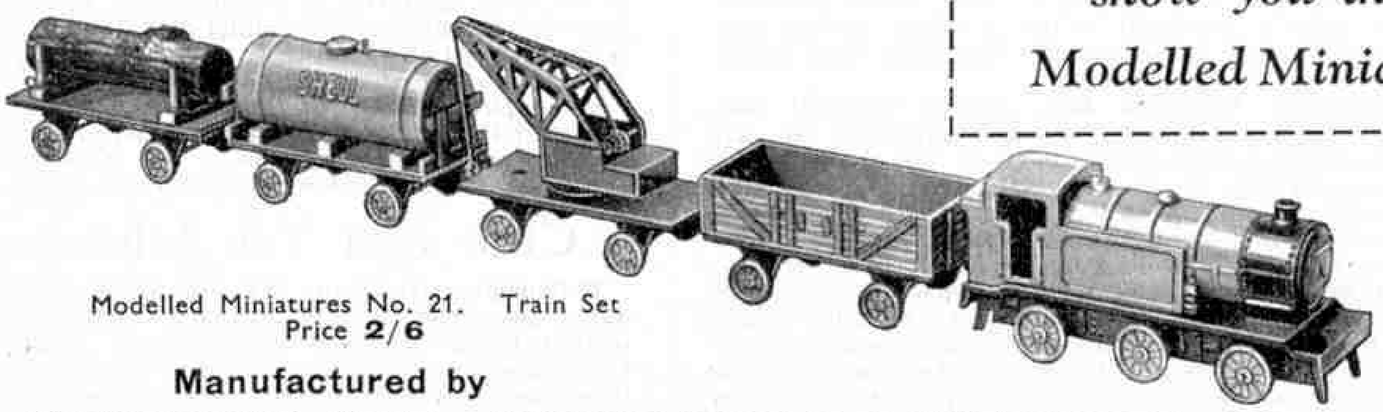
Modelled Miniatures No. 2. Farmyard Animals
Price, per set, **1/6**

Modelled Miniatures No. 3. Passengers
Price, per set, **1/6**

Modelled Miniatures No. 4. Engineering Staff
Price, per set, **1/6**



Modelled Miniatures No. 5. Train and Hotel Staff
Price, per set, **1/3**



Modelled Miniatures No. 21. Train Set
Price **2/6**

Manufactured by

MECCANO LTD., BINNS ROAD, LIVERPOOL 13

PRODUCT of MECCANO LIMITED LIVERPOOL

HORNBY MODELLED MINIATURES

PRODUCT of MECCANO LIMITED LIVERPOOL

ADD REALISM TO YOUR RAILWAY

Boys, think how your model railways would be improved by the addition of the interesting items shown on this page! You must have railwaymen to deal with your trains, and passengers to travel in them; car attendants to look after the passengers, and engineers for the maintenance of the railway and its equipment. You want farmyard animals for lineside fields, and motor vehicles for road traffic. Then you should have at least one of the famous "Hall's Distemper" advertisements alongside your line! For running on the table when you cannot put down your layout, the miniature train set is exactly what you want. These splendid Modelled Miniatures may be purchased in complete sets as shown or, with the exception of Hall's Distemper Advertisement, they may be purchased separately.

Modelled Miniatures No. 1 Station Staff

These models add the final touch of realism to Hornby Station Platforms. The complete set is composed of a Station Master to supervise operations, a Ticket Collector for the station barrier, a Guard giving the "right away," a Locomotive Driver with his oil can, and two Porters.
Price, per set, **1/6**

Modelled Miniatures No. 2 Farmyard Animals

Miniature farmyard animals are useful for placing in lineside fields. The set comprises six animals: Sheep, Pig, two Cows, and two Horses. Price, per set, **1/6**

Modelled Miniatures No. 3 Passengers

The various types of passengers to be seen at any railway station are well represented in Modelled Miniatures No. 3. The set contains six figures as illustrated, comprising Business Man, Male Hiker, Female Hiker, Newsboy, Lady, and Mother and Child.
Price, per set, **1/6**

Modelled Miniatures No. 4 Engineering Staff

This set is composed of six figures representing Electrician two Fitters, Storekeeper, Greaser and Engine Room Attendant. They may be used along the line and on railway premises generally, especially stations, engine sheds and yards. Price, per set, **1/6**

Modelled Miniatures No. 5 Train and Hotel Staff

Five figures are included in this set, including Pullman Car Conductor, two Pullman Car Waiters and two Hotel Porters. The Car Attendants are conspicuous in smart white jackets, and can be used on trains and in stations. The Hotel Porters, in livery, are essentially for use at important stations.
Price, per set, **1/3**

Modelled Miniatures No. 13 Hall's Distemper Advertisement

This miniature of a well-known line-side advertisement is intended to be placed in the fields adjoining the railway track. The two figures are die cast while the plank they are carrying is of best quality pulp board, attractively printed in two colours.
Price **9d.**

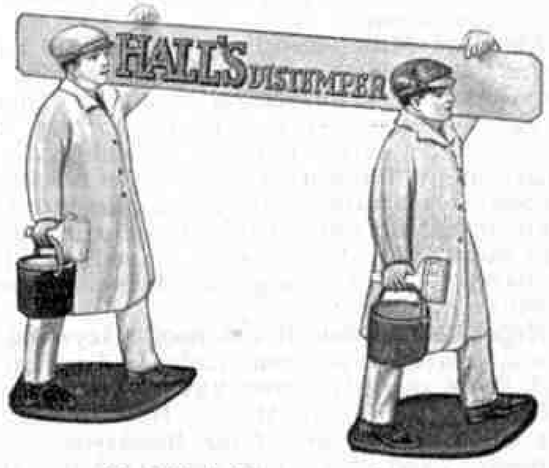
Modelled Miniatures No. 21 Train Set

This Miniature Train Set is a very realistic and attractive model. It is die-cast in hard metal and includes Locomotive, Wagon, Crane Truck, Lumber Wagon and "Shell" Petrol Tank Wagon, complete in detail and perfect in finish. Price **2/6**

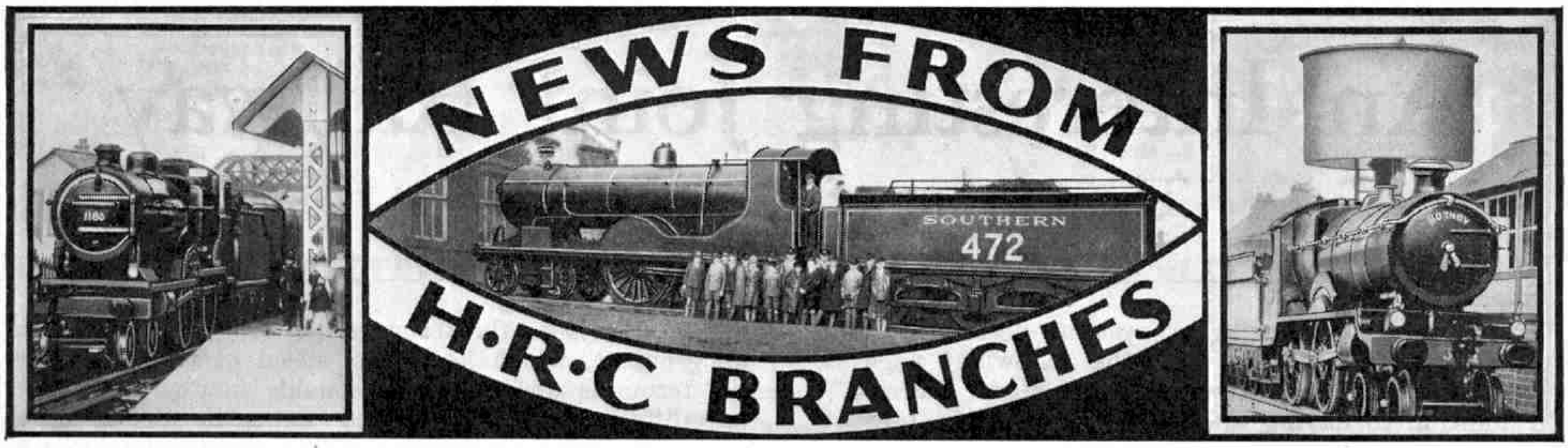
Modelled Miniatures No. 22 Motor Vehicles

This very attractive set of modelled miniatures consists of two Motor Cars, two commercial Vehicles, one Tractor and one Army Tank. The realistic design of each model is clearly shown in the illustration.
Price, per set, **4/-**

Ask your Dealer to show you these Modelled Miniatures



Modelled Miniatures No. 13
Hall's Distemper Advertisement
Price **9d.**



Branch Notes

ST. SAVIOUR'S (RAYNES PARK).—Pressure of business has compelled Mr. Newman, Chairman of the club, to resign, and Mr. Britton has kindly taken his place. Track work is pursued regularly, and practically every variety of railway operation is practised. An interesting innovation is a 15-minute Talk on "*The Southern Railway*" at the end of each meeting. These talks are given by an official of the S.R., and deal with the early history of that railway and with changes in operation that have led to the system now employed. Secretary: D. J. Fielden, 117, Bushey Road, Raynes Park, London, S.W.20.

FINCHLEY.—Meetings are held on Saturday afternoons, and the long periods of track operation now possible are thoroughly enjoyed by members. The longer meetings also enable a more extended trial to be given to the various types of track laid down. Several large locomotives were thoroughly examined during an enjoyable visit to the Camden Town Locomotive Sheds of the L.M.S.R. Secretary: J. Price, "Mancroft," Windsor Road, Church End, Finchley, London, N.3.

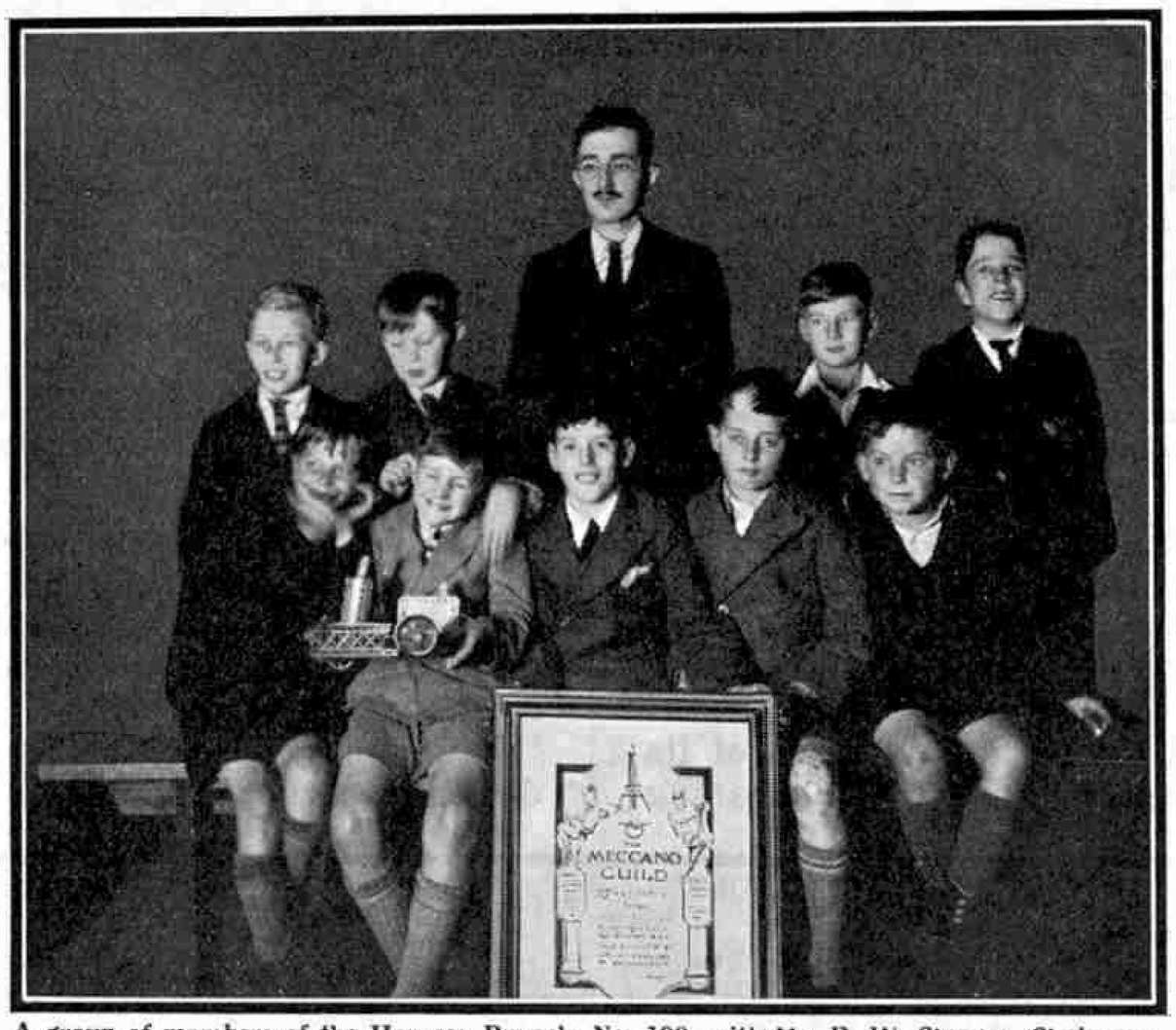
LOUGHBOROUGH.—The Branch layout represents the West Coast main line of the L.M.S.R., and separate passenger and goods tracks are provided between Euston and Crewe. These arrangements enable interesting operations to be carried out to timetable, six locomotives being employed. The stations at Loughborough have been visited in order to observe various points of special railway interest, and a tour of the L.M.S.R. works at Derby proved exceptionally attractive. Secretary: R. E. Trotter, 2, Radmoor Road, Loughborough.

BRANKSOME.—The Branch room is appropriately decorated by means of posters kindly supplied by the British Railways Press Bureau. Four working gangs have been formed, and these are named "The Flying Scots," "The Cheltenham Flyers," "King George V" and "Lord Nelson." An excellent system of track working in which every member takes a responsible part is being developed. Lectures play a great part in the proceedings, and a series of Lantern and Film Lectures have been arranged, to be given at regular intervals throughout the session. Secretary: C. Morris, Branksome, Godalming, Surrey.

WHITGIFT SCHOOL.—So many new members have joined the Branch that two sections have been formed in order to give every member full opportunity of taking part in track work. Track meetings have been held regularly, proceedings sometimes taking the form of a competition. Visits have been paid to the Fairfield Telephone Exchange and to the London Bridge Signal Box on the S.R. Lantern Lectures have been given on "*Transport Through the Ages,*" by Mr. Deacock, a master at the school; and on "*London Omnibuses,*" by M. M. Young, the slides being kindly lent by London Transport. Secretary: H. J. Kirby, "Minniscot," Riddlesdown Avenue, Purley, Surrey.

ELMSIDE (EXETER).—At each track meeting a timetable drawn up by one of the directors is put into operation, and various members also are given the privilege of formulating programmes for these meetings. The "*Cornish Riviera Express*" and the "*Torbay Express*" are run at every meeting, and other operations show great variety, passenger, goods and mixed services being operated in turn. At one meeting the Branch track was in continuous operation for six hours. Various classes of services were run in turn, and at the end of the meeting every member agreed that they had put in a fine day's work! At another meeting the track was lit by means of searchlights constructed by members, and novel results were obtained by running the "*Torbay Express*" in a realistic miniature thunderstorm, in which the "lightning" was very vivid! Secretary: D. Legg, 25, Chute Street, Exeter.

HOLYWELL (OXFORD).—Steady work is being carried out on the Branch track in order to enable a satisfactory design to be decided upon. Several layouts have been tried, and altered in order to improve working. A special visit was paid to Banbury Engine Sheds. A special Lecture on "*Locomotives of the Southern Railway*" has been given by Rev. L. A. Garrad. Secretary: M. Weatherall, 29, Holywell, Oxford.



A group of members of the Hornsea Branch, No. 190, with Mr. R. W. Shooter, Chairman. This Branch was formed from the Hornby Railway Section of the Hornsea M.C., and was incorporated in May, 1930. A layout specially adapted for realistic operations has been steadily developed and cinematograph displays by the Chairman add to the pleasures of membership of the Branch.

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:—

LONDON—R. Hiscock, 24, Greystoke Lodge, Hangar Hill, Ealing, London, W.5.

CATERHAM—J. Pleydell, Council School, Croydon Road, Caterham Valley, Surrey.

LONDON—J. Buchanan, Belmont, Mill Hill, London, N.W.7.

NOTTINGHAM—J. Butler, Cottesmore School, Lenton, Nottingham.

SOUTHPORT—Mr. E. M. Hindle, 12, Melling Road, Southport.

CARSHALTON—A. D. Prince, Esq., B.Sc., 7, The Park, Carshalton, Surrey.

ABERDEEN—Master J. Rowand, 4, Adelphi, Aberdeen.

Branches Recently Incorporated

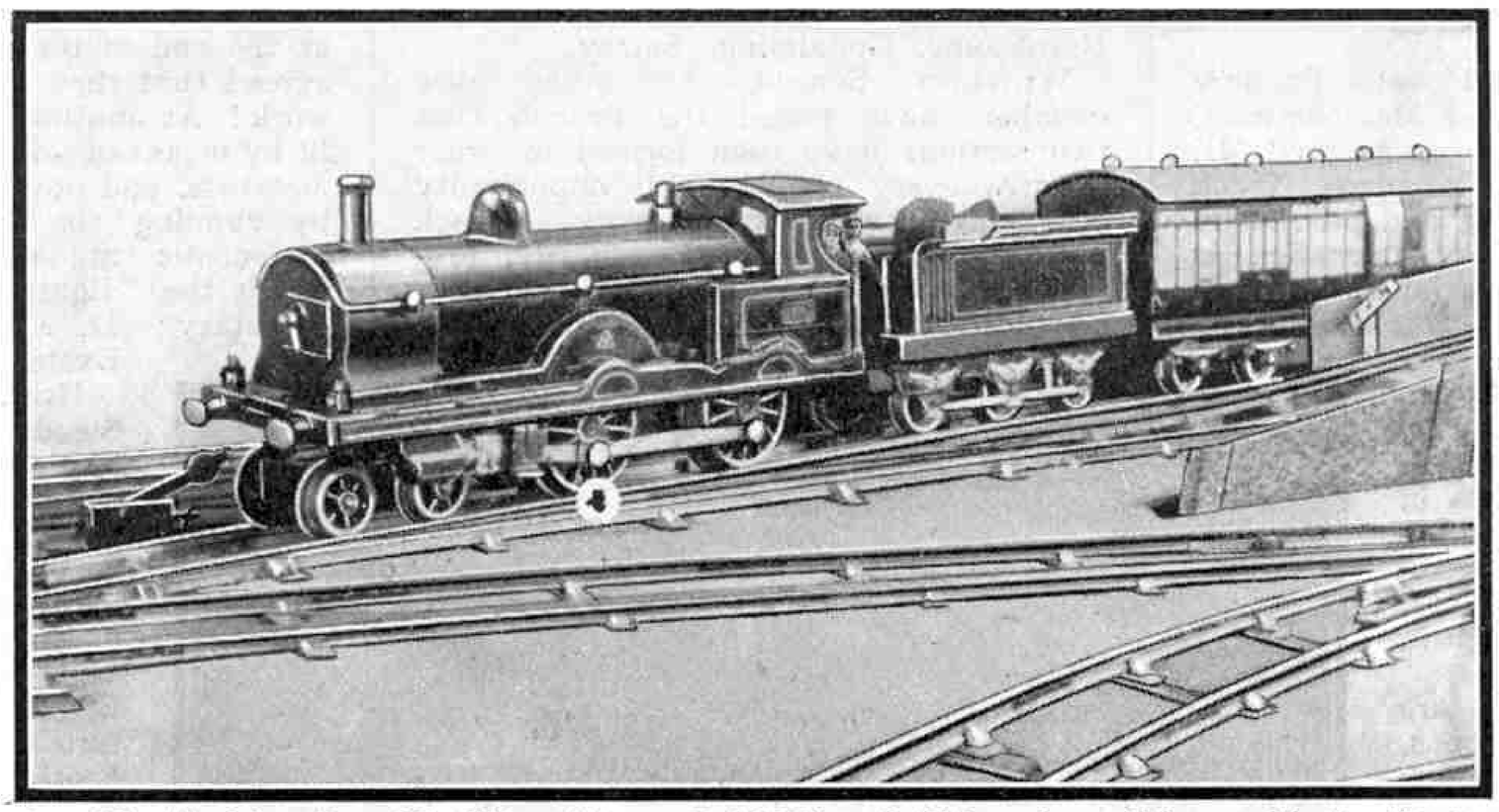
253. NEW BARNET—D. Edington, Normandhurst, Lyonsdown Road, New Barnet.

254. ALFRETON—A. Reid, 5, King Street, Alfreton, Derbyshire.

An Interesting Joint Railway

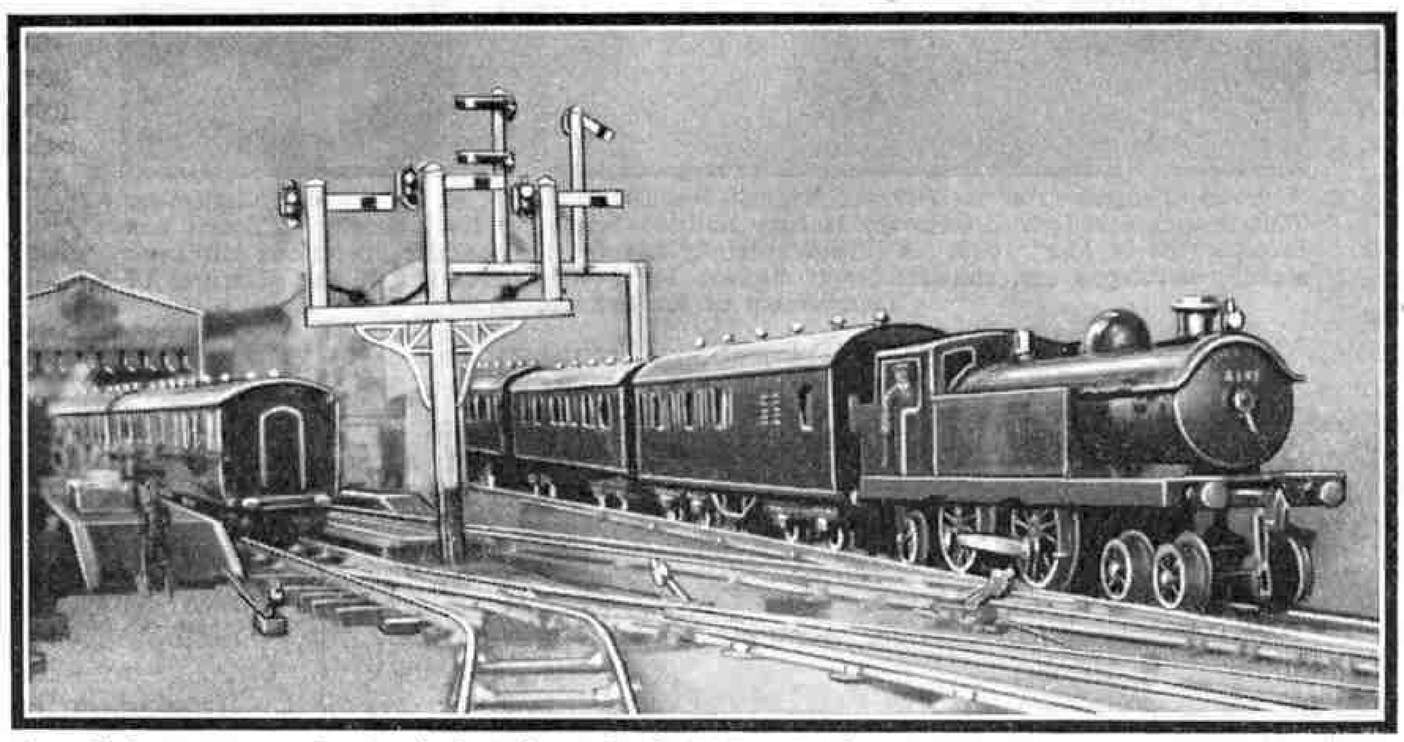
The Layout of D. J. M. Thorne

THE miniature railway system described and illustrated on this and the following page is known as the "Stewart Avenue Model Railway." In addition to having up-to-date stock of the present railway groups in operation, it also possesses several examples of miniature locomotives of historic interest. These veterans, of types familiar in miniature in pre-war days, have been handed down from a previous system owned by the father of the present "Chief Mechanical Engineer." Their former owner still takes a keen interest in miniature railway matters, and holds the position of General Manager, where his experience is naturally very valuable, and the important post of Treasurer to the present line. The existing layout is therefore extremely interesting on account of the variety of engines and stock that can be seen, so much so that the initial letters of its title, "S.A.M.R.," have been referred to as meaning the "Survey of Ancient and Modern Railways"!



One of the older locomotives of the "Stewart Avenue Model Railway" still in service. This was originally a Hornby No. 2 Tender Locomotive, but now represents a Webb compound of the former L.N.W.R.

The main line is laid on a raised foundation in a garage, and consists of a continuous oval track giving a run of rather more than 40 ft. to each circuit. The main terminal station lies roughly parallel to one side of the main track, and has a total of four platform faces each of which can easily accommodate trains of four and five coaches, in addition to the necessary locomotives. Practically opposite to the situation of the main terminus is a passing station, and in addition to the through main line there is from the terminus to this station a relief line that is particularly useful in times of heavy traffic. An interesting point about the main line is that from the terminus the track is laid on an up gradient, which keeps the speed of trains leaving the terminus down to a reasonable figure, yet is not too difficult for single-headed trains to ascend in a satisfactory manner. It is of course of considerable assistance in shunting operations, the force of gravity being employed instead of locomotive power for inward movements.



A realistic scene near the terminal station. An L.M.S.R. suburban train hauled by a Hornby No. 2 Tank is passing along the main line.

From one of the platform roads of the terminus a connection is made to a steeper incline, which carries a single track up and over the main line after the manner of a flying junction, and continues round at high level, re-crossing the main line near the passing station. This high-level line is useful for the storage of stock for ordinary working, but it is particularly interesting in that it leads to what is known as the "Museum." This Museum siding provides accommodation for the old locomotives previously mentioned, some of which can be seen in one of the accompanying photographs.

Included in the collection of original or rebuilt models there are locomotives representing characteristic types of no less than nine pre-group railways. A miniature Midland "single-wheeler" is a prominent feature in the photograph, and there is also an interesting model of the G.W.R. "City" class. The sole remaining Midland single-wheeler now preserved at Derby, and the famous G.W.R. "*City of Truro*" at York, are thus represented in miniature in this unique "Railway Museum."

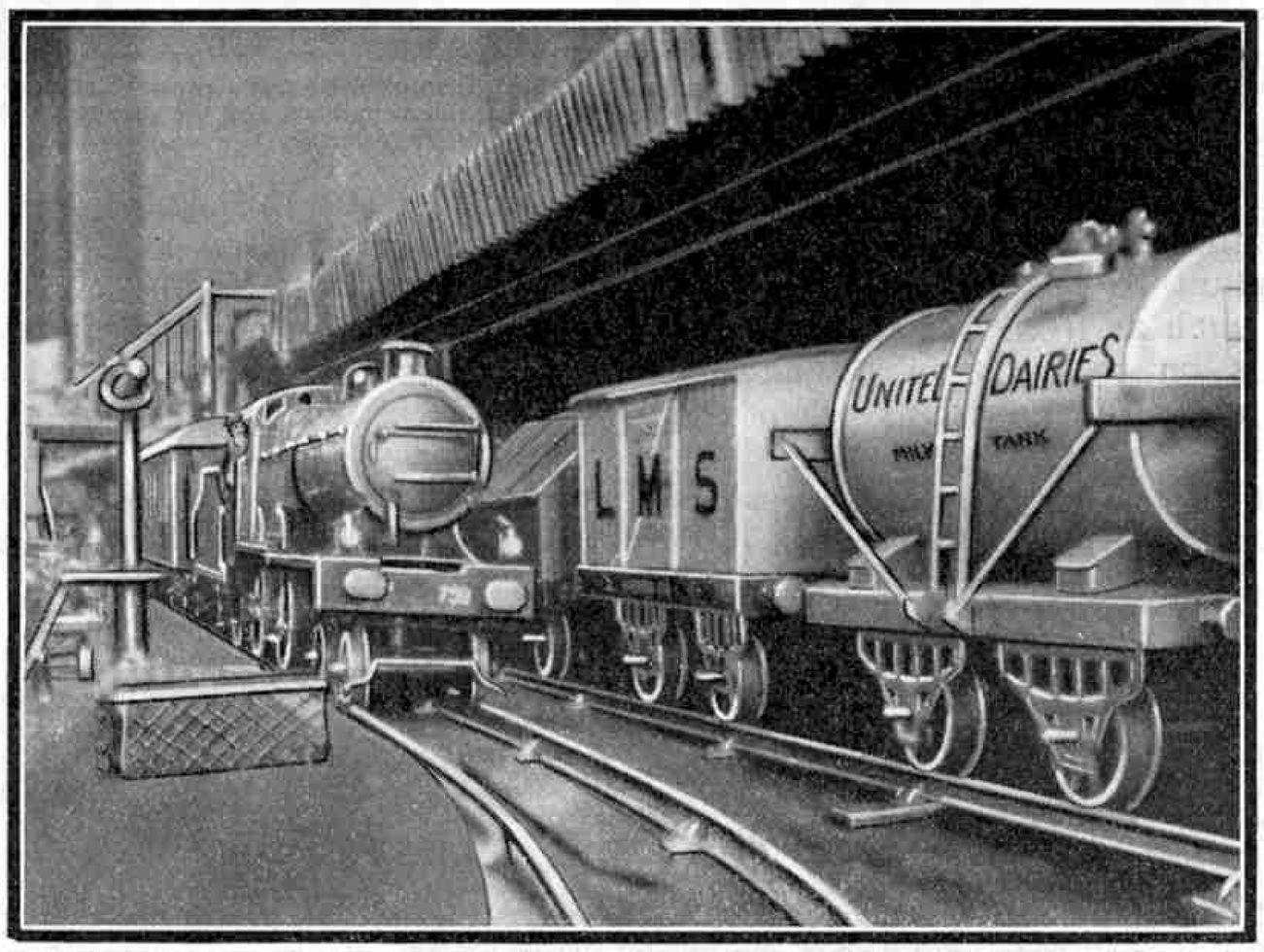
A favourite scheme of operation is to run a selection of trains representing the chief main line services of

the four groups, and owing to the variety of rolling stock available this presents no difficulty. There are suitable Hornby Locomotives of the No. 2 Special variety for each group service. Operations are conducted by means of a timetable that has been made up from the public timetables of each group, so that the miniature railway may show the arrival and departure of famous trains at the actual times their prototypes are arriving at or departing from their respective termini.

Among the rebuilt miniature locomotives already referred to is an ingenious adaptation of an old Hornby No. 2 4-4-0 locomotive as a four-cylinder "Webb" compound of the former L.N.W.R. Outside cylinders have been added, the characteristic shape of the smoke-box has been reproduced with the aid of sheet metal, and one or two minor alterations made. The now obsolete Hornby No. 2 type of tender of course closely resembles the older Crewe pattern of tender in several respects. The complete locomotive is painted in the L.N.W.R. pre-War style of black with red and white lining, and the company's crest appears on the driving wheel splasher.

The two track levels at the passing station. In the high-level "Museum" siding are several veteran miniature locomotives, such as the M.R. "single-wheeler" No. 650, while below is an interesting rail motor coach constructed at home.

Another more modern example is a Hornby S.R. No. 3C engine, "*Lord Nelson*," which has been modified in details, such as boiler fittings, to represent one of the handsome Great Central "Atlantics"; that at all events is the impression of the onlooker who sees its left-hand side, the words "Great Central" appearing on that side of the tender. On the other side of the engine, however, its S.R. character is preserved, but as a Brighton section 4-4-2 No. 2424 "*Beachy Head*"; so this engine as rebuilt has definitely a dual identity. As visitors can only view the railway from the inside, the scheme has its advantages on this line when it is necessary to represent different trains of different lines at short intervals.



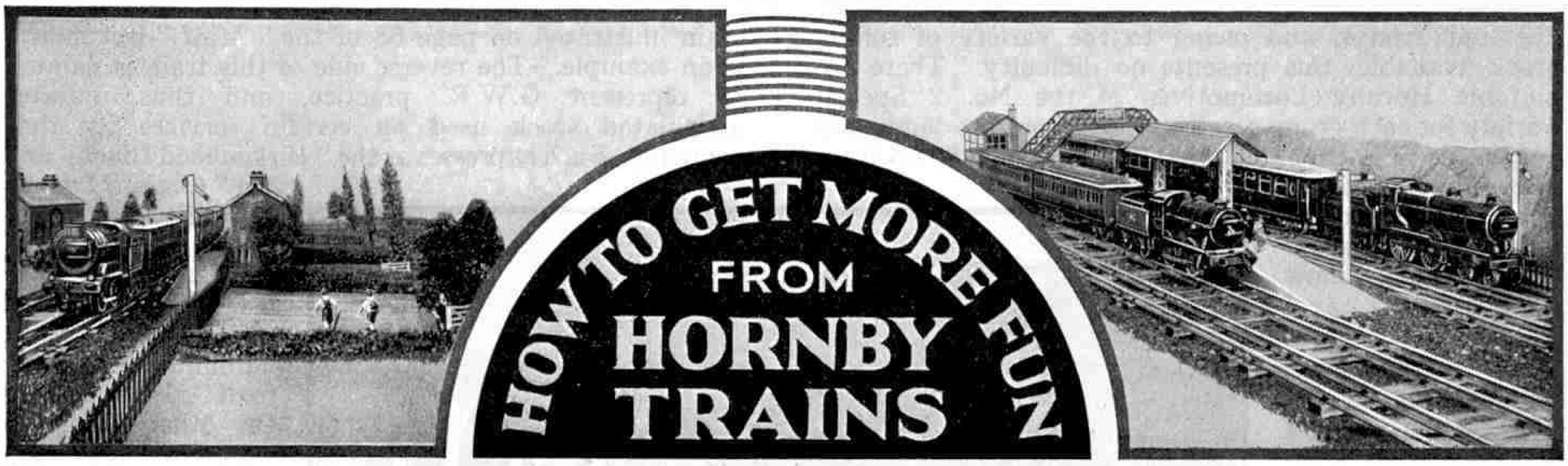
A Southern Railway Dover express passing a mixed goods train. Trains of all groups are represented on this interesting miniature railway system.

A similar arrangement is applied to several examples of coaching stock, of which the L.N.E.R. "Tourist" train illustrated on page 68 of the "*M.M.*" last month is an example. The reverse side of this train is painted to represent G.W.R. practice, and thus imitates articulated stock used on certain services by that company. Such expresses as the "Birkenhead Diner" and the "*Channel Islands Boat Express*" are thus represented when required, their haulage being performed by a "County of Bedford" locomotive. On other occasions the vehicles represent an L.N.E.R. "Tourist" train with a "Yorkshire" locomotive at its head.

An interesting vehicle is the rail motor coach illustrated in one of the accompanying photographs. This represents the type of coach with enclosed steam engine, and is based on the old L.N.W.R. version of this type of traffic unit. The body has been made of cigar box wood with a sheet metal roof, details of the sides and ends being painted on to the chocolate and white body colour. Motive power is supplied by a mechanism of the Hornby M1/2 reversing variety, which will propel the coach for 175 ft., even when four goods wagons are attached to form a mixed train, as operated occasionally on branch lines.

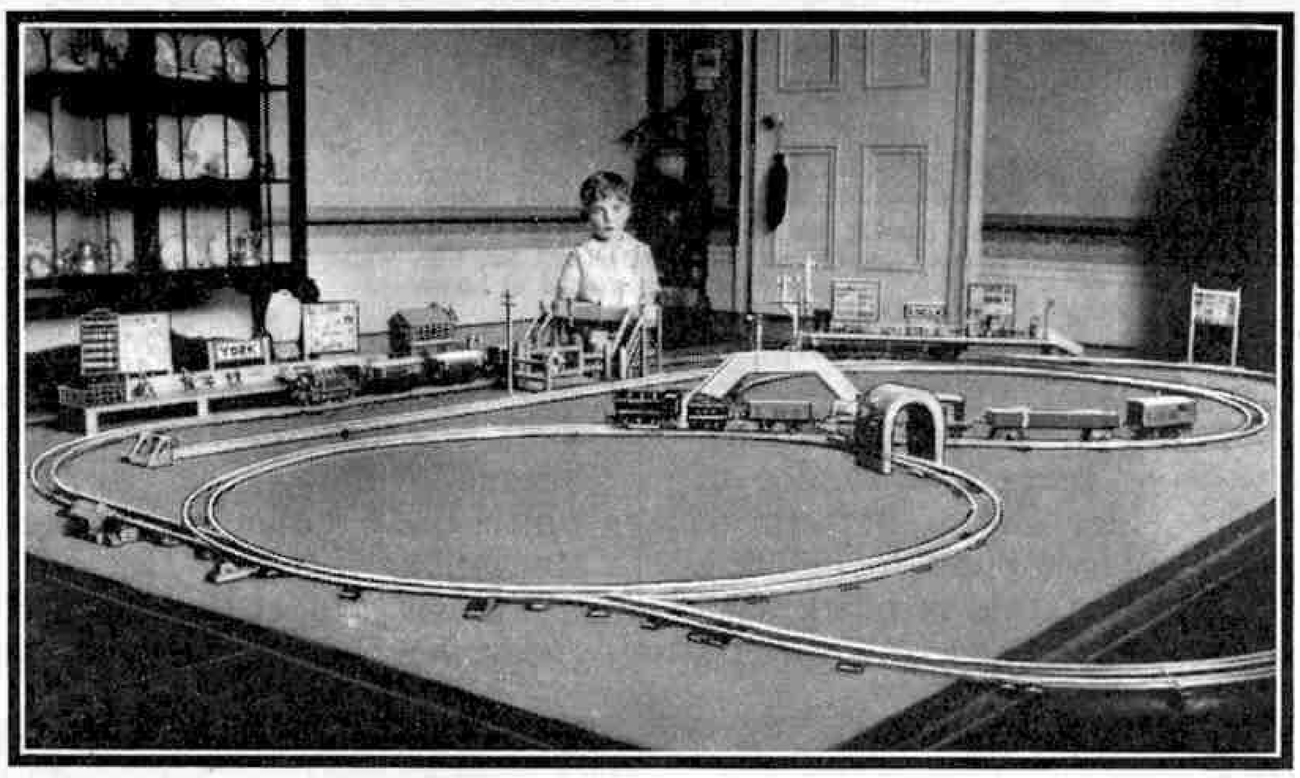
The same mechanism does duty when required in another body arranged to represent a Diesel-electric shunting locomotive, and can deal in a satisfactory manner with loads up to eight wagons, the distance of 110 ft. then being covered. In this connection it must be remembered that the layout is a permanent one on a firm foundation. and all the vehicles referred to are fitted with die-cast wheels, both of which conditions are favourable to the locomotive. In addition sufficient adhesion is ensured by the application of a suitable amount of lead, both in the Diesel-electric body and in the rail motor coach.

Particular attention is paid to the performance of the locomotives, and careful tests are made periodically to compare their respective capabilities. Remarkably good results have been obtained with heavy loads.



LXIV.—COMMENCING THE HORNBY RAILWAY HOBBY

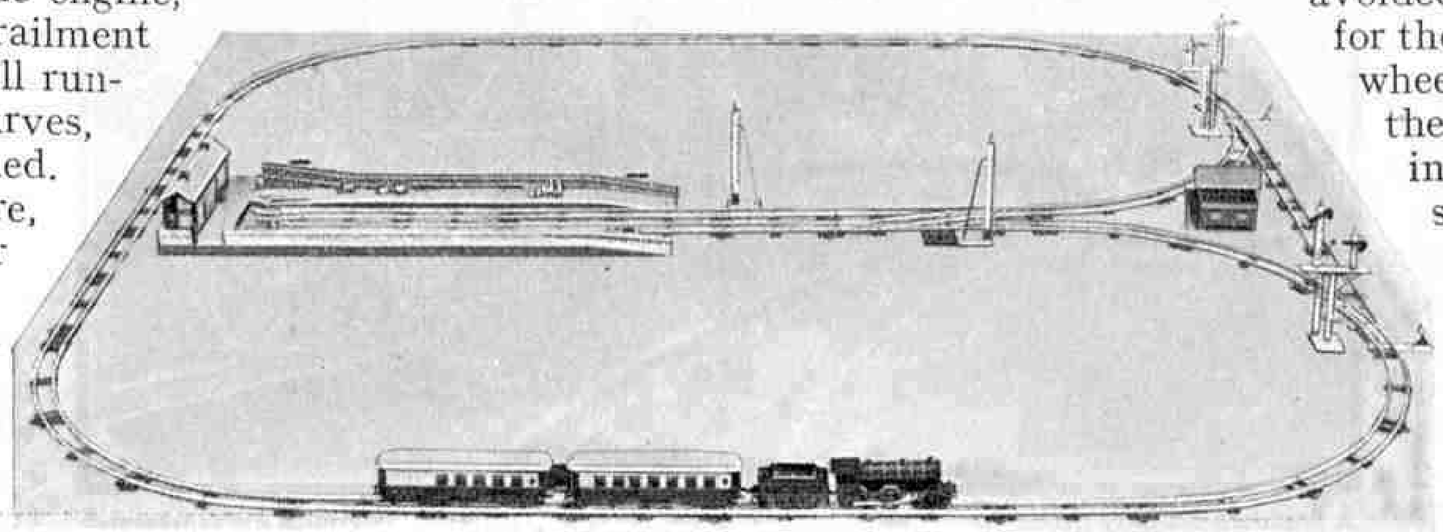
DURING the past few weeks large numbers of boys have become for the first time owners of one or other of the Hornby Train Sets, and have taken up the fascinating hobby of model railway working. In order to obtain the greatest possible amount of fun from any hobby it is necessary to commence it in the proper manner, and thus avoid discouragement and disappointment. In order to help readers who have just commenced their model railway career we propose this month to give a few general hints which, if followed out, will set the young enthusiast on the right road to success.



The Hornby railway of H. Cosgrove of Darlington. This youthful enthusiast frequently changes the plan of his layout in order to try the possibilities of various rail formations and the arrangement shown in this photograph is a very effective example.

The first necessary condition for satisfactory running is that the rails should be laid on a firm and level foundation. If the lines are not on the table, but have to be laid down on the floor, it is important to see that there are no abrupt changes of level, such as from a mat on to the carpet and then perhaps on to linoleum. Such undulations hinder the running of the trains when the gradient is against the engine, and are a source of derailment trouble when downhill running, especially on curves, has to be performed.

Selecting, therefore, a suitable area for our operations, we lay down our rails, making sure that the projecting pegs of each are firmly pushed home at the joints. For further security special connecting plates are provided with 1 ft. and 2 ft. radius rails, and one of the accompanying photographs makes clear the exact method of their application. After the rails have been joined together by means of the pegs, a connecting plate is slipped between the two end sleepers of each rail in such a manner that the turned-up edges of the sleepers are gripped by the clips of the plate. It should be noted that these connecting plates are not provided for 9 in. radius rails.



A simple form of continuous layout with a central terminal station. Interesting working is possible, and the general scheme can be developed to a considerable extent.

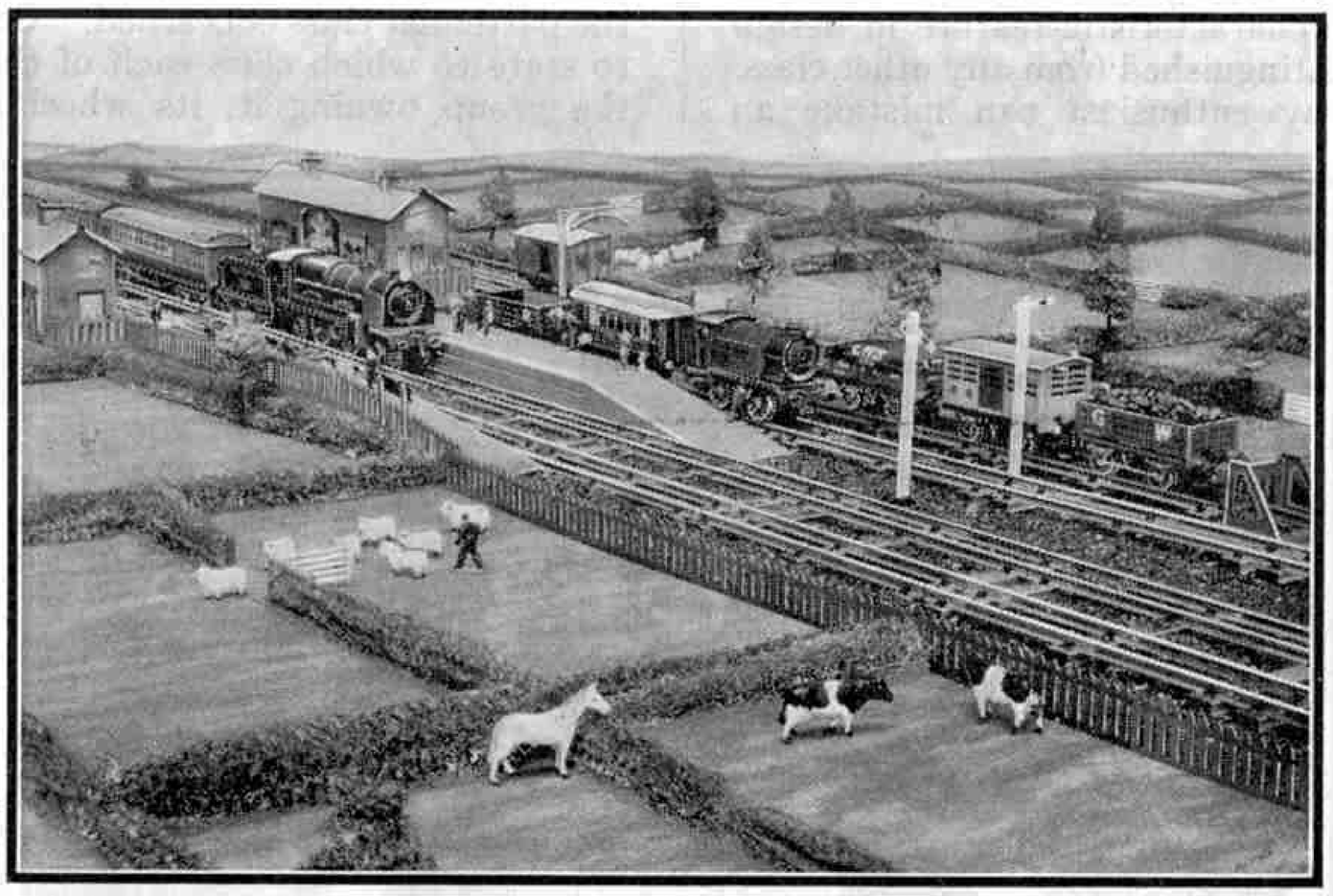
When the connecting plates have been applied throughout a circle or small oval of new rails, it is sometimes found that a springiness exists that results in the sleepers not settling down quite flat. To remedy this state of affairs each rail should be twisted over with the hands towards the centre of the circle or oval. This twisting must be done gently, a little at a time, with each rail in turn, until finally they are all persuaded to settle properly.

The next process is to test the truth to gauge of the rails, by means of the rail gauge formed on the handle of the locomotive winding key. Any tight places are found immediately by sliding the gauge along the track, as shown in one of the accompanying illustrations, and may be corrected by easing out the rail at the point where the defect occurs. Tight places should be carefully avoided, especially on curves, for they are apt to pinch the wheel flanges and retard the train. If excessive in extent they may even squeeze the wheels out of the track and thus cause derailments.

Having now got the track in order, we proceed to look over the engines and rolling stock. A most necessary preliminary in their case, especially when new, is correct but not excessive lubrication. When a new engine is purchased the mechanism is already lubricated, but it is a good plan to put a few drops here and there in order to ensure a good supply for the first few trips. For this lubrication an oil can should be used, and the Meccano " K " type

can is the most suitable. Its nozzle enables every vital point to be reached without difficulty, and the press button affords perfect control of the oil.

The application of too much oil should be carefully avoided, as it will be flung off the swiftly-moving working parts and will find its way on to the wheel treads and so to the rails. It is surprising what a nuisance even a small quantity of oil on the wheels can be. First of all difficulty in starting with a load will be experienced owing to slipping; then as this slipping will be continued to a greater or less degree throughout the run, much power will be lost, and the distance travelled will be diminished. Further, the oil will be spread round the track and will be picked up by the wheels of the rolling stock. If not removed it will attract dust and ultimately form a black "mud" deposit. This deposit accumulates on the wheels, and thus increases the resistance of the train; so that with the engine slipping and the rolling stock running badly the train service is bound to suffer.

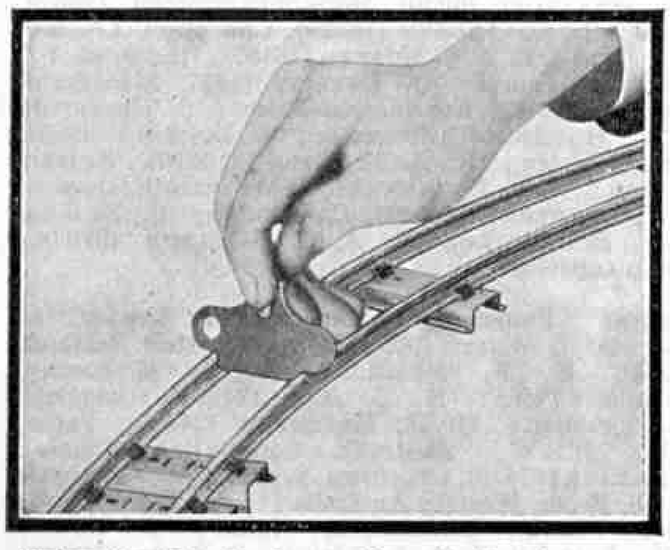


This photograph shows how a layout is improved by the addition of Hornby Countryside Sections and various accessories. The realistic appearance of the line is very striking when compared with the track in the lower illustration on the previous page, the miniature figures and animals in particular adding considerably to the lifelike aspect of the scene.

The remedy for oily wheels and rails is to wipe them carefully with a rag moistened with a small quantity of petrol. This removes the oil and evaporates quickly, leaving the wheels and the rails clean and dry. Paraffin is of little use for this purpose, as although it removes the oil, its own oily nature renders the rails slippery for some time after use, as it does not evaporate anything like so quickly as petrol. The petrol used to moisten the rag should be contained in a small bottle, and should be kept well away from the fire.

The mistake is often made of supposing that a new locomotive should immediately demonstrate its full powers of speed and haulage. Hornby Locomotives, in common with mechanisms of all kinds, require to be "run in" before they achieve their highest efficiency.

The use of the correct oil for the lubrication of miniature locomotives and rolling stock is most important. The special Meccano Oil is of exactly the right quality for lubricating the small moving parts of clockwork mechanisms and for miniature railway purposes generally. Thick oil is unsuitable for the small bearing surfaces of a clockwork mechanism, for owing to its heavy nature it actually has a retarding effect. An excellent lubricant for the springs of clockwork mechanisms is the special Graphite Grease that is now available in tubes. This should be applied with a small paint brush, so that it becomes well worked in between the coils of the spring. It can be applied most easily and effectively when the mechanism is out of the housing. There is no difficulty in removing the mechanism, and as the Grease need only be applied at long intervals, the trouble involved is very slight. In order to get the individual coils of the spring to separate satisfactorily so that the Grease can be applied to every point, it may be necessary to give the winding spindle a few turns of the key. Only just sufficient Grease should be applied to provide a film over the surface of the spring.

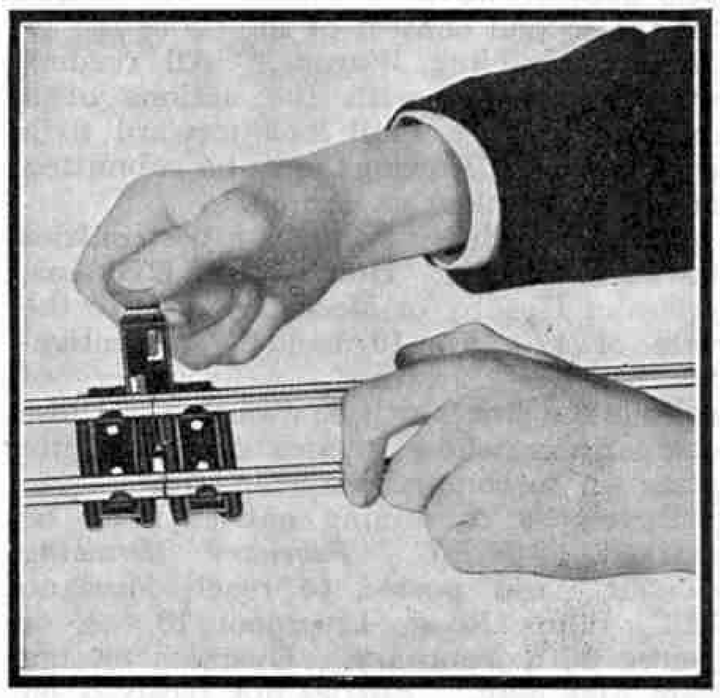


Using the Hornby locomotive winding key as a rail gauge, as described in this article.

The winding of the engine, simple as it may appear, is another important point. Beginners are often afraid of overwinding the spring, but with reasonable care there is no danger of this happening with a Hornby clockwork locomotive. The number of turns to be given to the key varies with different sizes of mechanisms, but in every case it is safe to turn the key as far as it will go without forcing. In order to be on the safe side it is a good plan to count the number of turns required for full winding, and then to make a practice of giving one or two turns less than that number. This of course applies only when the engine is being wound up from a run down condition. A series of experiments should be made to determine how far an engine will travel with a certain number of turns of the winding key. From the information thus obtained it is easy to calculate the turns that must be given to enable the locomotive to complete any desired length of run.

It is important to remember that all Hornby clockwork locomotives are wound by turning the key in a clockwise direction—that is from left to right—and the key must on no account be turned backward, for this may result in a broken spring, or in the spring becoming detached from the main winding spindle. The key must be pressed home as far as it will go on the winding shaft, otherwise the extra strain on a small section of the main spindle is liable to wear the

(Continued on page 135)



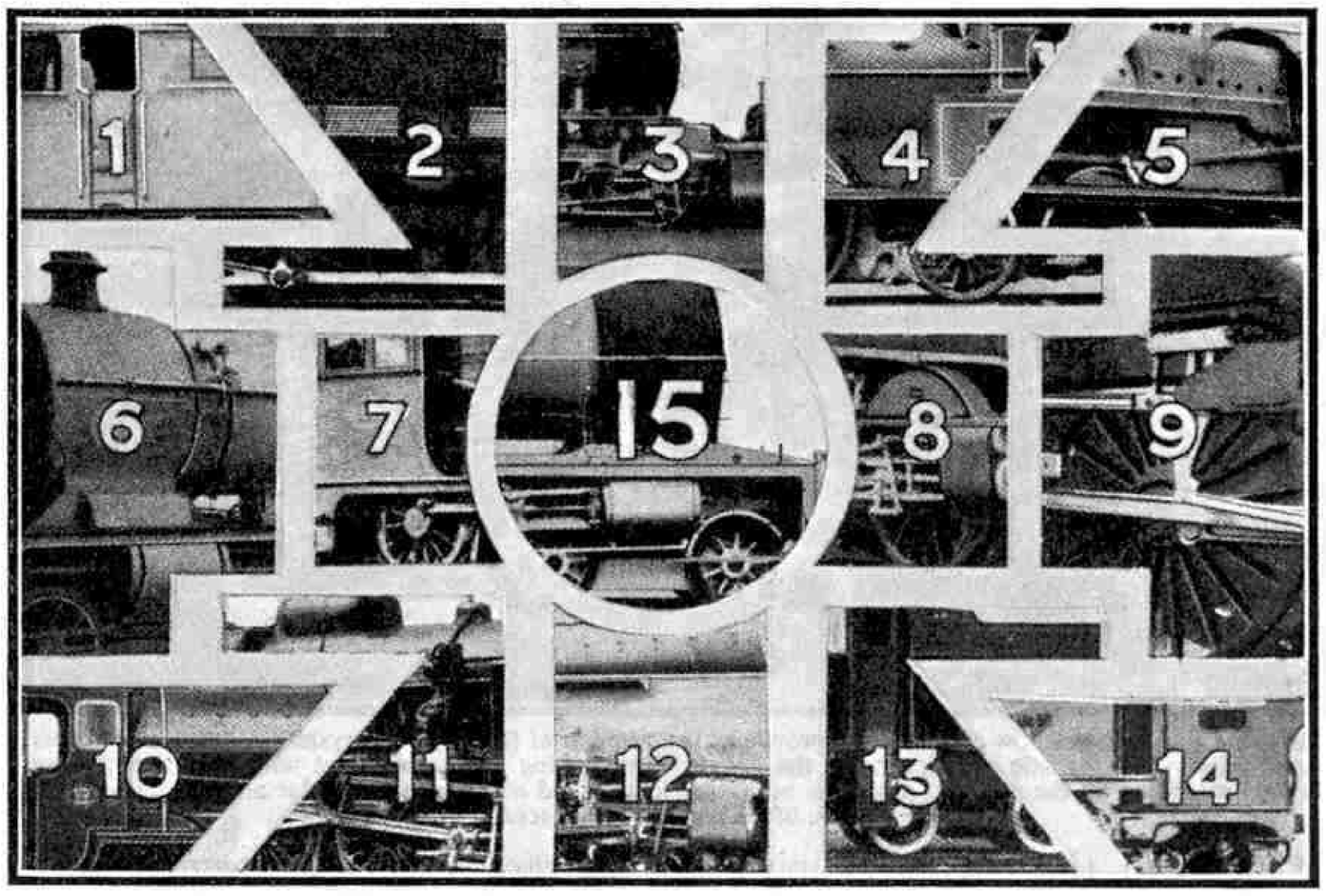
How the connecting plates are attached to the sleepers at the joints of Hornby rails.

H.R.C. COMPETITION PAGE

Competitions appearing on this page are open only to members of the Hornby Railway Company. Envelopes containing entries should have the title of the competition clearly written in the top left-hand corner and should be addressed to the Hornby Railway Company, Meccano Ltd., Binns Road, Liverpool 13. The name, address and membership number of each competitor should appear in clear writing on the back of every sheet of paper used.

LOCOMOTIVE FEATURE CONTEST

The four British railway groups possess many different classes of both passenger and goods engines. Most of these classes have some characteristic feature in design by which they may be distinguished from any other class. For instance, no railway enthusiast can mistake an L.N.E.R. "Pacific," a G.W.R. "King," or an L.M.S.R. "Royal Scot" for an engine of any other class. There are numbers of locomotives that are not quite so easy to identify, however, on account of the fact that they are variations of other classes, from which they differ only in minor details. Thus the "Experiment" engines of the L.M.S.R. Western Division are at first glance very similar in appearance to the "Prince of Wales" on the same line. Except for a difference in the size of their smoke-boxes, and one or two other outstanding details, the two classes are so alike as to be easily confused.



From the identification point of view these locomotives are among the most interesting, because of the problems they present. The most popular competitions that have appeared on this page have been those in which H.R.C. members were invited to put their railway knowledge to practical test, and this month we provide an opportunity of this kind in regard to locomotives.

The illustration on this page shows portions of different classes of well-known locomotives, and each of the pictures includes some prominent feature peculiar to the particular class concerned. Competitors are required to state to which class each of the locomotives belongs, the group owning it, its wheel arrangement, and the characteristic feature in the picture by which the locomotive was identified. This last-mentioned feature need not be a long description; it will be sufficient to state in a few words exactly what it is.

To the competitor in each of the two Sections, Home and Overseas, who sends in the most accurate solution, a prize of Hornby Train material (or Meccano products if preferred) to the value of 21/– will be awarded. To the senders of the three entries judged next in order of merit will be awarded similar goods to the value of 15/–, 10/6 and 5/– respectively. There will also be a number of consolation prizes. In the case of a tie, neatness of presentation will be the deciding factor.

Envelopes containing entries should be marked "*H.R.C. Loco Feature Contest*" in the top left-hand corner, and posted to reach Meccano Ltd., Binns Road, Liverpool 13, on or before 28th February. Entries from competitors in the Overseas Section should be posted to arrive not later than 31st May.

Drawing Contest

Last month we announced a new series of Drawing Contests in which competitors were asked to sketch a particular railway employee carrying out one of his duties. The subject we have chosen this month for the second contest of the series is "*A Shunter Coupling Wagons.*" All readers will be familiar with the actions of a shunter, and we shall look forward to a large entry. Drawings may be submitted in pencil or colour as desired.

To the senders of the four best entries in each section, Home and Overseas, prizes of Hornby or Meccano goods to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded. A number of consolation prizes will be awarded to those competitors whose entries do not quite come up to competition standard.

Envelopes containing entries must be marked "*H.R.C. February Drawing Contest,*" and posted to reach Meccano Ltd., Binns Road, Liverpool 13, on or before 28th February. Overseas closing date 31st May. Entries not received on the dates specified will be disqualified.

Voting Contest

This month we announce our annual Voting Contest, in which we invite H.R.C. members to help us to decide which of the Contests held during the past year were most popular.

Every entrant for the Competition is required to state: (1) Which of the main 12 H.R.C. Contests in 1933 was his favourite. (2) Which he considers are the eight most popular of these Contests in order of their popularity. Competitors need not necessarily include in this forecast the Contest that is their own personal favourite.

Prizes of Hornby Train or Meccano goods to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded to the four winners in each Section, Home and Overseas, who give the most accurate forecasts of the final order of voting. In addition there will be a number of consolation prizes.

Envelopes should be clearly marked "*H.R.C. Voting Contest*" and posted to reach Meccano Ltd., Binns Road, Liverpool 13, on or before 28th February. Overseas closing date, 31st May.

COMPETITION RESULTS

HOME

November "Locomotive Progress Contest."—First: R. Wood (179), Gorton, Manchester. Second: J. Mathewson (34686), Scotstoun, Glasgow. Third: K. Costain (5108), Bolton, Lancs. Fourth: R. Barbary (5580), Mevagissey, Cornwall. Consolat on Prizes: D. Swan (16798), Winchester, Hants.; J. Gercken (28434), Harrow, Middx.; J. J. Horne (17501), Moreton-in-Marsh, Glos.; R. C. Cockerill (22837), Wolverhampton; H. E. Jones (14740), Chingford, London, E.4.

November "Layout Planning Contest."—First: C. E. Wrayford (6039), Moretonhampstead, Devon. Second: D. G. Tucker (16329), Chingford, London, E.4. Third: R. A. S. Musker (13162), Hightown, Nr. Liverpool. Fourth: J. Everitt (542), Streatham, London, S.W.16. Consolation Prizes: J. Griffiths (17337), Hucclecote, Gloucester; A. Lucking (3556), Witham, Essex; R. E. N. Eyles (10010), Wolverhampton; W. B. Hudson (1733), Weymouth, Dorset; K. W. Ashberry (14344), Cambridge; F. Hodson (9430), Bolton, Lancs.; A. I. Macleod (37079), Weston-super-Mare.

OVERSEAS

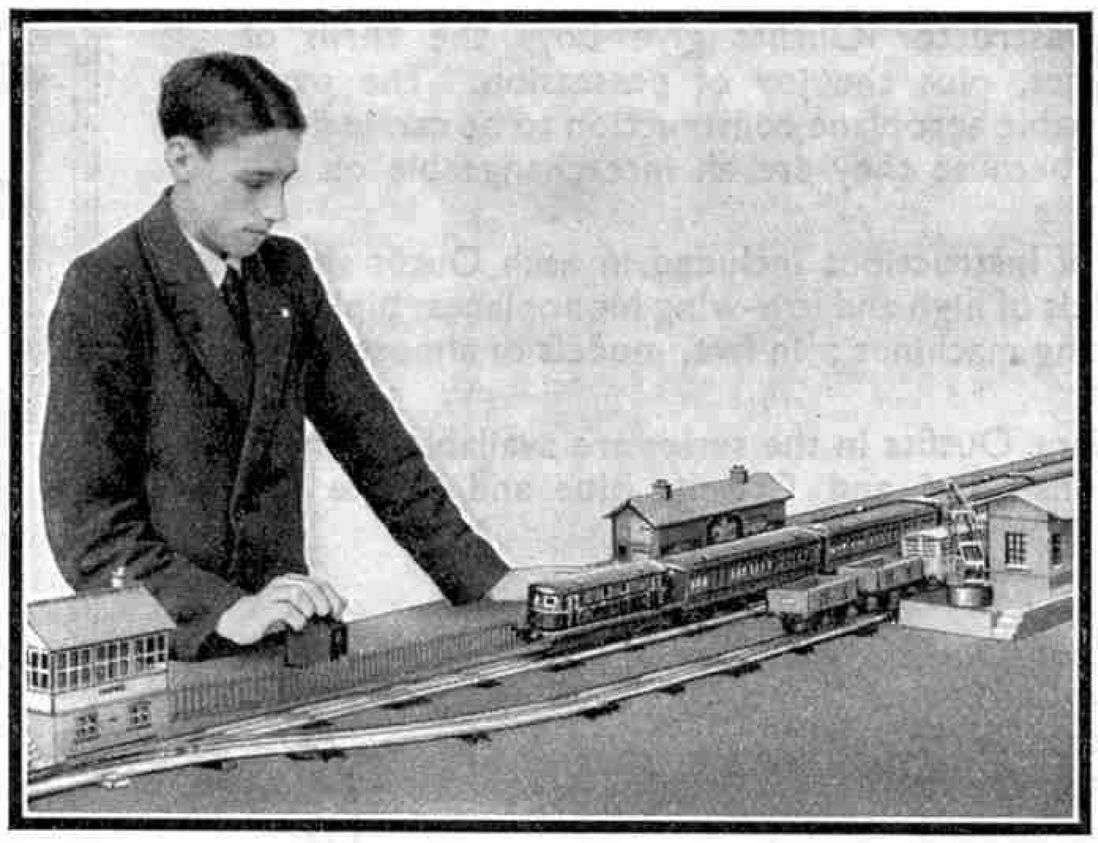
August "Fourth Name and Number Contest."—First: D. J. White (9333), Dunedin, New Zealand. Second: R. B. McMillan (9592), Melbourne, Australia. Third: H. C. Key (24764), Calcutta, India. Fourth: H. H. Matthews (24642), Parramatta, N.S.W., Australia. Consolation Prizes: G. Hallack (17578), Capetown, S. Africa; G. Gardham (34769), Perth, Western Australia; J. G. Gnanadurai (1964), Puthur, Trichinopoly, India; B. Chiles (9191), Port Elizabeth, S. Africa; S. Smith (30082), Dunedin, N.Z.; R. A. Wragg (7913), Bandikui, India.

Installing a Hornby Electric Railway

Current Supply and Connections

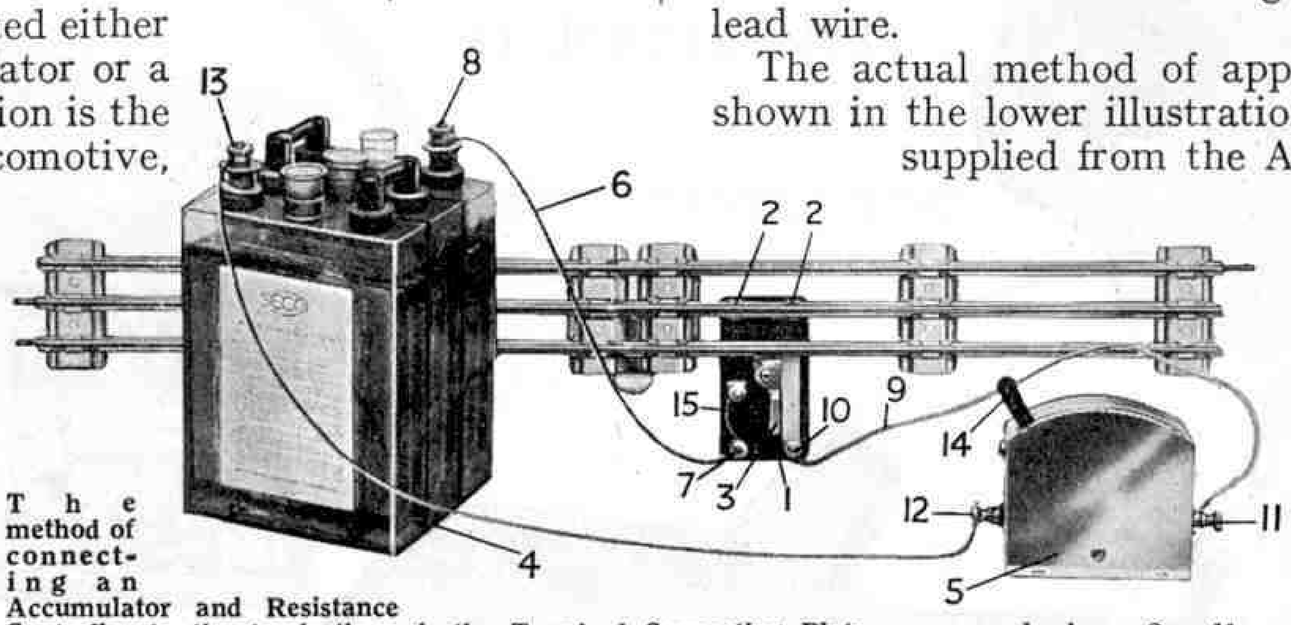
THE use of electricity as the motive power for miniature railways is extending rapidly. The main advantage of an electric railway is that trains can be started, stopped and controlled for speed from a controller outside the track, without the necessity of handling the locomotives. A smaller but still important advantage is that electric locomotives do not require to be wound up, but keep on running as long as the current remains switched on.

The first question to be decided by the prospective owner of an electric layout is that of a suitable power supply. Here the choice lies between an accumulator and a transformer, the latter being used where the household electric mains supply is alternating current. We are often asked whether Hornby Electric Locomotives can be run from direct current mains through resistances; and we take this opportunity of emphasising that this practice is dangerous to the user and bad for the motors of the locomotives. On the other hand, the use of a Meccano Transformer, where alternating current is available, is perfectly safe.



Controlling a Hornby Metropolitan Train by means of the Resistance Controller.

All Hornby 6-volt Electric Locomotives, with one exception, may be operated either by means of an accumulator or a transformer. The exception is the No. 1 Electric Tank Locomotive, which can only be operated from an accumulator. The Meccano 6-volt Accumulator supplies current suitable for all Hornby 6-volt Locomotives, and there is a wide range of Transformers for both 6-volt and 20-volt Locomotives which are available in many interesting types.



The method of connecting an Accumulator and Resistance Controller to the track through the Terminal Connecting Plate.

The control of the locomotives is the next important point to be considered. Transformers Nos. T6 and T6A, and T20 and T20A have a speed regulator incorporated, which enables locomotives to be started, controlled for speed and stopped as required. The T6M and T20M Transformers do not include this regulator, so that with them a standard Resistance Controller in the circuit is necessary, just as in the case of an accumulator. All Hornby Electric Locomotives, except the No. 1 Electric Tank Locomotive, are reversed by manipulation of a lever in the cab. The No. 1 Electric Tank, on the other hand, is controlled completely, both for speed and reversing, by means of a special Speed and Reverse Control Switch.

In every Hornby electric railway, whether the power supply be from an accumulator or from a transformer, the actual connection to the track is effected by means of a Terminal Connecting Plate. This Plate is listed in two types, TCP6 and TCP20, for 6-volt and 20-volt trains respectively, and a suitable one is included in every Hornby 6-volt and 20-volt Train Set. In addition to forming the power connection to the track, the Terminal Connecting Plate forms an important safety device. It is arranged to accommodate a length of fuse wire that melts in the event of a short circuit occurring between the centre and the running rails, and so disconnects the power supply from the track. A length of suitable fuse wire is included with each Terminal Connecting Plate, and further supplies of this wire are obtainable. It should be noted that the correct wire for the 6-volt Terminal Connecting Plate is No. 41 S.W.G. tinned copper wire, and that for the 20-volt Terminal Connecting Plate is No. 32 S.W.G. lead wire.

The actual method of applying the Plate is clearly shown in the lower illustration on this page. Power is supplied from the Accumulator 4 through the Resistance Controller 5. One lead 6 from the Accumulator goes directly to one of the terminals 7 of the Terminal Connecting Plate 1. The other lead 9 is arranged to incorporate the Resistance Controller, as shown, being finally attached to terminal 10 of the Terminal Connecting Plate. The fuse wire 15 is shown between terminal 7 and another terminal nearer the track, which is not marked.

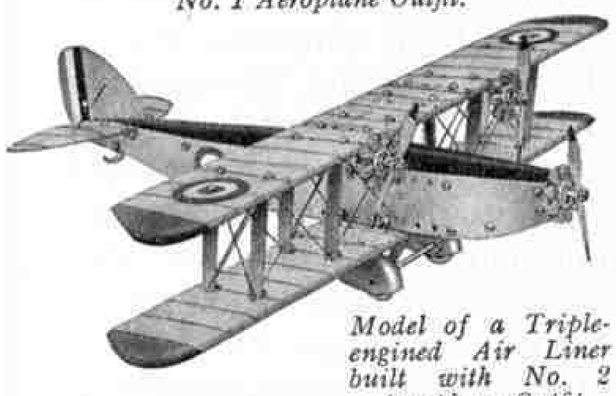
The attachment of the Terminal Connecting Plate to the track, which may be effected at any convenient point on the layout, is carried out by placing it under the rails, so that the projecting catch pieces 2 2 engage with the centre rail; it is secured by the turning of lever 3, so that the latter clips the outer rail and so fixes the Plate in position. Where a T6M or T20M Transformer is in use, its connection to the appropriate Resistance Controller and to the track is carried out as for an accumulator.

MECCANO

AEROPLANE CONSTRUCTOR OUTFITS

Model of a High Wing Monoplane built with No. O Aeroplane Outfit.

Model of a Standard Light Biplane built with No. 1 Aeroplane Outfit.



Model of a Triple-engined Air Liner built with No. 2 Aeroplane Outfit.

Model of a Light Biplane built with No. 2 Special Aeroplane Outfit.

Boys, Build Your Own Model Aeroplanes!

Meccano Aeroplane Constructor Outfits give boys the thrill of building their own aeroplanes, plus the joy of possession. The parts contained in these Outfits enable aeroplane construction to be carried out on sound engineering lines, because they are all interchangeable on the famous Meccano principle.

The illustrated Manual of Instructions included in each Outfit shows how to build wonderful models of high and low-wing Monoplanes, Biplanes, Seaplanes and other interesting machines; in fact, models of almost every type of aircraft can be built.

All the Meccano Aeroplane Outfits in the series are available in three different colour combinations—Red and Cream, Blue and White and Green and Ivory.

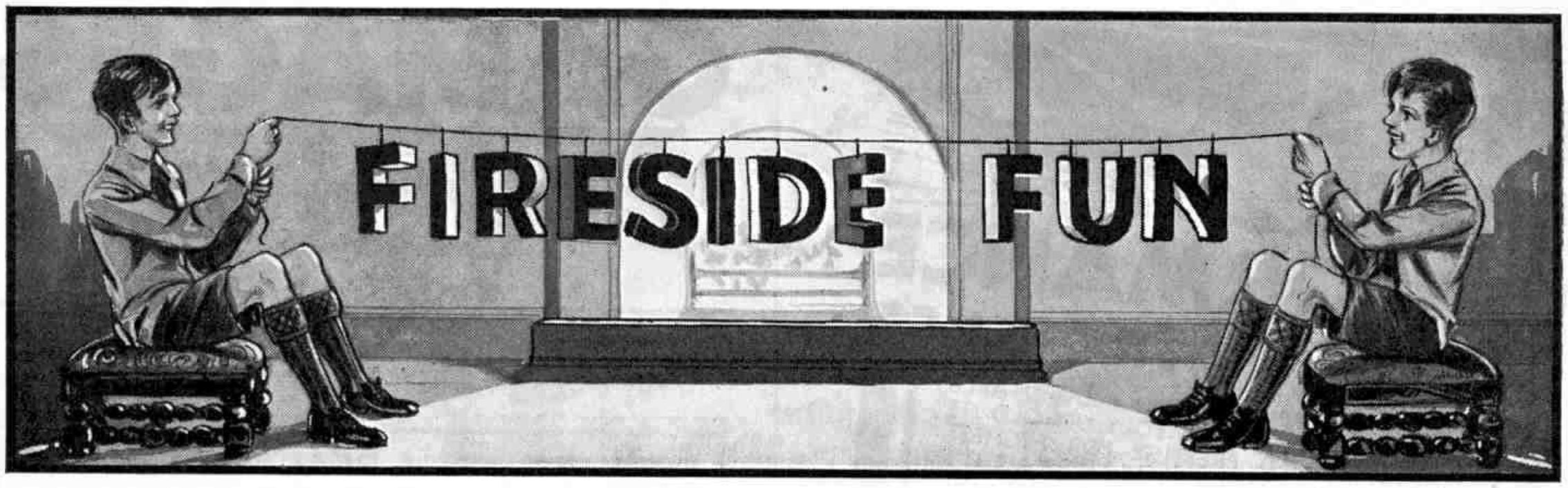
PRICE LIST

No. O Aeroplane Constructor Outfit	**5/-**
No. O1P Aeroplane Hangar Outfit	**10/-**
No. 1 Aeroplane Constructor Outfit	**9/-**
No. 2 Aeroplane Constructor Outfit	**16/6**
No. 1 Special Aeroplane Constructor Outfit	**15/-**
No. 2 Special Aeroplane Constructor Outfit	**25/-**

Note. The parts in the No. O and No. O1P Outfits are not intended for use with the larger Outfits.

MECCANO LTD.
BINNS ROAD
LIVERPOOL 13

No. 2 Special Aeroplane Outfit.



STRATEGY

The grocer told the little boy to help himself to a handful of nuts. But the boy shook his head.

"Why, what's the matter, don't you like nuts?"

"Yes," replied the boy, but he still hesitated, so the grocer put a generous handful in his pocket.

When they had left the shop his mother asked her small son why he hadn't taken the nuts when the man asked him.

"'Cause his hand was bigger than mine!" came the reply.

* * * *

The short-tempered sergeant was drilling an awkward squad of recruits.

"Mark time!" he ordered.

Presently he noticed that one of the squad in the rear rank was not taking any notice of his order.

"Mark time, there!" repeated the sergeant.

"Shall I mark time with my feet?" asked the offender.

"Of course," roared the sergeant. "Did you ever hear of marking time with your hands?"

"Yes, sergeant, clocks do."

* * * *

Pat saw Mike coming along the pier.

"Hallo, son of Old Ireland," he said, "What ye been doing?"

"Testing my weight," said Mike.

"How much do ye weigh?" asked Pat.

"One hundred and seventy-five pounds," said the other.

"What!" exclaimed Pat. "But ye must a' weighed yerself with yer coat on."

"That I did not," replied Mike. "I held it over my arm."

* * * *

Lady (purchasing thermometer): "And would you be so kind as to set it to sixty-five, because that's what the doctor says I'm to keep the room at."

* * * *

Mistress: "Your hands are terribly dirty."

Maid: "It's all right, mum. I've just done the grates, but I shall be doing the pastry next, so they'll soon be clean again."

* * * *

"My chief has the worst memory I ever heard of."

"Forgets everything, does he?"

"Rather not; he remembers everything!"

* * * *

NO GUIDE REQUIRED

Estate Agent: "I'm very sorry, sir, I meant to have told you about that hole."

Prospective purchaser of house: "Don't worry, I've discovered it for myself."

TOO LONG

"Didn't I get my last haircut in this shop?"

"I don't think so, sir. We've only been in business two years."

* * * *

Little May's grandmother had an old-fashioned way of measuring a yard by holding one end of the goods to her nose and then stretching the piece at arm's length.

One day Mary found a piece of ribbon. Carrying it to her grandmother, she requested gravely: "Grandma, smell this and see how long it is!"

* * * *

NOTHING WRONG WITH THE LACES

"Do you think these shoes are worth repairing?"

"Well, the laces are alright. We might fit new uppers and then sole them."

* * * *

"Look here, Sam, when be you goin' to pay me that thirty shillings for pasturin' your heifer? I've had her now for about ten weeks."

"Why, Si, ther critter ain't worth mor'n two pounds."

"Well, supposin' I keep her for what you owe me?"

"No fear. Tell you what I'll do; keep her three weeks more, and you can have her."

* * * *

Doctor (held up for speeding): "But I'm on my way to an urgent case."

Constable (sceptically): "I know; it'll be 'eard next Tuesday."

* * * *

They had just left the meeting and were discussing a few details.

"In my opinion," declared one, "public speakers are not made, but born."

"You're right," agreed the other, sadly. "They have to be borne."

* * * *

There was a terrific crash. The grocer hurried out of his shop and saw his plate-glass window shattered to pieces, while down the road ran the obvious culprit.

The grocer streaked after him and caught him.

"Now, then," he said, shaking the boy, "what do you mean by breaking my window and running away?"

The boy raised two pleading eyes.

"Oh, sir," he replied, "I couldn't bear to see my ball go through all that pane."

* * * *

The new maid rushed in excitedly. "Somebody's just gone off with your car, sir," she said.

"Oh!" said the master, all attention. "What was the man like?"

"I could not see him clearly, but I took the number of the car."

A FULL-DRESS REHEARSAL

"Grandma, if I was invited out to dinner should I eat pie with a fork?"

"Yes, indeed, Johnny."

"You haven't got a pie in the house that I could practise on, have you, grandma?"

* * * *

The Scotsman went into a shop and bought an attaché case. "Shall I wrap it up for you?" asked the assistant.

"Oh, no, thank you," replied Sandy; "just put the paper and string inside."

* * * *

First Boy: "Your father must be a mean man—him a shoemaker and makin' you wear old boots."

Second Boy: "He's nothin' to your father—him a dentist, and your baby only got one tooth."

* * * *

During a history lesson the teacher pointed out to her young pupils that a surname often indicated the trade or profession of the ancestors of those who bore the name.

"For instance," she said, by way of illustration, "supposing your name was Baker, that means your ancestors were makers of bread. Or, as another example, supposing your name was Smith, that means that your ancestors were workers in iron—blacksmiths, and so on."

She pointed to one of the boys. "What were your ancestors, Webb?" she asked him.

The boy looked thoughtful. "Spiders, teacher," he said, after a while.

* * * *

"Yes," said the oculist, "he had a curious affliction; everything he looked at he saw double."

"Poor fellow. I suppose he found it hard to get a job?"

"Not at all. The gas company snapped him up, and now he's reading meters."

* * * *

"So your name is MacDonald?"

"Yes."

"And you want to change it to Laurie Maurice Stevenson. Tell me why you want to do so."

"It is my wife's idea. She thinks I ought to have the same initials that are on our spoons and towels."

* * * *

A BIG NUT

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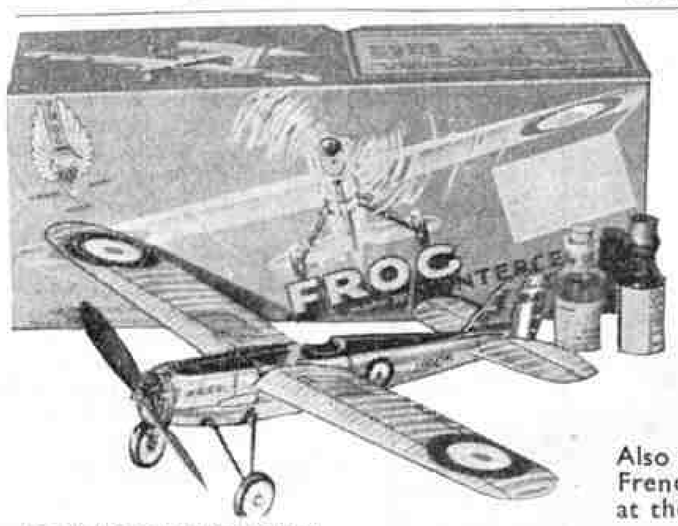

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Competition Corner

WHICH WERE THE MOST POPULAR COVERS IN 1933?

Among voting contests none has retained so high a degree of favour among our readers as the annual Cover Voting Contest held to decide the order of popularity of the coloured covers of the previous year's issues.

In the above illustration the coloured covers that appeared on the various issues of the "*M.M.*" during 1933 are reproduced in a reduced form in their order of publication—January to June in the upper row, and July to December in the lower. The reproductions are intended for reference purposes only. They convey nothing of the brilliancy of the colour of the originals, but new readers will find them of great assistance in forming their judgment. Those readers who possess copies of the 1933 issues, or are able to obtain them, should make a careful study of the originals before completing their entries.

Referring to each cover by its month of issue, each competitor is asked to state on a postcard :—

A. The 1933 cover he likes best of all.

B. His idea of the order of popularity of the covers as decided by the massed vote of all the competitors.

This list must cover the whole year, every month being included. The name of the month must be given, and its number in the volume. Competitors need not place their own favourite cover at the head of list B, unless they believe that it will prove to be the popular choice of the remaining competitors. They should place it in the position in which they anticipate it will be placed by the massed vote.

The entrant's name and address must be added to the card, which should be addressed " Cover Voting Competition, Meccano Magazine, Binns Road, Old Swan, Liverpool 13." No competitor may submit more than one entry.

Prizes of Meccano products, to be chosen by the winners, to the value of 21/-, 15/-, 10/6 and 5/- respectively, will be awarded to the four competitors whose lists most accurately forecast the final result. In addition there will be a number of consolation prizes for entries not in order of merit. In the event of a tie for any of the prizes, preference will be given to the entry displaying the neatest or most novel presentation. Closing date, 28th February. Overseas, 31st May.

Figure Drawings Contest

Many of our readers will recall the popular " Figure " competitions that we held a year or two ago, notably the " Loco Figures," " Tree Figures " and " Figure Face " contests. Recently it has been suggested that another of these competitions would prove very popular. Our artist has not run short of ideas that we could use for the purpose, but we think it would be interesting on this occasion for the subject to be a drawing provided by one of our readers. Accordingly this month we offer prizes for Figure Drawings.

For the benefit of new readers we must explain that in the figure competitions referred to we published drawings of a locomotive, a tree, and a boy's face, in which the outlines and all the details of the subjects were indicated by figures, that is to say, by one or another of the numerals 1 to 9. Competitors were required to ascertain the total of the figures employed in each drawing.

In making up a picture for the purpose of the present contest competitors will not be hampered by restrictions as to the subjects that may be used. The most important consideration is that each numeral used should be clear and distinct, particular care being taken to distinguish " sixes " from " nines."

It is not necessary for the numerals used to appear right way up, of course ; they may be laid on their sides or upside down, as the requirements of the drawing dictate.

In each section, Home and Overseas, there will be four prizes, consisting of Meccano Products value 21/-, 15/-, 10/6 and 5/- respectively ; and also there will be a number of consolation prizes.

Entries should be addressed to " Figure Drawings Contest, Meccano Magazine, Binns Road, Liverpool 13." Closing date, 28th February. Overseas, 31st May.

COMPETITION RESULTS

October Silhouettes Contest. The Overseas section now having closed, we give below the solution to this contest. Readers will remember that the silhouettes were taken largely from well-known advertising figures that are included in the Hornby Miniature Posters series.

The awards in the Overseas section of the competition will appear next month.

The silhouettes were as follows :—1. Marmite ; 2. Oxo ; 3. K.L.G. Sparking Plugs ; 4. Swan Vestas Matches ; 5. Beefex ; 6. Golden Shred Marmalade ; 7. Bird's Custard ; 8. Mazda Electric Bulbs ; 9. Ovaltine ; 10. Flit ; 11. Yardley's Lavender ; 12. Waverley Oats ; 13. H.P. Sauce ; 14. Bovril ; 15. Atora Suet.

HOME

November Sketchograms. First Prizes : Section A, G. Swyer (London, N.W.11) ; Section B, V. S. Wilson (Liverpool) ; Second Prizes : Section A, L. T. Channing (London, S.W.18) ; Section B, D. Vickers (Wallasey).

Best Bargains. 1. G. A. Batty (Liverpool) ; 2. A. D. Tarry (Harpenden) ; 3. Wm. Tingle (Leicester) ; 4. M. Biancheri (Southampton).

OVERSEAS

September Photo Contest. First Prizes : Section A, A. A. Boult (Auckland) ; Section B, N. F. Robinson (Capetown) ; Second Prizes : Section A, F. Dorfman (Antwerp) Section B, B. T. R. Miller (Sydney).

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5	Gambia ...	1/-	5	Seychelles ...	1/-
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GERMANY'S TRIBUTE TO WAGNER

AMONG the many charity stamp series issued last Christmas the most interesting was the German National Relief issue, serving the dual purpose of a charity issue and the commemoration of the 50th anniversary of the death of Richard Wagner, the great opera composer.

There are nine stamps in the set, and the design in each case is based on a scene from one of the Wagner operas. An interesting feature of the design is that the original pencil sketches by Alois Kobb, Professor of Steel Engraving at the Leipzig Academy of Graphic Arts, were made in the exact size of the finished stamps, and only few modifications were necessary before the preparation of the beautiful miniature engravings from which the stamps were printed. The printing is on paper watermarked with the swastika, the emblem of the Nazi Party.

The stamps range in denomination from 3 Rpf. to 40 Rpf., and to each there is added a premium for charitable purposes. We illustrate six of the stamps on this page.

Richard Wagner was born at Leipzig in 1813, and it was not until comparatively late in his boyhood that signs of his remarkable musical talent became plain. From 1833 to 1839 he held various appointments as conductor, and during this period he composed two minor operas and the early acts of his first big work, "*Rienzi.*" The years 1839 to 1842 were spent in Paris. "*Rienzi*" was produced in 1842 at the Dresden Opera House, with great success, and in the following year came the first performance of "*The Flying Dutchman,*" a scene from which is shown on the 4+2 Rpf. stamp, illustrated here. The story of this opera is based on a legend of a phantom ship popularly supposed to haunt the seas in the vicinity of the Cape of Good Hope. The skipper, one Vanderdecken, had been condemned for his blasphemy to sail his vessel for ever against the wind, and in the stamp design he is shown standing in the bow of his vessel. Sailors consider the appearance of the "*Flying Dutchman*" to be a very bad omen, and quickly alter their course to avoid it!

The legend is not Teutonic in its origin, but has its counterpart in almost every maritime country. According to Sir Walter Scott, the ship was carrying bullion, a murder was committed aboard, and plague broke out.

In February 1843 Wagner was appointed Court Conductor at Dresden, and two years later he completed the composition of the ever-popular "*Tannhäuser.*" On the 3+2 Rpf. stamp the minstrel Tannhäuser is shown playing his lute in the scene in Act 1 where he sings his song of love to Venus and begs to be allowed to leave the Venusberg to explore the outside world. The opera was not an immediate success when it was produced at Dresden in 1845, for Wagner's methods were vitally different from those of earlier opera composers and of those of his day. Nevertheless the composer stuck to his guns, and was steadily establishing his views when he was compelled to flee the country as the consequence of his prominent part in the political uprising of 1849. He settled in Zurich and remained in retirement until 1859.

After the production of "*Tannhäuser*" Wagner chose "*Lohengrin*" as the subject of his next opera. Actually he had completed the work before he was compelled to leave Dresden. He took the score with him and arranged for its production at Weimar by the great pianist Liszt. "*Lohengrin*" is represented by the 25+15 Rpf. stamp, illustrated here. Lohengrin, "the Knight in shining armour," is shown arriving in answer to the prayers of Elsa, the principal female character in the opera. The swan that miraculously drew his boat is also shown.

Liszt had long recognised the genius of Wagner and pressed him to push on with new work while in exile. It was as a result of this request that Wagner gave serious attention to the composition of the cycle of operas based on the great legend of the Nibelungs, that he had had in mind for a considerable time. The cycle is composed of four operas, the whole comprising one great work. Three of the four operas are represented in the stamp series, the first of them, "*The Rhinegold,*" being on the 5+2 Rpf. The design shows a group of Rhine-maidens, guardians of the Rhinegold. The loss of the gold to the dwarf Alberich commences the series of events that constitute the story of the four operas. Alberich is shown in the stamp standing on the river bank clutching at his prize.

"*The Valkyrie,*" the second opera in the cycle, is represented by the 8+4 Rpf. stamp in which Wotan, the God of Gods, is seen bending over Brünnhilde, his daughter, and taking her helmet from her head. This is an incident in the third act, where Brünnhilde, having displeased her father, is put by him into a trance from which she is awakened by Siegfried.

The third opera, "*Siegfried,*" is represented by the 12+3 Rpf. illustrated here. The design of this stamp shows Siegfried slaying Fafner, the dragon guardian of Wotan's treasure. "*Götterdämmerung*" ("The Fall of the Gods"), the final opera of the cycle, for some unexplained reason, is not represented in the series of stamps.

In 1857 Wagner completed "*Tristan and Isolde,*" a story based upon the Celtic legend of that name. This opera is represented by the 20+10 Rpf. stamp, in which the hero and heroine of the play are shown drinking a love potion.

Wagner's next work was "*The Mastersingers*" and in the 6+4 Rpf. value Hans Sachs, the talented cobbler upon an incident in whose life the opera is based, is shown at work at his bench.

Wagner's last and, as many believe, his greatest work, "*Parsifal,*" is represented by the 40+35 Rpf. stamp in which Parsifal, known in the parallel British legend "*Morte d'Arthur*" as Sir Percival, is seen holding aloft the Holy Grail and proclaiming himself the new King of the Knights of the Grail.

This great opera was produced at Wagner's own theatre at Bayreuth in 1882, and the first sixteen performances in July and August of that year were stage managed and conducted by the composer himself. Unhappily the exertion of directing so many consecutive performances seems to have overtaxed Wagner's already failing strength. He spent the autumn of the year at Venice, and was well enough on the Christmas Eve to hear a private performance of his own first symphony composed 50 years before. Late in the afternoon of 13th February, 1883, he was seized with a sudden attack of faintness and passed away in the early evening.

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Stamp Gossip

and Notes on New Issues

The Christmas Charity Issues

As promised in our last issue, we illustrate this month a selection from the many stamps issued last Christmas for charitable purposes.

The outstanding series is of course Germany's Wagner commemorative set, to which our principal article is devoted this month. Six of the nine stamps in the series are illustrated with that article.

Germany issued a series commemorating the 10th anniversary of her first issue of charity stamps. The set consisted of a reprint of the four 1924 charity stamps, overprinted with the dates 1923/1933, in sheets each containing one stamp of each value in a simple strip, printed on specially watermarked paper. Above the four stamps the watermark reads, in translation, "10 years of German Charity," and below the stamps are the watermarked dates, "1923-1933."

The Swiss *Pro Juventute* issue as usual is a very striking set to which it is impossible to do justice in monochrome reproduction. The three low values 5c., 10c. and 20c. depict girlhood of French, German and Italian Switzerland as typified in the Vaud, Berne and Ticino cantons. As our illustrations of the 5c. and 10c. values show, in each case the portrait is superimposed on typical scenery in the canton. The high value, 30c., shows a portrait of Father Gregoire Girard, the eminent Swiss philosopher, who was born at Fribourg in 1765, and died there in 1850.

Father Girard is chiefly to be remembered as a pioneer of educational methods. He introduced to Switzerland the system of mutual education whereby the elder students teach the younger, but his idea was in advance of the times, and the authorities insisted upon the abandonment of the system.

The Dutch Child Welfare issue is also very striking, but unfortunately it is not a good subject for reproduction. There are four values, 1½c., 5c., 6c., and 12½c., a premium for Child Welfare funds being added to each. The design illustrated here is common to the four stamps, but an interesting feature is that the star and scroll feature are printed in gold and silver ink on the 6c. and 12½c. values respectively. In the originals the effect is very striking.

Belgium also uses only one design for the six values in the annual anti-tuberculosis campaign issue. This is a simple but beautiful design showing a young girl sufferer in an attitude of supplication, holding aloft the double barred cross, the symbol of the fight against tuberculosis.

New Zealand has contented itself with a single stamp this year, the penny value shown here. The design is symbolical of the road to vigorous health.

The Austrian series consists of a range of earlier general issues, simply overprinted and surcharged to show the charity premium. There are four values, 5g+2g, 12g+3g, 24g+6g and the 1s+50g, illustrated here.

A Simplified Gibbons' Catalogue

Without giving the slightest previous hint, Stanley Gibbons Ltd., have sprung a first-class philatelic sensation. They announce the impending publication—early in March—of an entirely new Gibbons' catalogue, to be known as "Stanley Gibbons' Simplified Stamp Catalogue." As the name implies, the new volume will be drastically simplified as compared with the existing Gibbons' catalogue, which has made a most important feature of the many varieties that are the life blood of the specialist's collection.

There will be no "varieties" whatever. Watermarks will not be mentioned, gauges of perforation will not be distinguished, there will be no shades, no minor varieties, no errors, and only major types of overprint and surcharge will be shown.

Even on this reduced scale, the new Gibbons' catalogue will list over 50,000 different stamps. The complete volume will contain approximately 900 pages. It will be priced at only 5/–, and will provide an ideal catalogue for the young and the new collector.

A Stamp Glossary

Although almost every book on stamp collecting has included some sort of glossary of the hobby, most collectors, and particularly young collectors, have felt the need for a really comprehensive glossary that would define most of the less frequently encountered terms.

In an effort to meet that need a sub-committee of the Philatelic Congress of Great Britain undertook the compilation of such a work. The result is a simple little handbook, "*A Glossary of Philatelic Terms*" that covers every philatelic term known to the committee and its many expert helpers. This handbook costs one shilling, and is obtainable from most stamp shops, or direct from the Philatelic Congress of Great Britain, 34, Gloucester Street, London, S.W.1, price 1/1½ post paid. It should be in every stamp collector's library.

Century Old Stamps

Most British stamp collectors have been looking forward to celebrating seven years hence the centenary of the first adhesive postage stamps. It has been supposed generally that Great Britain's 1d. black and 2d. blue of 1840 were the first such issues.

A sensational announcement in the *Philatelic Journal of Great Britain* makes it seem that the centenary should have been celebrated two years ago, however, for there has come to light from Greece a sheet of postage stamps prepared to the order of the Governor of the Island of Poros in May, 1831. The signature of the Governor himself appears on the back of the sheet, which is believed to be a sample submitted to the Governor at Athens for approval.

Letters dating back to 1840 franked by these stamps are included in the collections of several leading specialists, but hitherto it has been assumed that the stamps were in the nature of postage due labels, an impression created by their appearance on the back of the letters. In a very well reasoned and detailed account of the stamps and their discovery, the *Philatelic Journal* disposes of this argument.

The postal arrangements of those days, in Greece as elsewhere, were very primitive, and there is not really a very great amount known concerning the newly discovered stamps. One well-known authority scouts the likelihood of them proving to be "officially issued stamps of full Government status."

Whatever may prove to be the case ultimately, the fact remains that a new and intensely interesting chapter has been added to philatelic history.

We thank Stanley Gibbons Ltd. for their courtesy in loaning the stamps from which the illustrations for our stamp pages have been made.

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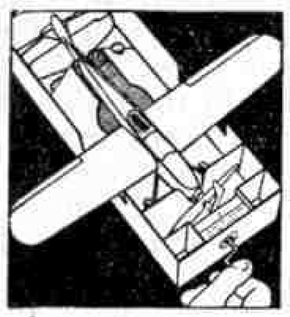

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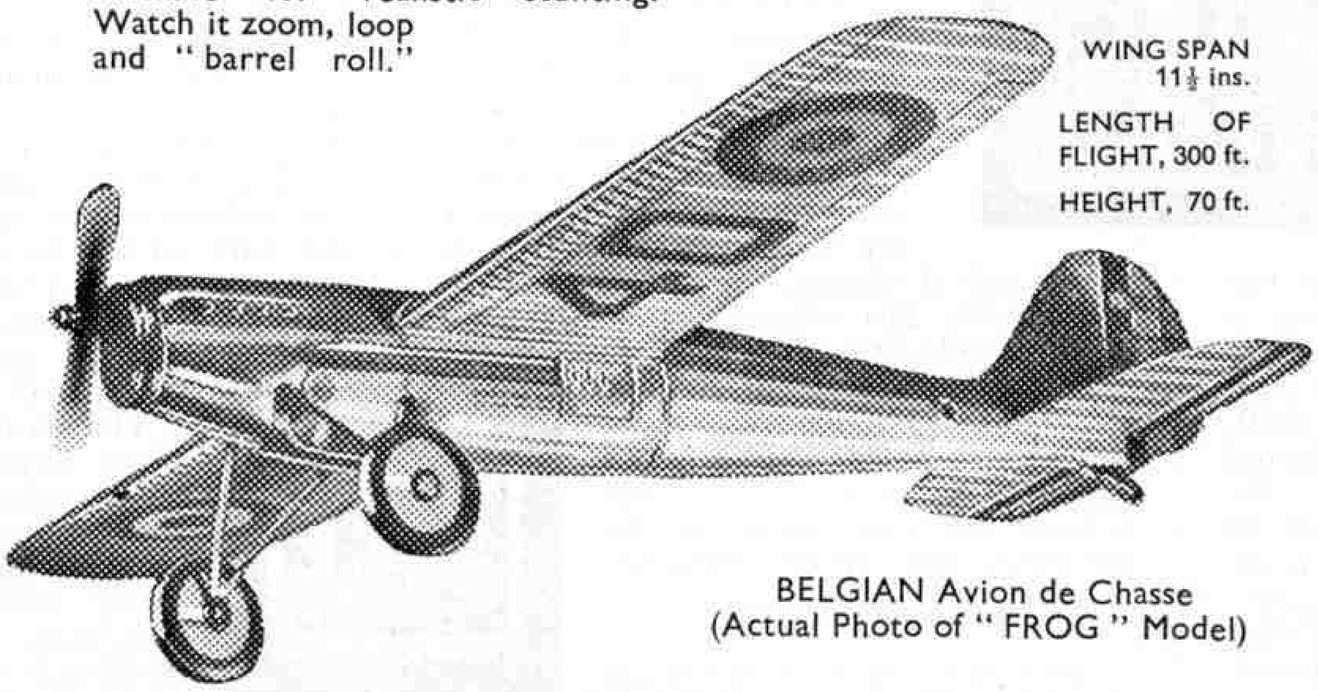

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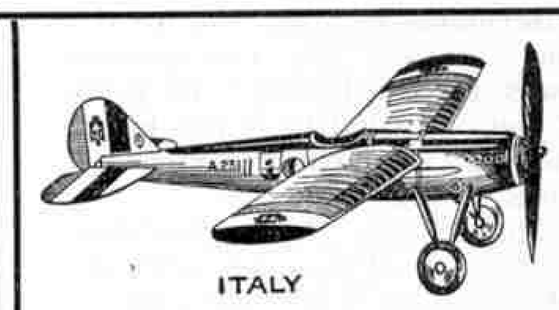
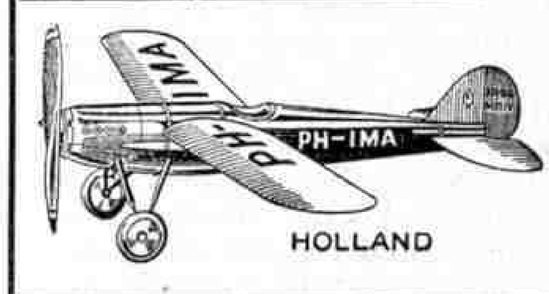


ITALY



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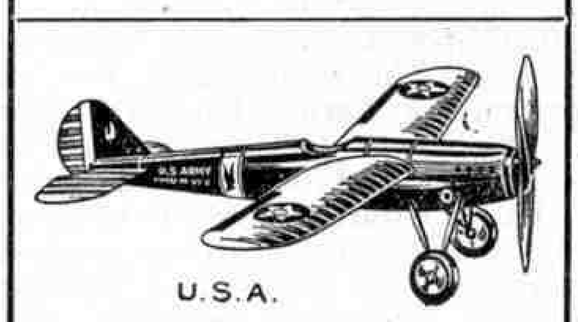

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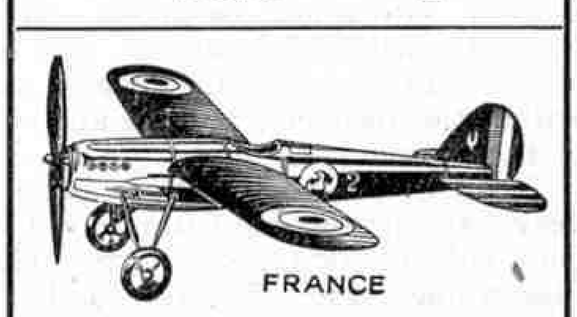

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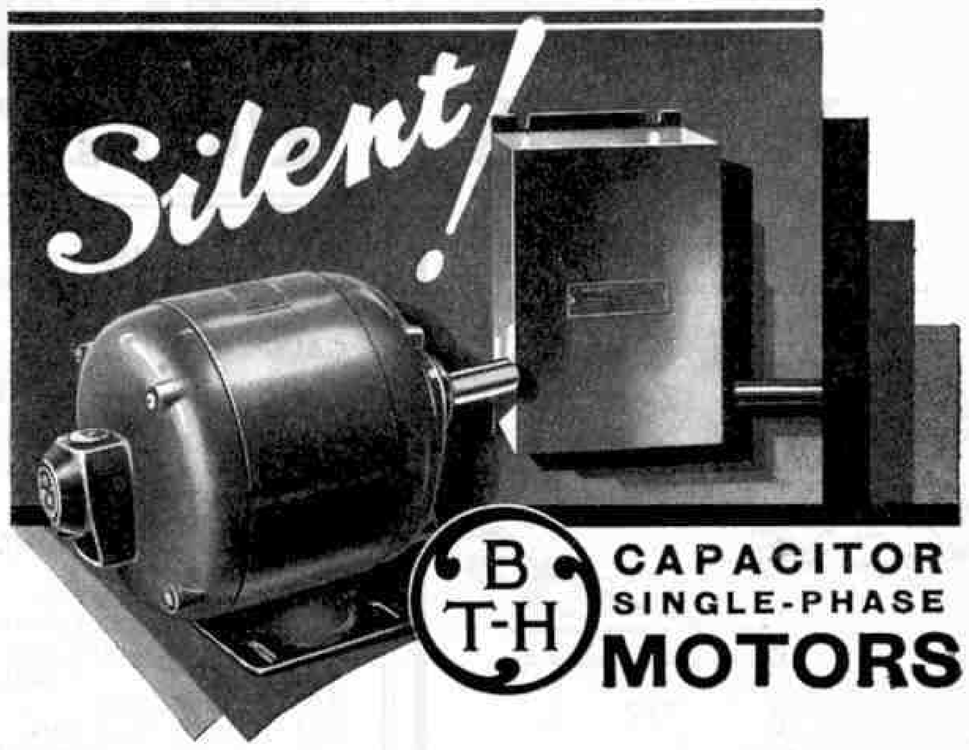

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The Story of Hoover Dam—(*Cont. from page 99*)

sides of the Canyon had to be scaled by men carrying "jackhamers," or light compressed-air drills, with which to smooth out projections at inconvenient points, or to remove loose material that threatened to fall; and roads had to be cut through solid rock to give ready access to the bottom of the Canyon. Freedom of movement along great stretches of the banks of the river was essential if work was to be carried on expeditiously, and roads were built along the Canyon by dumping spoil from this constructional work to form ledges nestling at the bases of the sheer walls between which the river runs. It is estimated that before these preparations were complete, and work on the project itself could begin, an expenditure of £500,000 had been incurred, and the cost of building Boulder City and providing the necessary schools, hospitals and means of recreation and amusement for its 4,000 inhabitants, is nearly another £500,000.

Then began the attack on the Colorado itself. The first task was to divert its waters through gigantic tunnels bored in the rocky walls of Black Canyon in order to uncover the site on which was to be built the great Dam itself. How this task was carried out will be explained next month.

The Hoover Dam is being built to the requirements of the United States Government, and its official name was changed to Boulder Dam soon after Mr. Roosevelt succeeded Mr. Hoover as President. The former name is retained in this article because the structure is already well known by it all over the world.—EDITOR.

Climbing Kanchenjunga—(*Cont. from page 103*)

reached camp eight, and from there they continued their slow ascent until they had established camp 10, where they waited for those whom they had left behind. When the expedition was reunited they resumed the attack, and five days of upward toiling enabled them to establish camp 11 at 25,250 ft., less than 1,000 ft. below the summit of the spur.

Two members, named Hartmann and Wien, plodded slowly on through knee-deep snow to the summit, where they made the disconcerting discovery that a treacherous and almost vertical wall of snow, about 600 ft. high, separated the spur from the main north ridge of the mountain. The wall was examined carefully, and it proved to be in such a state of avalanche that any attempt to climb it would have resulted in certain disaster. It is easy to imagine the feelings of the mountaineers, thus defeated and forced to turn back when within sight of their goal. The expedition descended to the plains by way of the Zemu Glacier, leaving the mighty Kanchenjunga still unconquered.

Gold—Noblest of Metals—(*Cont. from page 141*)

Because of its power of overcoming the noble metal, the mixture of the two acids is known as "*aqua regia*," which means "*royal water*."

Gold can be made to undergo a chemical change also by exposing it to the air in a dilute solution of the very poisonous compound potassium cyanide. It then forms a complex chemical that is soluble in water, and it can easily be separated again from the solution by adding zinc, which then takes its place in the compound formed by the action of potassium cyanide and air. This action is now used on a large scale for extracting gold from the "tailings" or residues left when gold has been extracted from quartz. The greater part of the metal in crushed gold quartz is extracted by washing it over plates of copper coated with mercury, with which it forms an amalgam that can be scraped off, and the mercury is then driven off by heating. The proportion of gold that cannot be retained in this manner passes away in the tailings. These are carried into enormous vats containing the potassium cyanide solution, and there the gold in them is dissolved, and afterwards precipitated, either by the addition of zinc, as already mentioned, or by electrolysis.

Gold to-day is valuable as a means of exchange, and the monetary systems of most countries are founded upon the value of this metal as a standard. It is too soft to be used alone in coining, and British gold coins contain about eight per cent. of copper, which gives a harder alloy with a reddish colour. Pure gold seen in masses is yellow, and this colour is retained in Australian sovereigns, in which the metal is alloyed with silver instead of copper.

The jeweller marks his wares to show the proportion of gold in the alloy from which they are made, and the unit he uses is the carat. The pure metal is described as 24-carat gold, and an 18-carat alloy is one with 18 parts of gold in 24 parts of the alloy.

Electricity in the Home—(*Cont. from page 139*)

prevent loss of heat while the oven is in use. The front and sides of the cooker are next assembled, and the skeleton now begins to take on the appearance of the finished product, for in quick succession the door is fitted, the switches are assembled and the grill door and grill plates are placed in position. The boiling plates are then fitted to the hob, and this is placed in position. The necessary electrical connections are then made to the switches and plugs.

This completes the assembly, but the cooker is not yet ready for despatch, since it undergoes a thorough trial to ensure that it is in complete working order. Finally it is carefully inspected, particular care being taken to see that the vitreous enamel is not chipped or cracked, and only then is it cleaned and packed.

Electricity from Magnetism—(*Cont. from p. 136*)

in one coil are connected through the Switch to the Bichromate Cell, and those of the other lead to the galvanoscope, constructed as explained on page 6 of the Elektron Manual No. 2. The galvanoscope is placed as far away as the lengths of the wires allow.

Although there is no connection between the windings of the two coils, the needle of the galvanoscope moves sharply to one side when the Switch is closed, showing that a current is flowing through the wires surrounding it. The needle returns to its central position, showing that the current acting on it is momentary, but swings in the opposite direction when the Switch is opened, thus indicating the flow of a reverse current.

The currents acting on the needle of the galvanoscope are generated in the second of the two Magnet Coils when the flow of current in the first is started or stopped. The reason for this is that in each case the number of lines of magnetic force passing through the second coil is suddenly altered. This can be demonstrated by replacing the first Coil with a Bar Magnet. The needle of the galvanoscope is unaffected so long as the Bar Magnet remains still, but deviates when it is pulled sharply away or quickly returned.

If the second Coil of the arrangement illustrated in Fig. 2 is replaced by one with a larger number of turns, the current generated in it is of higher voltage. This plan is followed in building a shocking coil, and the effect also is increased by winding the second coil over the first, instead of placing the two end to end, in order to enable the maximum number of lines of magnetic force to be intercepted.

A Novice's Night Out—(*Continued from page 133*)

speed falls off as the brakes are applied for the long curve. What a relief the little respites are! Fred works the engine a little heavier now, and I increase my efforts with a smile on my face, knowing that I can soon say *finished!* Up the incline to Whitmore. More water from the troughs, and that's the finish of firing; twelve more miles to go, but it's all downhill. I'm told to sit down and get my breath back. Now the fire doesn't require my attention I can look round. Between three and four tons of coal have been consumed, and certainly more than 6,000 gallons of water have been evaporated into the night air. I'm glad that Crewe's as far as we have to go. I can do with a bit of food; working, I forgot I was hungry, but now I've finished I feel empty inside. Still, what pride is mine to know I have done what was required of me, and as we run into Crewe right time I try and look as if I have been doing this sort of work all my life, although, perhaps, I don't feel quite like it!

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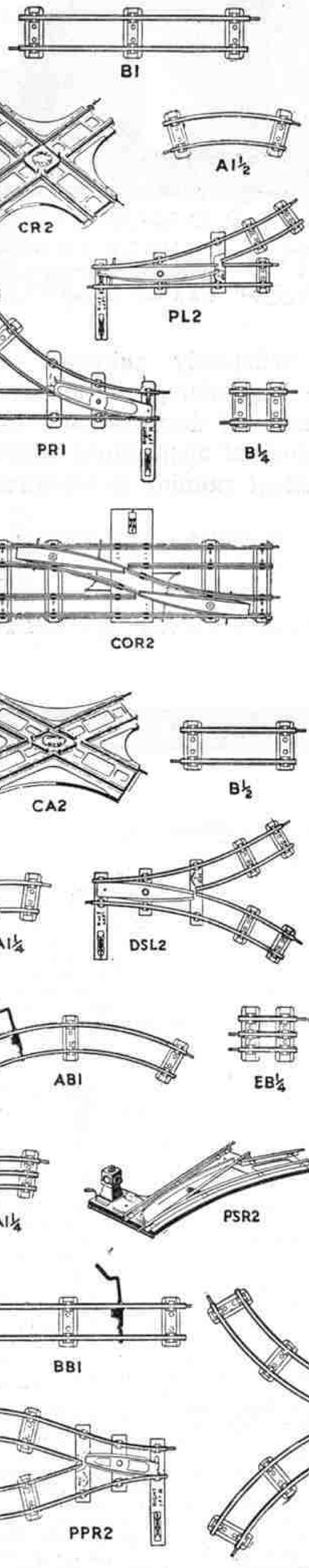

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MB9	Curved brake rails	each	3½d.
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A1	Curved rails	per doz.	4/6
A1½	Curved half rails	"	3/6
A1¼	Curved quarter rails	"	3/-
AB1	Curved brake rails	each	6d.
	2-ft. radius		
A2	Curved rails	per doz.	4/6
A2½	Curved half rails	"	3/6
A2¼	Curved quarter rails	"	3/-
AB2	Curved brake rails	each	6d.
DC2	Curved rails, double track ...	½ doz.	7/6

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BB1	Straight brake rails...	each	5d.
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POINTS

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MR9	Right-hand points	per pair	3/-
ML9	Left-hand points		
	1-ft. radius		
PR1	Right-hand points	per pair	4/-
PL1	Left-hand points		
	2-ft. radius		
PR2	Right-hand points	per pair	4/-
PL2	Left-hand points		
PSR2	Points on solid base, right-hand ...	per pair	8/6
PSL2	Points on solid base, left-hand ...		
RCP	Rail connecting plates	½ doz.	2d.

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EA1	Curved rails	per doz.	6/6
EA1½	Curved half rails	"	4/6
EA1¼	Curved quarter rails	"	4/-
	2-ft. radius		
EA2	Curved rails	per doz.	6/6
EA2½	Curved half rails	"	4/6
EA2¼	Curved quarter rails	"	4/-
EDC2	Curved rails, double track ...	½ doz.	9/-

STRAIGHT RAILS

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

CROSSINGS

ECA	Acute-angle crossings	each	4/-
ECR	Right-angle crossings	"	4/-

POINTS

	For 2-ft. radius curves		
EPR2	Right-hand points	per pair	7/6
EPL2	Left-hand points		

DOUBLE SYMMETRICAL POINTS

	For 2-ft. radius curves		
EDSR2	Double symmetrical points, right-hand	per pair	8/6
EDSL2	Double symmetrical points, left-hand		

PARALLEL POINTS

	For 2-ft. radius curves		
EPPR2	Parallel points, right-hand	per pair	8/6
EPPL2	Parallel points, left-hand		

CROSSOVER POINTS

ECOR2	Crossover points, right-hand	per pair	24/-
ECOL2	Crossover points, left-hand		
TCP6	Terminal connecting plates (6 volt)	each	1/6
TCP20	" " " (20 volt)	"	1/6

Electrical Points for 1-ft. radius curves are not supplied

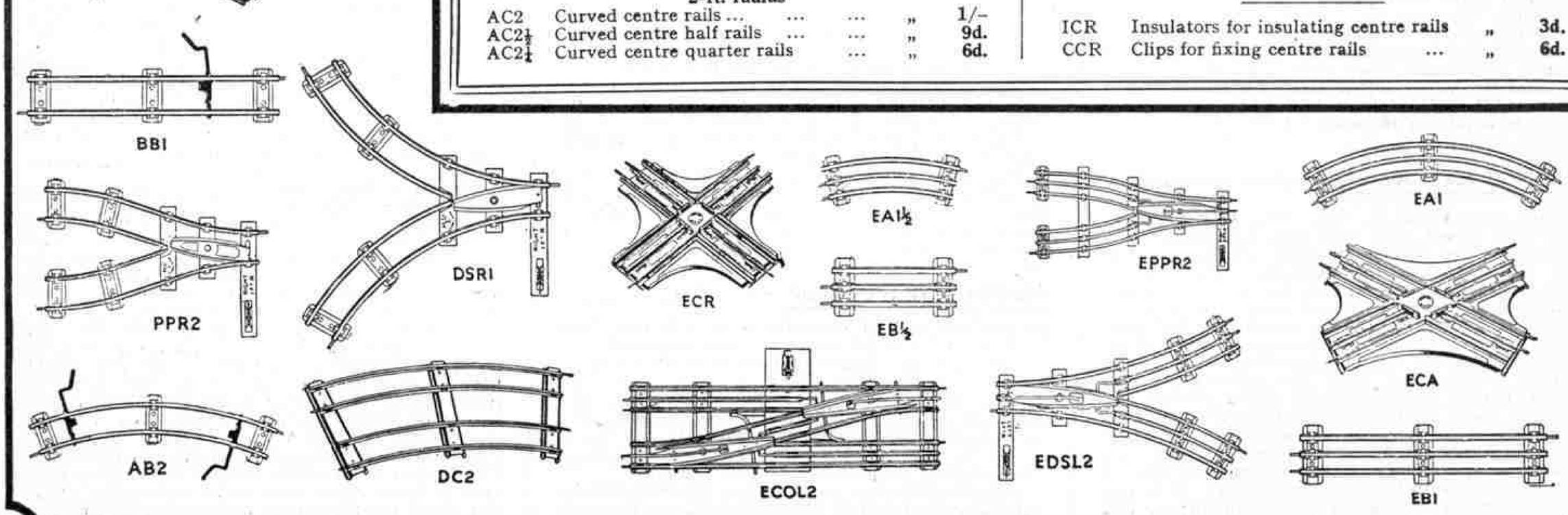
Centre Rails for Converting Ordinary Track to Electrical

CURVED CENTRE RAILS

	1-ft. radius		
AC1	Curved centre rails	per doz.	1/-
AC1½	Curved centre half rails	"	9d.
AC1¼	Curved centre quarter rails ...	"	6d.
	2-ft. radius		
AC2	Curved centre rails	"	1/-
AC2½	Curved centre half rails	"	9d.
AC2¼	Curved centre quarter rails ...	"	6d.

STRAIGHT CENTRE RAILS

BC1	Straight centre rails	per doz.	1/-
BC½	Straight centre half rails	"	9d.
BC¼	Straight centre quarter rails ...	"	6d.
ICR	Insulators for insulating centre rails	"	3d.
CCR	Clips for fixing centre rails ...	"	6d.



Manufactured by - - MECCANO LIMITED - - BINNS ROAD - - LIVERPOOL 13

Hamleys News

Estd. 1760.

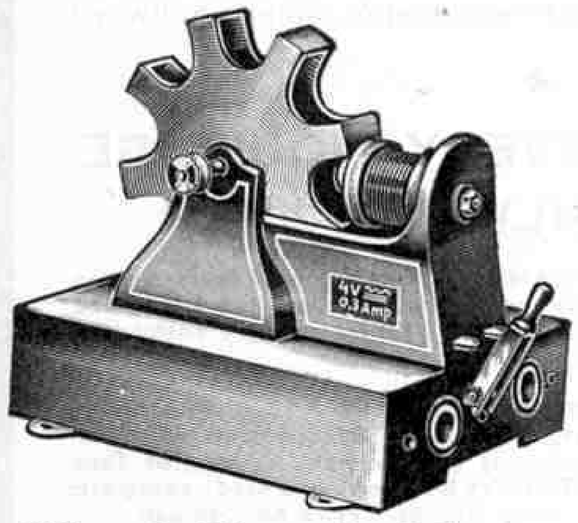
200 REGENT STREET W.1 — 200-202, REGENT ST., LONDON, W.1

Number Ten — YOU'LL ENJOY YOUR VISIT TO HAMLEYS — February, 1934

YOU MUST SEE HAMLEYS MODEL RAILWAY

The Finest of its Kind in the Country

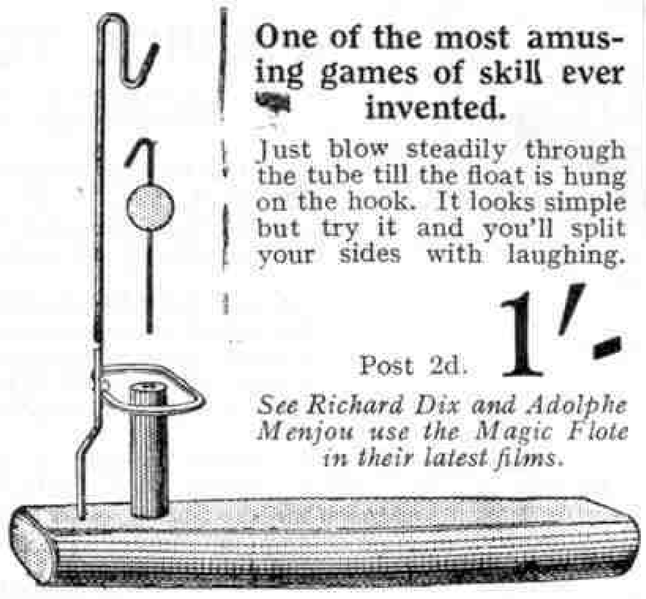
Working scale models of all the principal railways operating continually over 270 feet of track. Three new models can now be seen :—The **"Princess Royal," L.M.S., "Lord Nelson," S.R.** and **"Hush Hush," 10000, L.N.E.R.**



Novel Electric Motor

Surprisingly powerful. Runs for ten hours on ordinary flash lamp battery. Fitted with control switch. Size of base 3¾ in. × 2¾ in. Really wonderful value. Price **1/-**
Battery, 5d. extra. Postage 3d.

THE MAGIC FLOTE



One of the most amusing games of skill ever invented.

Just blow steadily through the tube till the float is hung on the hook. It looks simple but try it and you'll split your sides with laughing.

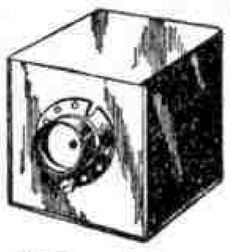
Post 2d. **1/-**

See Richard Dix and Adolphe Menjou use the Magic Flote in their latest films.

Make your own MAGIC LANTERN.

You will never tire of this game!

Make your own TELESCOPE

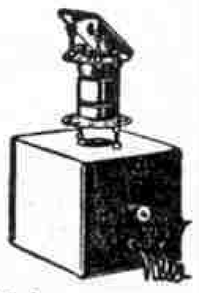


Make your own CAMERA.

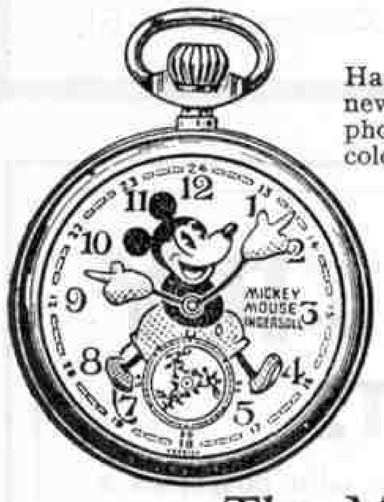
CONSTRUMENTS

Contains a whole boxfull of interchangeable parts, lenses, mirrors, ring mounts, bulbs and nuts. tubes and rods—all made and matched on scientific lines—from which dozens of thrilling and fascinating instruments can be built.

No. 100 set	37/6
No. 20 set	18/6
No. 10 set	10/-



Make your own MICRO-PROJECTOR.



Have you had your copy of Hamleys new catalogue? 96 pages in photogravure and 16 pages in natural colours. It will be sent you free and post free on request.

The Mickey Mouse Pocket Watch

He tells the time by his hands. Will give reliable time-keeping service and is covered by the Ingersoll guarantee.

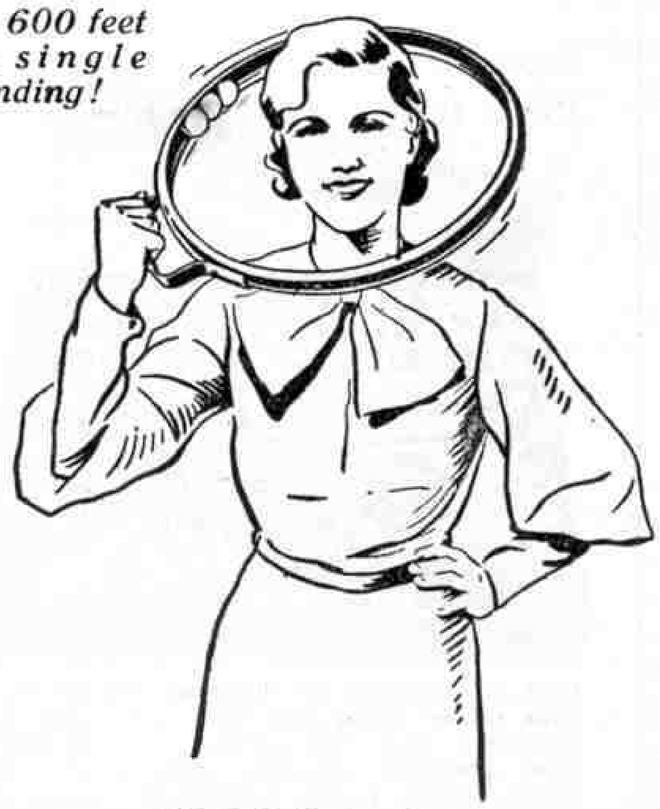
Price **6/11**

Flies 600 feet at a single winding!

F.R.O.G. D.H. 80a PUSS MOTH MODEL AEROPLANE

A wonderful flying model of the famous light aeroplane. All meta fuselage with reinforced bulk-heads. Patent wing construction. Dual motor and gear box. Complete with mechanical winder, **two spare motors,** lubricant, gear-box oil and full instructions. Wing span 18 in. Length of flight 600 feet. Ceiling 100 feet.

Price complete **17/6**
Postage 9d.



'BOLO,' the most fascinating of all crazes

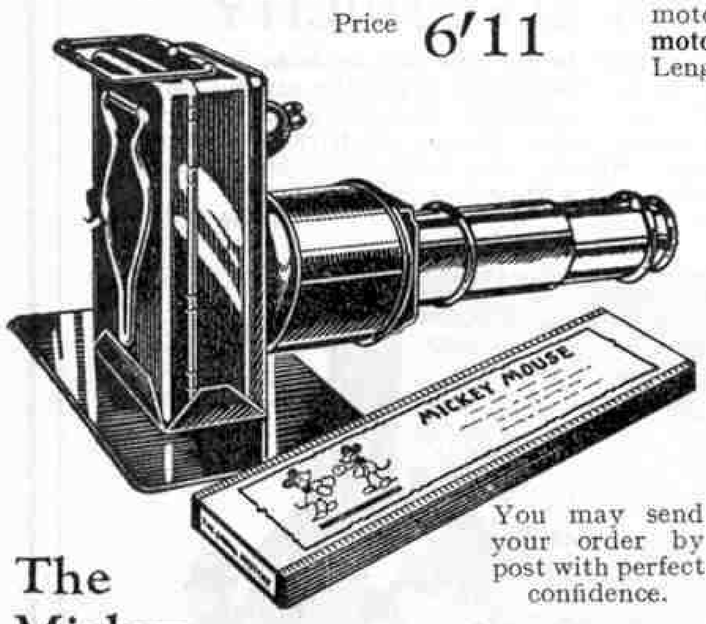
There are any number of tricks with the Bolo which you will soon think out for yourself.

Model No. 1 12 in. diameter, complete with 3 balls. Price **2/-**

Model No. 2 16 in. diameter, with 5 balls. Price **3/-**

Model No. 1c as No. 1 but with Chromium Plated Bolo. Price **4/-**

Model No. 2c as No. 2 but with Chromium Plated Bolo. Price **5/6**

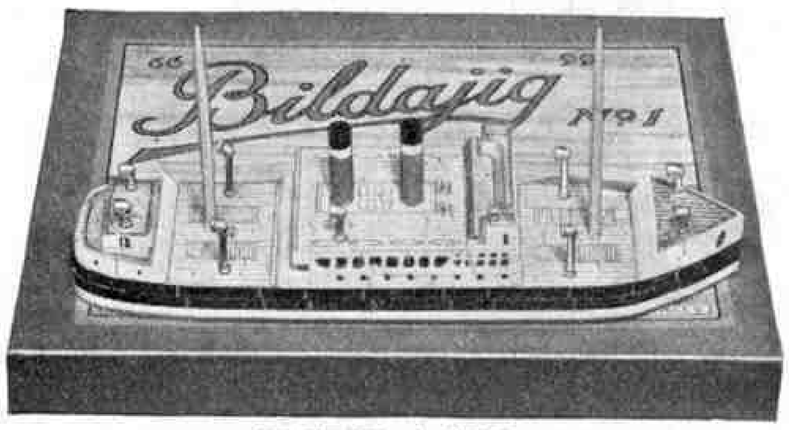


You may send your order by post with perfect confidence.

The Mickey Mouse Magic Lantern

Works from an ordinary torch battery. Detachable base. Complete with box of Mickey Mouse coloured slides.

Price **5/6**
Postage 6d.



BILDAJIG

Something new and unique in constructional jigsaw puzzles. A waterline model of a cargo liner is constructed. The ship is built deck by deck until the complete five are fully assembled. Attractively coloured. 144 pieces.

Price **12/6**
Postage 6d.

RUNNING A MODEL RAILWAY *is a* MAN'S *Hobby*

Children play with toys, but boys and men covet the **real** thing. A **scale model** is the nearest approach and that is why you should have BASSETT-LOWKE products. With them you are not only getting 30 years' tried skill and experience behind the goods, and can choose your locomotive and accessories from a firm who **pioneered** model railway working, but you can have the advice and help of that firm's consulting expert **free.**

A Model Railway has a fascination unequalled in the world. It will give you hours of real pleasure, and at the same time will develop your skill with hand and mind. It will make you form the habit of thrashing out problems yourself. Be practical and resourceful—build a railway !

Two happy people watching their scale model "Royal Scot" fly round the track. Be like them—start building a railway now !

A GUIDE TO EVERY WOULD-BE MODEL RAILWAY OWNER

The MODEL RAILWAY HANDBOOK—a splendid book written by Mr. W. J. Bassett-Lowke and Mr. Cecil J. Allen—describing ALL types of Model Railways, with scores of useful hints to the enthusiast. It only costs 2s. 3d. post free.

The new BASSETT-LOWKE Model Railway List A.18 is now ready. This useful and attractive book, costing only 6d., contains details of all their latest productions, including the splendid six-coupled Tank Locomotive, fitted with BASSETT-LOWKE'S new patented automatic couplings, which eliminate all trouble on sharp curves. Price 6d. per pair.

Two Fine Free Folders—"Realism in Miniature" and "British Playthings" will be sent on application. Model Ship Enthusiasts will also want the new edition Ships Catalogue S.18, to prepare for the Spring, price 6d. post free.

BASSETT-LOWKE LTD., Northampton

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Box 3
Price 10/6

LOTT'S CHEMISTRY
AND ELECTRICITY SETS

There are hours of really interesting experimenting ahead of the Boy who possesses a box of Lott's Chemistry or Electricity. Each set contains apparatus, etc., and an illustrated booklet of the experiments which can be carried out. Spare supplies of the Chemicals and Apparatus can be obtained.

Obtainable from all leading Toy Dealers and Stores

BOX. 3 Contains 30 chemicals, bunsen burner with rubber connecting tube, large and small test-tubes, flask with rubber cork and delivery tube, porcelain crucible, glass funnel, filter papers, litmus paper, magnesium ribbon, glass tubing, test-tube cleaning brush and Book of 131 experiments. **Price 10/6**

BOX 5. An especially fine set, Box 5 contains 43 chemicals and apparatus for a remarkable range of 228 experiments. The additional apparatus over and above the contents of the earlier boxes includes retort stand and ring (of great use in arranging the apparatus in a firm and convenient form), wire gauze, beaker and crucible tongs. Extra bottles of some of the chemicals most frequently used are also included. **Price 21/-**

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LOTT'S ELECTRICITY

BOX 2. As illustrated below this set contains apparatus and instructions for 84 experiments, including experiments in magnetism and static electricity, measuring of currents, resistance experiments, relay, buzzer, electrically controlled railway and traffic signals, etc., etc. Also contains two complete Leclanche cells with necessary chemicals.
(Other Electricity Sets at 6/- and 21/-.) **Price 12/6**

Box 2
Price 12/6

These prices apply only to Great Britain and Northern Ireland. Obtainable in South Africa at Stuttaford & Co. Ltd., Capetown ; Canada : at T. Eaton Co., Toronto ; H. Morgan & Co. Ltd., Montreal.

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FOR ACCURACY

● The finest series of constructive model aeroplanes on the market; not only are the machines themselves more accurate than anything of this type previously produced, but the range of accessories is surprisingly complete.

● The Anti-Aircraft Gun and crew in action defending a wartime aerodrome, in the background is a wartime hangar. This latest accessory costs 1/9 for the gun and crew of five. The angle of this gun can be varied by means of the adjusting wheels at the side. The wartime canvas hangar costs **2/6**

● NEW MODELS now ready:

No. 16. Armstrong Whitworth A.W. XV "ATALANTA." This model has a span of 15 inches, the largest in our series. The four cast model Armstrong Siddeley "Serval" engines are a unique feature. Price **10/6**

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No. 18. Percival "Gull." The very fast light aeroplane which has obtained such rapid popularity. This model has the unique novelty of folding wings. Price **2/6**

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■ **SKYBIRD** AIRPORT ..... Price **21/-**
An aerodrome when open—a box for your models when closed.

● **SKYBIRDS** descriptive details with 21 illustrations, post free, **7**d.

● NOW READY—"**THE SKYBIRD**," Vol.1, No.1 The official organ of the **SKYBIRD** LEAGUE post free, **5**d.

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8/- DOWN
brings immediate delivery of a Riley "Home" Billiard Table. You pay balance as you play.

7 DAYS
Free Trial. Rileys pay carriage and take transit risks.

Hours of endless enjoyment may be spent on a Riley Billiard Table—enjoyment in which all the family can participate. Father, mother, boys and girls will be equally keen on this popular pastime. But it should be played on a REAL Billiard Table and not a toy. Play it on a Riley, every model of which is a perfect replica in construction of a full size Billiard Table. Sizes and prices of Riley "Home" Billiard Tables are shown below, also the easy monthly payments.

4 ft. 4 ins. × 2 ft. 4 ins. ...	£7 0 0	or in	8/-
5 ft. 4 ins. × 2 ft. 10 ins. ...	£9 0 0	20	10/3
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DINE AND PLAY ON THE SAME TABLE

The Riley "Combine" Billiard and Dining Table offers something unique in house furnishing, combining in one a beautiful dining table and a flawless billiard table. After dining, it is ready in a couple of minutes for a delightful game of billiards.

Available in many attractive designs, oak or mahogany, for cash or on easy terms. Here are the sizes and prices for the round leg mahogany pattern.

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8 ft. 4 ins. × 4 ft. 4 ins. ...	£43 0 0

or in 13 or 20 monthly payments.

Rileys are the largest makers of Full Size Billiard Tables in Great Britain. Also specialists in accessories, re-covering tables, etc.

This is the Riley "Cabriole" design 6 ft. size, £34 10 0, or in 13 or 20 monthly payments.

E. J. RILEY LTD.
Deal Works, Accrington
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CP4

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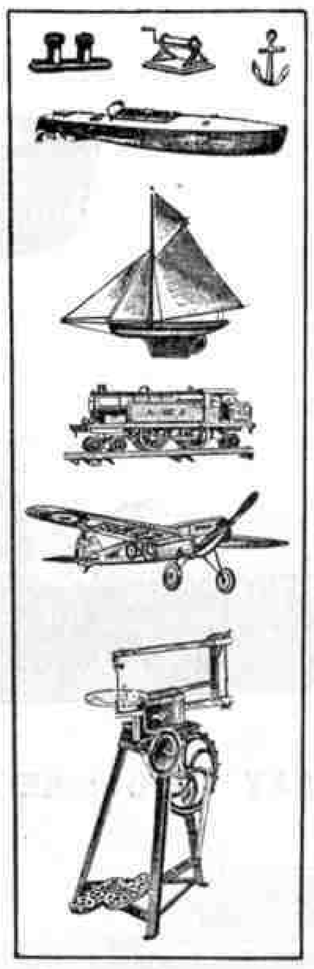

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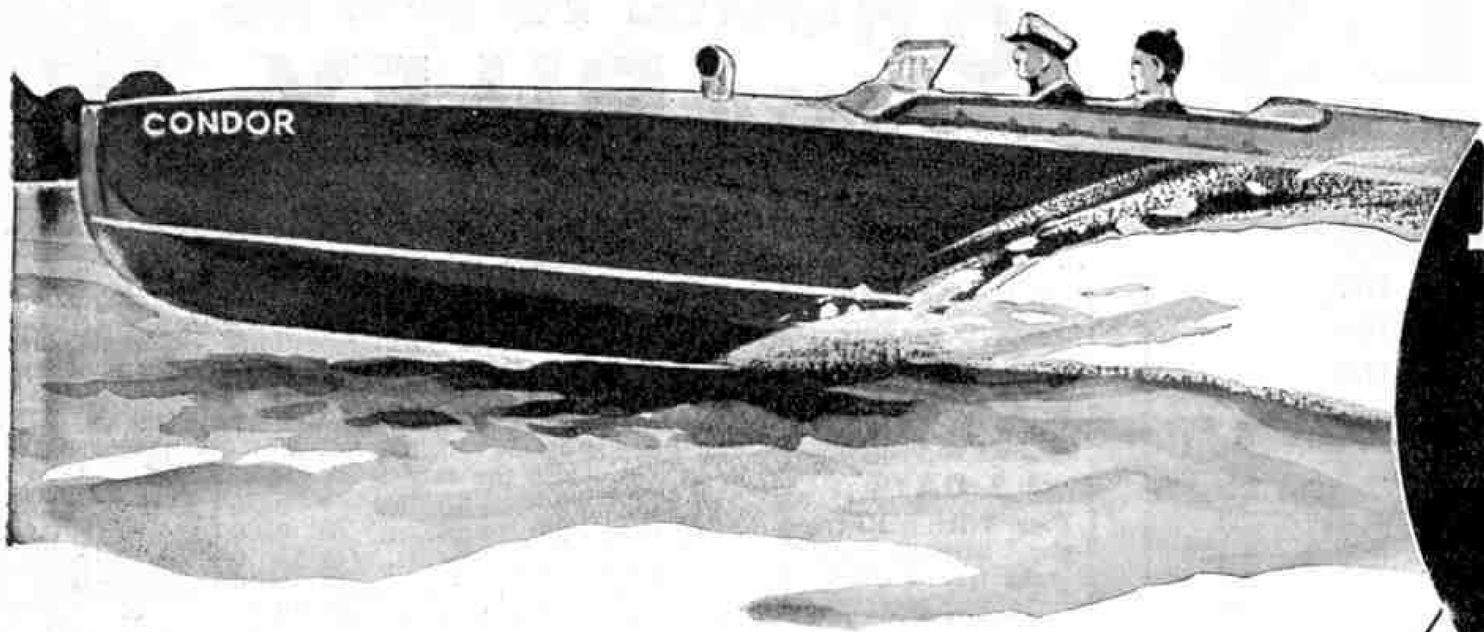
HOBBIES DEPOT
17, HOUGHTON STREET, LIVERPOOL
(Between Clayton Square and Playhouse)



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These are Hornby Speed Boat Days!

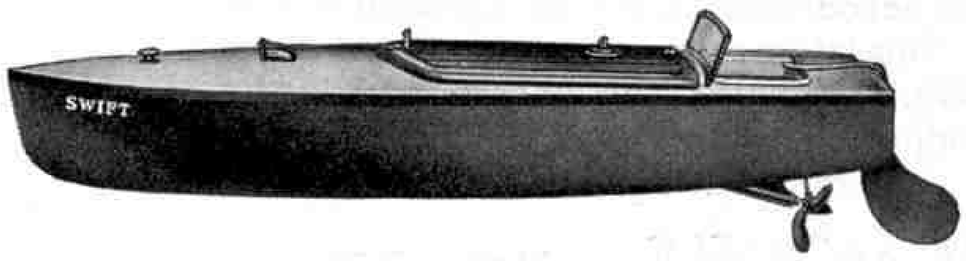
Hornby Speed Boats are the best that you can buy. The beauty of their appearance and the efficiency of their performance are the talk of thousands of Speed Boat enthusiasts everywhere. Here are some of the special features of these wonderful boats—streamlined hull and fine entry lines of bow giving great speed; exceptional length of run, due to the general excellence of the mechanism by which the boats are propelled; special design of propeller; each boat attractively finished with a special patent water-resisting enamel in a range of choice colour combinations.

HORNBY SPEED BOAT No. 1. "MARTIN." PRICE 4/6

Five different models to choose from

There are five splendid models, ranging in price from 4/6 upwards, each attractively finished and available in three different colour combinations. Ask your dealer to show you the full range of Hornby Speed Boats.

PRODUCT of MECCANO LIMITED LIVERPOOL



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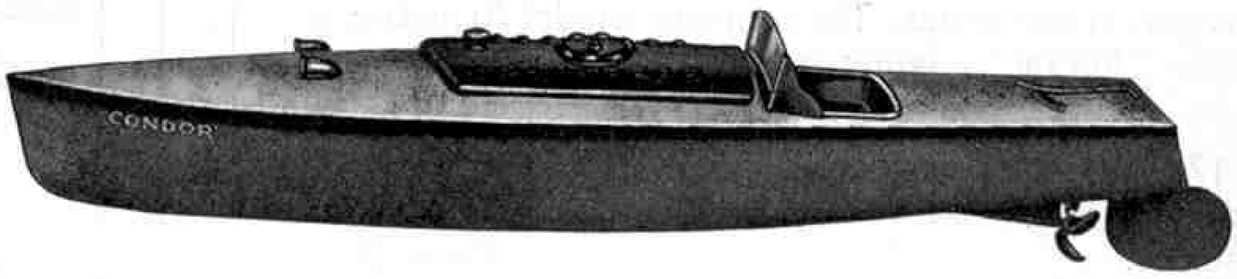

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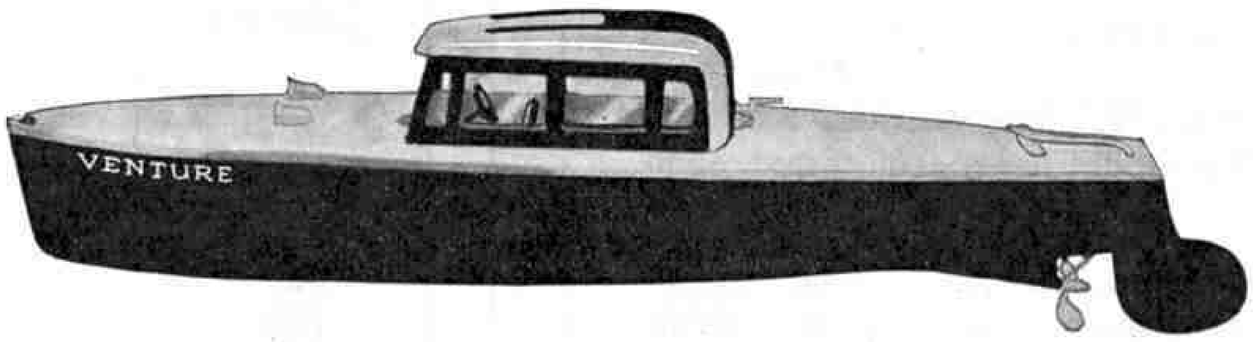

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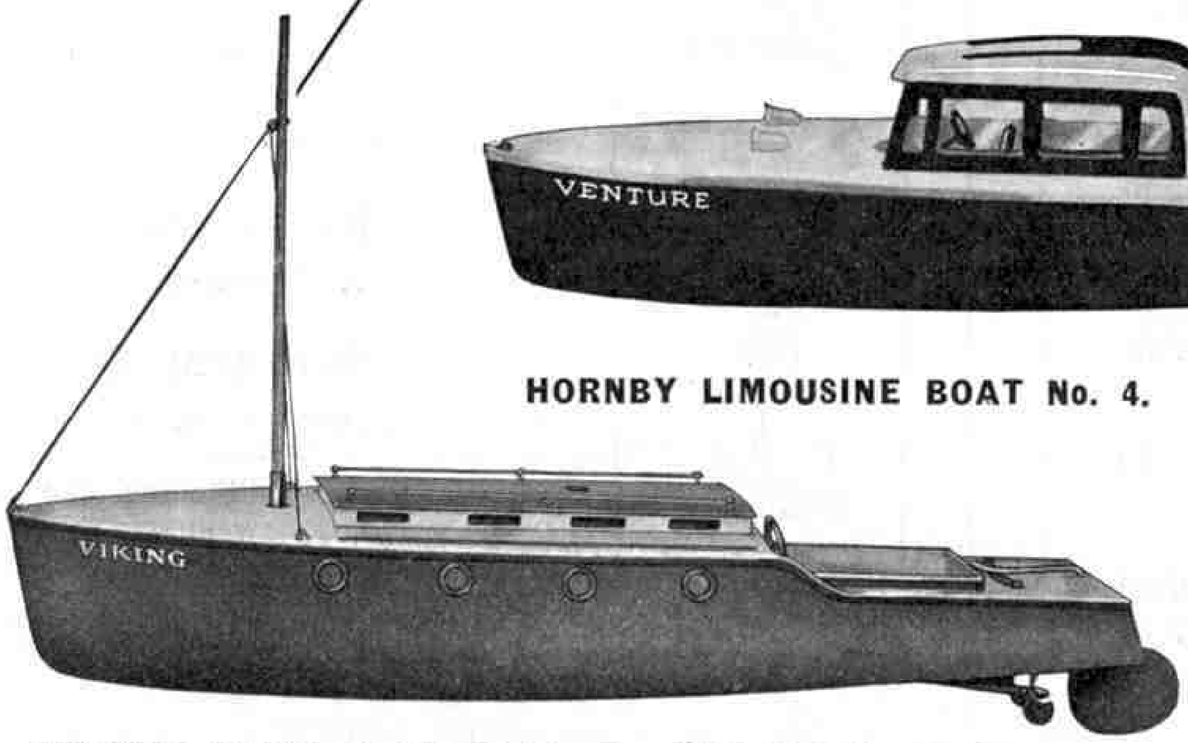
HORNBY SPEED BOAT CLUB

This is the Hornby Speed Boat Club Badge, which may be purchased from your dealer, price 6d., or direct from us, price 6d., post free.



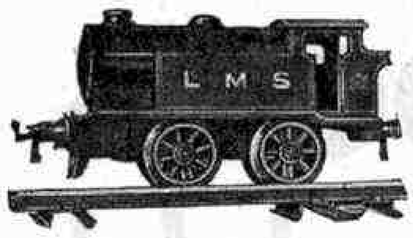
HORNBY CABIN CRUISER No. 5. "VIKING." PRICE 16/6

PENNANTS

Pennants for Hornby Speed Boats Nos. 3 and 4 may be purchased separately from any Meccano dealer. Price 2d. each.

MECCANO LIMITED, BINNS ROAD, LIVERPOOL 13

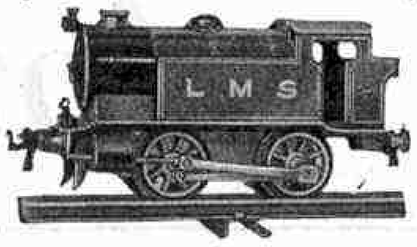
HORNBY TANK LOCOMOTIVES



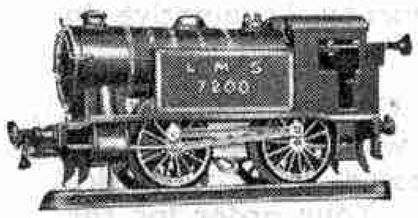
M3 Tank Locomotive

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

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



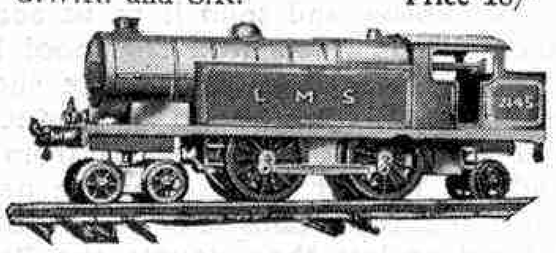
No. 1 Tank Locomotive



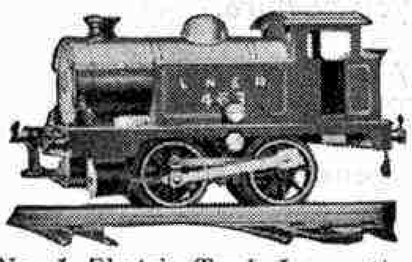
No. 1 Special Tank Locomotive

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

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



No. 2 Special Tank Locomotive



No. 1 Electric Tank Locomotive

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

Price 32/6

This Locomotive cannot be run from the mains supply.

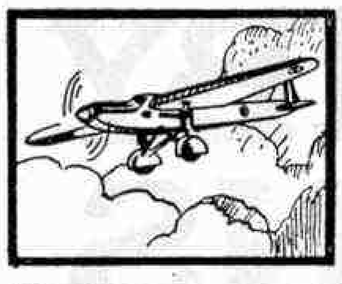
MECCANO LTD. - BINNS ROAD - LIVERPOOL 13

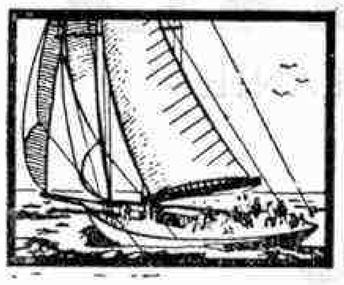
HERE'S YOUR CHANCE BOYS!! A real CORONET camera which will make marvellous pictures (standard film $3\frac{1}{2} \times 2\frac{1}{2}$). Two brilliant view-finders. Fast Meniscus lens. Leather carrying handle. There are no disappointments with this amazing camera. GET YOURS NOW!!

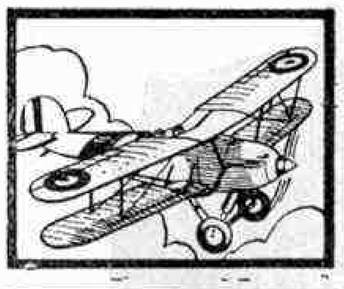
Other models 7/6 to 65/-

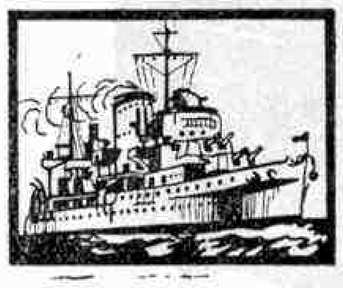
5/6

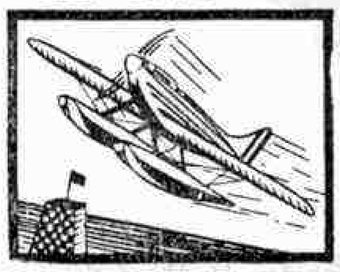
CORONET CAMERA CO., 315, Summer Lane, Birmingham 19











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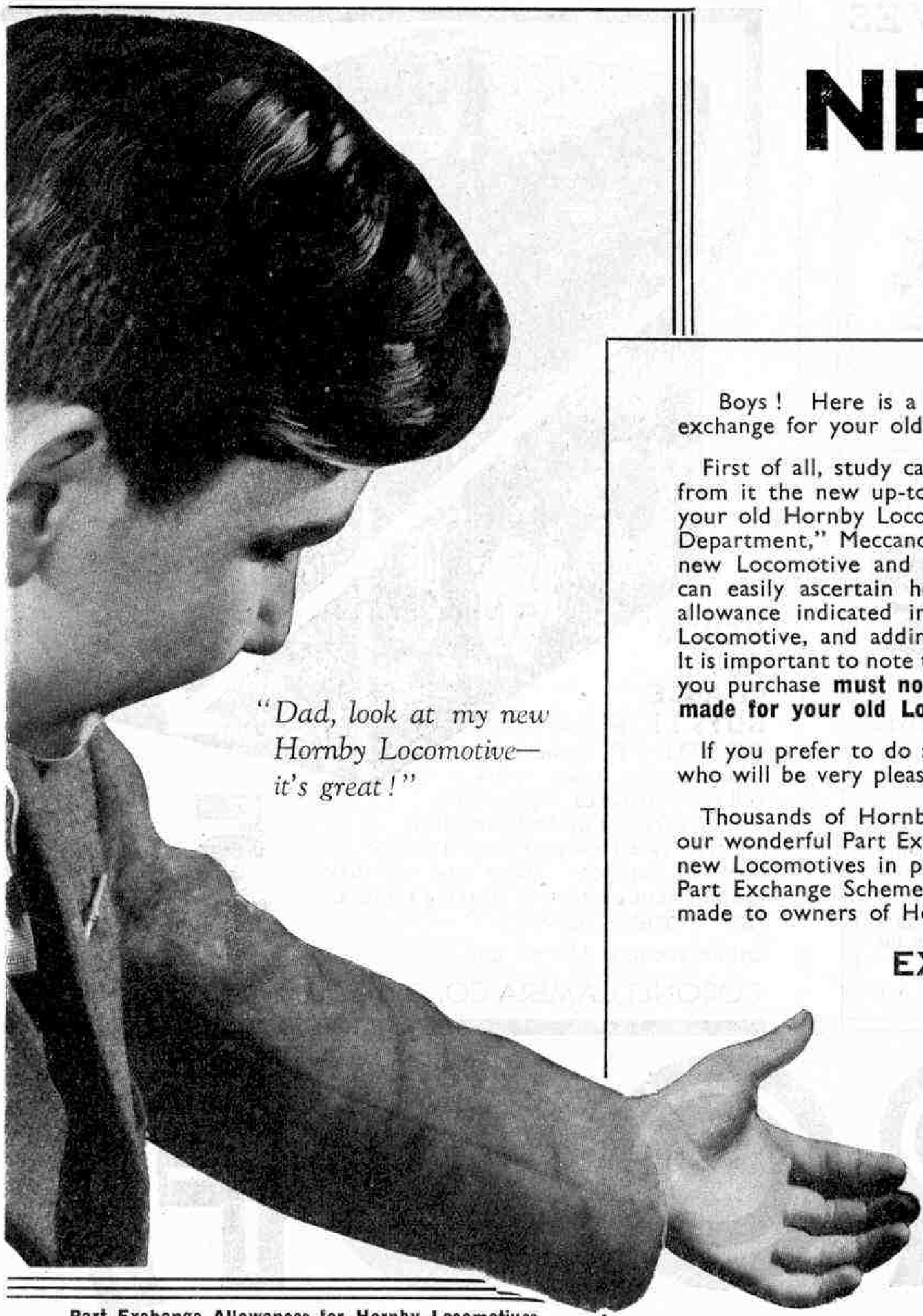

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No. O Locomotive	5/3
No. 1 Tank Locomotive	6/3
No. 1 Locomotive	6/3
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No. 1 Special Locomotive	8/3
No. 1 Special Tank Locomotive	8/3
LST M3/20 Tank Locomotive (20-volt) ...	11/3
No. 2 Special Locomotive	11/3
No. 2 Special Tank Locomotive	11/3
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LE 1/20 Locomotive (Swiss Type), 20-volt...	13/3
LE 2/20 Locomotive (20-volt)	16/6
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No. 3E Locomotive	18/9
No. 3E Riviera "Blue" Locomotive ...	18/9
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No. 2 Tank Locomotive, fitted for Hornby Control	12/6
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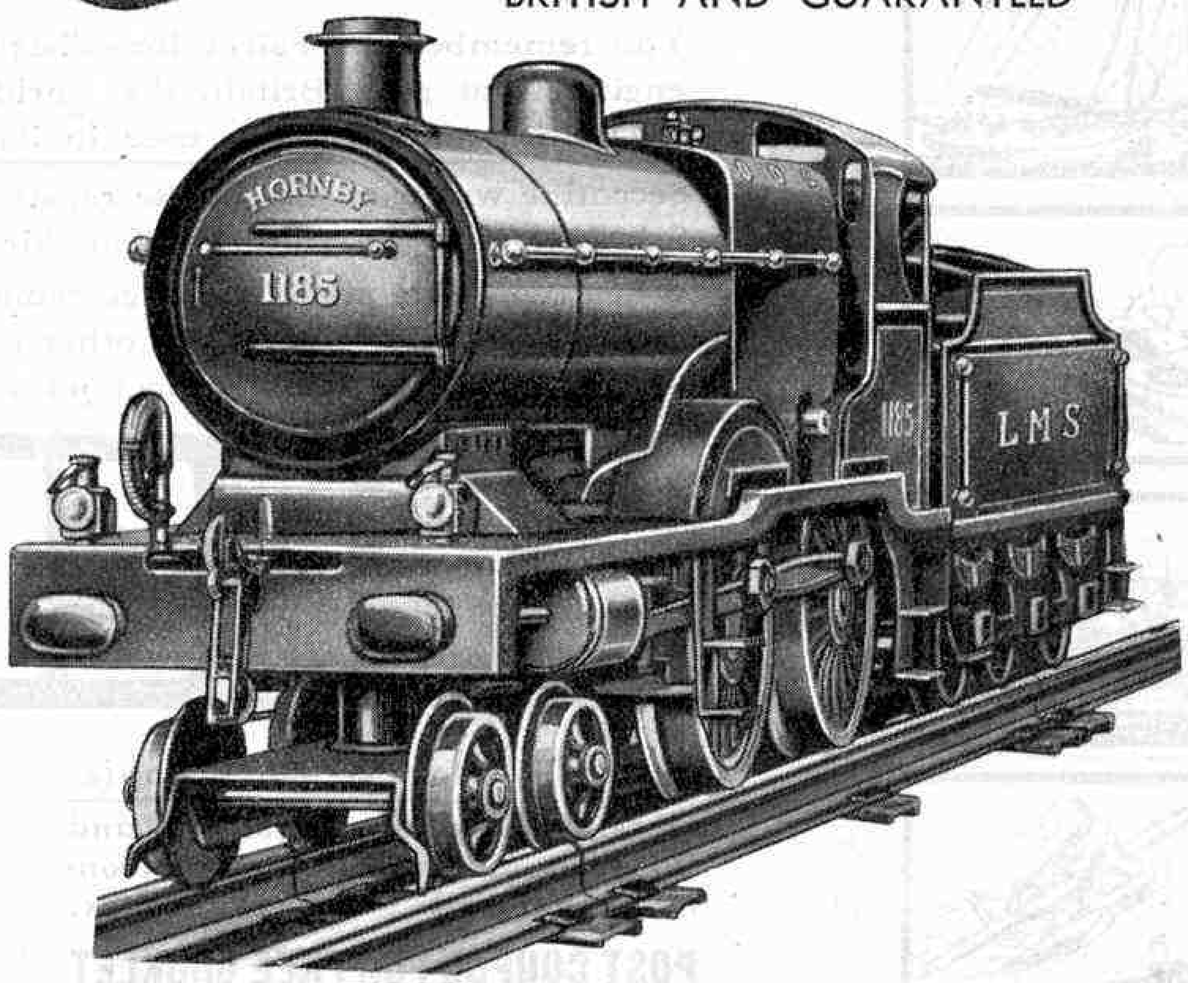

MECCANO LIMITED - BINNS ROAD - LIVERPOOL 13

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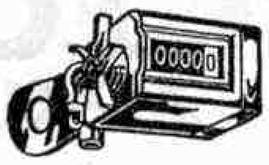

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THE RAILWAY MAGAZINE

PRINCIPAL CONTENTS
FEBRUARY ISSUE

Railway Developments in New Zealand.
The L.N.E.R. "Claud Hamiltons."
The Hedjaz Railway.
How Nature Harasses the Railway.
Present-Day American Locomotive Performance.
Stroudley Survivals.
Rebuilt Highland Passenger Locomotives, L.M.S.R.
Some Great Central Reflections.
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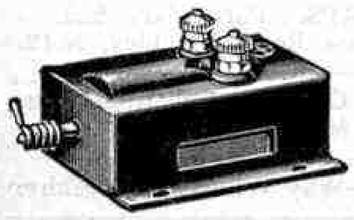

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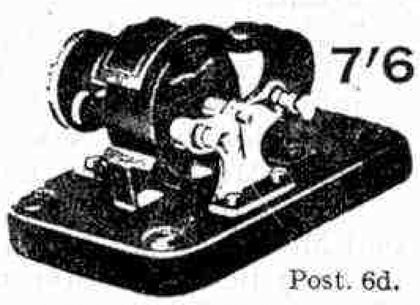

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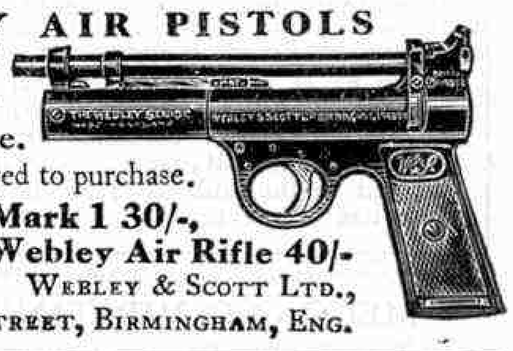

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For Sale. Pye "Q" Portable Receiving Set, with turntable, two 2-volt accumulators and new H.T. battery. All as new and little used. Cost 14 guineas. Accept 8 guineas.—Box 202.

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Sale. Duplicate Stamps, 400 1/10. Excellent bargains.—Waterton, 27, Cambridge Street, Saltburn, Yorkshire.

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Butterfly Collecting Apparatus, Taxidermy Tools, "Meccano Magazines," Gauge OO Railway. Lists.—Abbey, 19, Thornton Avenue, Streatham, London.

Webley Senior Air-pistol, 2 barrels .177 .22 rifled. Bought five weeks ago. Cost £3. Take £2 or near offer.—A. Slaymaker, New Street, Westerham, Kent.

Meccano Guild member wishes to correspond with readers in the British Isles and Overseas.—Box No. 201.

Sale. "Meccano Mags.," 1926, 7, 8, 9 and 10 of 1930. What offers?—Ingham, 69, West View, Sowerby Bridge.

Wanted. "Meccano Magazines," February 1929, January and November 1932.—Stern, Combecote, Dartmouth, Devon.

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Second-hand Photographic Apparatus for sale. Stamp for list.—"Crowland Lodge," Easton Road, Bridlington.

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For Sale. Gibbons Stamp Catalogue, 1932, 5/-. Kelly's Handbook, Landed Gentry Officials, 1933, 7/6. —Queckett, Arva House, Cavehill Road, Belfast.

30/- Bowman Steam Engine. Seldom used. Accept 24/- or nearest.—Griffin, Foyers, West Way, Rickmansworth.

Sale. "Meccano Mags.," 1927-1930 complete. Perfect condition. Offers.—H. Platt, 60, Brighton Road, Aldershot.

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Will Mr. D. Eaton, who advertised for copies of Gibbons' Catalogue in the September 1933 "*M.M.*," please communicate with our Advertisement Manager. Correspondence directed to the address given in the advertisement has been returned.

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It's a Girl!

Although I am a mother, and may, on occasion, enjoy all the deference and respect to my opinion that is rightly mine when buying a present "to be sent to my son at school," yet I am also an aunt, and have tasted the ignominy of shopping as one. I was therefore to some extent prepared for misunderstanding when I entered the toy department to buy a Meccano outfit for my little niece.

"How old is the boy?" enquired the assistant.

"She is six, and a girl," I replied, firmly.

"I think, for a boy of six, you would require a No. 1 Outfit." He ignored my explanation as to sex. Clearly he could not sell Meccano for a girl.

"Oh! but this is the first time she has had Meccano, and I think the simplest—"

"But he can't make many models from 'No. O,'" he interrupted sadly.

I was overcome by the feeling that I was trying to make a foreigner understand English. Slowly and distinctly I said: "This—little—girl—is—only—six."

"Well, I think madam would be well advised to give him No. 1," he replied with dignity. There was a tinge of pity in his voice now. "Where shall I send it?"

I was defeated.

"Miss Pat Henderson." I rallied a little.

"Pat Henderson," he repeated, ignoring my prefix. He was triumphant. "Certainly, madam."

"And perhaps you can send a message with it. Say 'From Aunt Molly.'"

"From Aunt Sally." He beamed. Here was the explanation. "From Aunt Sally," he repeated.

"Molly," I croaked feebly, but in my heart I know that to-morrow my niece will receive a present addressed to "Master Pat Henderson," and the message enclosed will read "From Aunt Sally."

Luckily, she is only six. M. R.

MECCANO MAGAZINE

Registered at G.P.O., London, for transmission by Canadian Magazine Post.

EDITORIAL AND ADVERTISING OFFICE:—

LIVERPOOL 13, ENGLAND.

Telegrams: "Meccano, Liverpool."

Publication Date. The "*M.M.*" is published on the 1st of each month and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price 6d. per copy. It will be mailed direct from this office, 4/- for six issues and 8/- for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

Readers' Sales and Wants. Private advertisements (i.e., not trade) are charged 1d. per word, minimum 1/-. Cash with order. Editorial and Advertising matters should not be dealt with on the same sheet of paper.

Advertisers are asked to note that private advertisements of goods manufactured by Meccano Limited cannot be accepted.

Small Advertisements. 1/6 per line (average seven words to the line), or 16/- per inch (average 12 lines to the inch). Cash with order.

Display. Quotations for space bookings, and latest net sale figures, will be sent on request.

Press Day, etc. Copy should be sent as early in the month as possible for insertion in following issue. We usually close for press on or before 1st of each month for following issue. Half-tone blocks up to 100 screen.

Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher copies. Sent free to advertisers booking one inch or over. Other advertisers desiring vouchers should add 8d. to their remittance and should order voucher copy at same time.

Remittances. Postal Orders and Cheques should be made payable to Meccano Ltd.

Ordering the "M.M." Overseas

Readers Overseas and in foreign countries may order the "*Meccano Magazine*" from regular Meccano dealers or direct from this office. The price and subscription rates are as above, except in the cases of Australia, where the price is 1/2 per copy (postage extra), and the subscription rates 8/- for six months and 16/- for 12 months (post free); Canada, where the price is 10c. per copy, and the subscription rates 65c. for six months, and $1.25 for 12 months (post paid).

The U.S.A. price is 15c. per copy, and the subscription rates $1 and $2 for 6 and 12 months respectively (post free).

Overseas readers are reminded that the prices shown throughout the "*M.M.*" are those relating to the United Kingdom and Northern Ireland. Current Overseas Price Lists of Meccano Products will be mailed free on request to any of the undermentioned agencies. Prices of other goods advertised may be obtained direct from the firms concerned.

CANADA: Meccano Ltd., 34, St. Patrick St., Toronto.
UNITED STATES: Meccano Co. of America Inc., New Haven, Conn. Meccano Co. of America Inc., 200, Fifth Av., New York.
AUSTRALIA: Messrs. E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W.
NEW ZEALAND: Models Limited, Third Floor, Paykel's Buildings, 9, Anzac Avenue (P.O. Box 129), Auckland.
SOUTH AFRICA: Mr. A. E. Harris (P.O. Box 1199), 142, Market Street, Johannesburg.
INDIA: Karachi: Daryanamal and Bros., Elphinstone Street, Bombay; Bombay Sports Depot, Dhobi Talao. Calcutta: Bombay Sports Depot, 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.

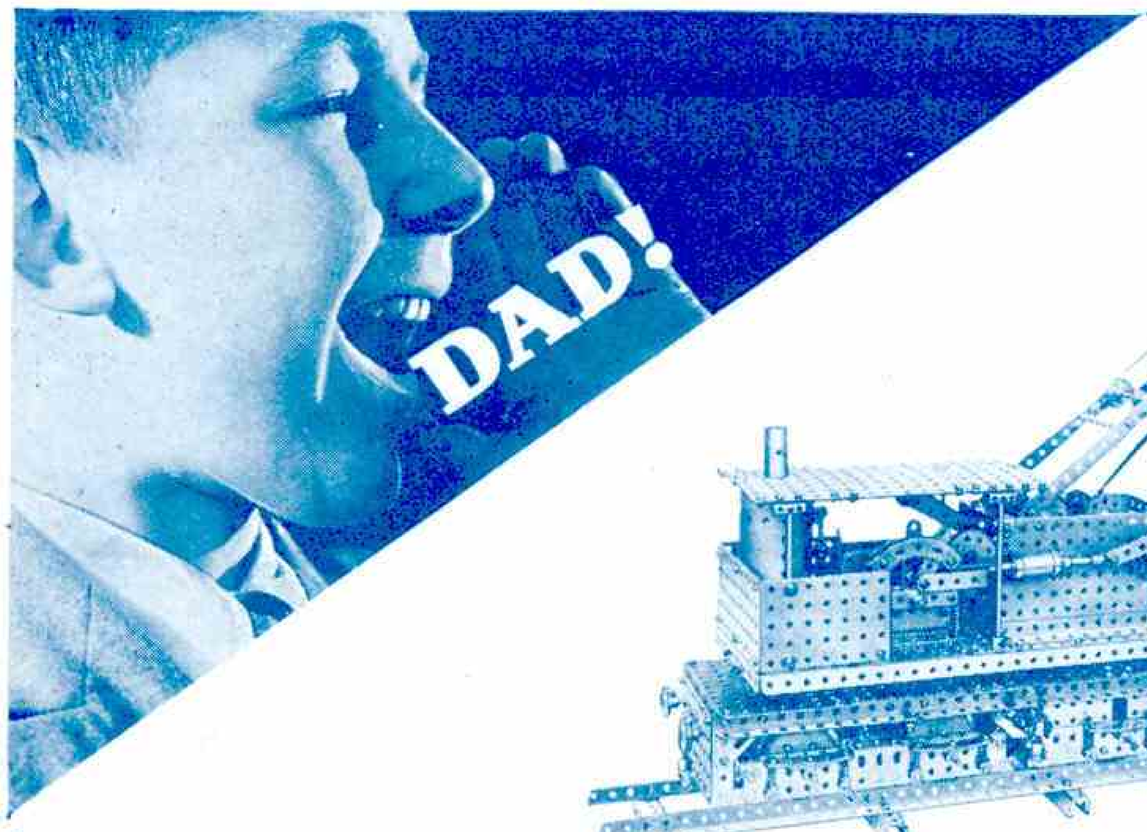
Bowman 21/- Locomotive, used six times only, 15/-. —Bradbury, Barkway Road, Royston, Herts.

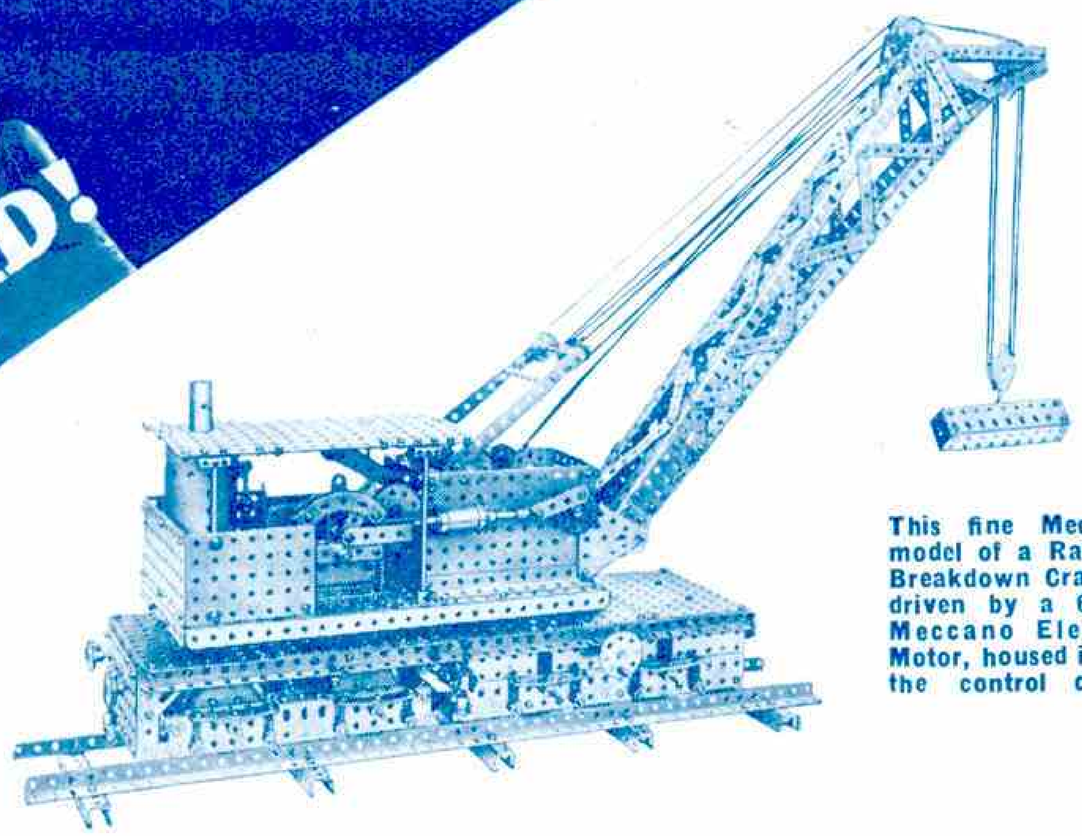
PRINT YOUR OWN SNAPS. Particulars from—Photo Service, 90, Woodhouse Road, Finchley, N.12.

Birds' Eggs, Butterflies, Cabinets and Apparatus. Lists free.—Forbes, Dept. M., Clutton, Chester.

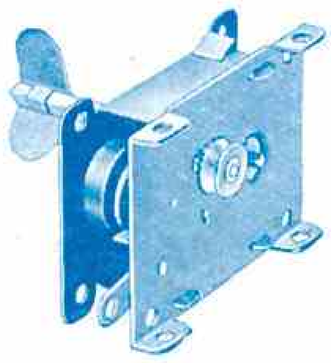
500 World-Wide Stamps, 6d.—Way, Wilmslow, Cheshire.

1,000 Perfect Assorted Cigarette Cards, 3/3. Sets, Odds, Lists—Thornton, 159, Grosvenor Rd., Liverpool, 15.



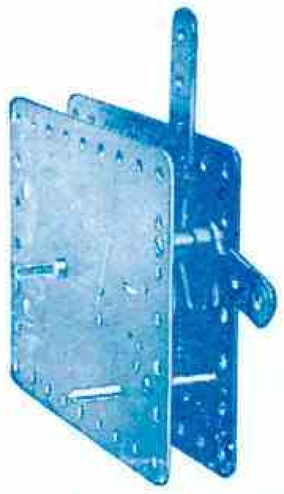


This fine Meccano model of a Railway Breakdown Crane is driven by a 6-volt Meccano Electric Motor, housed inside the control cabin.

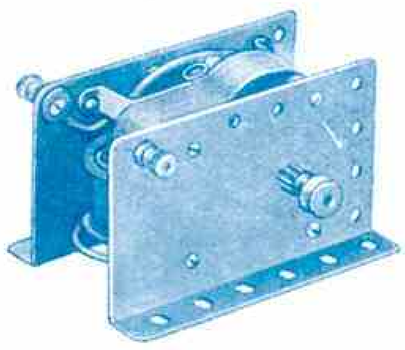


X Clockwork Motor

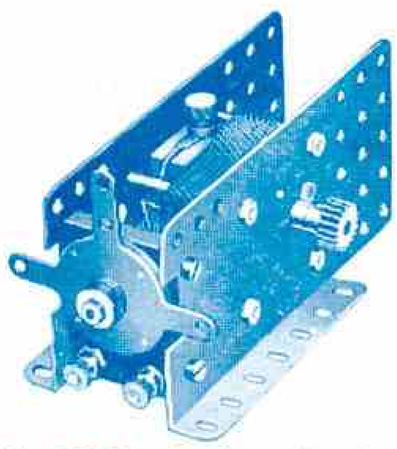
No. 1 Clockwork Motor



No. 2 Clockwork Motor



No. E1/20 Electric Motor (20 volt)



No. E6 Electric Motor (6-volt)

—I *want a Meccano Motor to work my Meccano models*"

In order to obtain the fullest enjoyment from the Meccano hobby you should operate your models with a Meccano Motor.

Each Motor is strongly made and the utmost care is taken in its manufacture to ensure that it will give satisfaction. The side plates and bases are pierced with the standard Meccano equidistant holes, which enable the motor to be built into any model in the exact position required.

Particulars and prices of the Motors and Accessories are given below.

Meccano Clockwork Motors

These are the finest clockwork Motors obtainable for model driving. They have exceptional power and length of run and their gears are cut with such precision as to make them perfectly smooth and steady in operation.

X SERIES CLOCKWORK MOTOR. A fine Motor specially designed to drive with ease any of the X Series models. It is non-reversing ... ... Price 2/6

No. 1 CLOCKWORK MOTOR. An efficient and long-running Motor fitted with a brake lever. It is non-reversing ... ... Price 5/-

No. 1a CLOCKWORK MOTOR. The Motor is more powerful than the No. 1 Motor and is fitted with reversing motion. It has start, stop and reverse levers. Price 7/6

No. 2 CLOCKWORK MOTOR. This is a Motor of super quality. Brake and reverse levers enable the Motor to be started, stopped or reversed, as required. Price 10/-

Meccano Electric Motors

The five Meccano Electric Motors listed below provide smooth-running power units for the operation of Meccano models. The 6-volt Motors may be operated either from a 6-volt Accumulator or through a Transformer direct from the mains, providing that the supply is alternating current. They cannot be run satisfactorily from dry cells. The 20-volt Motors are most conveniently operated through a 20-volt Transformer from alternating current supply mains.

No. E1 Electric Motor (6-volt). Non-reversing ... ... Price 9/-
No. E6 Electric Motor (6-volt). Reversing .. 15/6
No. E1/20 Electric Motor (20-volt). Non-reversing 10/-
No. E20A Electric Motor (20-volt). Non-reversing 16/6
No. E20B Electric Motor (20-volt). Reversing . 18/6

Meccano Transformers

A Meccano Transformer provides a convenient and safe means of driving a Meccano Electric Motor from the mains supply where this is alternating current.

There are six Transformers in the series, all of which are available for the following A.C. supplies :—100/110 volts, 50 cycles ; 200/225 volts, 50 cycles ; 225/250 volts, 50 cycles. Any of the Transformers can be specially wound for supplies other than these at a small extra charge. When ordering a Transformer the voltage and frequency of the supply must always be stated.

No. T6 Transformer (Output 25 VA at 9 volts) for 6-volt Electric Motors. Fitted with speed regulator. Price 21/-

No. T6M Transformer (Output 25 VA at 9 volts) for 6-volt Electric Motors. This is similar to No. T6, but is not fitted with a speed regulator ... ... Price 16/6

No. T6A Transformer (Output 40 VA at 9/3½ volts) for 6-volt Electric Motors. Fitted with speed regulator and separate circuit for supplying current for eighteen 3½-volt lamps ... ... Price 26/6

No. T20 Transformer (Output 20 VA at 20 volts) for 20-volt Electric Motors. Fitted with 5-stud speed regulator ... ... Price 21/-

No. T20M Transformer (Output 20 VA at 20 volts) for 20-volt Electric Motors. This is similar to No. T20, but is not fitted with speed regulator ... ... Price 16/6

No. T20A Transformer (Output 35 VA at 20/3½ volts) for 20-volt Electric Motors. Fitted with speed regulator and output sockets for lighting lamps ... Price 26/6

Accumulators

The 6-volt 20-amp. Accumulator is specially suitable for running Meccano 6-volt Motors and Hornby 6-volt Electric Trains ... ... Price 27/9

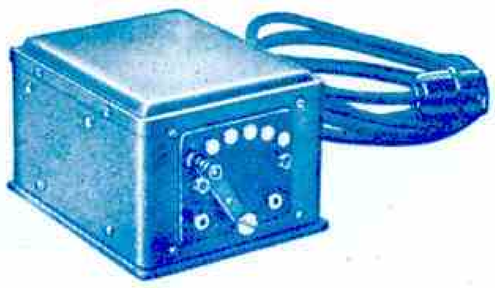
The 2-volt 20-amp. Meccano Accumulator is supplied for converting 4-volt Accumulators to 6-volt ... Price 9/3

Resistance Controller

This Controller enables the speed of Meccano 6-volt Motors and Hornby 6-volt Electric Trains to be regulated as desired ... ... Price 3/9

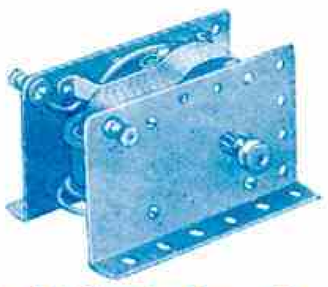
MECCANO LIMITED — BINNS ROAD — LIVERPOOL 13

6-volt 20-amp. Accumulator

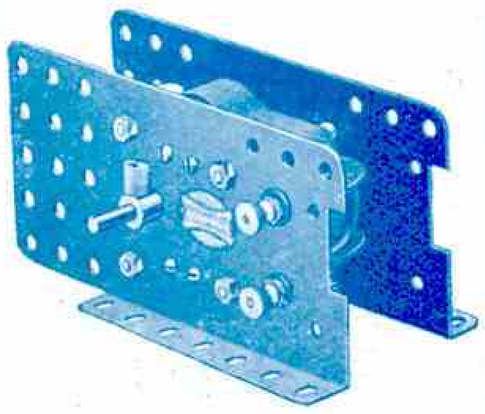


No. T20 Transformer

Resistance Controller



No. E1 Electric Motor (6-volt)



No. E20a Electric Motor (20-volt)

MECCANO MOTOR CAR

CONSTRUCTOR OUTFITS

Meccauto 538189

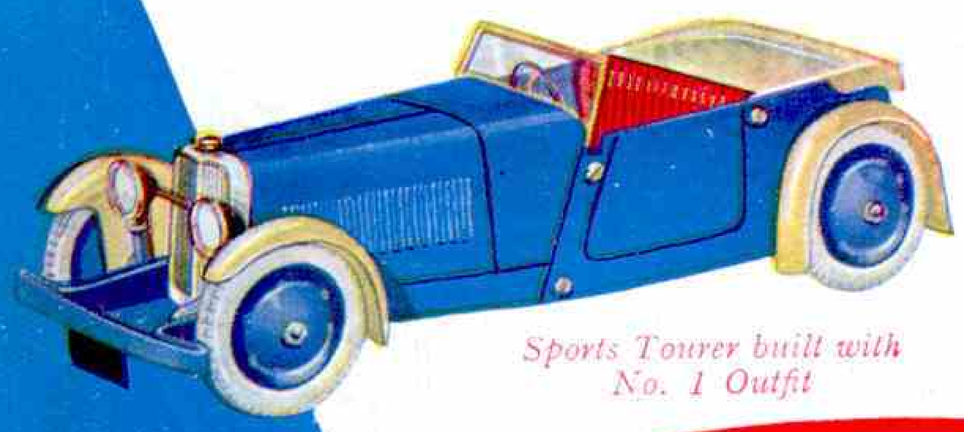
Saloon Coupé built with No. 1 Outfit

Build your own Motor Cars!

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

Perfect miniature reproductions of many different types of car can be built with these splendid Outfits, including sports four-seaters, speed cars, sports coupés and others. A powerful clockwork motor, that gives the models a long run on one winding, is included in each Outfit.

The parts are finished in rich enamel and nickel-plate, the complete Outfits being masterpieces of miniature automobile craftsmanship.



Sports Tourer built with No. 1 Outfit

No. 1 Motor Car Constructor Outfit

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

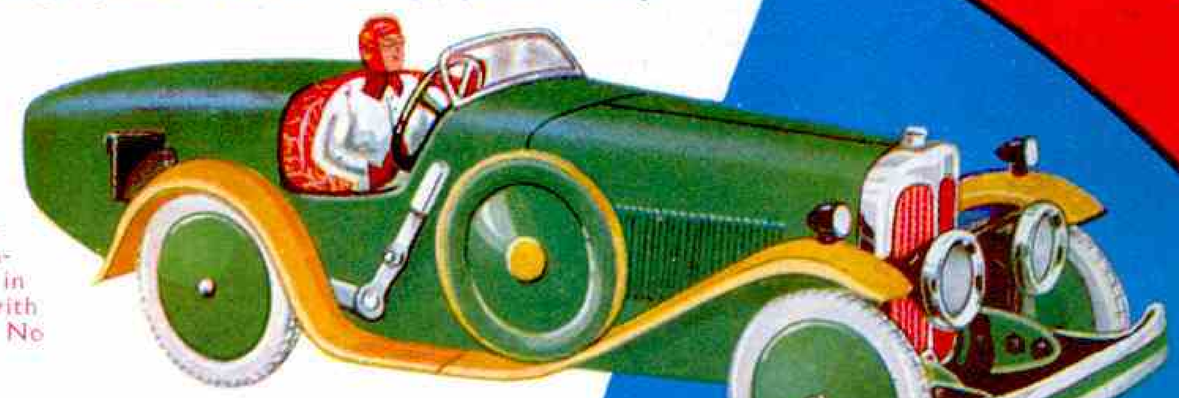
No. 1 Outfit is available in four different colour combinations—Red and Light Blue, Light Blue and Cream, Green and Yellow, and Cream and Red. It is supplied complete with powerful Clockwork Motor. Price **14/6**

PRODUCT of MECCANO LIMITED LIVERPOOL

Choice Range of Colours

If extra parts in any of the standard colours are required they can be purchased from any Meccano dealer. In addition to the four standard colour combinations, the following parts are available in the colours indicated :—
Body Sections : orange, yellow. Wheels : orange, yellow. Wings : orange, green.

IMPORTANT.
No. 1 Motor Car Outfit parts cannot be used in conjunction with those of the No 2 Outfit.

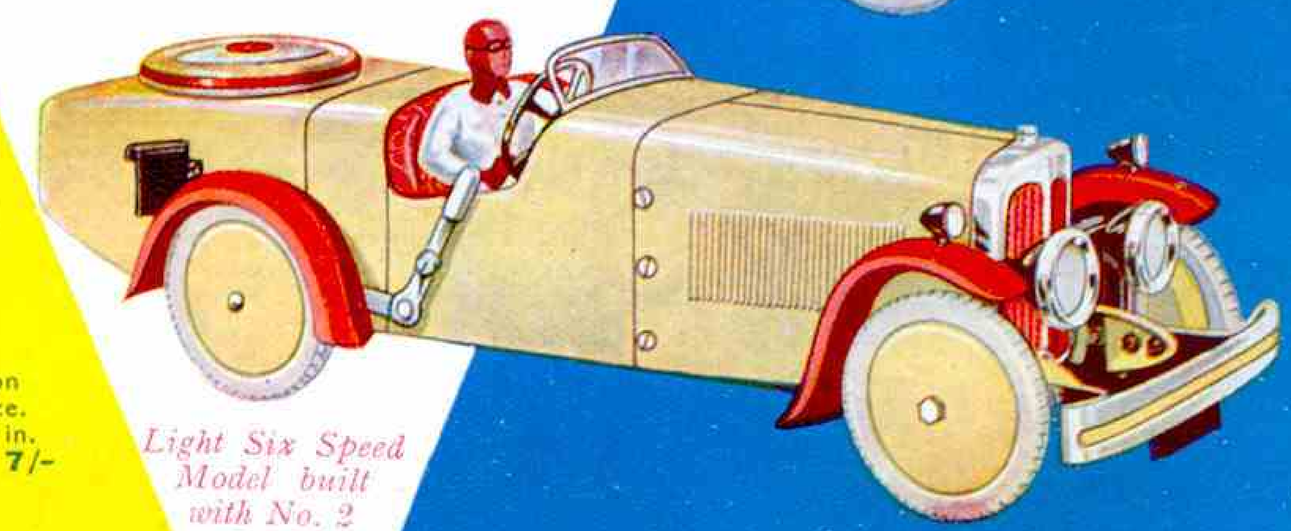


Sports Tourer built with No. 2 Outfit

No. 2 Motor Car Constructor Outfit

Larger models of a superior type can be built with No. 2 Outfit. They are perfectly designed, beautifully finished and the most attractive examples of constructional engineering ever produced for the delight of boys. Their handsome and realistic appearance may be judged from the accompanying illustrations.

No. 2 Outfit is available in four different colour combinations—Red and Light Blue, Light Blue and Cream, Green and Yellow, and Cream and Red. A powerful Clockwork Motor that gives a run of 150 feet on one winding is included. Price **25/-**



Light Six Speed Model built with No. 2 Outfit

Motor Car Lighting Set

This Lighting Set enables the headlamps of Motor Car models built with the 1933 No. 2 Motor Car Outfit to be electrically lighted Price **2/6**

Motor Car Garage

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

Manufactured by

Meccano Ltd., Binns Rd., Liverpool 13

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