VOL. XVIII. No. 9. SEPTEMBER 1933

MECCANO MAGAZINE

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(see page 650)

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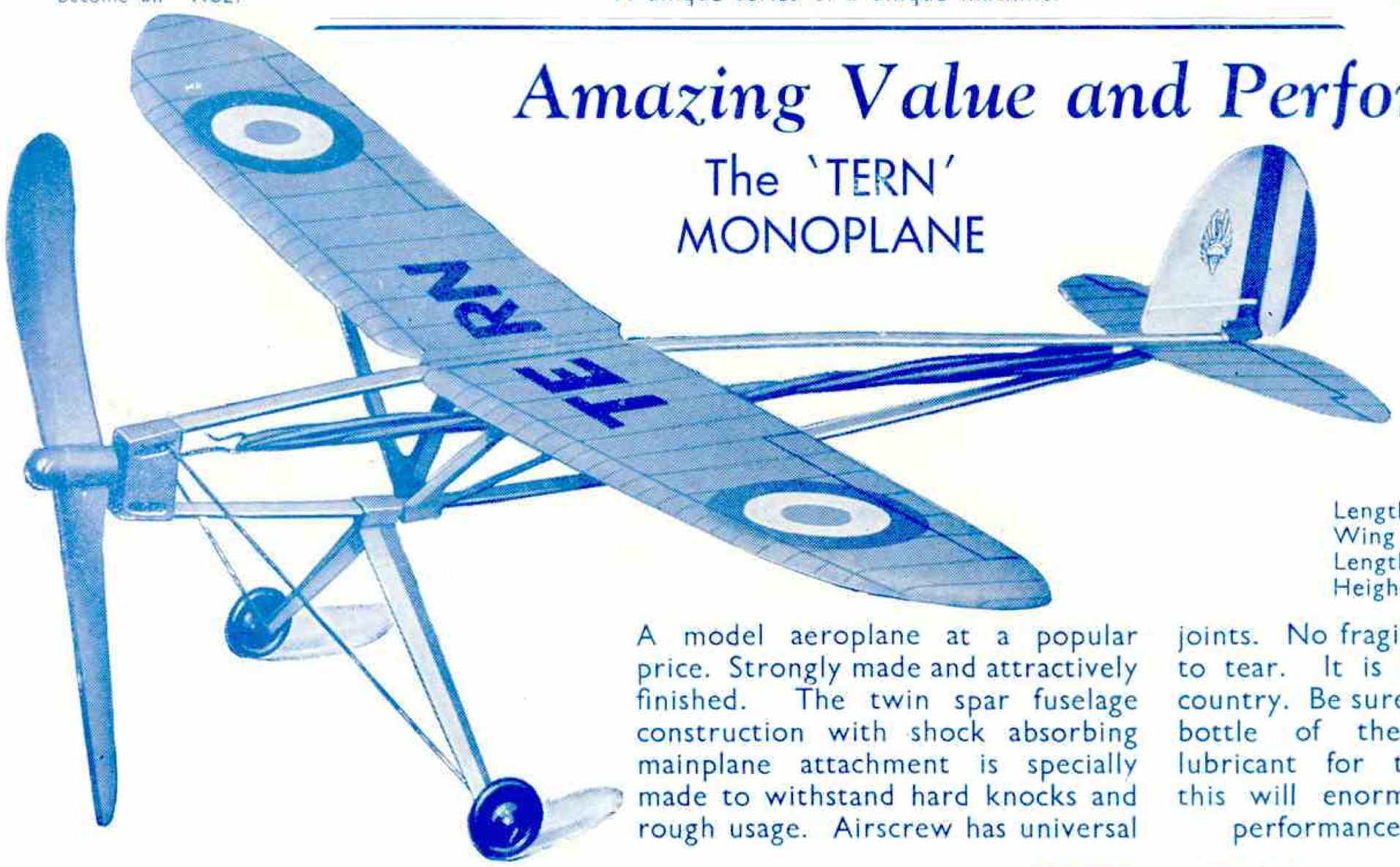

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MECCANO MAGAZINE

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September, 1933

With the Editor

Relics of the Past

Most of us at one time or another, when visiting some ancient castle or abbey, have been bored to distraction by the dreary discourse of the guide when he has reeled off a long succession of facts and dates. No doubt these were all correct, but undoubtedly they were terribly uninteresting! On the other hand, those of us who have been fortunate enough to have been taken over an old ruin by an antiquary, have been able to see how an intelligent interest in the subject, as against a parrot-like repetition of dates and facts, has made the old stones come to life. The antiquary has been able to paint such a picture as has made us, in imagination, see the men who built the ruin and the others whose lives were bound up with its history. Instead of being told that three men were killed at a certain spot in 1456, we learn that at this spot three gallant knights fought to the death against hopeless odds. The antiquary shows us where the fight began, and how the knights were driven back step by step. He points out where the first fell, where the second was wounded, and where the third made his last stand and, scorning to surrender, died fighting.

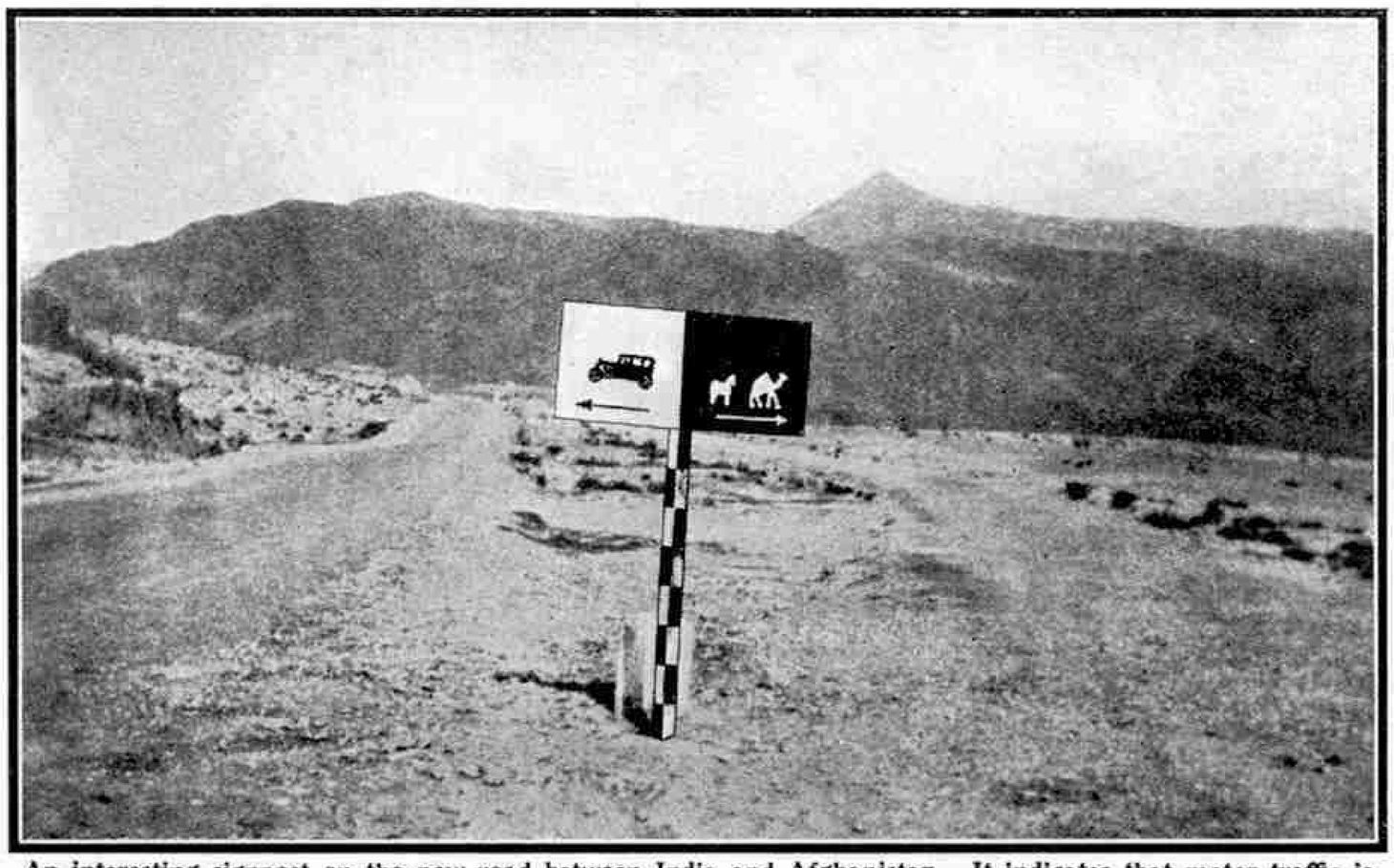
The difference in the two stories is accounted for by the fact that the antiquary is a man of vision, and has not only gathered his knowledge from books, but has personally investigated the subject and has probably lived again the events that have occurred in and around the ruin that he is describing. Moreover, he has genuine enthusiasm for his subject, which the guide cannot always be expected to show, considering that he has to tell the same story over and over again, day after day!

We are fortunate in having as a contributor to the *"M.M."* Mr. W. Coles Finch, whose enthusiasm for antiquarian subjects is well known. He is the author of several books dealing with his beloved county, and I can assure my readers that a ramble with this "Man of Kent" is a delightful experience. Most of us probably would see little of interest in the ancient church described on page 669, but Mr. Coles Finch reveals much that is hidden, and shows us that built into its rubbly walls are tiles that are unmistakably of Roman origin.

Speaking of Roman relics reminds me of the boy who, for the life of him, could not see anything wrong with the story of the man who unearthed some coins bearing the head of Cæsar on one side and the date 55 B.C. on the other! Admittedly, the point of the story is rather obstruse, but I do not think it too subtle for my readers!

Old and New on the Indian Frontier

As the engineer progresses slowly but surely in his conquest of the world for civilisation, his work brings into existence many strange contrasts. One of these is shown in the photograph reproduced on this page, on which are seen side by side a modern motor highway and an ancient caravan route that form links between India and Afghanistan. For many centuries the camels and ponies of traders have trodden the old road, and from time to time savage hordes from Central Asia have swept down upon India by this and similar routes through the passes of the North-West frontier. To-day motor cars run along the metalled surface of the splendid new road, but the pass through which this road winds still carries the highway for traffic of the old type.



An interesting signpost on the new road between India and Afghanistan. It indicates that motor traffic is to proceed along the new road on the left, while camel and pony drivers must keep to the ancient track that runs alongside on the right.

The signpost bears on one side a picture of a motor car, with an arrow pointing to the new road on the left. On the other side, with an arrow pointing to the old road on the right, are depicted a camel and a pony. Those who pass this way speak many tongues, and a considerable proportion of them are unable to read. This simple sign conveys to every traveller the information necessary for his guidance, for it speaks a language that is both universal and unmistakable.

The New Kemex and Elektron Outfits

This month appear the first of a series of articles linking up with the recently-introduced Kemex and Elektron Outfits. These articles give practical advice in regard to commencing the new hobbies, and show how to extract the greatest possible amount of fun from the Outfits.

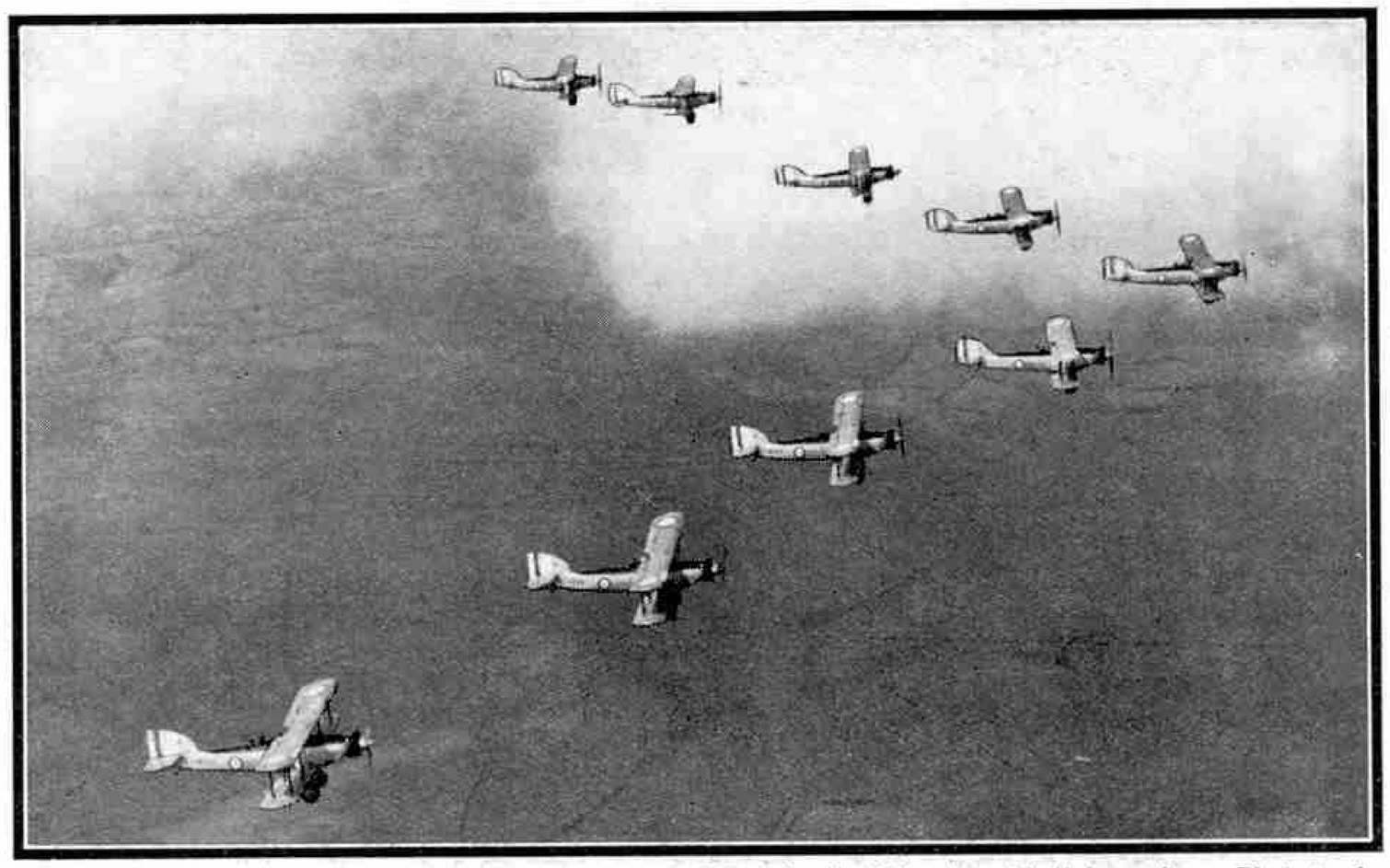
The splendidly illustrated Manuals of Instruction that accompany these Outfits describe a large number of experiments that can be carried out with the apparatus and materials provided, but these experiments do not by any means exhaust the possibilities. In later articles in this series there will be described and illustrated many other fascinating experiments that can be performed with the Outfits, and in this manner the interest of the hobbies will be maintained and increased.

I want to see these fine new hobbies develop and extend on the best possible lines, and with this aim in view I invite owners of either Kemex or Elektron Outfits to write and tell me of their experiences. Large and increasing numbers of Meccano and Hornby Train enthusiasts write to me in regard to their hobbies, and I want Kemex and Elektron enthusiasts to do the same.

Air Forces of the Empire

THERE are six Air Forces in the British Empire. The Royal Air Force is the largest of these, and the others are the Royal Australian, the Royal Canadian, the New Zealand, and the South African Air Forces, and the Army Air Corps of the Irish Free State. Various aspects of the work and machines of the Royal Air Force have been dealt with from time to time in the "*M.M.*" and in this article we shall deal briefly with the other Services.

The first step towards the formation of an Air Force in Australia was taken in 1912, when a Central Flying School was established at Point Cook, Laverton, Victoria, with a personnel consisting of two officers and 50 other ranks. In the following year an Aviation Instructional Staff was established. The Australian Flying Corps, a branch of the Australian Imperial Force, was founded in 1915, and in 1918 the Corps formed its own training wing in England. At this time there were four Australian squadrons on active service.



A squadron of Fairey "Gordon" day bombers of the R.A.F. flying in "Squadron Vic" formation. Photograph by courtesy of "Flight." The upper illustration shows Westland "Wapitis" of the South African Air Force on the Bulawayo Aerodrome.

After the War, when the Australian Flying Corps had returned from active service, the Aviation Instructional Staff was disbanded, and an Australian Flying Corps was formed as a branch of the Commonwealth Military Forces. This was replaced by the Royal Australian Air Force in 1921, although the Air Force Act had not then been passed. When the Act received Royal Assent in 1923, the R.A.A.F. definitely became a separate service of the Defence Forces of the Commonwealth.

The R.A.A.F. is run on similar lines to the R.A.F., including the classification of the ranks. Certain squadron work in conjunction with the Army and Navy is undertaken, but the most useful work is in connection with the revision of military survey maps of Australia. The task is being carried out in conjunction with the Army, the part played by the R.A.A.F. consisting of the photography from the air of extensive areas in Victoria, New South Wales and Queensland. The R.A.A.F. has also co-operated with the Department of the Interior in searching for oil in Queensland. One section of this work consisted of the aerial survey of an area of some 300 sq. miles, and excellent results were achieved. Another important activity is the organisation of forest fire patrols in Victoria, where during the dry season, the most dangerous time of the year for fires, about 2,000 sq. miles of forest are regularly patrolled by air. The machines that undertake this work are fitted with wireless so that immediately they discover an outbreak they can communicate with the Fire Wardens.

Various types of machines are employed by the R.A.A.F., the most popular landplanes being the D.H. "Moth," the Bristol "Bulldog" and the Westland "Wapiti." Several Supermarine "Southampton" flying boats also are employed, together with Supermarine "Seagull" boat amphibians.

The Air Services of Canada, which form a Branch of the Department of National Defence, are under the control of four Directorates. The first of these is the Royal Canadian Air Force, which is responsible for all training and service operations; the second controls Civil Government Air Operations, the third, Aeronautical Engineering, and the fourth, Civil Aviation.

The Royal Canadian Air Force is divided into two sections, the Active Air Force and the Reserve. The Active Air Force is further divided into the Permanent Active Air Force and the Non-Permanent Active Air Force, members of the first branch being on continuous

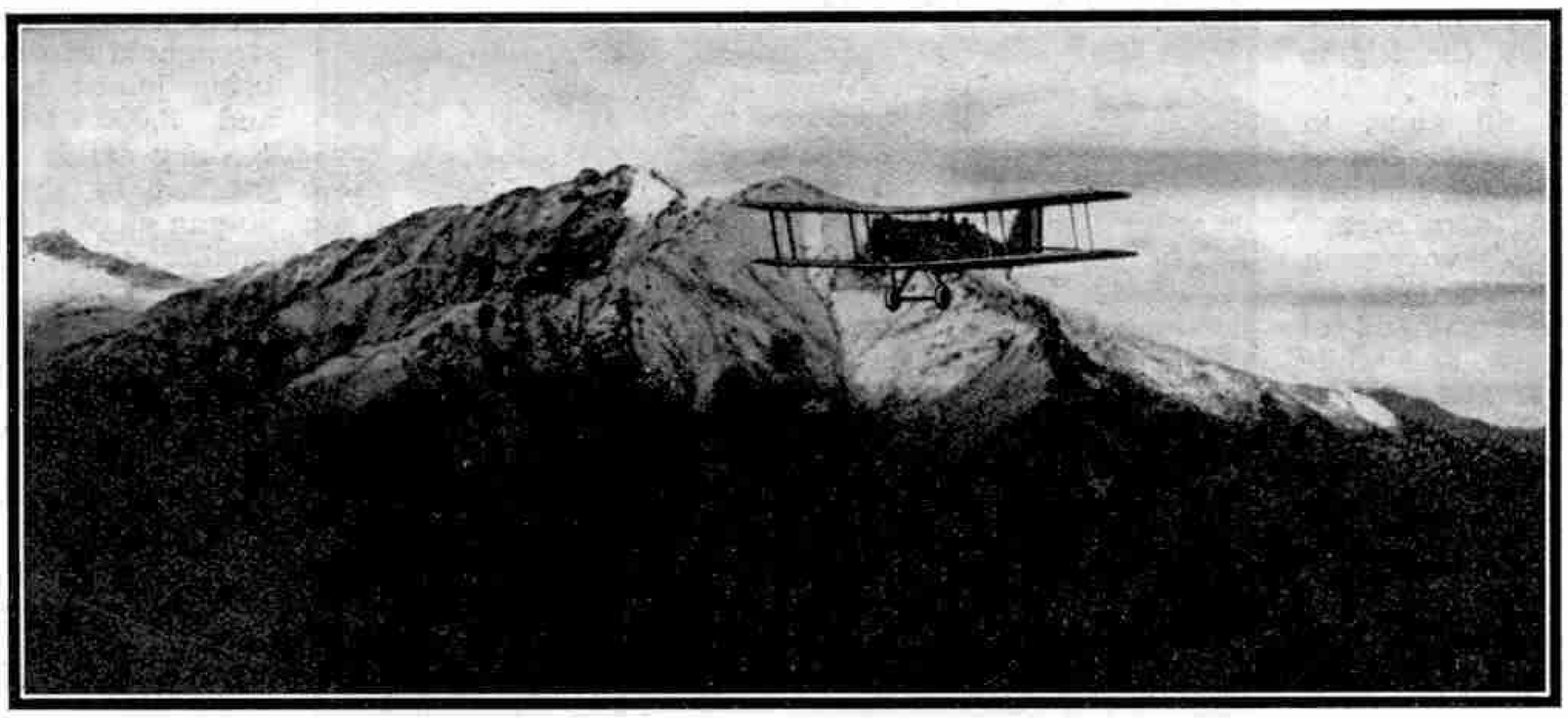
service as are members of the R.A.F., while personnel of the Non-Permanent Force are employed on full-time duty when required, and are called up for instructional courses when not so employed and as circumstances permit. The Air Services are at present being reorganised, and consequently these arrangements may not hold for any length of time.

The work of the R.C.A.F. is similar to that of the R.A.F., but on a smaller scale. Manœuvres in co-operation with Naval and Military forces are carried out and, owing to the nature of the country, a good deal of attention is given to seaplane flying. A few commercial pilots are allowed to take specialist courses at R.C.A.F. centres.

D.H. "Tiger Moths" used for military training purposes. "Flight" photograph.

All the work of the Civilian Government Air Operations Directorate is carried out by Royal Canadian Air Force personnel and civil servants, and it consists for the most part of aerial surveys and forestry protection patrols.

In New Zealand there are two air forces, the New Zealand Permanent Air Force and the New Zealand Air Force (Territorial). The Permanent Air Force was formed in June, 1923, and its duties consist mainly of co-operation work with New Zealand Naval and Military Forces, the administration, of civil aviation, the training of the New Zealand Air Force (Territorial) and the carrying out of air survey and research and communication flying for Government Departments and Public Bodies. In 1929 a scheme was prepared for the extension and improvement of the New Zealand Permanent and Territorial Air Forces. Unfortunately, however, the financial depression has prevented the plans from being carried out, but it is hoped that it will be possible for them to be put into operation in the near future.



A Westland "Wapiti" flying on the North-West frontier of India. For this photograph and the upper one on the opposite page we are indebted to the Westland Aircraft Works.

The South African Air Force is similar to the Air Forces already mentioned, in that, in addition to purely military flying, it co-operates with other Government Departments in the carrying out of useful public work. This usually consists of aerial survey work and photography, an excellent example of this being a valuable photographic survey of the Kalahari Desert that was made in 1925 by two machines of the S.A.A.F. in co-operation with a scientific expedition to the Desert. A great deal of survey work has been carried out for the Department of Irrigation. Military aeroplanes are co-operating also with the Naval Hydrographic Survey. The work in this connection includes the photographing of the coast line, and saves a great deal of shore work that otherwise would have to be carried out by Naval personnel.

The S.A.A.F. also carries out important experimental work in connection with the spraying of crops and trees for the extermination of pests. This is being done in conjunction with the Department of Entomology and Forestry, and was commenced in 1925, when a gum plantation infested by the eucalyptus snout beetle was sprayed with calcium arsenate powder by S. A. A. F. machines. The work was attended with great success. Military machines in South Africa are used also to carry diamonds from Alexander Bay to Capetown. Various types of machines are used by the S.A.A.F., but probably the most popular are the Avro "Avian," employed as a trainer, and the Westland "Wapiti." All the aircraft required are built at an Air Force Depot, even the propellers being made on the spot.

The youngest of the Empire air services is that of the Irish Free State. This is not a separate service of the defence forces, all military flying being carried out by an Army Air Corps. The Corps has a number of aerodromes and also an Air Corps School, and in addition to carrying out military flying, assists the Department of Industry and Commerce in its work of controlling civil aviation.

VIII.—LORD RODNEY

THE frequent naval conflicts with France and Spain during the second half of the 18th century provided many opportunities for great achievements, and one of the outstanding British admirals engaged was Lord Rodney.

George Brydges Rodney was born at Walton-on-Thames about the beginning of 1719—the exact date is uncertain—and was sent to Harrow at an early age. When he was 12 years old he entered the Navy as a volunteer, and joined the "*Sunderland*" at Sheerness on 21st June, 1732. During the first 10 years of his naval career Rodney served in many different ships, most of which were attached to the Channel fleet. He was promoted Lieutenant in 1739 and made a Captain three years later while serving aboard the "*Namur*," flagship of Admiral Mathews, in the Mediterranean. Mathews transferred Rodney to the "*Plymouth*," of 60 guns, and gave him charge of a convoy of 300 merchant ships about to leave Lisbon for this country. Rodney successfully escorted the ships, although a French fleet was cruising in the Channel on the lookout for them, and he was warmly thanked by Parliament.

During the next five years Rodney commanded successively the frigate "*Sheerness*," of 20 guns; the "*Ludlow Castle*" of 40 guns, in which he took part in the patrolling of the Scottish coast during the Jacobite rising in 1745; and the "*Centurion*," made famous by Anson's voyage in her round the world. In 1747 he was appointed to the command of the "*Eagle*," of 60 guns, and while serving in this vessel he had his first real taste of battle. The "*Eagle*" was one of a small squadron of six ships commanded by Captain Fox, in the "*Kent*," that was sent in April of that year to intercept a large French convoy of 170 merchant ships homeward bound from the West Indies. The convoy was escorted by four ships of the line commanded by Admiral De la Motte, and Fox met and pursued it off Cape Ortegal. The French Admiral saw that he was outnumbered, and after being chased all day he abandoned the convoy and escaped during the night. Fox captured 48 of the merchant ships, which proved to be laden with valuable cargoes.

Admiral Lord Rodney. The illustrations to this article are from prints in the possession of T. H. Parker Ltd., 28, Berkeley Square, London, by whose courtesy we are enabled to reproduce them.

The "*Eagle*" and the "*Kent*" were included in the British fleet commanded by Rear-Admiral Hawke that severely defeated a French squadron off Ushant on 14th October, 1747, as described in the previous article in this series. The "*Eagle*" took a gallant part in this hard-fought engagement, and during the early stages she was exposed to the fire of two French ships, both more heavily armed than herself, but she succeeded in forcing them to surrender. Major-General Mundy, in his "*Life of Lord Rodney*," relates that when Rodney returned to this country Lord Anson presented him to the King, who said that "he did not imagine that he had so young a captain in his Navy." Lord Anson replied: "Sire, young Rodney has been six years a captain in your Majesty's navy, and without reflection I wish, most heartily wish, your Majesty had one hundred more such captains, to the terror of your Majesty's enemies."

In 1749 Rodney was appointed Governor and Commander-in-Chief of Newfoundland, with the rank of Commodore, and in command of the "*Rainbow*" he sailed from England to take up his new duties. His term of office ended in 1752, and he then returned home. He took part in Hawke's expedition against Rochefort in 1757, and in the next year went with the expedition led by Admiral Boscawen against Louisburg, Cape Breton Island. After the capture of the fort he came back to this country, bringing with him the convoy of French prisoners. On 19th May, 1759, Rodney was promoted to Rear-Admiral, and in 1761 he was elected Member of Parliament for Penryn, Cornwall. He did not occupy his place in the House of Commons long, however, as in October of that year he was appointed Commander-in-Chief of the Leeward Islands, and ordered to carry out an attack against French possessions in the West Indies. The squadron left England in October 1761, and five weeks later reached Barbadoes.

Martinique was the chief French stronghold in that quarter, and after being joined by General Monckton and 3,000 troops from Canada, Rodney sailed for there. The fleet totalled 14 ships of the line, four 50-gun ships, 14 frigates and several smaller craft, and arrived off the island on 7th January, 1762. After much difficulty the troops were landed in a bay about four miles from Fort Royal, and by 24th January the arduous task of hauling the batteries over the intervening hilly country was accomplished. The ensuing siege was short, as the fort surrendered on 4th February, 1762, and eight days later the entire island was in British hands. Two other islands in the West Indies were also won from the French. Rodney received the thanks of Parliament for his victories, and in October 1762 he was promoted to Vice-Admiral of the Blue.

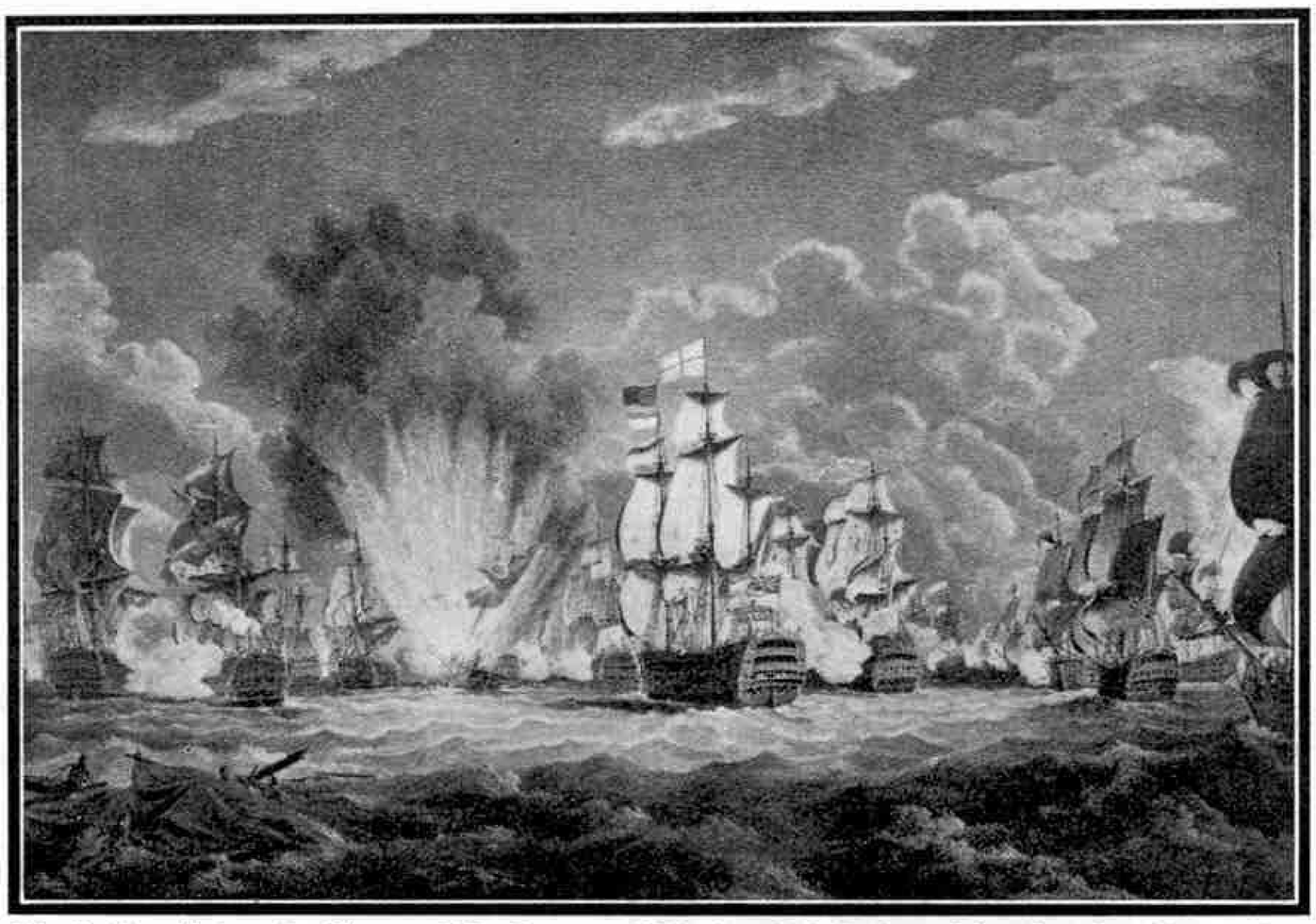
While this campaign against the French in the West Indies was in progress, England declared war against Spain, and in December 1761 Rodney received orders to attack Spanish possessions in the West Indies. In March 1762 a special expedition under Admiral Pocock was sent out to attack Spanish holdings in South America, and instructions were sent ahead to Rodney not to continue his aggressions pending the arrival of this expedition. Pocock called at Martinique, and many of Rodney's ships and Monckton's troops were added to his expedition, which then proceeded on its way. A peace treaty between England, France and Spain was eventually signed at Paris on 10th February, 1763, and Rodney returned to England later in the year.

In 1764 Rodney was created a Baronet, and from 1765 to 1771 he was governor of Greenwich Hospital, retiring on being appointed Commander-in-Chief of Jamaica. Shortly afterwards he was

promoted to Rear-Admiral of Great Britain. His term of office at Jamaica ended in 1774 and he returned to this country.

When France recognised the newly-claimed independence of America, and in 1778 sent troops, arms and funds to aid the colonists against England, peaceful relations between France and this country ended abruptly. In the West Indies a French fleet captured St. Vincent and several other islands. Rodney was therefore re-appointed Commander-in-Chief of the Leeward Islands, and ordered to prevent further enemy successes in that part of the world. As Gibraltar was being blockaded by a combined French and Spanish fleet and besieged by a Spanish army, he was also ordered to relieve the fort on his way to the West Indies. Rodney sailed on 29th December, 1778 with a fleet totalling 21 ships of the line and nine frigates, and including a squadron commanded by Rear-Admiral Digby, sent specially to help in relieving Gibraltar. The fleet escorted about 300 merchant ships bound for Gibraltar, Portugal and the West Indies. When 10 days out from England Rodney encountered and captured five armed Spanish ships escorting a convoy of 15 merchantmen laden with produce for Cadiz and Cartagena.

On 16th January, 1780, Rodney sighted south of Cape St. Vincent the Spanish squadron that was taking part in blockading Gibraltar. The squadron totalled 11 sail of the line and was commanded by Admiral Don Juan de Langara, who quickly saw that he was greatly outnumbered, and endeavoured to avoid a battle. Rodney gave the signal for a chase, and by keeping between the enemy and the coast he prevented them from seeking refuge. A running fight began late in the afternoon in spite of stormy weather and approaching darkness. About nine o'clock the Spanish ship "*San Domingo*," of 70 guns, blew up, and all on board perished; and the British ship "*Bienfaisant*," which was near by, almost suffered the same fate. The battle lasted until two o'clock next morning and ended in the capture of six of the Spanish ships, including De Langara's flagship "*Pheonix*," of 80 guns. When the Spanish Admiral went aboard Digby's flagship "*Prince George*" he was astonished to find Prince William Henry, afterwards William IV, serving as a "middy" and sharing the discomforts of the ordinary seamen of those days.



The battle off Cape St. Vincent, 16th January, 1780, in which Rodney defeated a Spanish squadron commanded by Admiral de Langara.

After defeating the Spanish squadron Rodney relieved Gibraltar, and left there the store ships he had captured on the way. Digby and his squadron then returned home, while Rodney, with four ships of the line and the merchant ships bound for the West Indies, resumed his long voyage. On 27th March he reached the island of St. Lucia and there took command of the West Indies fleet. He was told that a large French squadron had established itself at Martinique and had several times cruised in sight of St. Lucia, and he determined to engage them when next they put out to sea.

On the evening of 15th April Rodney received word that the French fleet was out. He immediately set off in pursuit, and overtook them early on the 17th off Guadeloupe, where he forced them to fight. The two fleets were strung out in parallel, the British ships much closer together than the French, which were under the command of Admiral Guichen aboard the "*Couranne*." Rodney gave the signal for each British ship to attack the enemy ship abreast of it. This was a novel command, and was misread by some of the captains, who headed for the particular French ships occupying the same numerical positions as themselves. By doing this they spread out the English line and robbed the attack of its solid character. The misreading of the signal was noted by an aide-de-camp of the governor of Martinique, on the "*Couranne*," and turning to Guichen he exclaimed: "Courage, General, the English desert their commander!"

The "*Sandwich*," of 90 guns, boldly attacked the enemy, and soon three French ships, one of which was the "*Couranne*," closed in upon her. In spite of their terrific fire she succeeded in driving them off and effected a serious break in the French line. Her fine work was wasted, however, as the enemy eventually succeeded in getting out of range of the English fire and escaped. Thus an action that had promised well ended indecisively.

At the close of 1780 England declared war against Holland, and in January 1781 Admiral Hood, who had been appointed second-in-command to Rodney, arrived at St. Lucia with reinforcements. The two admirals co-operated in an attack on Dutch possessions in the West Indies that ended in the capture of the island of St. Eustatius and its great wealth, and of many ships in the bay; and in the capture of several smaller islands. Rodney learned that a Dutch fleet, laden with valuable cargoes and accompanied by one ship of the line for protection, had sailed from St. Eustatius shortly before his arrival. He therefore sent three ships in pursuit and these overtook and captured the fleet the next day.

In February 1781 Rodney received word that a strong French fleet was on the way out to Martinique, and he despatched Hood with a squadron to intercept it, but Hood missed it. The French fleet was commanded by Admiral de Grasse, and totalled 20 ships. During the summer Rodney's health failed and he returned to England, leaving Hood in command of the British fleet. He was convalescing at Bath in November of the same year when information reached England that de Grasse had captured several islands in the West Indies, and was preparing to join forces with a strong Spanish fleet from Havana for a combined attack on Jamaica. It was realised that Hood would be hopelessly outnumbered, and Rodney was at once given command of the 12 ships of the line available. Hoisting his flag in one of them, the "*Formidable*," of 90 guns, he sailed with this force for the West Indies on 15th January, 1782. The start had been delayed a month by bad weather, and strong westerly gales prolonged the voyage, but Rodney reached Barbadoes on 19th February and was joined by Hood off Antiqua a week later. The British fleet then totalled 36 sail of the line. After an unsuccessful attempt to intercept a French convoy known to be on the way out from Brest, Rodney retired to St. Lucia, and posted a long line of frigates out to sea to keep watch upon the enemy in Fort Royal Bay.

On the 8th April, 1782, de Grasse put to sea with 36 sail of the line to join a large Spanish squadron, carrying 6,000 troops, which was waiting for him near Cape Francois, to co-operate in the attack on Jamaica. Immediately Rodney heard of the departure of the French fleet he set out with his 36 ships, and sighted the enemy near Guadeloupe four days later. The van of Rodney's fleet caught up with the French off the group of islets that Columbus had named "the Saints." De Grasse saw that an action was unavoidable, and there quickly developed the greatest naval battle in which Rodney ever took part.

The English van was commanded by Hood, in the "*Barfleur*," and by magnificent fighting kept the French at bay until the arrival of the English centre and rear. At one time seven French ships of the line were concentrating their fire upon the "*Barfleur*," but she withstood the terrific onslaught and replied vigorously. As the running fight continued, the ships of the English centre and rear came into action one by one. By a sudden manœuvre Rodney, in the "*Formidable*," penetrated the French line just behind its centre, and his example was quickly followed by Hood, who broke through just behind the French van. Every effort was then made to prevent the separated portions of the enemy fleet from rejoining, and many thrilling encounters took place between individual ships, with the most serious losses to the French.

Rodney was keen to capture himself the French flagship, "*Ville de Paris*," a fine vessel of over 110 guns, and he determinedly pursued her. Frequently other

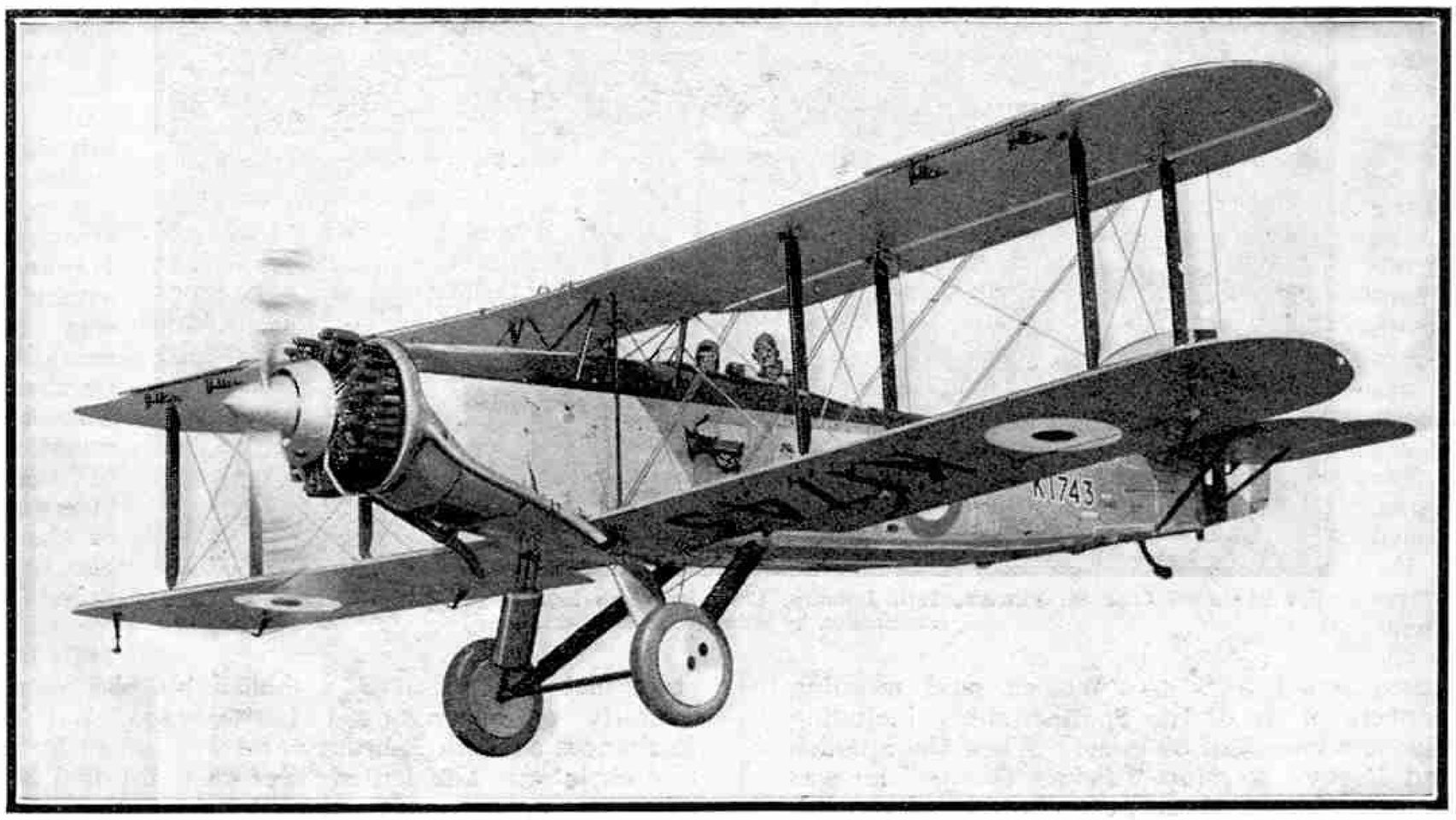
(*Continued on page 690*)

A Radial Compression Ignition Engine

A radial air-cooled compression ignition engine made by the Bristol Aeroplane Co. Ltd., and known as the Bristol "Phœnix," was displayed for the first time in public at the Royal Air Force Display this year. The engine has been produced as the result of seven years' intensive research and development carried out by the firm, and it has now made a number of satisfactory flights and has run for more than 200 hours on the test bench. It is not specially tuned up in any way, nor is any special blend of fuel used, but in spite of this it develops a maximum of 400 h.p. and is capable of giving normally 350 h.p. at 1,900 r.p.m. The engine is of the 9-cylinder type, weighs 990 lb. in a dry condition, and measures 53 in. in overall diameter.

An interesting comparison may be made between the "Phœnix" and the Bristol "Pegasus" engine that develops 600 h.p., which is 200 h.p. more than the "Phnœix." The engines are the same weight, but the fuel consumption at cruising speed of the new engine is 25 per cent. lower.

We hope to publish illustrations and further details of this important and interesting engine in the near future.



A Fairey "Gordon" day bomber in flight. This machine is almost identical with the Fairey 111F but for the fact that it employs an Armstrong Siddeley "Panther" engine instead of a Napier "Lion." Photograph by courtesy of "The Aeroplane."

Vacancies in the R.A.F.

The Air Ministry announces that 245 aircraft apprentices between the ages of 15 and 17 are required by the Royal Air Force for entry into the schools of technical training at Halton, Bucks. and Cranwell, Lincs. They will be entered partly by competitive examination and partly by "Direct Entry" on presentation of an approved first school certificate. Entry from both sources will take place in January, 1934.

The competitive examination will be conducted at numerous local centres on the 7th November next. The sons of officers, warrant officers and Senior N.C.O.'s of the three Services will receive special consideration. Full information regarding the examination, the methods of entry and the apprenticeship training scheme generally can be obtained upon application to the Secretary, Air Ministry (Aircraft Apprentices Department), Gwydyr House, Whitehall, London, S.W.1.

Successful candidates will be required to complete a period of twelve years' regular Air Force service from the age of eighteen, in addition to the previous training period. At the age of thirty they return to civil life but will normally be given an opportunity to enter the R.A.F. Reserve for four years, and to draw a gratuity of £100. A proportion, limited by the requirements of the service, may be permitted to re-engage to complete time for pension.

During the training period the present rate of pay is 1/– a day for the first two years and 1/6 a day thereafter until the apprentice has both attained the age of eighteen and been posted to a Unit on completing his apprenticeship training. When he is posted to a Unit for duty as an aircraftman the commencing rate of pay at present varies from 3/6 to 5/6 a day according to the marks obtained in the passing out examination. He also receives free board and lodging and an allowance for uniform. Subsequently, there is the prospect of promotion subject to his having passed certain prescribed tests.

A few apprentices of special promise are granted free cadetships at the Royal Air Force College for training for commissioned rank. For the remainder, opportunities arise later to volunteer to qualify in flying and become airman pilots. About 100 of the latter are selected annually from volunteers of all trades. From amongst airman pilots a few are periodically selected for advancement to commissioned rank.

New Log for Aircraft

A new air log that is to be a standard fitting in the D.H. "Leopard Moth" provides a record of the total number of hours flown up to 999.9. It is not necessary to switch the instrument on when taking off, which some pilots might forget to do, but is designed so that, as soon as a certain speed is attained, a hand that has been at zero begins to move round the dial of the instrument, which is graduated into 60 minutes and sub-divided into quarter minutes. As each hour is flown it is recorded in a small opening marked "Trip Time." The time is also automatically added to figures in four openings at the bottom of the dial, the hours and tenths of hours being shown. The trip time can be set back to zero without in any way affecting the figures showing the total flying time. This useful instrument has an overall dimension of only about 3½ in., and is only 12 oz. in weight.

British Engines for Spanish Air Line

The Lineas Aereas Postales Espanolas, the Spanish air line company usually known as the L.A.P.E., have just ordered three Fokker F.VIIb—3m ten-passenger high wing monoplanes, each to be equipped with three 340 h.p. British Armstrong Siddeley "Serval" engines, 12 of which have been ordered from the Coventry factory. The first Fokker machine equipped with Armstrong Siddeley "Lynx" engines was supplied in 1929, and since then three other machines of this type have been added to the L.A.P.E. fleet.

The L.A.P.E., which is financed by the Spanish Government but is run as a normal commercial enterprise, operates daily services between Madrid and Barcelona, and between Madrid and Seville. During this year it is hoped that a new line will be opened between Seville and the Canary Islands. The line will go by way of Cape Juby and Rio de Oro, and it is for this service that the new equipment is wanted.

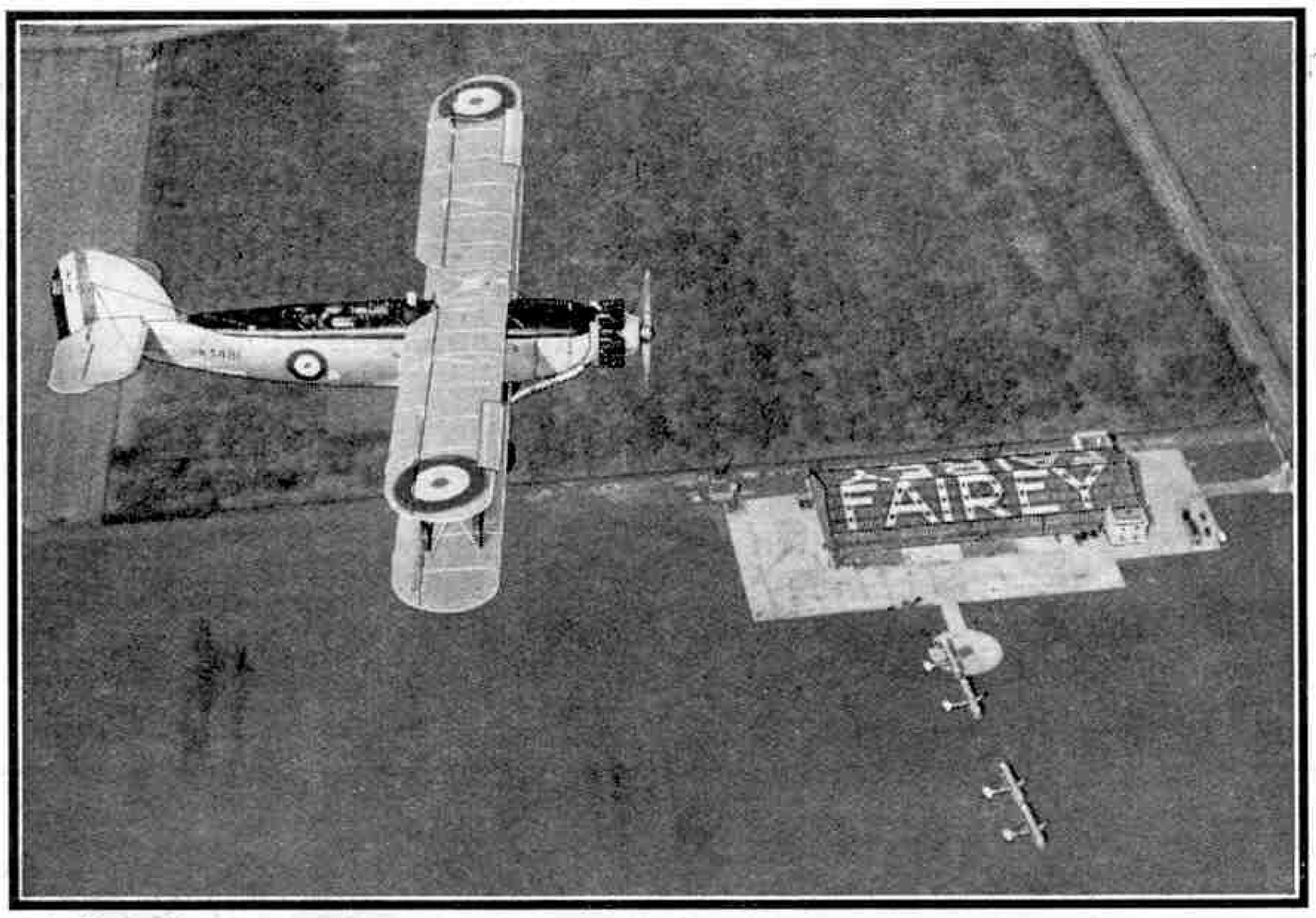
Another service planned is from Barcelona to the Balearic Islands. In 1932, the total distance flown by the company's machines was 379,000 miles.

The London-Calcutta Service

Further details are now available of the extension to Calcutta of the England-India air line, which was briefly mentioned in our last issue. The extension from Karachi to Calcutta is flown by way of Jodhpur, Delhi and Allahabad, and brings the city of Calcutta within seven days of London by air, as compared with 16 days by surface transport. The extension is 1,500 miles in length, and is flown in one day by machines of the Armstrong Whitworth "Atalanta" type. These are big high wing monoplanes equipped with four Armstrong Siddeley "Serval" engines.

The cost of travelling on the new service between Calcutta and Karachi is £30; from Calcutta to Jodhpur is £23; from Calcutta to Delhi £16; and from Calcutta to Allahabad £9. The cost of longer flights is proportionate, the fare from Calcutta to Cairo, for instance, being £82, from Delhi to Baghdad £47, and for the through journey from London to Calcutta £122. Air mail is carried on the service, the inclusive rate for a letter from Great Britain to points east of Karachi being 8d. for the first half ounce and 7d. for each additional half ounce.

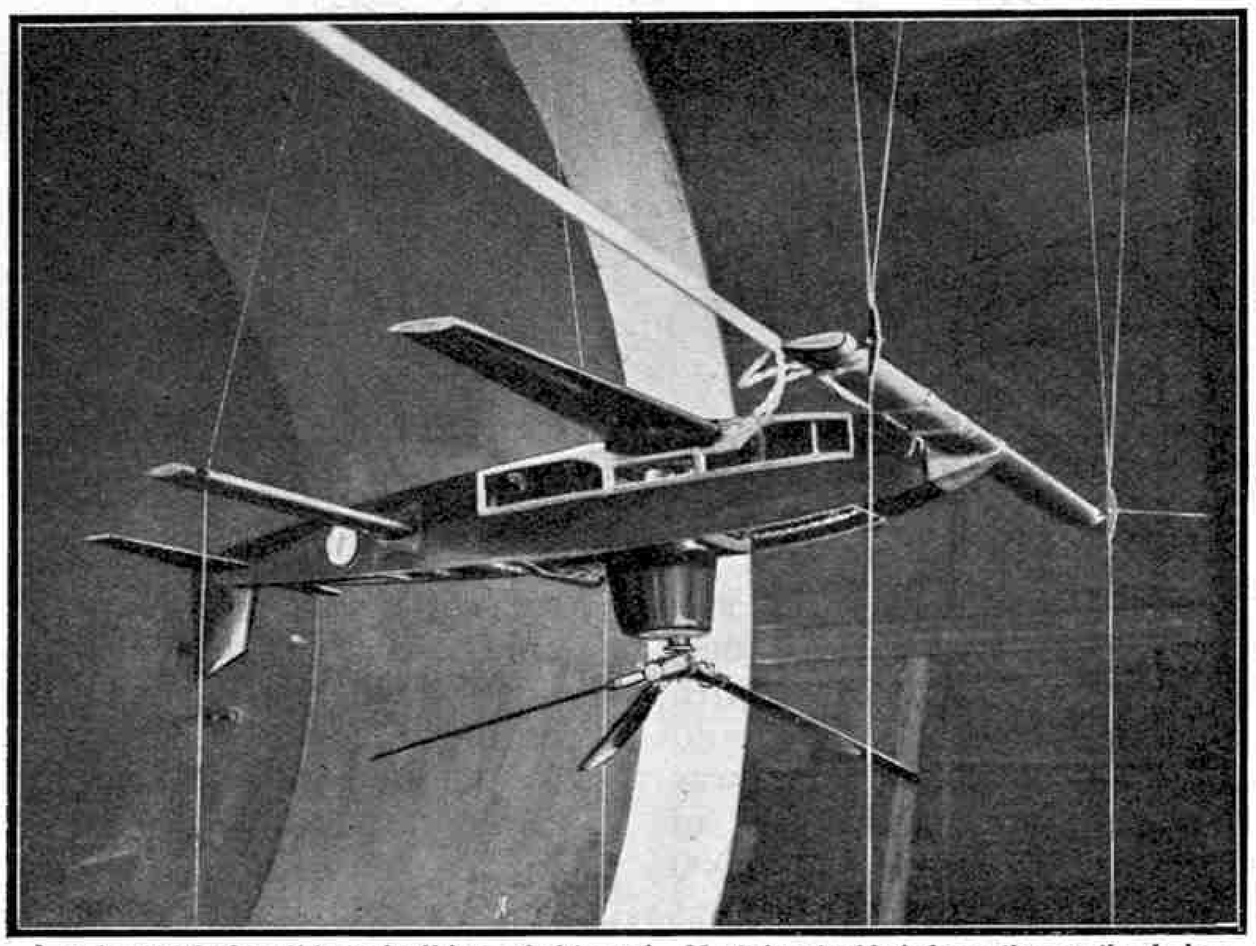
Imperial Airways hope within the next six months to be able to connect up with an Australian air line from Australia.



This illustration shows a Fairey "Seal," the Fleet Air Arm version of the "Gordon," flying over the Fairey aerodrome. Photograph by courtesy of "Flight."

New British Light Engine

A new British engine designed for light aeroplanes has recently succeeded in passing the Air Ministry Type Test. The engine has been built by the British Salmson Aero Engine Ltd., and is of the geared air-cooled radial type. It is known as the A.D. 9.R, and it normally develops 72 h.p. at 3,000 r.p.m., and a maximum power of 77 h.p. at 3,300 r.p.m. It is 174 lb. in weight and thus has a weight-power ratio of 2.26 lb. per h.p.



A scale model of an "Autogiro" in a wind tunnel. Much invaluable information on the design, strength and behaviour of aeroplanes under various conditions has been gained from experiments with scale models in wind tunnels.

The new engine has been developed from the British Salmson A.D.9, a 48 h.p. engine that has seen much service. It is of the 9-cylinder type, and is particularly suitable for use in low-powered light aeroplanes, as distinct from such comparatively high-powered light machines as the D.H. "Moth," and the Avro "Avian." It is also suitable for use in small twin-engined cabin monoplanes. Some idea of its economy in operation may be gained from the fact that the petrol consumption is 4½ gall. per hr.

A Steam-Driven Aeroplane

An aeroplane fitted with a steam engine has been successfully flown in the United States. A flight made with a steam engine would be of great interest if the engine were designed specially for the aeroplane, but the remarkable thing about the American flight is that the power unit employed was a switching engine intended for shunting Pullman cars. The engine is actually now in service on this work.

The engine has been made by Beslar Systems, who for many years have been engaged in work connected with the development of high-pressure light-weight steam power plants. It is a compound double acting Vee unit of the two-cylinder type, one of the cylinders operating at high pressure and the other at low pressure. The bores of the two cylinders are 3 in. and 5¼ in. respectively, and they each have a stroke of 3 in. The cylinders are fed from a boiler of patented design that consists of a single tube 500 ft. in length, and it is claimed that the construction of the boiler makes it possible for a constant pressure to be automatically maintained. The boiler is heated by an automatically controlled oil burner designed to release a maximum of 3,000,000 British Thermal Units per cubic ft. of fire-box area. It is interesting to note that the boiler uses about 1,500 lb. of water per hour, but a special condensing system is provided that recovers about 99 per cent. of this.

The engine develops 150 h.p. at a speed of 625 r.p.m. and with a steam pressure in the boiler of 1,200 lb. per sq. in. The weight of the engine is 180 lb., but the auxiliary equipment brings the total weight up to about 665 lb. If an engine of this design were to be built specially for use in aircraft, however, it is certain that the weight could be appreciably reduced.

During the flying tests the engine was found to be extremely quiet, and an interesting feature was the fact that, as it was possible for the engine to be reversed, the airscrew could be used as an air brake. This feature would often be of great value to an airman.

New Name for Deutsche Luft Hansa

Readers will be interested to learn that the name of the Deutsche Luft Hansa, the German air line company whose activities were described in an article in our July issue, has been changed to "Deutsche Lufthansa Aktiengesellschaft."

The Portishead Power Station

An Important Link in the "Grid" Scheme

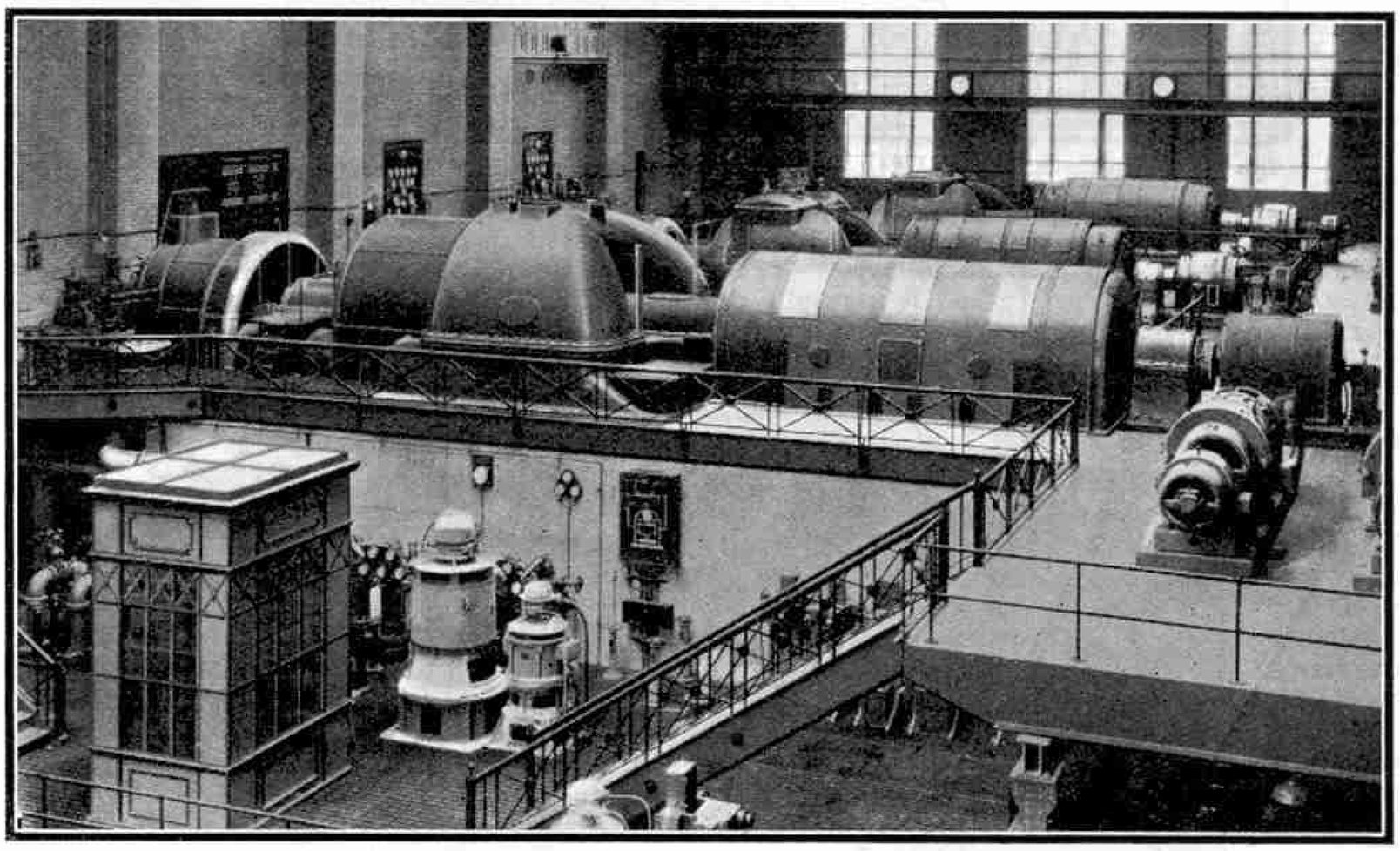
By L. P. Storey

THE last ten years have seen a remarkable expansion of electrical undertakings in Great Britain. The use in electrical form of the energy stored in coal offers many advantages. Electrical appliances are clean and convenient in action, and every year an increased proportion of our coal is devoted to the production of electric light and power.

Fortunately electrical undertakings have not been allowed to grow up in a haphazard manner, and a national scheme controlled by the Central Electricity Board is now in operation. The essential feature of this scheme is the closing down of the smaller and less efficient stations and concentration on a selected few that are larger and more efficient.

When the Electrical Commissioners began their task, there was not a sufficient number of large stations to fulfil requirements, and consequently it was decided to build more "base-load" stations, as they were called, on sites chosen with due regard to load requirements and fuel and water supplies. One of these new stations was designed to serve Bristol and a surrounding area of 115½ sq. miles. In Bristol itself, a city of 400,000 inhabitants, the demand for electrical energy has increased very rapidly during the last few years, and in order to meet future demands a station with a capacity of 340,000 kW has been planned. At present only two 20,000 kW and one 50,000 kW generators are in operation, but later there will be added five turbo-alternators, each of 50,000 kW capacity. Before the station reaches the capacity for which it has been designed, several million pounds will have to be spent on it, and on other work connected with the distribution system, and when it is completed it will form a very important link in the national scheme of the Central Electricity Board.

Bristol formerly obtained current solely from a station in Feeder Road. This station was built in 1902 and has a capacity of 40,000 kW. When the necessity for increasing the supply arose, it was seen that to enlarge the old station by the instalment of new generators was inadvisable, owing to the insufficiency of the water supply available for cooling purposes. A site having no undesirable limitations was required, and this was found near Portishead Dock, which is about nine miles from the city. It is near the River Severn, and is conveniently situated alongside the Portishead Dock and the tracks of the Great Western Railway.



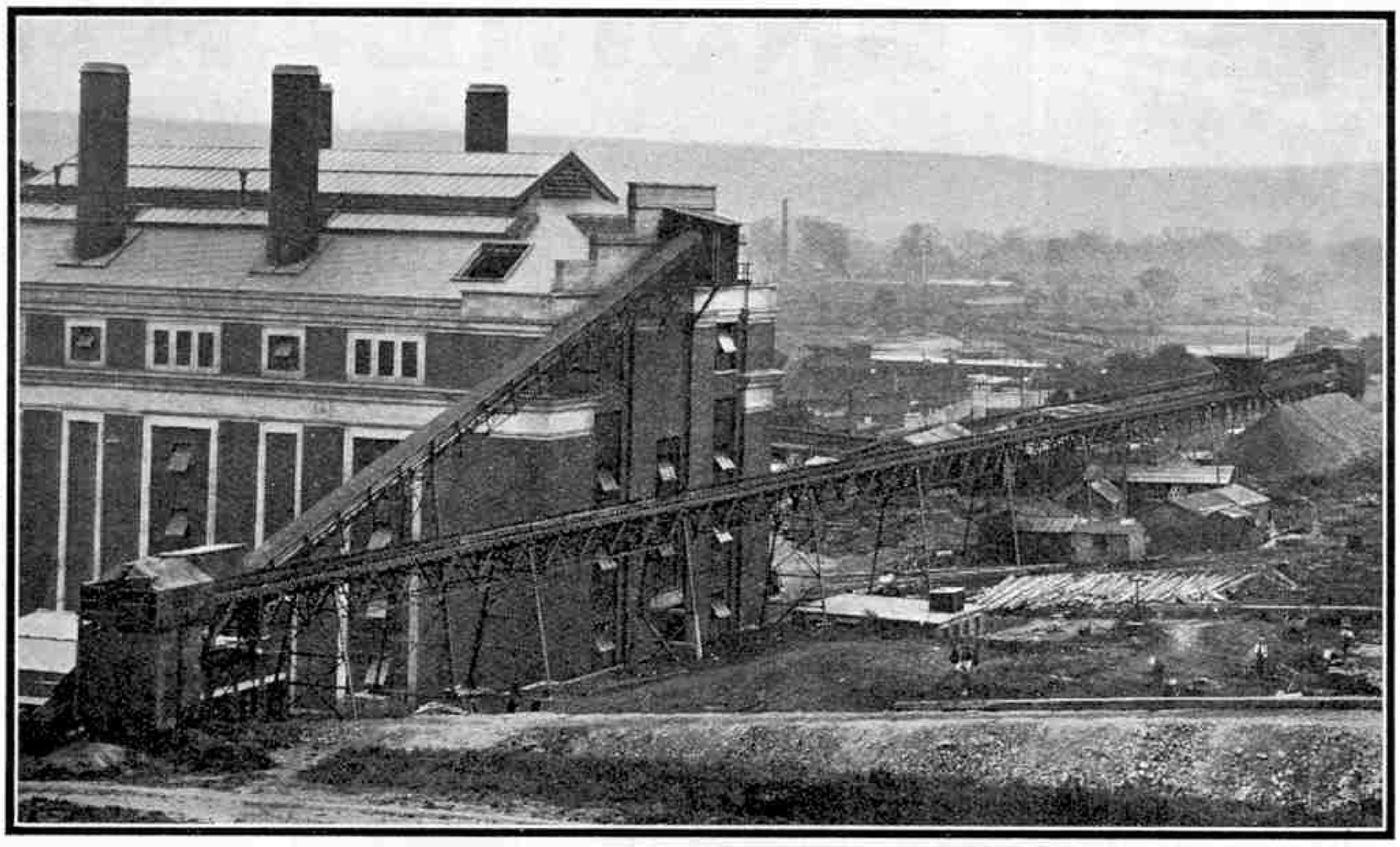
View of the interior of Portishead Power Station. In the centre is seen the 50,000 kW generating set, with the two 20,000 kW sets behind it. The illustrations to this article are published by courtesy of Metropolitan-Vickers Electrical Company Ltd.

The chief requirements of any site for a large generating station are accessibility, room for subsequent expansion, and the presence of an ample water supply for cooling. In each of these respects the Portishead site is almost ideal. Coal can be brought to it either by boat or train, and transferred to the station with a minimum of handling; the site covers 23 acres, and is capable of accommodating plant with a far greater capacity than the 340,000 kW for which the present station is designed; and an unlimited supply of cooling water can be obtained from the River Severn at all states of the tide.

One of the many difficulties to be solved by the contractors was how to find the simplest manner of arranging the run of the innumerable cables within the station. The total length of these is about 15 miles, and it was important to avoid unnecessary crossings, and also to have the number of holes and chases in the walls and floors as small as possible. It is interesting to learn that the problem was simplified by constructing

a Meccano model of a portion of the station, and employing thin copper wires to represent the cables.

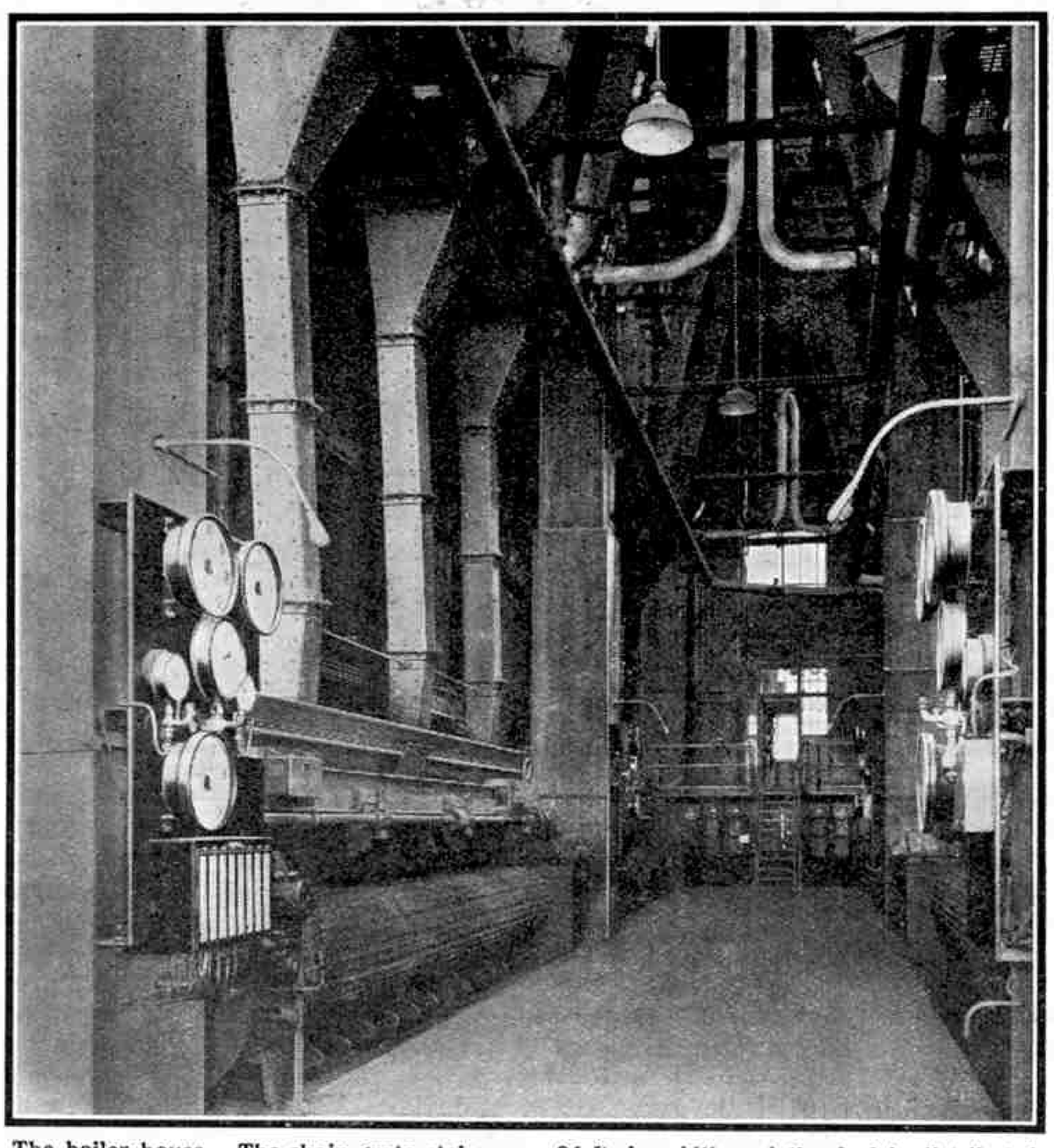
Coal is brought to the station by boat and train. The fuel-handling plant unloads coal at the docks, or in the railway siding, and carries it by belt conveyors to bunkers on top of the boiler house, or to a storage ground at the back. At either of these points 100 tons can be discharged per hour. Other overhead conveyors transport the ashes into wagons on the railway siding or into road carts, while submerged sluices also have been installed in order to discharge them into barges at the wharf.



The conveyor plant at the Power Station. Coal arriving by either rail or water is handled throughout by means of belt conveyors, and ash is carried to the discharging bunker in a similar manner.

From the bunkers the coal is fed to the boilers on travelling chain grate stokers, one to each boiler. Each of these has an area of 432 sq. ft., and burns about 5 tons per hour. The boilers themselves are of the steel-cased, water-tube type, and each has a heating surface of 14,900 sq. ft. Steam is generated at a pressure of 325 lb. per sq. in., and its temperature is raised to 750°F. in superheaters of 3,300 sq. ft. surface.

It is interesting to note that the feed-water system is closed, steam that has passed through the turbines being condensed and returned to the boilers. Distilled water is used throughout instead of natural water, and trouble arising from the deposition of scale is thus avoided. The small percentage of make-up water required is obtained from evaporators fed with water from the cooling system, the necessary heat for these evaporators being provided by steam bled from the low pressure side of the turbines. The utmost use is made of the surplus heat that is contained in the exhaust steam, and after leaving the turbines it is used to raise the temperature of the feed water to approximately 145°F.



The boiler house. The chain grate stokers are 24 ft. in width and the fuel is distributed evenly over them by means of three traversing shutes.

The Metropolitan-Vickers Electrical Co. Ltd., have supplied the whole of the electrical plant within the station, and have installed two-cylinder turbines of the latest and most efficient type. The alternators used in conjunction with them are of the 3-phase 50-cycle type, and generate power at 11,000 v. The 20,000 kW sets run at 3,000 r.p.m. and the 50,000 kW set at 1,500 r.p.m. The rotors of each of the two smaller sets weigh about 20 tons, and that of the 50,000 kW set 33 tons.

An outstanding feature of the station is the manner in which the condensers are supplied with the immense quantity of cooling water necessary. This is obtained from the River Severn, and is brought to the station through four huge culverts each of which has a diameter of 7 ft. 6 in. The range of the tide at this point of the river is no less than 51 ft., and it was necessary to drive the culverts at such a level that water should be available at all states of the tide. The site selected is such that no trouble from silting up is feared.

The culverts installed will deal with from 25,000,000 to 30,000,000 gallons of water per hour. The direction of flow can be reversed, and thus each culvert may be used in turn for suction or discharge. An interesting point is that by concentrating the discharge into a smaller number of culverts the rate of flow through them can be increased in order to scour them clean. Incoming water passes through screens in order to clean it before it enters the circulating water pumps.

In order to overcome the difficulty (Continued on page 690)

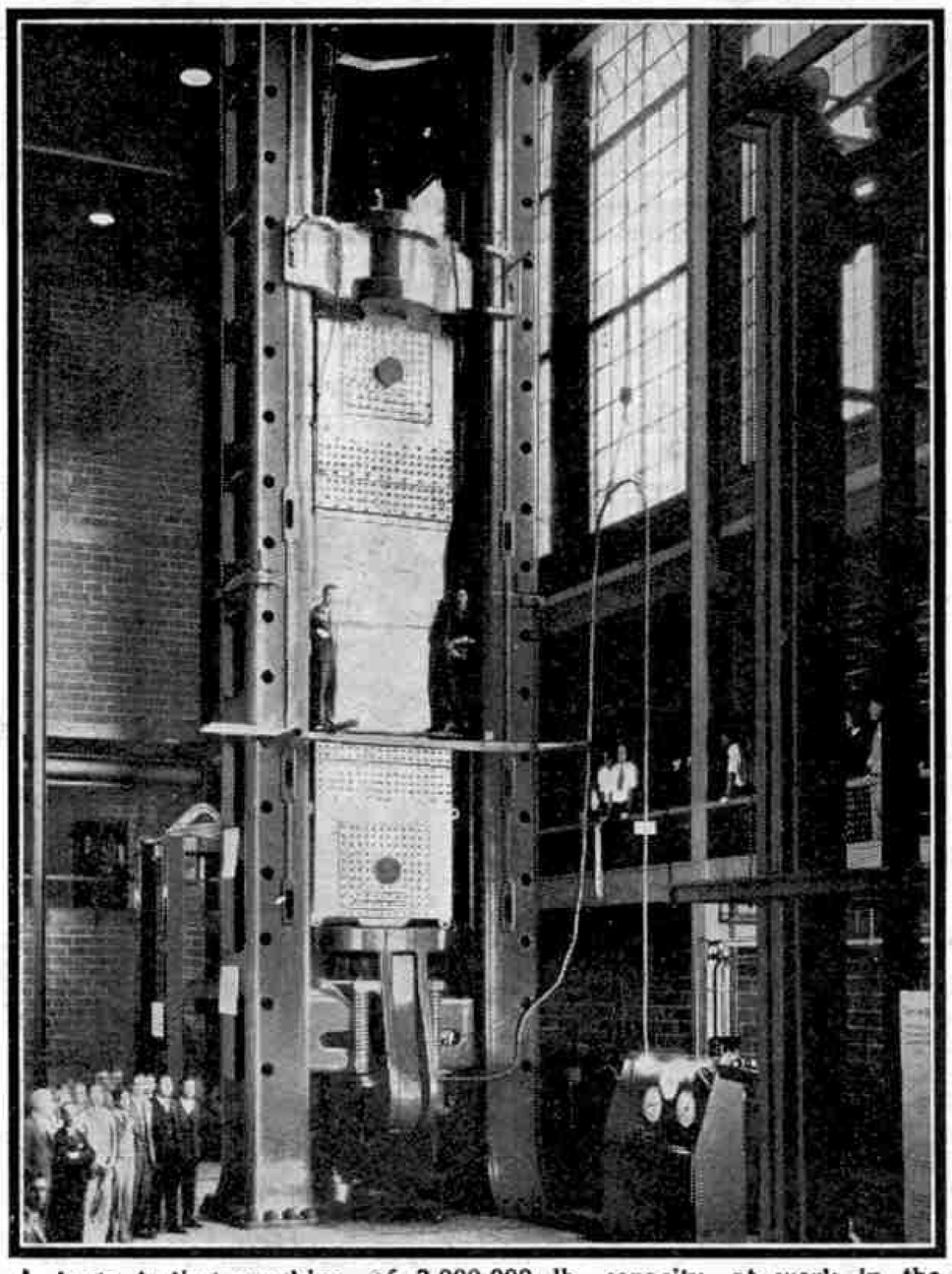
ENGINEERING NEWS

A Remarkable Testing Machine

The great stress and strain to which materials are subjected in modern engineering has led to the invention of some remarkable instruments for testing materials under the most severe conditions. A modern testing machine must operate smoothly and quietly, and respond to delicate control; in other words, its action must be gentle, although it holds in reserve enormous power. In addition it must be extremely accurate, both in its operation and in the recording of the results of tests.

One of the most remarkable machines of this type is installed in the testing laboratory at the University of Illinois, U.S.A. This machine has the enormous capacity of 3,000,000 lb., and is used for tension and compression tests on long specimens of material and for transverse tests on long beams. It operates with equal precision and sensitivity on specimens of all sizes and at all loads. The accompanying illustration gives some idea of the great size of the machine, which provides a maximum opening for tension and compression of 38 ft. 6 in., and a clear width of 7 ft. 6 in. between the huge columns. It is a single-cylinder machine with a 36 in. stroke.

In our illustration a butt weld in a plate 5 ft. by ½ in. is seen undergoing tensile test. The weld broke at 1,000,325 lb.



A huge testing machine, of 3,000,000 lb. capacity, at work in the laboratory of the University of Illinois, in the United States. The machine, which is described on this page, was constructed by the Southwark Foundry and Machine Co., Philadelphia, to whom we are indebted for this illustration.

Bus for Desert Service

A bus specially designed for service across the desert has been built by Albion Motors Ltd., and will be used for the operation of a passenger service between Baghdad and Haifa. The route will be from Baghdad across the Syrian Desert to Damascus, down to Beyrout on the Coast of Palestine, and from there on to Haifa. The first stage is the most difficult, for it is approximately 535 miles in length, and no made or metalled road is available. The nature of the ground differs according to the time of the year, for in dry weather patches of loose sandy soil are often experienced, while in the wet weather the ground becomes very soft and almost prevents progress being made.

The bus produced for the service has accommodation for eight passengers in very comfortable seats, together with room for 140 lb. of luggage for each passenger. It is fitted with two 35-gallon petrol tanks to enable it to complete the journey across the desert without refuelling, while two 5-gallon water tanks are situated on the roof to provide a supply of drinking water. These tanks are surrounded by a packing of ice, and water is led from them to small taps arranged by the side of the seats. The bus can normally cover the journey over the desert at an average of 20 m.p.h., being fitted with special low pressure tyres to assist it in the loose sand.

New Steamships for L.M.S.R.

Two paddle steamships are now being built on the Clyde for the L.M.S.R., to replace the "*Mercury*" and the "*Caledonia*." Although definite figures of their size cannot be given, it is said that they are very similar to the "*Duchess of Hamilton*," an 800-ton ship that made her maiden voyage on the 28th June of this year. This vessel is 271 ft. in overall length, 32 ft. in moulded breadth, 10 ft. 7 in. in moulded depth, and 7 ft. 6 in. in draft, and she is considered to be one of the most comfortable pleasure steamers in operation in this country.

A New Type Tramcar

A tramcar that has been put into service experimentally at Leeds has a number of very interesting features. It is a double-decker, but in spite of this is only 14 ft. 9½ in. in overall height, this low height being necessary to enable the vehicle to travel below a railway bridge that crosses the route on which it runs. Another unusual feature is that the level of the floor in the lower saloon is only 2 ft. 4 in. above the rails, which speeds up the time required for loading and unloading passengers. A specially enclosed compartment fitted with a hinged seat is provided at each end of the vehicle for the driver. There is accommodation for 70 passengers, 30 of these being carried in the lower saloon and 40 in the upper. In both saloons the accommodation consists of transverse seats for two, except that there is one longitudinal seat at each end of the lower saloon. The stairs are completely enclosed.

In order to reduce risk of danger in case of accident the windows are made of the new "Triplex Toughened" armour plate glass, a small beam of which has, as mentioned on page 181 of our issue for March last, withstood the weight of three elephants. This glass is employed also for the curved windows of the vestibule at each end. The vehicle is provided with double headlights, another departure from the usual practice in electric tramcar construction.

The propulsion machinery consists of four 30 h.p. compound-wound motors connected in pairs. The car is arranged for regenerative control, and it is claimed that this is the first time this control has been used with a two-pair motor layout. With this type of control it is impossible for the car to exceed a certain predetermined speed, and when the car is running downhill the motors—which then are not receiving current—are driven by the momentum of the car and act as dynamos, the current that they generate being returned to the circuit.

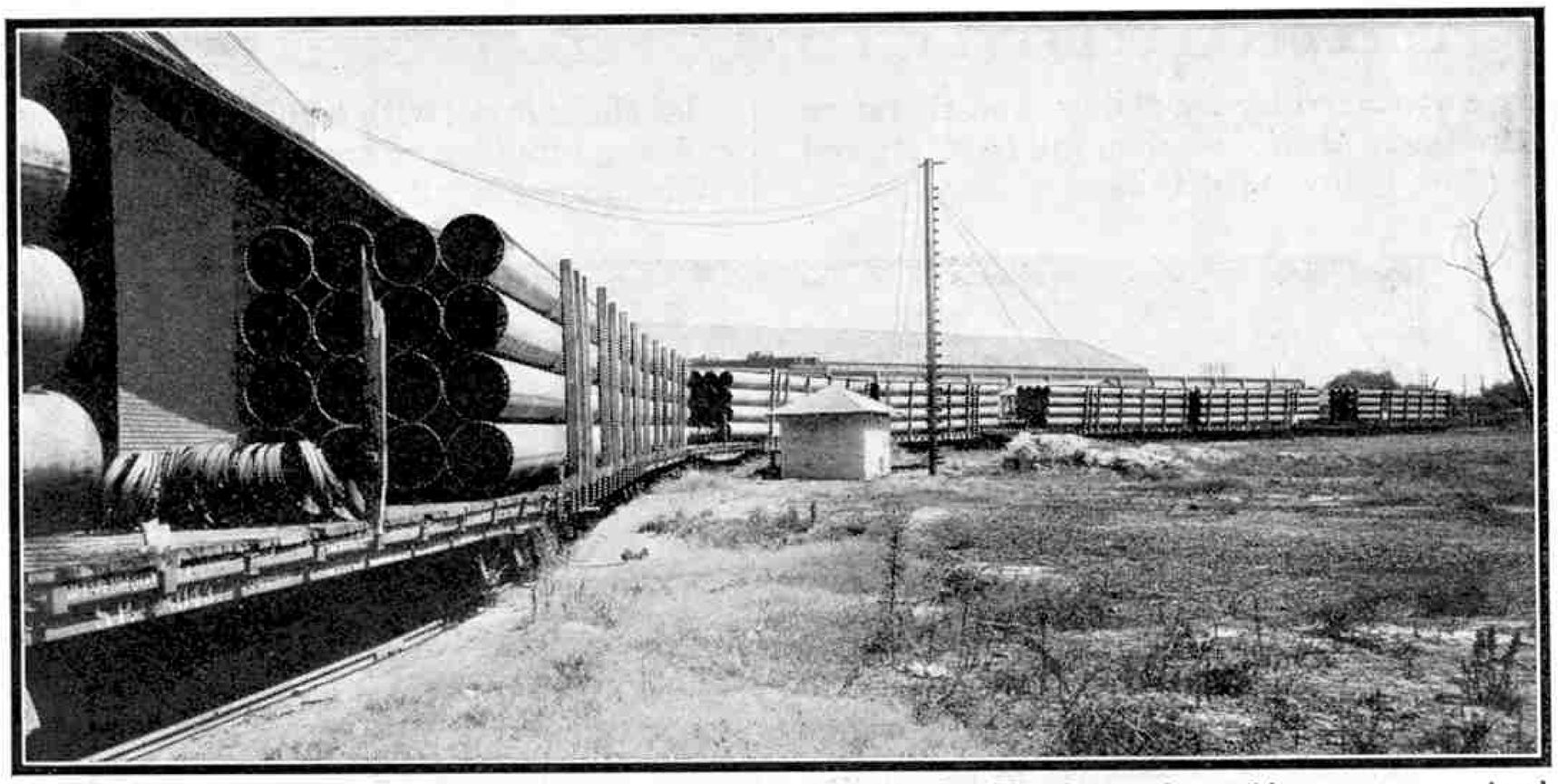
The makers of this interesting car are the Brush Electrical Co. Ltd., the electrical machinery having been provided by the Metropolitan Vickers Electrical Co. Ltd.

* * * *

It is claimed that a new Italian motor liner, the "*Oceania*," maintained an average speed of 22.12 knots for nine consecutive hours during her trials. The vessel is supposed to be the most fireproof ship in the world.

A 207-mile Pipeline for Natural Gas

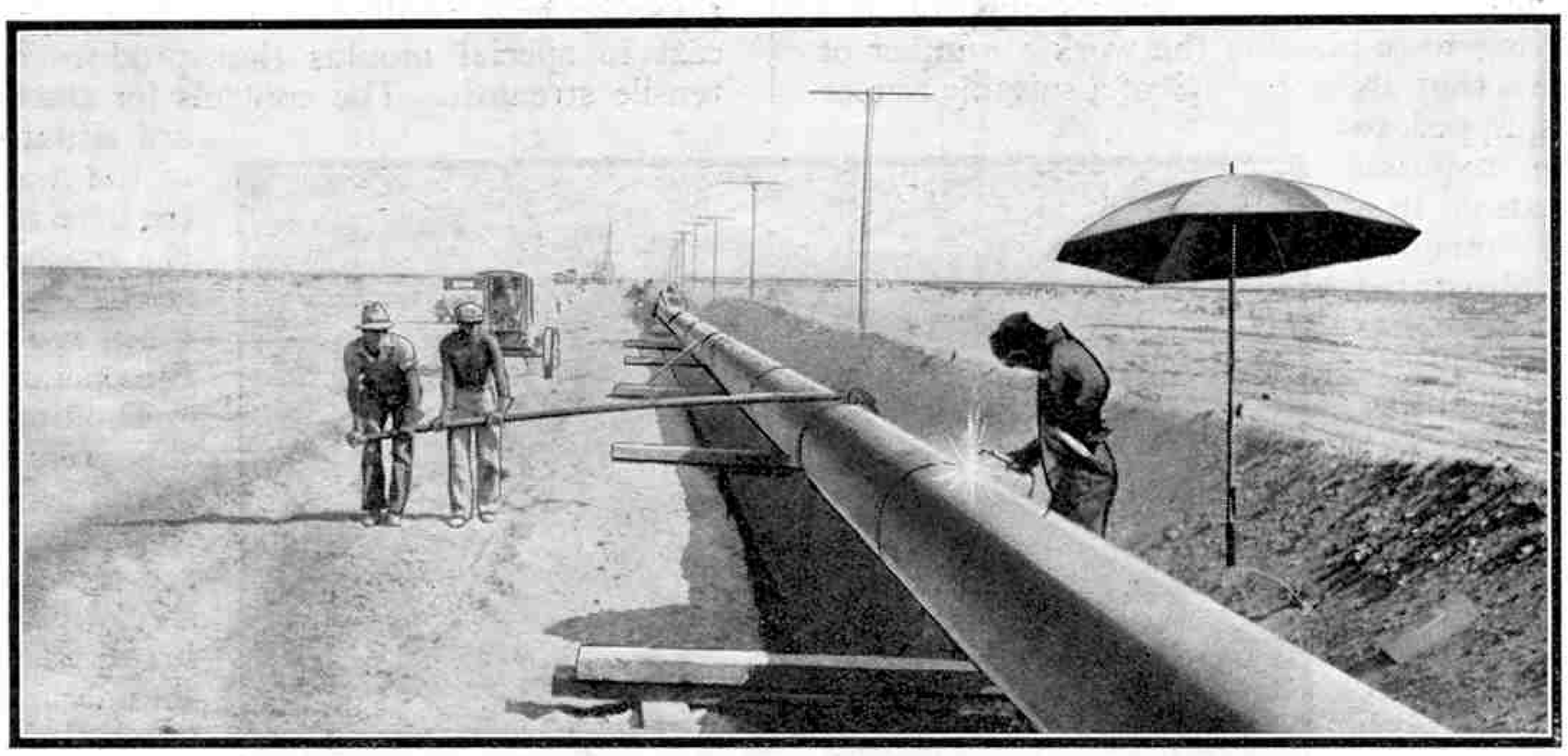
The Southern Fuel Company of Los Angeles, California, have constructed a 26-in. steel pipeline from Kettleman Hills to Long Beach, California, a distance of 207 miles. The purpose of this pipeline is to provide a supply of natural gas for use by the Southern California Edison Company in their steam plant at Long Beach, and for distribution through distributing companies to Los Angeles and the vicinity. The line has a capacity of 130 million cubic feet of gas per day. Three different thicknesses of steel were used in constructing the pipe, 5/16 in. at the Kettleman Hills end of the line, where the pressure is greatest, graduated down to 9/32 in., and finally ¼ in. on the lowest pressure section. The system is designed for an initial pressure of 400 lb. per sq. in., and a minimum pressure at the extreme southern terminus of 50 lb. per sq. in.



A train load of steel pipes for a 207-mile pipe line constructed in California. The photographs on this page are reproduced by courtesy of the General Electric Company of New York.

The Western Pipe and Steel Company of California constructed 76 miles of the pipe used on this line at their Los Angeles plant. The pipe was formed from flat plate. The plates were crimped at the edges in the usual manner, and then formed on bending rolls, after which they were transferred to automatic arc welding machines, where the 30-ft. longitudinal seams were welded by the automatic metallic arc process. After this welding operation, pairs of 30-ft. sections were welded together into 60-ft. lengths, and in this form were shipped to the field location, where they were welded into a continuous line.

The machines used for welding the pipe were equipped with General Electric automatic arc welding heads. Several General Electric 1,000-ampere arc welding generators were required, together with a large outfit of accessories. In conveying the pipe to the field location, an idle flat car had to be placed between every pair of loaded cars, because of the great length of the pipe sections.



Welding operations being carried out on the 26-in. pipe-line constructed through Kettleman Hills to Long Beach, as described on this page.

Craigavon Bridge in Northern Ireland

A new bridge, known as the Craigavon Bridge, has been built across the River Foyle at Londonderry by Dorman, Long & Co. Ltd., to replace the old Carlisle Bridge which has been rendered obsolete by the volume of modern road and rail traffic passing over it.

The new bridge carries two decks, one for a road and the other for a railway line, on spans of 130 ft. There are 17 single deck approach spans, which make the total length 1,260 ft. The roadway is on the upper deck and is 40 ft. in width between kerbs, with two footways 10 ft. in width on each side. On the lower deck is a three-rail track giving gauges of 5 ft. 3 in. and 3 ft. This deck is electrically lighted and provides accommodation for gas and water mains and electric cables.

The construction of the new bridge, which was commenced on 13th April, 1931, involved the removal of some 9,100 cubic yd. of spoil and the placing of 8,600 cubic yd. of concrete. The complete bridge contains 5,000 tons of steel.

The bridge, which is named after Viscount Craigavon, Prime Minister of Northern Ireland, was opened by the Lord Mayor of London.

Open-Mesh Decking for Bridges

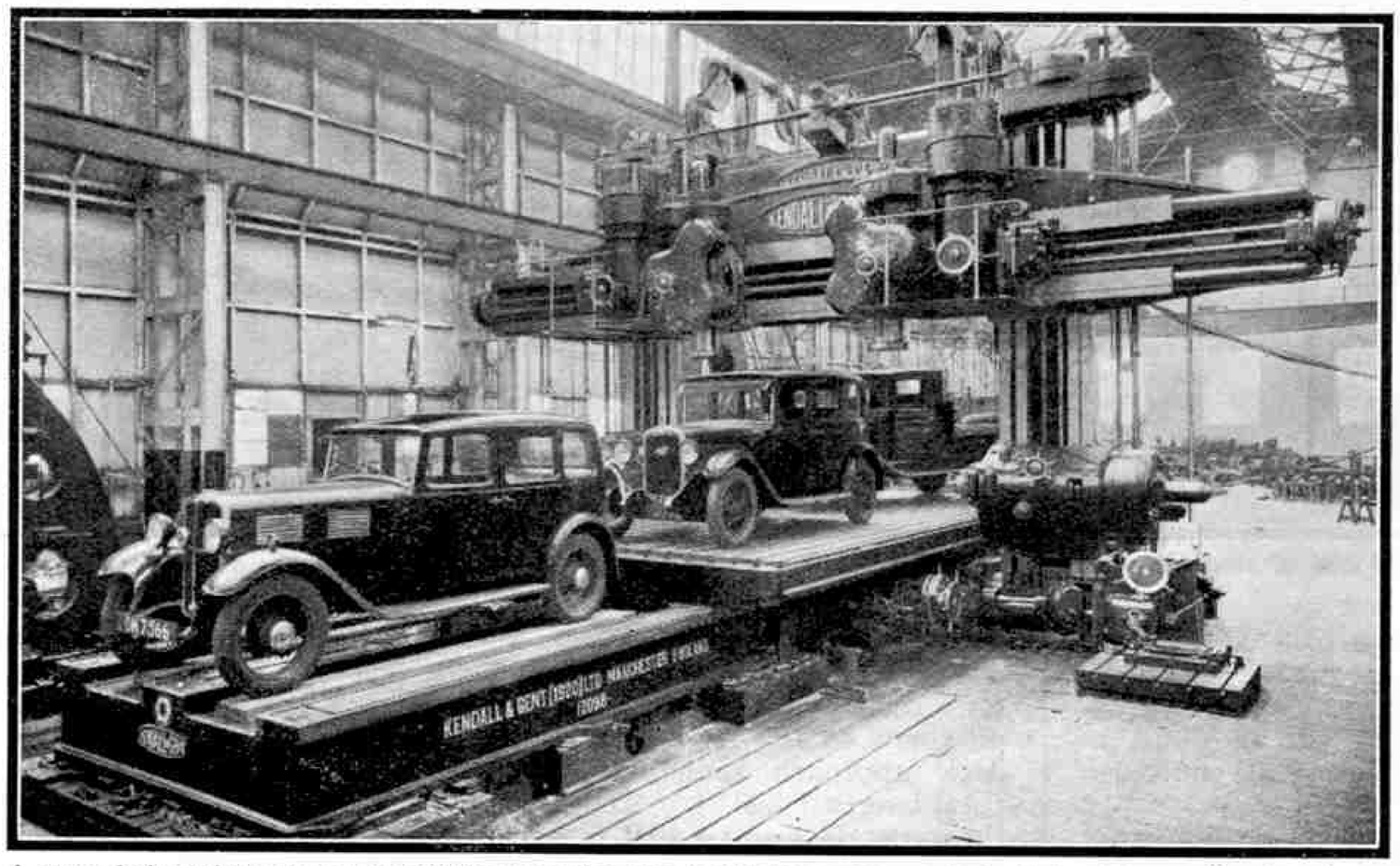
In the construction of a large bridge the weight of the deck is an important consideration, for ordinary concrete and steel flooring usually weighs about 120 lb. per sq. ft. This is of particular importance on bridges with long spans, or on vertical lift and bascule bridges. For some time engineers have been endeavouring to cut down the weight of bridge decks. In many cases lightweight concrete has been employed, but although this reduces the total dead-weight to some extent, it is not a particularly effective method. A better scheme, in which open-mesh decking is used, has been employed on the extension to a bridge at Seattle, Washington, U.S.A. This bridge is of ordinary bascule design and has a normal concrete pavement. Owing to a great increase in traffic it was thought that a new and larger bridge would have to be constructed, but the engineers found that by using steel-mesh decking they were able to support two extra lanes for traffic on cantilevers on each side of the bridge. The weight of this decking is only 21 lb. per sq. ft., which is a very substantial reduction.

Various objections have been put forward to the use of this material on bridges, the most important being that it would be impossible for small animals, such as sheep, to pass over it, as their feet would slip through the meshes. This difficulty could be overcome by sending the sheep across in lorries, or by filling up the meshes with light concrete, which would add to the weight, but would not produce a total weight anything like that of a deck built in the ordinary manner. Cattle and horses are able to cross open-mesh decking without difficulty. Among other points in favour of the decking are that dirt does not accumulate on it, and that it is practically impossible for ice and snow to block up the highway. In addition, in bascule bridges the wind resistance is reduced.

Machining Large Castings

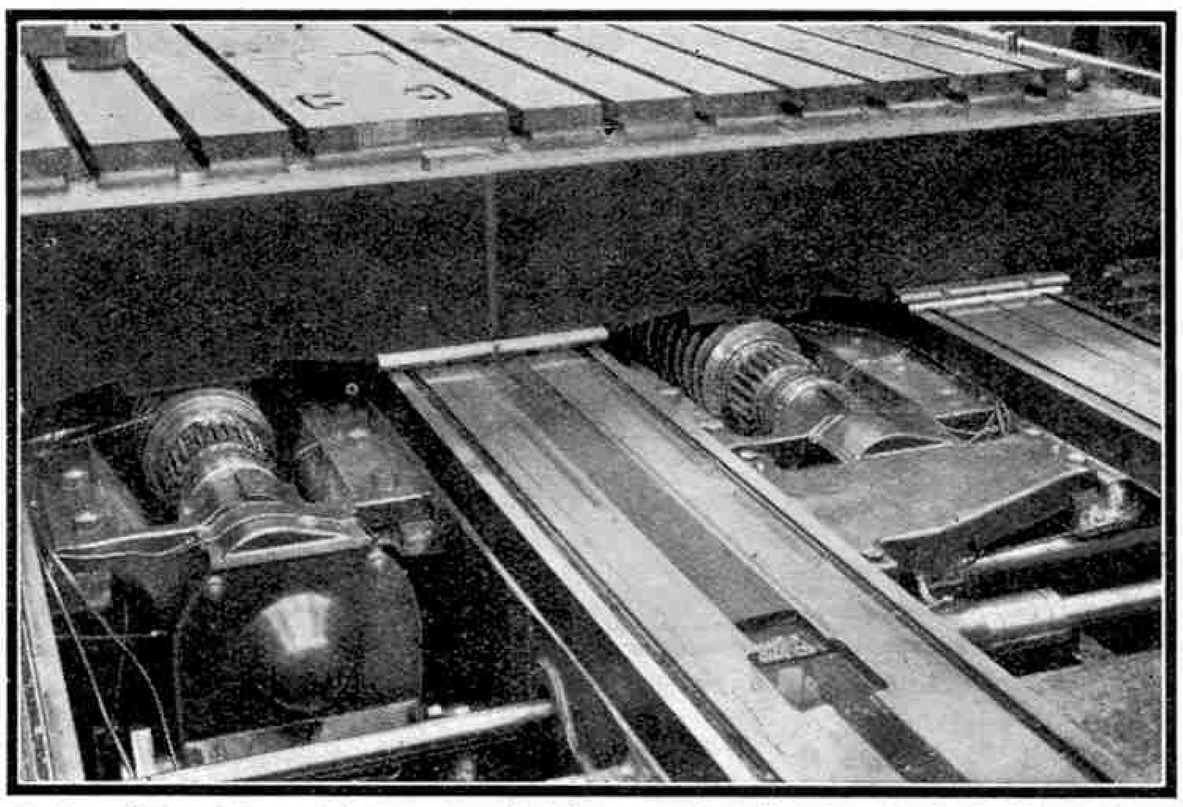
Giant British Machine of New Design

MOST of us are attracted by big things, and therefore we feel sure that "*M.M.*" readers will be interested in reading the following details of a huge plano-milling machine built recently by Kendall & Gent (1920) Ltd., of Manchester, to the order of a foreign Government. This machine is indeed a triumph of British machine tool-making, for it is the largest plano-milling machine yet built in this country, and with it all kinds of the heaviest castings and components, such as are required for large Diesel, steam and other engines, can be handled with comparative ease. This work in the past has generally presented considerable difficulty on account of the necessity of having to re-position the work a number of times on machines that are either not of a suitable size or not properly equipped to carry out the required machining operations in a straightforward manner. The machine illustrated and described here has been designed specially to overcome these difficulties, however, and it works to a very high degree of accuracy.



A general view of the giant Plano-Milling Machine described in the accompanying article. The machine is so large that two motor cars and a truck can be accommodated on it quite easily, as shown here.

One of the principal features of the machine is that it is equipped with multiple milling heads, which enable it to work very rapidly. Work up to 12 ft. wide by 8 ft. high, and 28 ft. long can be handled, and the machine is provided with four spindles. Two of these are fitted on the cross-slide and work in the vertical position, and one on each upright, the left-hand vertical spindle and left-hand horizontal spindle being arranged to swivel 20° each side of the centre line.



A view of the slides and twin worms that traverse the table along the bed. Illustrations to this article by courtesy of Kendall and Gent (1920) Ltd.

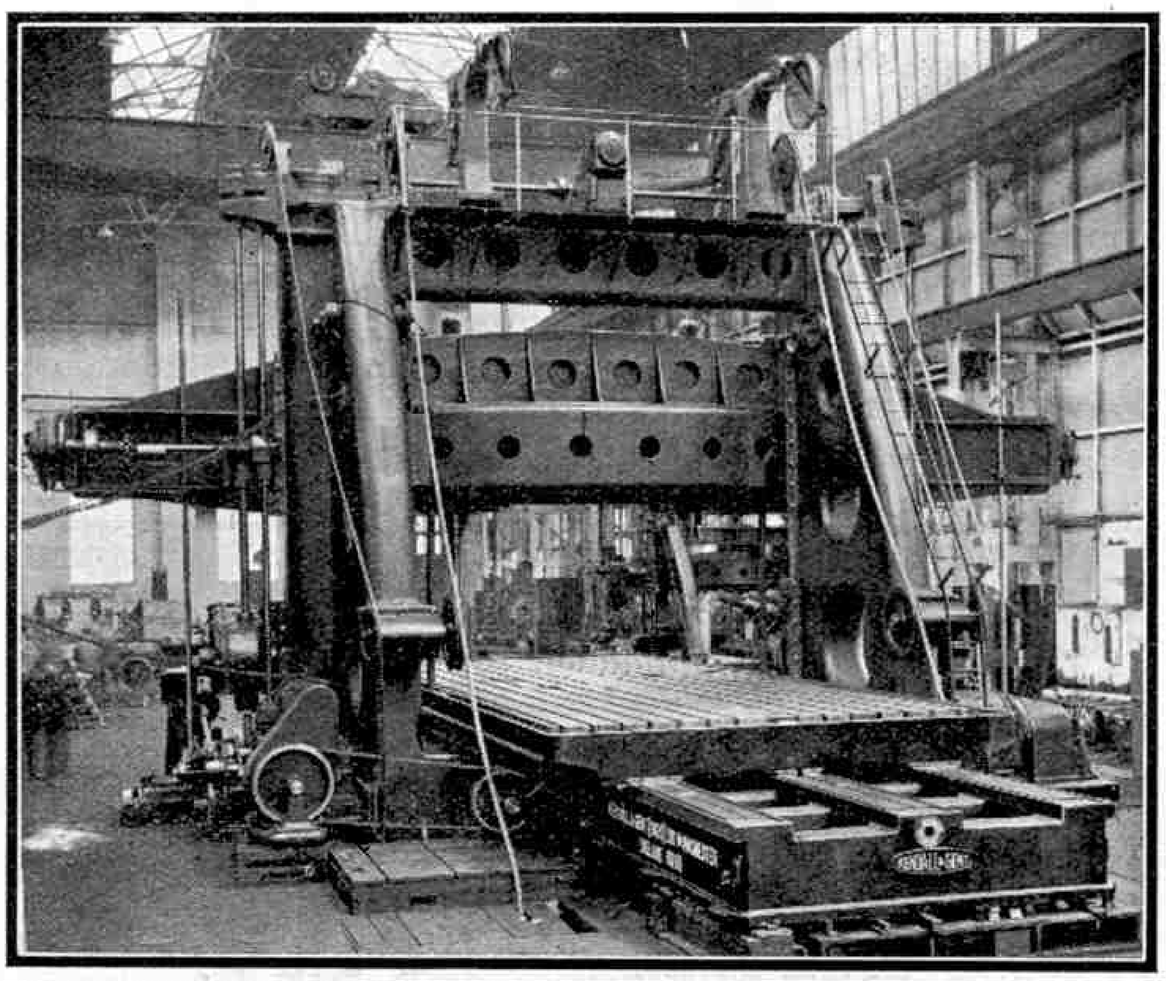
The bed of the machine, which is 53 ft. long, is made of close-grained cast-iron, and is of box section, resting on the foundation for its entire length. Accurately machined flat slides fitted with troughs to collect surplus lubricating oil are provided to receive the work table, which is 12 ft. 6 in. wide overall, and is strongly ribbed on its underside to prevent any deflection or bending when carrying heavy loads. The slides for mounting on the bed have three sliding ways provided with spirally cut oil grooves to ensure the oil being evenly distributed, and so reduce frictional resistance. The job to be machined is held in position by "T" bolts that engage "T" slots cut in the table.

The table is operated by long twin worms that engage with semi-circular racks, the end thrusts on all the worms being taken by heavy ball washers. The racks and worms are cast in special moulds that produce castings of high tensile strength. The controls for the table movement are situated on each side of the machine, care having been taken in designing the machine to place the controls in positions most convenient for the operator.

The uprights that carry the cross-slide and horizontal saddles, in which the rotary milling spindles are mounted, are of massive proportions with broad bases resting on the foundations, and are securely bolted to the sides of the bed and connected at the top by a cross stay. The vertical slides on which the cross-slide and saddles move have broad and accurately machined surfaces. The cross-slide is moved up and down the uprights by a reversible motor mounted on the cross stay at the top of the machine. It is of special deep section, and is designed to prevent any deflection when the two vertical saddles are working in the centre of the machine, in which position the greatest strain is thrown on the slide. The cross-slide has to be

moved up and down the vertical columns according to the height at which it is required to work on a particular job, and in order to reduce the motor power required to move it the cross-slide is partly balanced by a movable counterweight. The slide is worked up and down the columns by elevating screws, and as these are subject to wear, a special type of compensating clutch is fitted on a shaft at the top of the machine so that the slide is always kept in a true horizontal position.

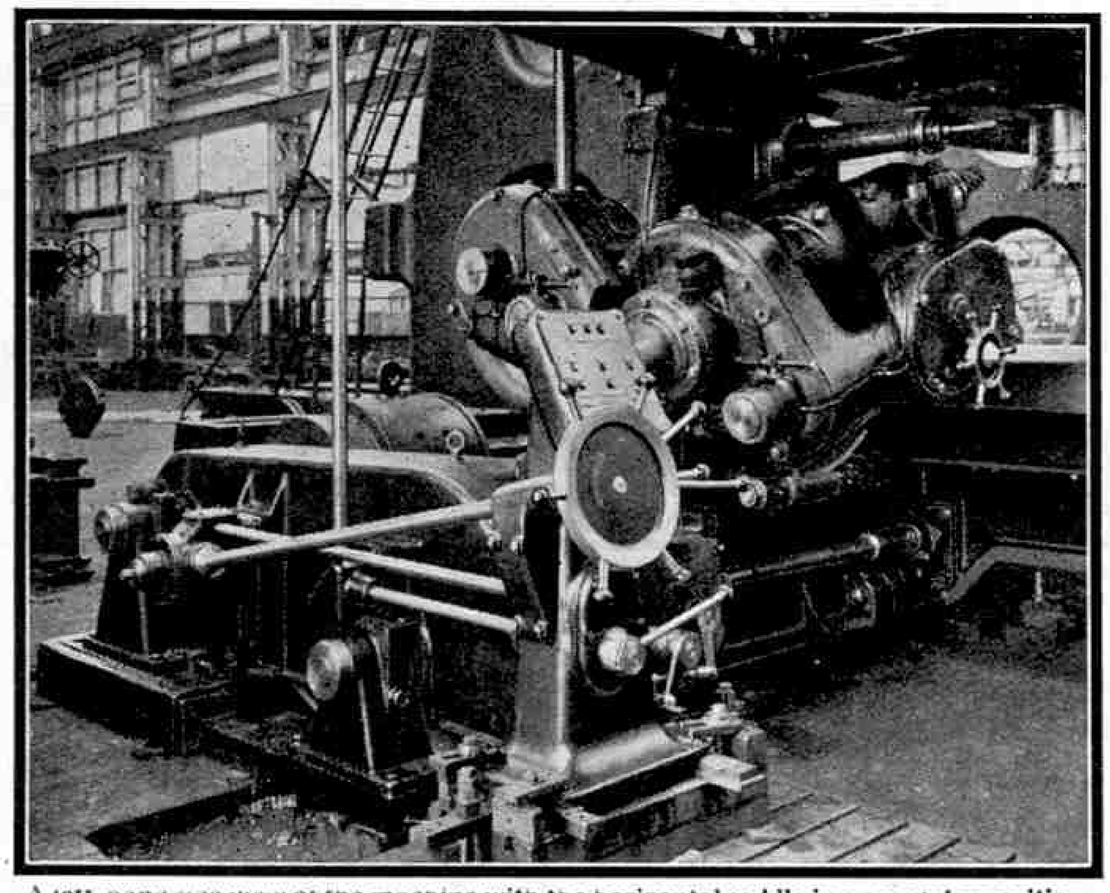
The vertical saddles on the cross-slide are provided with hand and variable self-acting reversible feed motions, together with rapid traverse to facilitate setting up a job, the controls of the feed motions being operated from the platform without the operator having to leave the work. The left-hand vertical saddle is arranged to swivel 20° each side of perpendicular, the purpose of which is to allow castings having angular faces to be machined without any re-setting of the job on the work table. The driving motion to the vertical spindles is taken from separate motors, each of 30 h.p., coupled by gearing to each spindle.



This rear view of the machine gives a good idea of the massive proportions of the uprights and cross-slide, which carry the vertical saddles.

The horizontal saddles, which are mounted on the uprights, are counterbalanced and can be moved in a vertical plane by either hand or variable self-acting reversible feed motions. The horizontal saddles are also fitted with rapid traverse motion similar to that provided for the vertical saddles on the cross-slide, for use when setting up a job. These saddles may be traversed either independently or simultaneously, as desired, and the saddle on the left-hand upright can be swivelled 20° each side of the horizontal.

The main driving motions to the horizontal spindles are obtained from a 60 h.p. variable speed motor situated on the left side of the machine and having a speed variation of 4 : 1. The motor is coupled to the right and left-hand saddles by Texrope drive, substantial shafts and gearing. The spindles carrying the milling cutters are made of heat-treated high tensile steel and run in adjustable conical gun-metal bearings, the front bearings being carried in a steel sleeve that is provided with a fine adjustment, operated by a worm wheel, rack and pinion, for putting on the cut. The casting is closed firmly on the spindle by locking-bolts, which makes the sleeve practically solid with the saddle. Each spindle nose has a recess for receiving the rotary milling cutter or mandrel, the drive being transmitted to the cutter by flats on the collar. Large face milling cutters, however, are mounted direct on to the flange on the spindle.



A left-hand side view of the machine with the horizontal saddle in an angular position. The push-button control panel, from which the various operations of the machine are controlled, is shown in the centre foreground.

The feed motions to the work table and saddles are obtained from a 20 h.p. reversible motor, which is coupled to a gear-box fitted with hardened steel gearing mounted on splined shafts that run continuously in oil. The gear-box gives nine rates of feed to each spindle speed.

All the various motions of this wonderful machine may be operated independently or simultaneously, and are controlled by means of levers and push-buttons switched from the operator's normal working position on each side of the machine. This arrangement is very useful and necessary on a machine of this size and weight, and is largely responsible for the continually high output that can be maintained without undue fatigue to the operator.

Lubrication of the various units of the machine has received careful attention. Wherever possible splash lubrication is employed, a special forced feed being used in places where the splash system is unsuitable.

The whole of the electrical equipment of this machine was supplied by the Metropolitan-Vickers Electric Co. Ltd. The motors are of particularly robust design, and were tested to withstand the very arduous and severe conditions under which they will have to operate. The control panels, on which are mounted the various push-buttons governing the different motors, are so arranged that in the event of any spindle of the machine stopping while the feed motion is in operation, the feed motor is automatically cut out, thus preventing any damage to the milling cutters. To prevent still further any possibility of damage to the cutters, it is made impossible to operate the feed motions without starting the spindle required for the work in hand.

When it is necessary to move the work table and saddles for setting-up purposes, however, a special change-over switch may be operated, enabling these motions to be carried out. Push-button controls are also placed at points most convenient for the operation of the various motions, enabling the operator to start and stop every motion from the normal operating position.

Largest Synchronous Electric Motor

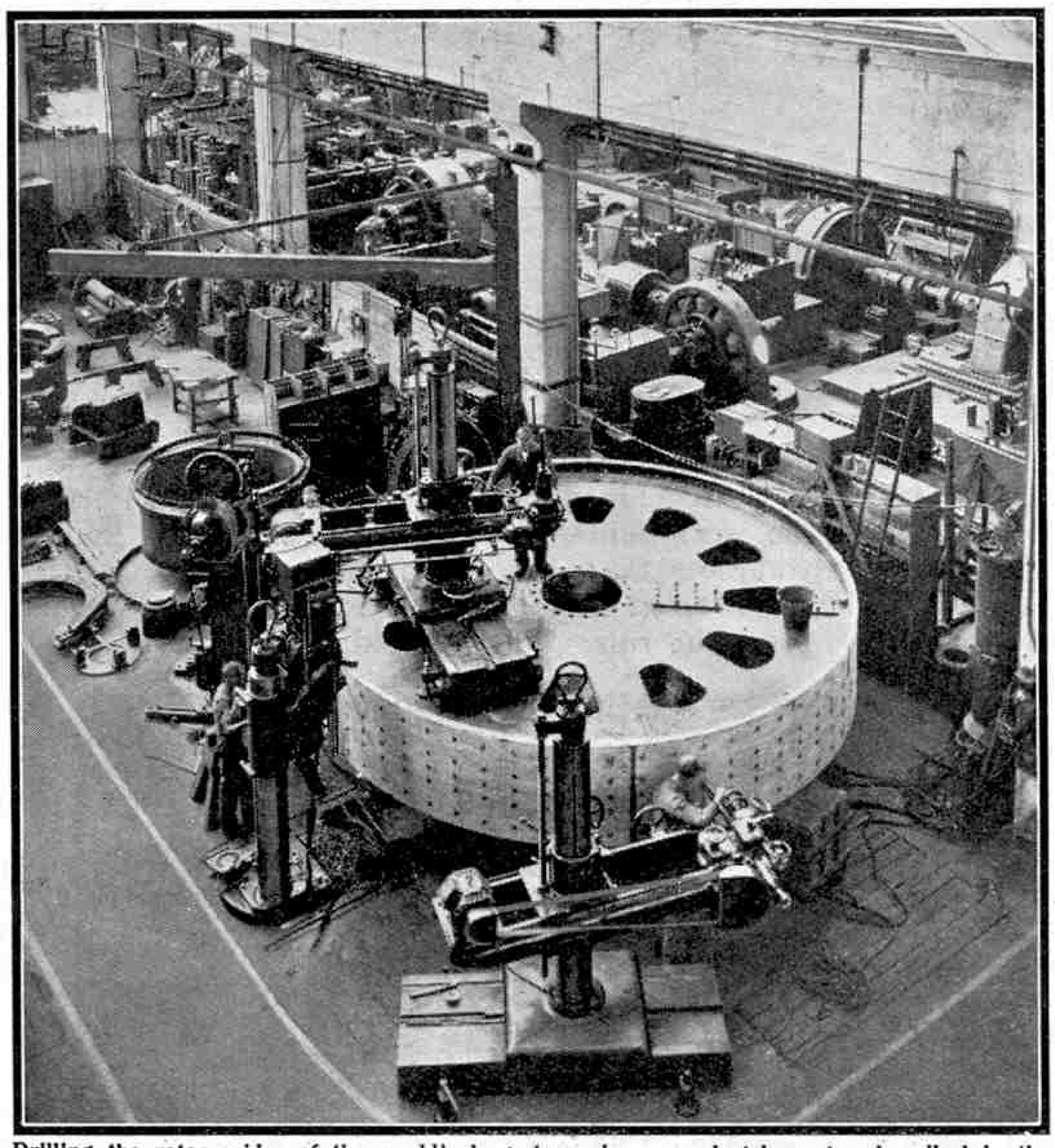
A British Firm's Great Achievement

AT the Rugby Works of the British Thomson-Houston Company Ltd., there has been built a wonderful electric motor that is believed to be the largest of its kind in the world. The motor, which is of the synchronous type, totally enclosed, is rated at 7,500 h.p., 6,300/3,150 volts and 50 cycles, and will be able to take peak loads of 18,750 h.p.

This huge machine will be employed to drive the steel-rolling mill at the Jamshedpur Works of the Tata Iron and Steel Co., in India, and is the first large synchronous motor built in this country for rolling mill drive. Its tremendous size will be better realised when it is known that the outside diameter of the stator frame is 26 ft., while the length of the complete machine over the coupling is 22 ft. 10 in. The total weight of the complete stator is 53 tons, and the rotor weighs 68 tons, including the shaft and coupling of 21 tons. The total weight of the complete machine, including the baseplate and bearing pedestals, is 160 tons.

The B.T.H. Co. Ltd., received the order for the motor on 19th August, 1932, and on 8th October, seven weeks after the order was received, the machine was completed and had passed its final tests. The speed with which the work was carried out is therefore in itself a remarkable achievement, and one of which the B.T.H. Co. Ltd., and the British electrical industry generally have every reason to be proud.

In accordance with the best modern practice in building medium and large-sized electrical machines, the motor is constructed of fabricated steel throughout. In this form of construction built-up sections made from steel plates welded together are used in place of castings. This kind of construction ensures a lighter yet stiffer structure than is the case when castings are used, and also there is no delay in waiting for patterns and castings to be made, so that the process is particularly valuable when a job is urgently required. The only castings used in this great machine are the pedestals and bearing liners.



Drilling the rotor spider of the world's largest synchronous electric motor described in the accompanying article. For our illustrations we are indebted to the courtesy of the British Thomson-Houston Company Ltd.

The circular stator frame, which supports the stator core and coils, and inside which the rotor revolves, is of box section and is built up from heavy steel plates and cross bars, the various members being welded together to form an extremely rigid structure. In order to prevent condensation of moisture in the stator core and windings during periods when the motor is not working, special heating units are provided in the stator frame.

The stator core consists of segmental soft steel laminations, and many ventilating ducts are provided, which communicate with the back of the frame to allow unrestricted circulation of air for cooling purposes. The laminations are held to the stator frame by means of folding keys, consisting of two parts tapered and dove-tailed so that when they are placed together they form split double dove-tailed keys, which fit into corresponding dove-tailed slots in the stator frame and the stator laminations. These keys hold the laminations hard up against the stator frame, and in addition the laminations are securely clamped together by means of heavy steel bolts placed at the back of the stator core.

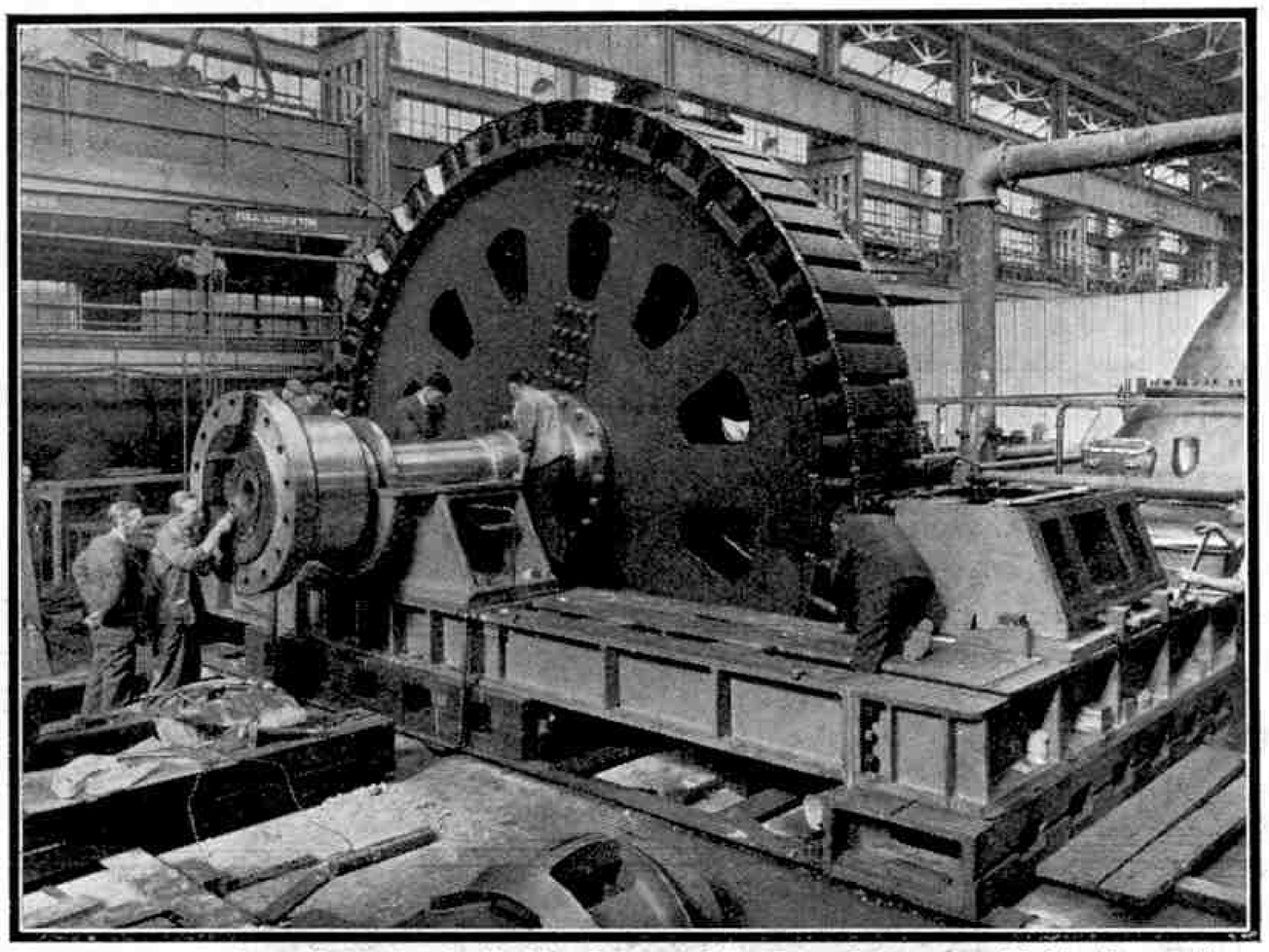
The stator coils are wound on a former, all the turns being arranged in a single tier in order to maintain a low voltage between adjacent conductors. The individual conductors are of rectangular asbestos-covered copper wires, and each turn is insulated with mica tape. The portions of the coils that fit into the slots provided in the cores are insulated with mica-folium, ironed on by a special process and then pressed to the shape and size of the slots. The end windings are also insulated with mica and then covered with a final protecting layer of varnished tape.

In order to protect the coils from accidental mechanical injury, varnished horn fibre slot liners are provided, and specially treated wedges are driven in over the coils. The end windings are supported by being securely lashed to insulated steel rings held by brackets from the stator frame. The ends of the stator are enclosed by

sheet iron covers assembled on a channel framework in sections, the whole arrangement being such that by removing the covers the motor could be converted from a totally enclosed to an open type machine whenever operating conditions on site required this change.

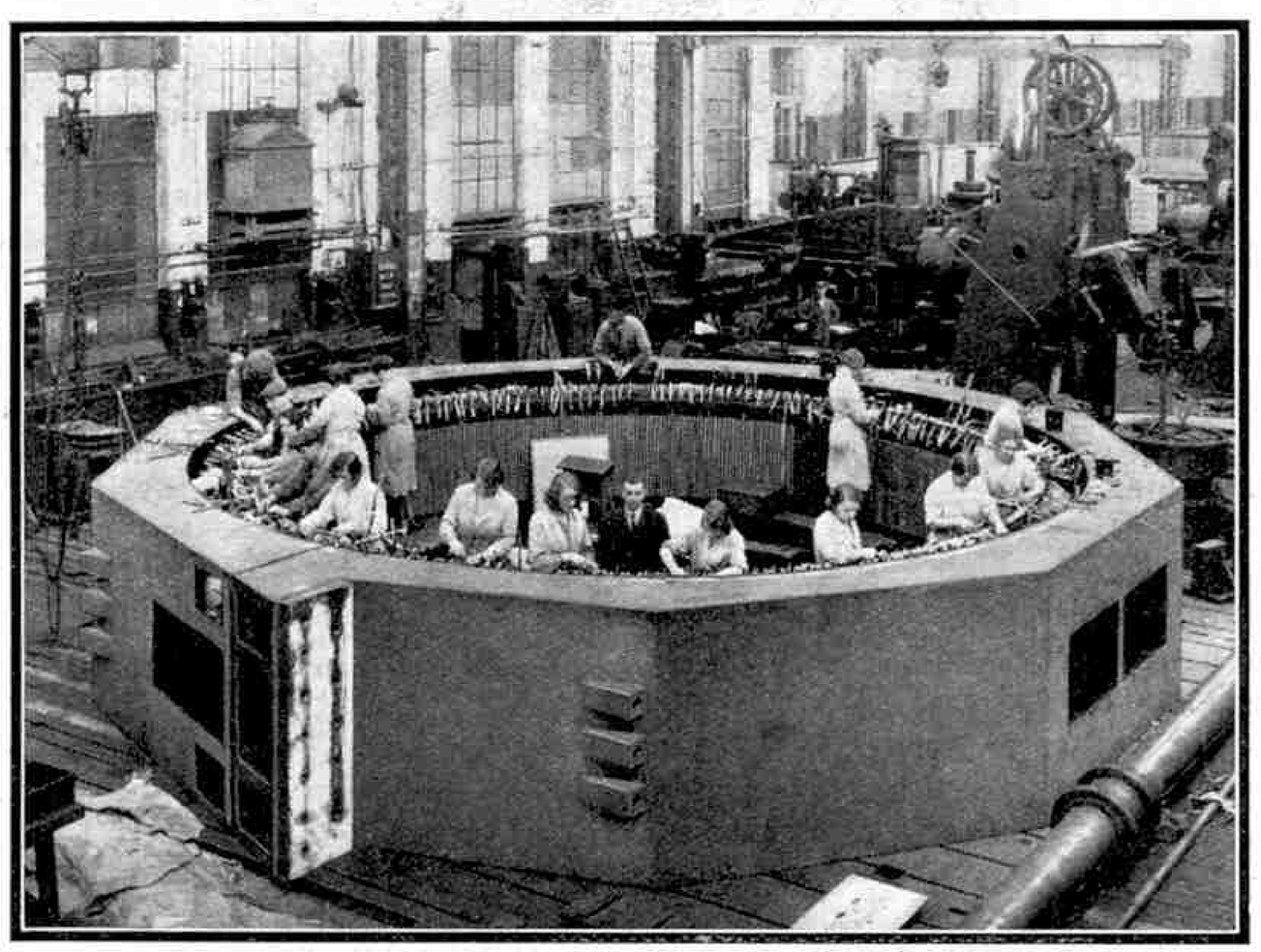
Two water-cooled bearings, each 24 in. in diameter and 38 in. long, are provided for the rotor shaft, and the bearing pedestals, caps and liners are all cast in semi-steel and are amply proportioned to carry the stresses imposed upon them.

A ring forged solid with the shaft forms the thrust collar for a thrust bearing that is provided to take up occasional accidental thrusts on the shaft. The thrust bearing consists of Michell thrust pads mounted on a semi-circular ring, which is secured to the bottom half of the pedestal inside the housing.



The photograph shows the bottom half of the Stator and the Rotor being assembled in the erecting shop. Comparison with the workmen gives an idea of the great size of the machine.

The rotor coils are mounted on poles built up of sheet steel laminations, hydraulically riveted together and fitted with steel end plates. The poles are secured to the periphery of a steel ring that forms the rim of the rotor spider. The windings consist of rectangular copper strip wound on edge and mica-insulated between each turn, the coils being insulated from the poles by mica reinforced with varnished horn fibre and securely supported in position between moulded insulation flanges. Pole face squirrel cage windings are provided, consisting of alloy bars embodied in holes in the pole faces and short circuited by means of brass segments to which they are silver-soldered.



Girl operators, working under expert supervision, engaged in the delicate task of winding the Stator coils. The diameter of the Stator is 26 ft., and it weighs 53 tons.

For the purposes of transport the rotor spider is made in two halves and consists of a steel rim and centre discs. These discs are connected by means of heavy bolts to corresponding flanges forged on the shaft. The joint between the two halves of the rim is made by means of tapered keys, and the two halves of the centre discs are joined together by means of plates and a large number of accurately fitting bolts.

Mild carbon steel is used for the shaft. After forging and before machining the shaft was thoroughly and uniformly annealled, and after machining to rough dimensions it was subjected to further heat treatment and then allowed to cool freely. A hole was then bored through the centre of the shaft for its full length so as to expose any internal flaws. When the shaft was completely machined all over to the finished dimensions, a forged half coupling, which connects to a half coupling on the mill shaft, was shrunk on and keyed in position.

The current collector rings are mounted on a sleeve insulated by means of a mica bush, and the brush holders are supported from the bottom half of the pedestal bearing, each holder being capable of individual adjustment.

The main terminals consist of insulated copper bars, which are brought to an opening at the bottom of the stator frame and clamped in position by means of aluminium plates, provision being made by means of links for changing the connection for either 6,300 volts or 3,150 volts as circumstances may render necessary.

The huge baseplate on which the stator frame and bearing pedestals are mounted is made up of heavy girders, and by means of hydraulic jacks the stator frame can be racked aside in order to expose the rotor poles and the inside of the stator core for inspection.

Starting, stopping, and reversing of the mill can be completely controlled from a pedestal placed in a convenient position near the mill, and carrying a master controller, a push button and three indicating lamps. By moving the master controller the motor may be started in either direction, stopped or " plugged " if a quick stop is desired. The master controller merely initiates the starting operation, which is thereafter carried out completely automatically by means of an automatic control panel working in conjunction with solenoid-operated circuit breakers in the stator circuit of the motor. In addition to the motor and starting gear there is a separately driven exciter machine for supplying

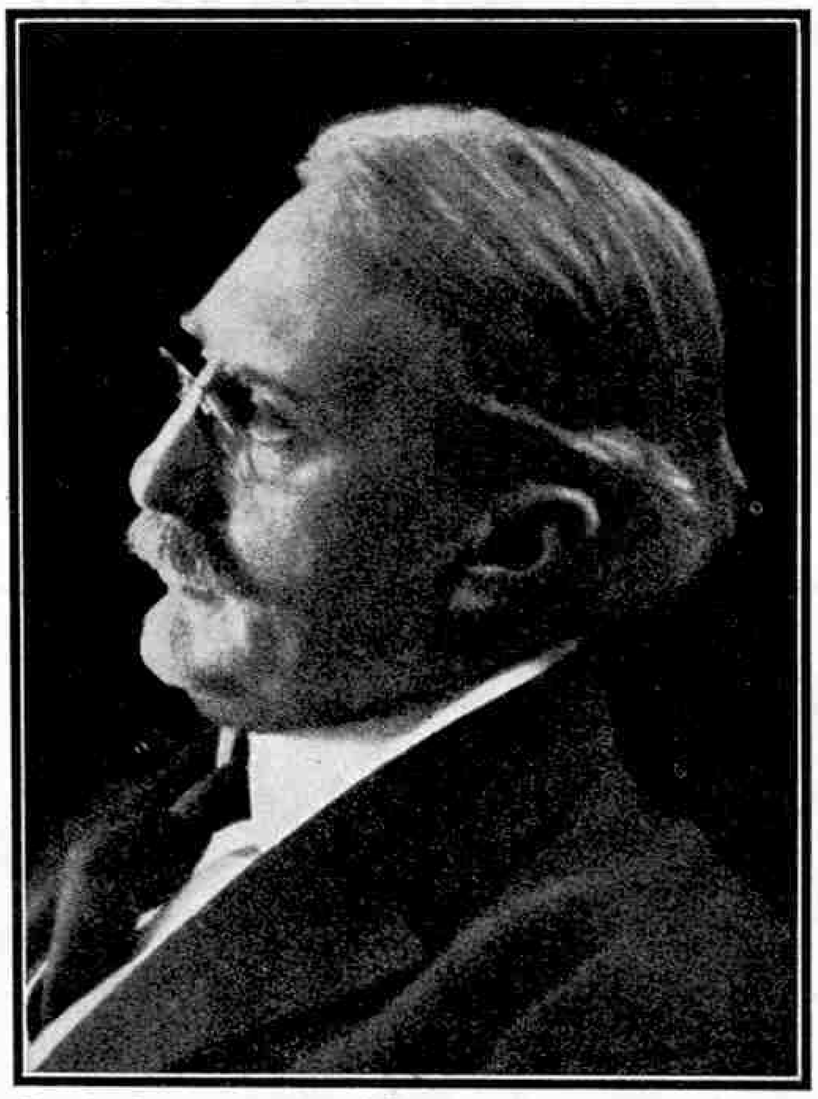
(Continued on page 683)

XLVI.—A SALESMAN

NOT very many years ago the salesman was only someone who accepted orders, wrapped up goods and received the payment for them. Nowadays salesmanship has become a highly specialised career, and in fact it is possible to obtain a university training in it in some parts of the United States. In this country we do not carry things quite so far, but definite training in the career is available, most of the big stores running schools and classes for their employees. These are more educational departments than sales training schools, for their object is not to "make" salesmen, but to turn to the best advantage the natural selling abilities of young aspirants. A good salesman must be smart in appearance, thoroughly acquainted with the goods of which he is endeavouring to dispose, and able to talk convincingly about them to the customer. It is necessary also to be courteous and obliging and, in order to make a real success, to be a keen student of practical psychology.

Years ago the customary method of embarking on the career of a salesman was to become an apprentice with a draper, or the owner of some other shop, the apprentice paying a premium and being boarded by his master, but receiving very little pay. It is not now usual for any proper apprenticeship indentures to be taken out, and comparatively good wages are paid. This is particularly so in the case of the larger shops.

Salesmanship is a career in which practical ability is always recognised more than purely theoretical knowledge. This fact must not deter a boy from obtaining as good an education as he is able, however, for it is absolutely necessary to obtain a good educational background in order to reach the highest positions. If possible, a boy should attend a good secondary or public school and remain there until he has reached the age of about 16 or 17. Before leaving school he should sit for the matriculation or school certificate examination, as some large firms require all applicants for employment to be in possession of one of these recognised educational qualifications. A boy who fails to pass any examination of this nature should not be downhearted, however, for some of the biggest firms in the country realise that in many cases such an examination often defeats a boy who would make an excellent salesman. It is therefore a general rule that, so long as a boy has more or less reached matriculation standard, and is intelligent and smart, he will be given a trial, provided, of course, that he is otherwise suitable and that there is a vacancy for him.



Mr. A. Gordon Selfridge, founder of Selfridge & Co. Ltd. Mr. Selfridge was born at Ripon, Wisconsin, U.S.A. in 1864. He began his career with the firm of Marshall, Field & Co., Chicago, from which he retired in 1904. In 1906 he organised Selfridge & Co. Ltd., which began business in 1909 in extensive premises in Oxford Street, London, and developed into one of the most successful enterprises of its kind in the world. Mr. Selfridge is the author of "The Romance of Commerce," which traces the growth of commerce from earliest times to the present day.

A boy who intends to become a salesman should definitely not leave the matter of securing work until he has left school. He should select some firm by whom he would like to be employed and should then write to the Staff Manager, stating when he will be leaving school and asking for an interview. If he is granted this, and he appears to be a suitable type of boy, he will be given an opportunity later of sitting for an entrance examination. This is quite different from the examinations conducted at schools, for it is really an intelligence test and is set to discover, not so much what the boy knows, but if he is mentally alert.

In some stores, particularly in the provinces, boys are started in one of the departments immediately after they have received a lecture dealing with their duties generally, and with the customs and methods of the store. In very large firms, such as Selfridge & Co. Ltd.—to whose Staff Controller, Mr. H. J. Clarke, we are indebted for much of the information in this article—a different plan is followed. The youths first spend some time, not in serving, but in obtaining a thoroughly good grasp of the work that goes on in all the departments. They see the shop, and in addition become acquainted with the large amount of work that is unseen and unthought of by the customer, but the smooth carrying-out of which is absolutely necessary if the ideal is to be attained of every customer being satisfied. Some of the departments in which work of this kind is done are the Receiving Room, where all the incoming merchandise arrives; the Delivery Department, which is perfectly organised for the sending out of parcels; the Adjustment Bureau, where any defects or errors are explained and straightened out; and the

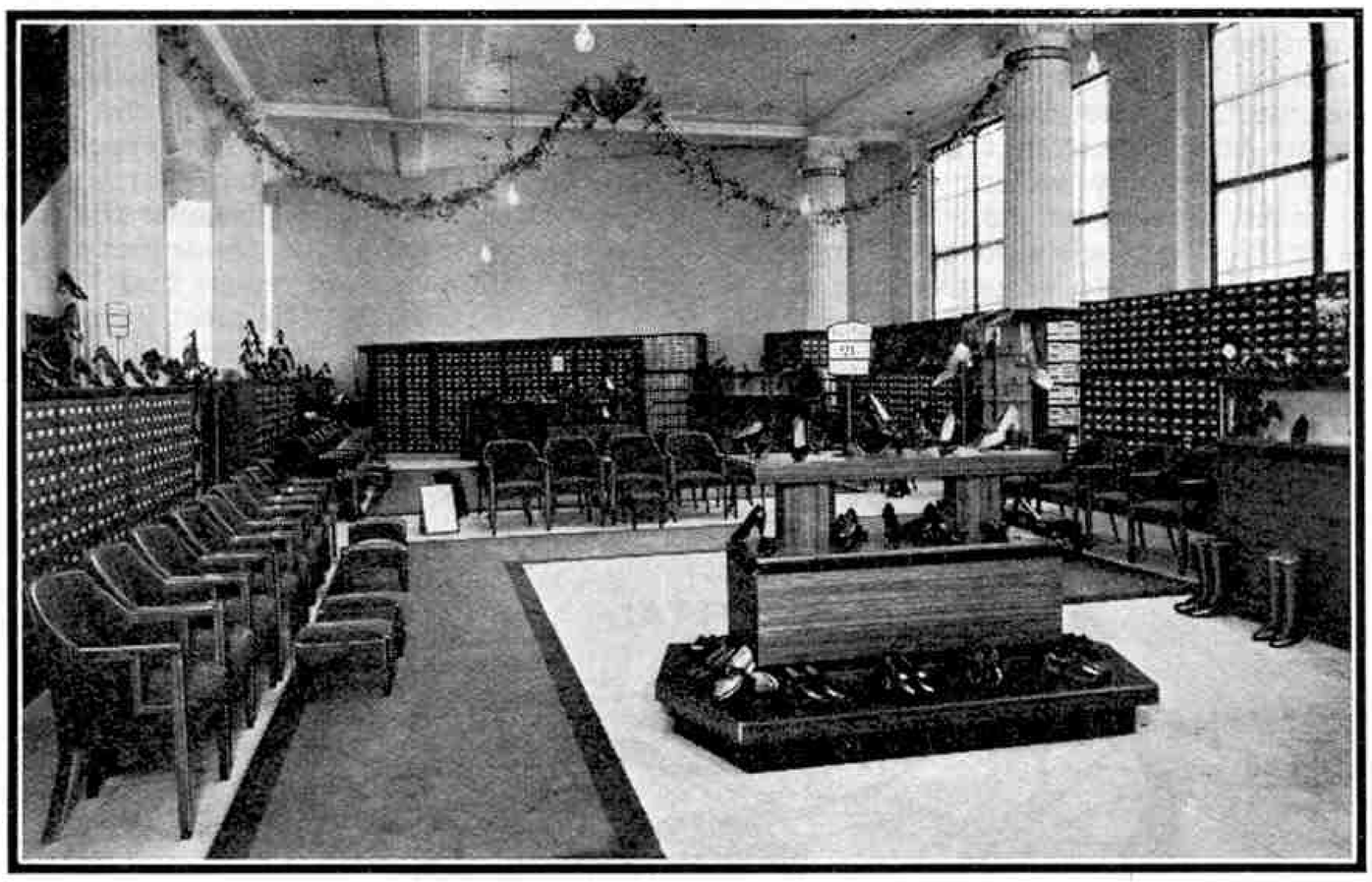
Cash Department. When a youth has visited all these departments and obtained a good general grasp of the work of the firm, he is permitted to take his place behind the counter. In some cases this may not take place until as long as six or eight months from the time he first obtained employment.

The Enquiries Bureau at Selfridge & Co. Ltd., where answers are given to all reasonable questions. The two illustrations on this page are published by courtesy of Mr. H. J. Clarke, Staff Controller of Selfridge & Co. Ltd.

Modern methods of salesmanship differ greatly from the old accepted ideas, for nowadays it does not matter very much what articles a man sells, as it is realised that the essentials of the art of salesmanship are the same whether he is selling matches or motor cars. The old method was for a man to learn to become a draper or a grocer first, and a salesman afterwards; now the order is reversed, and salesmanship takes pride of place. Because of this it is not of great importance which department of a shop a boy enters. Sometimes he may be allowed to choose a department, but those in authority study the best boys in order to find the departments in which they will be able to make most use of their various natural gifts. If a boy is mechanically minded, for instance, he may be put in the bicycle or tool department; if he is artistic he is likely to be selected for a department in which he can deal with fabrics or articles of decoration; if he is of a literary turn of mind he may be allowed to enter the book department.

On entering any department a boy must be keenly observant, and must try to learn as much as he possibly can about everything connected with the work of the department. He should read books about the articles that he sells, their manufacture and their use, and many stores assist him in obtaining this knowledge by arranging special classes during working hours. Visits to works and factories are also arranged, so that a boy is able to learn the whole processes of manufacture of numbers of articles, and thus to acquire information that enables him to talk convincingly to customers when explaining the quality and value of the articles he is selling.

The boy who has been selected for employment as an apprentice has good prospects. If he works hard, and takes an interest in his duties, he may eventually become a Section Head, and after this promotion to the position of Buyer will be sought. This is a responsible and remunerative post, and one in which there are good prospects of advancement.



This illustration shows a part of the extensive shoe department of Selfridge & Co. Ltd.

Apprentices in most large stores are paid a fair wage, although obviously no definite figures can be quoted. In most cases a fortnight's holiday is given with pay, but Buyers and those in other important positions are usually granted leave of absence for three weeks.

Boys who wish to become salesmen, but have not had a public or secondary school training, may sometimes obtain work as "floor boys." At first the duties are very menial, consisting of running messages and doing other odd jobs; but if he shows sufficient aptitude a floor boy may be made an apprentice. Another way is to obtain work in a small shop and then, when fully experienced, to apply to a larger firm for a position as salesman. Although this course is often followed, there can be no doubt that the best training for salesmanship is that outlined in the first part of this article.

Education authorities in London and in many of the large provincial centres have recently interested themselves in schemes of training in the principles of retail distribution. The City and Guilds of London Institute have introduced a scheme of instruction and examinations for students that should prove of great value. The syllabus is based on the assumption that students will attend for a minimum of four hours per week during three sessions of about 25 weeks each. The examinations will test a candidate in his knowledge of the main channels of retail distribution, the functions and organisation of retail businesses, methods of buying, methods of selling, financial control, etc. This scheme is directly concerned with the training of students for drapery and outfitting, using the terms in a very wide sense.

The Story of Prehistoric Man

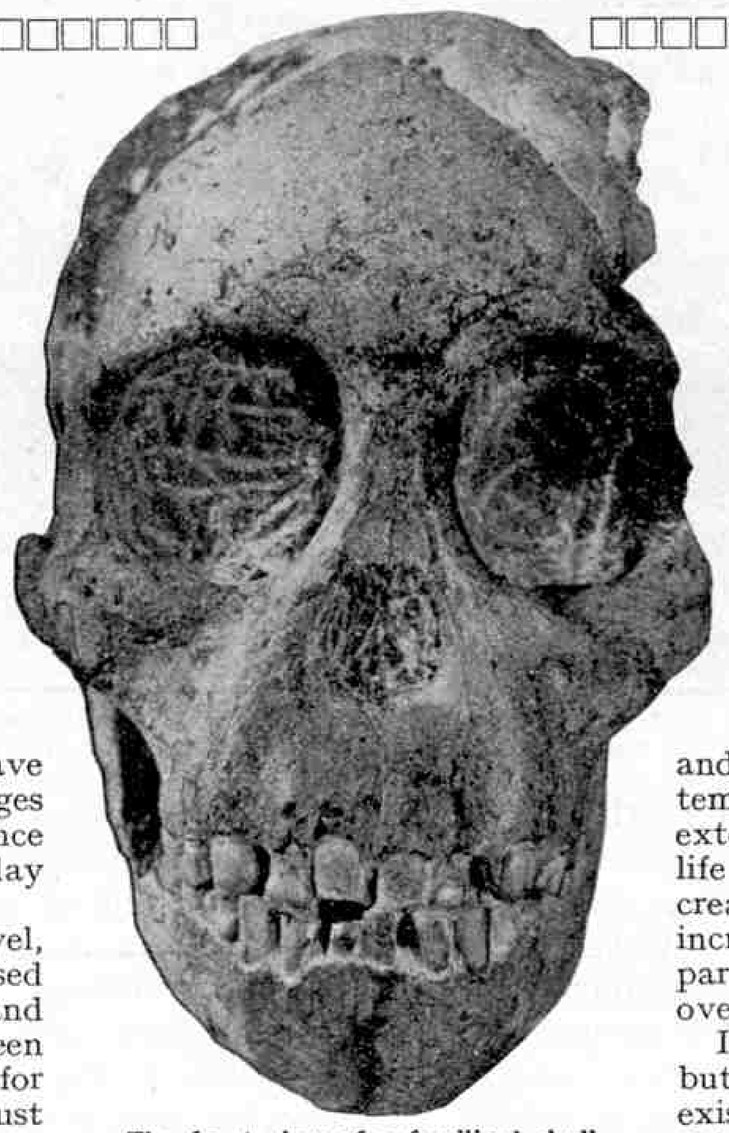
I.—Earliest Fossil Remains

THE earliest people of whom we have any direct knowledge from tradition or written record were mere savages in comparison with human beings of to-day, and lived in conditions that we should now regard as intolerable. They were certainly intelligent and resourceful, for they had learned to make and use tools and weapons, first of stone and later of bronze, that perhaps were crude but certainly were effective. The tools of the oldest and most backward human beings we are able to trace directly do not represent the earliest efforts of mankind, however, for rougher and clumsier axes, knives and scrapers rudely chipped from stone have been dug out of the earth, and it is believed that these were made by still earlier men who lived in prehistoric times. The races to which these people belonged have long been extinct, but they represent stages in the advance of Man from his first appearance on the Earth to the human being of to-day who is Master of the world.

The story of Man's rise is difficult to unravel, for it is revealed only by the tools he used at various periods in his development, and a few fragments of bones that have been buried in the Earth and thus preserved for examination. In order to follow it we must turn to the rocks that form the crust of the Earth. Geologists have arranged these rocks in a definite order that constitutes what is known as the geological record. The oldest rocks, which were formed earliest, are normally lowest in the series, and the newest rocks are the highest, but in many cases this orderly sequence has been broken by violent disturbances. Patient examination of the rocks themselves, and study of the fossils found in them, have enabled geologists to overcome this difficulty. They have not only learned to recognise the rocks of each geological era, but to read in them the story of the creatures living on the earth during the millions of years occupied in the formation of the rocks.

Five great periods have been recognised. The earliest, the Archæan period, is that during which the oldest rocks of which we have any knowledge were formed. Generally speaking, no remains of life are to be found in these rocks, and there is considerable doubt about the few traces that have been claimed as remains of this nature. Nevertheless it is certain that life must have existed even then, for the first creatures whose fossil remains appear in the rocks of the following period —the Primary or Palæozoic— are so complex and so varied in character that they must have been in process of development from more primitive forms for ages.

The Primary period was the age of shellfish and of ordinary fishes, a varied and abundant sea life being its most remarkable feature. Towards the end of the period amphibians began to appear, changes in conditions bringing about the transformation of certain fishes into creatures that breathed air directly through primitive lungs, instead of absorbing oxygen from water passing through their gills. These were the ancestors of the dinosaurs and other great reptiles that completely dominated land, sea, and air during the greater part of the Secondary or Mesozoic period that followed the Primary. Towards the end of this period the reptiles declined in numbers and there arose the class of animals known as mammals. As the reptiles became fewer, the mammals began to assert themselves, and in the succeeding Tertiary period they rapidly extended and developed, and became the dominant creatures of the Earth.

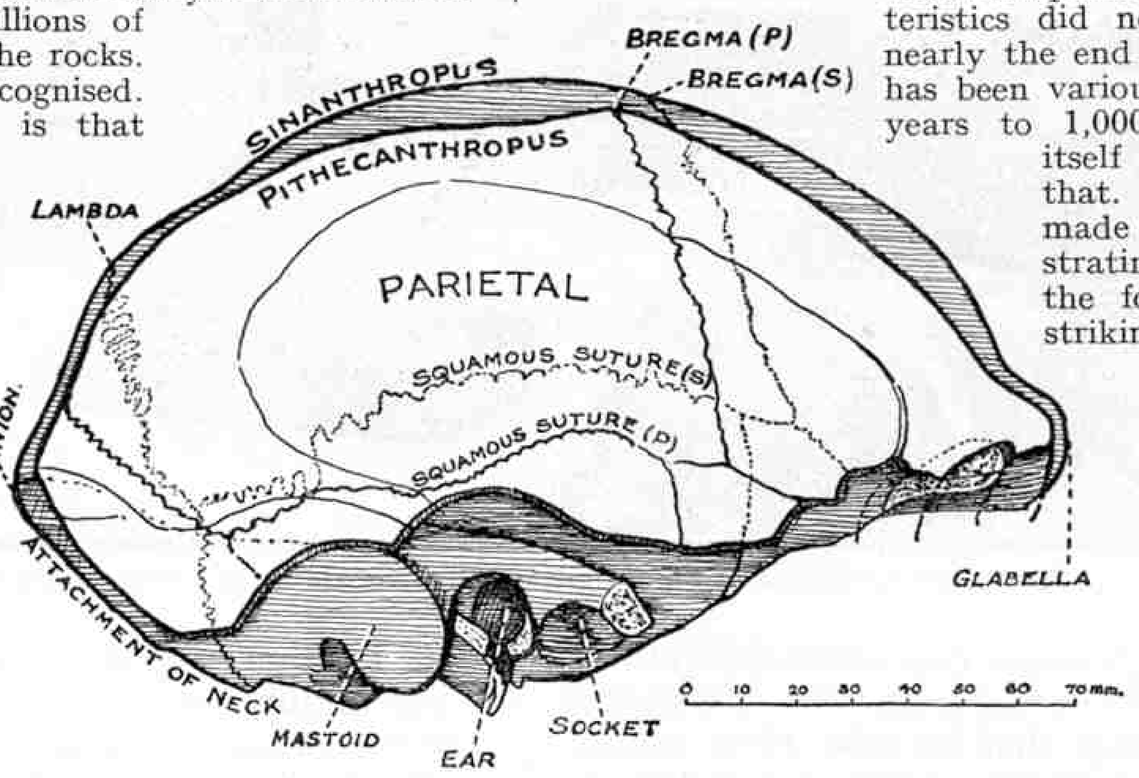


The front view of a fossilised skull found at Taungs, South Africa. It is believed to be that of a prehistoric higher ape, but the teeth show human characteristics.

It is probable that the mammals achieved their victory over the reptiles by reason of their greater adaptability to differing climatic conditions. The bodies of the reptiles were nourished by "mixed," or imperfectly oxygenated blood, the temperature of which depended upon that of their surroundings; with the result that in hot weather they were lively and vigorous, but in cold weather were lethargic and sluggish. In the mammals, on the other hand, the blood is fully oxygenated, and in consequence maintains a relatively high temperature. This makes the mammals to a large extent independent of climatic conditions. The life machine works more vigorously, and the increase of bodily activity is accompanied by an increase in intelligence that has played a great part in establishing the superiority of mammals over their reptilan rivals.

It was among the mammals that Man developed, but millions of years elapsed before he came into existence. In the meantime many new types in this great class flourished for a while, and then developed into new forms, or gave way before others derived from a different ancestry. Eventually a group of animals known as the primates developed. These were climbing animals, and to-day most of their descendants also inhabit trees. A few types learned to adapt themselves to life on the ground, however, and Man eventually sprang from one of these types, to become the dominant creature of the fifth geological period, the Quaternary, in which we live.

It is important to realise that Man is a newcomer on the Earth. The most primitive beings with human characteristics did not come into existence until nearly the end of the Tertiary period, which has been variously estimated as from 250,000 years to 1,000,000 years ago. The Earth itself of course is much older than that. Many comparisons have been made with the object of demonstrating this fact, and among them the following is perhaps the most striking. If we take the Earth's age as being represented by Cleopatra's Needle, the famous Egyptian monolith 68½ ft. high that stands on the Thames Embankment in London, the thickness of a penny placed on the top of the needle would represent the length of time during which life has existed on the Earth. If now we were to place a postage stamp on the penny, its thickness would represent the duration of Man's existence!



Comparison of the skull of Pithecanthropus, or Java Man, with that of Sinanthropus, or Peking Man. Reproduced from Sir A. Keith's "New Discoveries relating to the Antiquity of Man," by permission of the publishers, Williams and Norgate Ltd., London.

When we try to follow the story of the development of humanity we find that it is incomplete. Man and the apes resemble each other so closely in form that scientists believe them to have a common ancestry, but the gaps between them are so large, and the missing links in the family tree are so numerous, that we can form only a broad idea of what has happened. This is scarcely surprising in view of the fact that the story is revealed by a few fossilised remains that have been dug out of the Earth. It is

almost a miracle that any remains of our prehistoric ancestors should be found, for many destructive influences have been at work during the ages that have elapsed since they lived. In favourable circumstances their bones may be preserved in fossil form, but they are hidden in debris that has been accumulating for thousands of years, and their discovery is largely a matter of chance. Even when our feeble scratching of the Earth's surface reveals these remains we usually find them to be mere fragments. Nevertheless comparison with modern skeletons of apes and human beings, has enabled scientists to reconstruct the forms of the earliest creatures of whom we have any knowledge.

Fortunately, prehistoric Man had one habit that has helped us considerably in tracing our ancestry; and this was his tendency to dwell in caves. He preferred a cave with a southern aspect and a level space or platform in front of it, on which he could sit in the Sun. Excavations of the floors of many caves of this kind in all parts of the world have shown that they have been inhabited for thousands of years, for fossilised skulls and other remains of human beings at various stages of development have been found at different depths. The oldest of these are lowest in the caves, and the manner in which the changes have taken place have been revealed to a certain extent by careful examination of successive layers.

One of the greatest difficulties in dealing with prehistoric skulls is that of deciding whether their possessors were definitely human beings, or higher apes with a proportion of human characteristics. In many cases there is no difficulty, for both the characteristics of the skulls, and the absence in association with them of anything in the nature of tools, show quite plainly that we are dealing with apes. For instance, fossilised remains of a definitely ape-like form, known as *Propliopithecus*, have been discovered in Egypt. This is now regarded as a distant relative of the primates from which came Man and the higher apes, such as the gorilla and the chimpanzee.

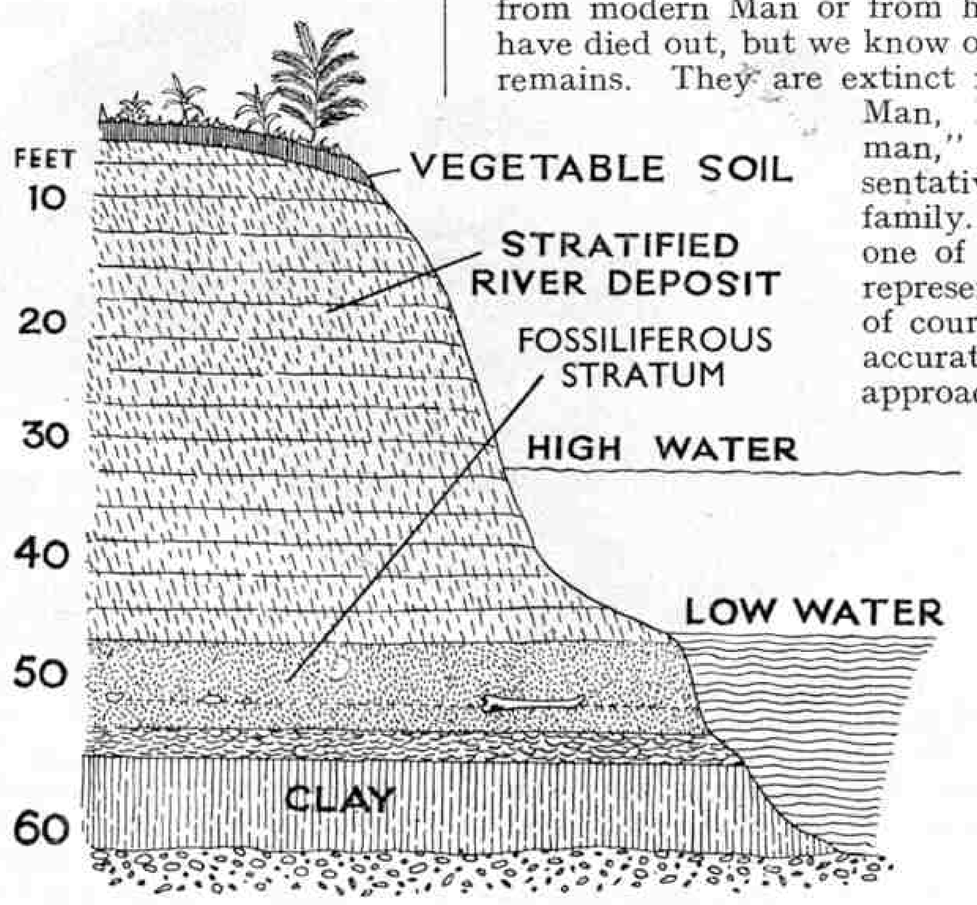
Greater difficulty was experienced in settling the character of another fossil form that was found in a limestone quarry at Taungs, in the South-western Transvaal. Ages ago the limestone in this quarry was honeycombed with caves that have since become filled in with sand and limestone. Brown patches now mark the positions of these caves, and the mass of material brought down from one of these during blasting operations in 1924 was found to contain a number of fragments of bones, practically all of which were found to be fossilised skulls of a baboon-like ape. A skull much larger than that of a monkey was included among them, however, and measurements showed that the creature to which it had belonged had a larger brain than that of an ape, and that its teeth were almost human in type. On the other hand its face could not be described as human, and in other respects it must have resembled the higher apes so closely that it cannot safely be regarded as a member of the human family. *Australopithecus*, as this long-extinct being has been called, probably was a relative of the ancestors of the gorilla and the chimpanzee.

Long before the Taungs skull came to light, other skulls from different parts of the world had been claimed as remains of missing links in the development of Man. The most famous of these was found in 1891 in an ancient river gravel near Trinil, Java, by Dr. Eugene Dubois, who was then an army surgeon. Dr. Dubois was born in 1858 at Eysden, Holland, and studied science and medicine at the University of Amsterdam, where he became lecturer in anatomy. His chief interest was the problem of the descent of Man, and he had been greatly impressed by the suggestion that the islands of the East Indies were likely places in which to find remains of extinct beings intermediate between Man and the apes. He therefore determined to search the limestone caves of Sumatra and other deposits in Java and Borneo in the hope of discovering these links. In order to carry out his object he sacrificed his University career in Holland to become a surgeon in the Dutch East Indian Army. He was stationed first in Sumatra, where he took every opportunity of searching for the remains he had come to find. It was not until he turned his attention to Java, however, that his persistence was rewarded by the discovery of the fossilised skull cap of a being that was clearly ape-like in many respects, but in others was almost human. Later a thigh bone and a back tooth also were recovered. The name of *Pithecanthropus erectus*, the erect ape-man, was given to the being whose existence was thus revealed, for the thigh bone is straight, thus suggesting that the creature walked practically upright. The brain was intermediate in size and in the complexity of its folding between that of the highest ape and that of the lowest type of existing human being, and in certain respects the skull was human in character. It is particularly interesting to find that the portion of the brain that would be concerned with the powers of speech was well developed, thus suggesting that Java Man was capable of talking, although no doubt in a very primitive manner.

A dawn form of humanity. Our illustration shows the probable appearance of Java Man, the restoration being due to Professor Rutot, Brussels.

Dr. Dubois had previously found part of a fossilised lower jaw at another site in Java, and there is good reason to believe that this also is a relic of the beings whose existence was first revealed at Trinil. It shows the ape-man to have been distinctly human in tooth and jaw, and leaves little doubt that in *Pithecanthropus erectus* we have a representative of a very early type of humanity.

To say that Java Man is human does not necessarily mean that he is to be regarded as one of our ancestors. To-day races of human beings vary considerably in size, colour, intelligence and other characteristics. Similarly in the past there have been races that undoubtedly were human, but differed considerably from modern Man or from his direct predecessors. These races have died out, but we know of their existence from their fossilised remains. They are extinct relatives of the ancestor of present Man, known as *Homo sapiens*, or "wise man," to distinguish him from the representatives of side branches of the human family. *Pithecanthropus erectus* belongs to one of these side branches. This creature represents a very low form of human being, of course, and probably it would be more accurate to say that Java Man is a near approach to humanity.



A section of the bank of the stream in Java in which Dr. Dubois found the thigh bone and part of the skull of Java Man. The positions in which these lay are marked, and excavations could only be carried on at low water.

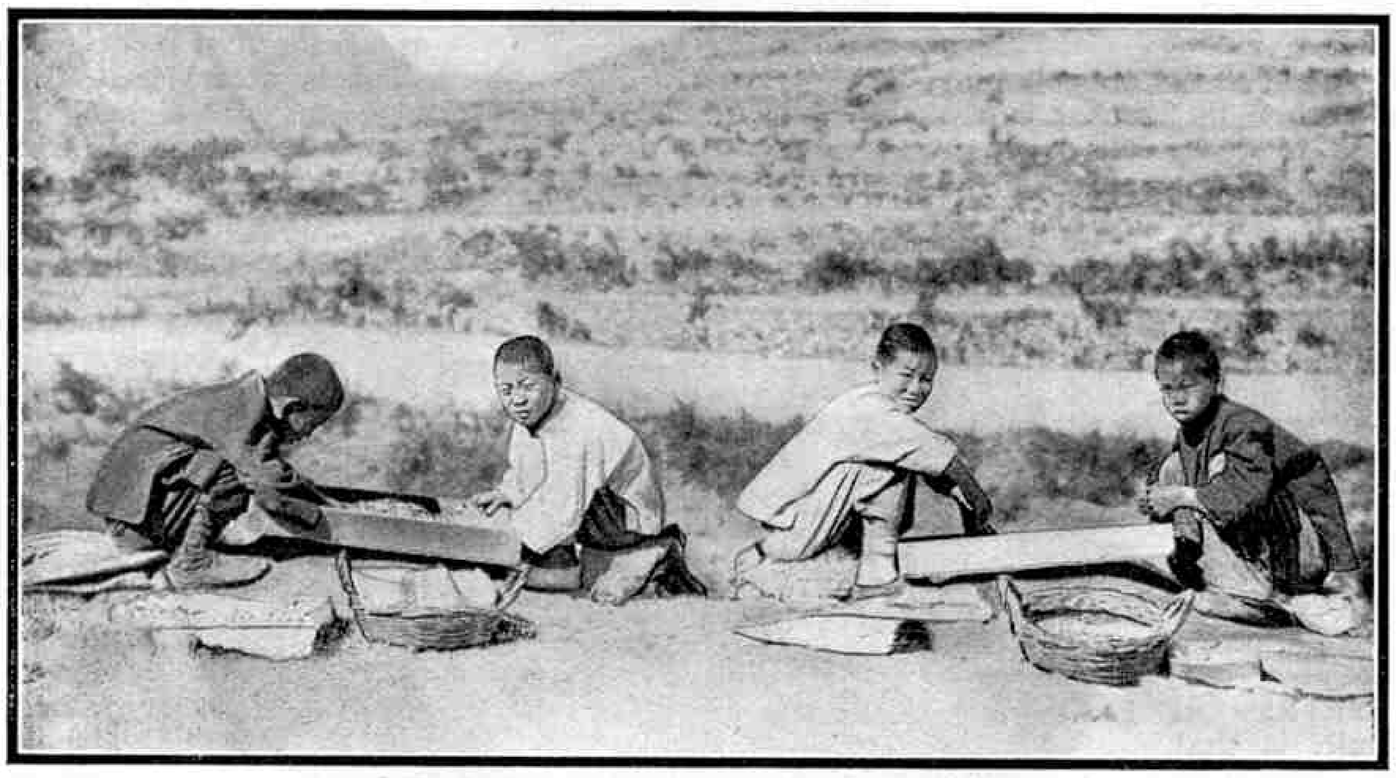
It is more than 40 years since *Pithecanthropus* was discovered, and since then other remarkable fossilised human skulls have been found. One of the most important of these comes from China, where it was found as recently as November, 1929, in a cave at Chou Kou Tien, a village at the foot of the limestone hills west of Peking. It is that of a being who may have lived about a million years ago.

The story of the discovery of the Peking skull is full of interest, for its existence was revealed after a careful search extending over several years. The druggists' shops of the great Chinese city contain hoards of "dragon's bones" used in compounding mysterious medicines. These bones are really fossilised remains dug out of caves and quarries, the hills near Peking being a prolific source. A large collection of "dragon's bones" bought in a shop in Peking in 1902 was sent to Europe for examination, and among these fossils Professor Schlosser, of Munich, discovered a tooth that interested him. It was very ancient, and Schlosser came to the conclusion that it had belonged

either to a higher ape, or to a very primitive type of Man. He suggested that further excavations in China might produce additional remains that probably would throw light on the ancestry of Man.

Schlosser's prediction was amply fulfilled nearly 30 years later. The first step was the discovery in 1921 of a piece of quartz in a fossil bed revealed by the opening of a quarry at Chou Kou Tien, and Dr. Andersson, the geologist who found it, was convinced that it had been brought there by a human being for there were no quartz deposits within two miles of the cave.

The search was next rewarded by the discovery of two teeth among fossils removed in 1922 from the cave or fissure at Chou Kou Tien. This was followed by an even greater find, for in 1927 the floor of the cave yielded a tooth that seemed to have belonged to a child of about seven years old. Careful examination of this by Professor Davidson Black, of the Peking Union Medical College, showed that it is different from the corresponding tooth of any other known human race, living or extinct.

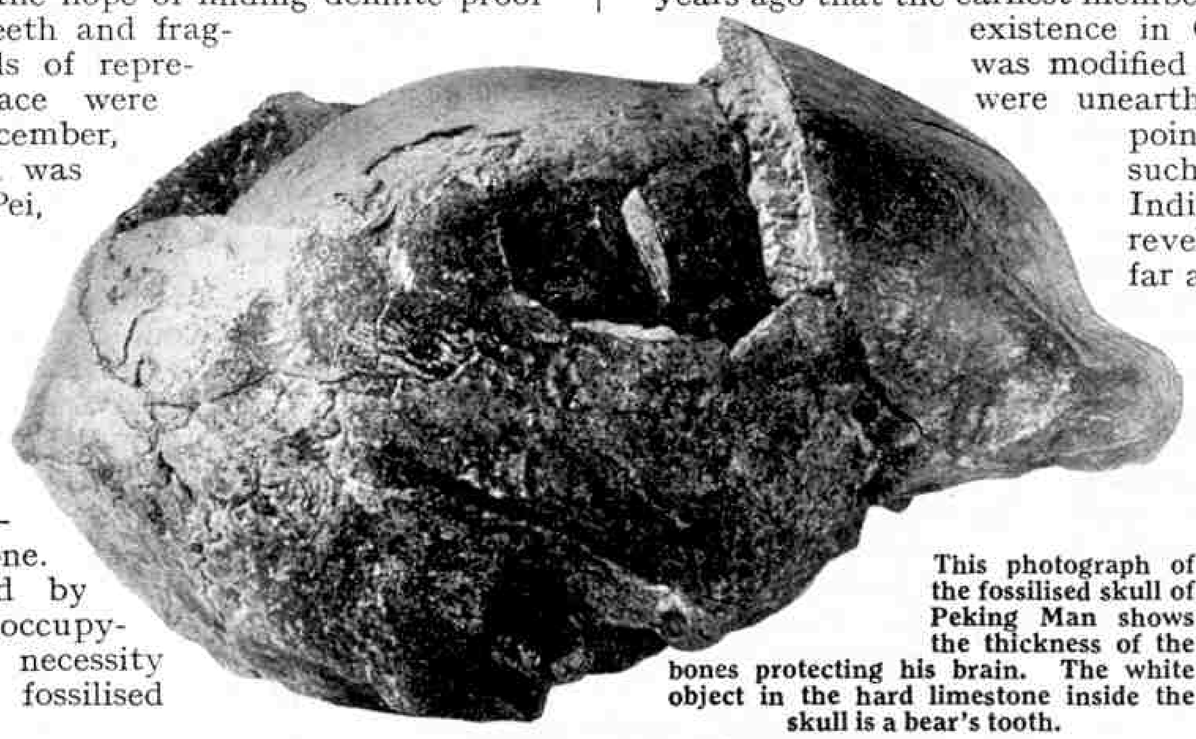


Chinese boys at work sifting material from the cave at Chou Kou Tien while searching for tools made and used by Peking Man. Many chipped stone implements were discovered in this manner. For the two illustrations on this page we are indebted to the courtesy of Professor G. Elliott Smith, F.R.S.

Professor Black is a Canadian who had become convinced that in China there were remains of primitive Man awaiting discovery, and it was the desire to follow up this belief that led him to accept an invitation to join the staff of the Peking Union Medical College, and so gave him the opportunity of taking part in the search. He was so sure that the ancient child's tooth he examined was evidence of the existence of a previously unknown race of human beings that he even gave this race a name, "*Sinanthropus pekinensis*." The first word in this name simply means Man of China, who usually is referred to as Peking Man.

The search was continued in the hope of finding definite proof of Dr. Black's belief. Other teeth and fragments of jaw bones and skulls of representatives of this extinct race were found, and finally, on 2nd December, 1929, an almost complete skull was brought to light by Mr. W. C. Pei, a young Chinese geologist.

The skull was discovered in an off-shoot from the main cave, and at a depth of nearly 110 ft. below its original roof. Water containing lime had dropped on it when it lay exposed and had partly encased it in a matrix of travertine, a hard form of limestone. This was laboriously removed by means of dental drills, the work occupying four months owing to the necessity for avoiding damage to the fossilised bones themselves.



This photograph of the fossilised skull of Peking Man shows the thickness of the bones protecting his brain. The white object in the hard limestone inside the skull is a bear's tooth.

When the hard casing of the skull had been removed it was seen that it was incomplete, but sufficient remained to reveal the chief characteristics of the ancient Man who inhabited Northern China a million years ago. The part that contained the brain is well preserved, and shows *Sinanthropus* to have been more definitely human than Java Man. The bones are very thick, but the brain appears to have been a little larger than that of *Pithecanthropus*, although far less than that of modern Man.

The greatest differences between the two primitive forms of humanity discovered in Asia are in the teeth and jaw and the part of the skull that surrounds the ear, for in Peking Man these show a nearer approach to those of human beings of to-day. This is particularly noticeable in the chin region. The possession of a chin has been described as the hall mark of humanity, for the front of the lower jaw of the ape slopes downward and backward. Peking Man's jaw is distinctly ape-like, but on a child's jaw-bone discovered among the remains of *Sinanthropus* there is a very small bony out-growth that is the beginning of a true chin.

Perhaps the most satisfactory proof that *Sinanthropus* really deserves the name of human being is that he had learned to make tools. Chipped stone implements have been recovered from the cave at Chou Kou Tien. There is little doubt that Peking Man made them, for a small bone from the wrist of one of the individuals of this race has been discovered and its form shows that his hands were similar to those of modern man. Other remains seem to show that his feet were more like those of an ape, and probably he walked with his toes turned in. Traces of hearths on which he built fires also have been discovered, and the men who made their home in the cave at Chou Kou Tien are the earliest human beings known to have mastered fire.

One peculiar feature associated with Peking Man is worthy of special notice. The skull and other bones of this primitive being were discovered in the remotest recesses of a complicated cave, and they were accompanied by fossilised remains of no fewer than 60 species of animals. These include buffaloes, deer, rhinoceros, hyænas, sabre-toothed tigers, wolves and bears. Buffaloes, deer and rhinoceros do not live in caves, nor is it likely that their remains were carried in by hyænas, wolves or bears. It is more probable that Peking Man hunted the animals for food, and threw the bones away to form one of the greatest mausoleums of extinct animals yet known. The discovery of these bones in association with the remains of *Sinanthropus* is a proof of the great antiquity of this primitive human race.

The discovery of such a primitive form of human being as Peking Man has awakened new interest in the problem of the birthplace of mankind. Charles Darwin, the famous naturalist, suggested 60 years ago that the earliest members of the human family came into existence in Central Africa. This suggestion was modified when the remains of Java Man were unearthed in 1891, for the discovery pointed to an eastern place of origin such as Southern India, the East Indies or Central Asia, and the revelation that man had wandered as far as Northern China at a very early stage in his history seems to strengthen the belief that he made his appearance in Central Asia.

In the distant ages when the ancestors of Peking Man began to develop the skill and brain power that distinguished them from the rest of the animal creation, Central Asia was not the desert that we know to-day, but was a country of forests enjoying a genial climate. The Himalayas had not then been thrust upward to their present height and there was nothing to prevent the passage of animals migrating northwards from India. It has therefore been suggested that the prehistoric creatures from whom man has descended had their origin in the forests of India, from which they gradually worked their way into other lands.

Some of these wanderers may have reached the East Indies, where they slowly developed into creatures like Java Man, who retained so many resemblances to the apes. Others probably migrated northward to Central Asia, and eventually were cut off from India by the rise of the gigantic mountain range of the Himalayas. The climate of Central Asia then became drier and colder, with the result that they were compelled to adapt themselves to an entirely new form of life, and in the struggle to survive in the changing conditions, they developed skill and intelligence beyond that attained by Java Man. Thus Peking Man, their descendant, was more definitely human than his relative in the East Indies. At present he is the only representative of his race, but traces of equally ancient human beings may yet be found elsewhere in Asia.

Relics of the Roman Past

Pagan Stones in Christian Churches

By W. Coles Finch

WHEN the Romans left our shores, the splendid examples of public buildings, institutions and dwellings, the work of more than three centuries of Roman civilisation, met with short shift at the hands of those who came after. The country was overrun by hordes of ruthless barbarians, known to us as Picts, Danes and Saxons. These invaders had no regard for the work of the Romans, and they destroyed beyond repair every vestige of their handiwork. At each incursion they penetrated farther and farther inland, continuing their work of devastation, and destroying house by house, town by town, and station by station. They left nothing for our discovery but pavement of forum, floor of temple, baths, and other indications of the merging and blending of the Roman and British civil life that preceded the dawn of Christianity. Thus it is that beneath coppice trees, river margins, ploughed fields, and even on hilltops, there are unearthed from time to time evidences of the Roman past.

Roman tiles built into the walls of the church of St. Margaret, the village church of Lower Halstow, on the bank of the River Medway.

Away back in the early centuries, when the first Christian churches were springing up, the ruins of these Roman examples of the builder's art were more easily traced. In many instances the spoil-heaps of destroyed buildings were drawn upon for material to help in the erection of the later dwelling houses and churches, and thus in many of these old buildings we find Roman bricks and tiles embedded in the walls and pavements.

An interesting and typical example stands near the writer's home. Here at Lower Halstow on the margin of the River Medway, in a spot known as Earth-pit Fields, in the excavation of a brick-field were unearthed the foundations of a Roman villa of considerable dimensions. Quite near this modern brick-field stands the ancient church of St. Margaret, the village church of Lower Halstow. No reliable data as to its age can be found, and its most ancient monuments are said to have been destroyed at the Reformation. The waters of the Medway still lap the foundations of the cemetery wall, and the surroundings hold a weird fascination even to-day, seeming to speak of a long-forgotten past. The name Halstow is said to indicate that in medieval days it was a place of trade, the creek offering access from river and sea.

The chief feature, however, is the church, which is of a time preceding that of Norman structures. It is supposed to be coeval with St. Martin's, Canterbury, which, as its architectural features indicate, dates back to Roman and Saxon times. If this be true, Halstow is at once famous as possessing one of our oldest churches. We do know that it has been connected with the diocese of Canterbury from the earliest times, and that John de London, nephew of Thomas à Becket, was instituted to the incumbency in 1184 by the Crusading Archbishop Baldwin.

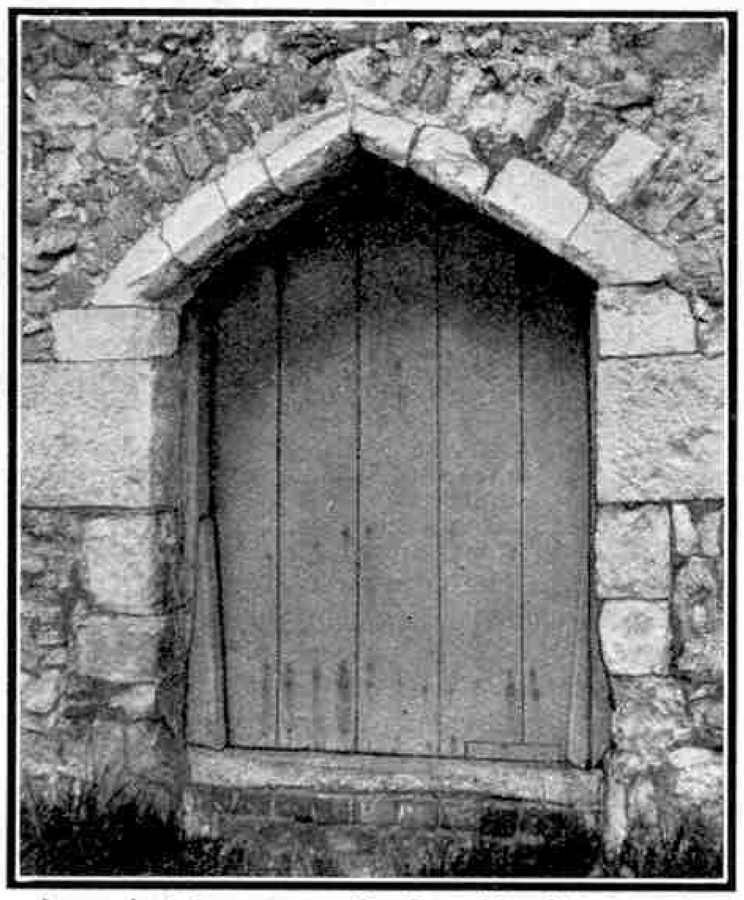
Here we are more particularly interested in the fact that in the walls of this ancient church may be seen the frequent introduction of Roman tiles corresponding absolutely with those unearthed from the long-buried foundations of the Roman villa near by. In some instances an arch has been turned with them. Again, perhaps with an idle fancy, the builder placed them in herring-bone form as they may be seen to-day, or scattered them indiscriminately about the walls, or introduced them into the paving of the interior.

The very mortar that binds together the rubbly mixture of rock and tile—debris of other fabrics—of which the building consists, denotes great age. It is of the coarsest kind, consisting almost entirely of sea shells; and yet it has held together this sacred building in a bleak exposed position for perhaps 1,000 years or more, for the 9th century has been suggested as the period of its erection.

Thus with a strange irony we see that the material from the home of a Roman overseer, or from a pagan temple, finally came to play a part in the erection of a Christian church.

Doubtless the restorations of 1878, 1907, and 1914 saved the edifice from ruin, but from an archæological point of view they somewhat spoiled its ancient appearance. However, there is still much of interest to be seen.

There is a tradition that the low doorway, still existing on the river side of the church, originally provided the means of access to the waters of the Medway for purposes of baptism. If this were the case, the spot where the converts were immersed is now occupied by the gaunt water-worn skeletons of old timber ships, whose picturesque but slow-decaying timbers offer protection to the foreshore adjoining the church, breaking the assault of the waves when the great gales blow.



An ancient doorway on the river side of the church.

The Rev. E. R. Olive, the Vicar, reminds us that in the 13th and 14th centuries the reputation of the miracle-worker, Sir John Shorne, was great in Halstow. Of him it was written:

"Sir John Shorne,
Gentleman born,
Who conjured the Devil into a boot."

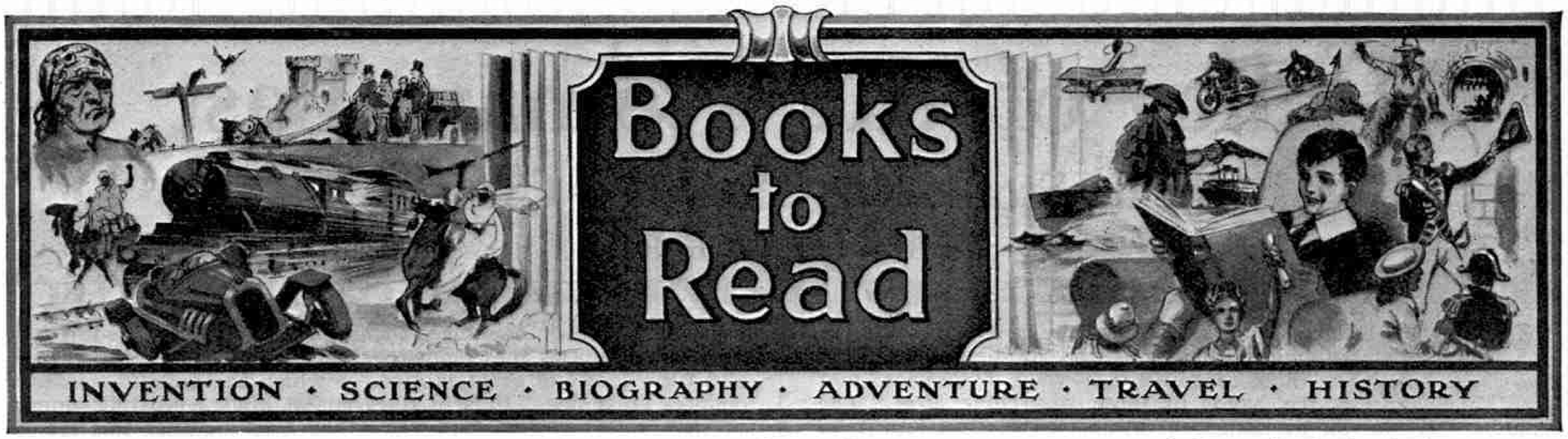
There was probably a shrine at Halstow dedicated to his honour, but this, with many other memorials of the past, disappeared as the result of 17th century vandalism.

One other point of interest concerning this church is worth recalling. During the Great War the heavy firing of anti-aircraft and other guns shook the plaster from the font, exposing to view a font of fine leaden workmanship, on the panels of which were depicted in bold relief figures of saints and angels. It is presumed that in the troublous times of persecution the font was covered with plaster to conceal this decorative work, and so protect it from threatened destruction.

Of the domestic relics of the Roman past, we know that when the Romans abandoned Britain in A.D. 448, the country was studded with the discarded hand-stone mill or querm with which the Romans ground their grain.

The borders of the Medway in the vicinity of Halstow and Upchurch are specially rich in the remains of the Roman occupation, particularly in the matter of coins, implements of peace and war, and pottery, for here their potters laboured. This was indeed one vast potter's field, and here was made the familiar blue-black Upchurch ware, well known for its elegant form and peculiar raised dotted ornamentation, so greatly prized by connoisseurs of ancient pottery.

The wealth of the remains, and most of the traces of the workers, now lie many feet beneath the blue mud deposited during the past ages by the Medway.



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.

"Stellar Wonders"

By CHARLES WHYTE, LL.D., F.R.A.S.
(Sheldon Press. 5/- net)

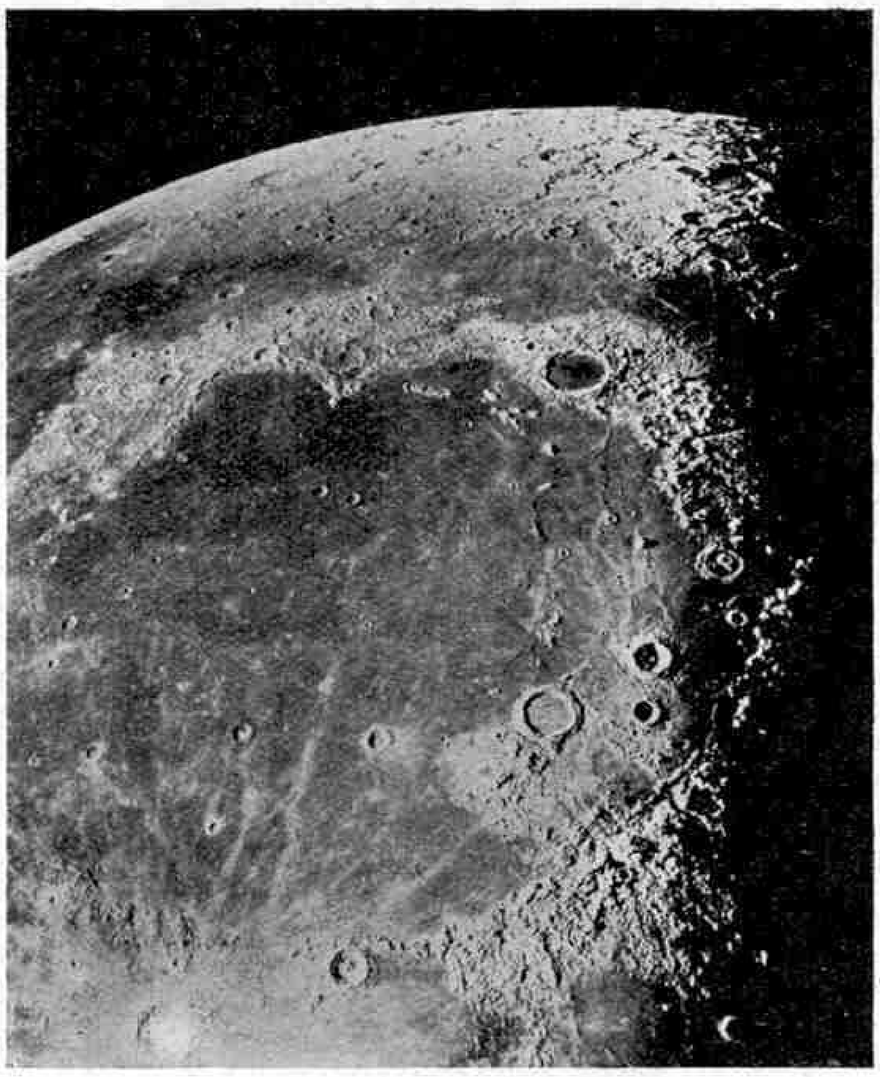
Many of our readers in the north who have listened to the Rev. Charles Whyte's broadcast talks on the wonders of the heavens will welcome the publication of these talks in book form. Mr. Whyte writes in an interesting and entertaining way of such things as sunspots, eclipses, planets, comets, the brightness of the stars, the Milky Way, and the origin of the Solar System.

Dealing with meteorites, we learn that numerous falls of meteoric stones are recorded in the works of ancient writers. In the Chinese records they are mentioned as early as 720 B.C., and both Livy and Herodotus mention falls. Some of these stones are enormous, as for instance one, to be seen at Tucuman in South America, that weighs 15 tons. Another, brought to New York by Peary the explorer, weighs about 90 tons. Some have fallen in this country, but generally these have been comparatively small ones. In 1931 one that fell to earth near a farm house in Llanwnda, North Wales, weighed 5 ounces. It made a hole nine inches in depth in hard ground.

In dealing with the enormous distances with which astronomers have to work, Mr. Whyte gives an interesting analogy by using a railway train for comparison. Taking first the distance from the Earth to the Sun, which is nearly 93 million miles, he points out that this is a little more than 3,700 times the circumference of the Earth. An express train going at 60 miles an hour, and running day and night without a stop, would require 177 years for the trip. At a fare of only 1d. per mile the cost of a ticket would be nearly £400,000!

"If sound could travel through the celestial spaces at the same velocity as in our air it would require fourteen years for the boom of one of the great explosions which sometimes occur upon the Sun to reach us. If some electric cable could be stretched between the Earth and Sun, capable of transmitting its telegraphic signals at the rate of 30,000 miles a second, it would be nearly an hour before the touch of the key at one end of the line would report itself at the other. Swift light itself, darting 186,000 miles each second, is eight minutes and a third upon the way. It is an immense distance, and yet across the abyss the Sun exerts its power upon the Earth and controls the motion of its huge mass as it whirls along its orbit 18.47 miles a second, more than forty times as swiftly as a cannon ball, holding it to its course by bonds of invisible attraction."

Despite this tremendous distance of the Earth and the Sun, it is nothing compared with the enormous extent of the universe. "Vast as the Solar System really is, it is little more than a mere speck as compared with the universe of the stars; for the stars, which to the eye look like mere glimmering points of light and even defy the power of the telescope to give them any apparent size, are really suns—some of them certainly many times vaster than our own."



Some of the craters on the Moon, near Mare Imbrium. A photograph taken at Mount Wilson Observatory, California, and one of the illustrations in "Stellar Wonders" reviewed on this page.

One of the nearest stars, known as Alpha Centauri is 275,000 times as far away as the Sun is from the Earth. An express train, travelling under the same conditions as the one previously mentioned, would require 48 million years to make the journey, and the fare would amount to £105,000,000,000! There are multitudes of stars that are hundreds, and even thousands, of times as far away as this. Such distances are quite beyond our comprehension, but as Mr. Whyte points out in his concluding chapter, the immensity and beauty of this enormous system of stars does at least give us a glimpse of the majesty of the Creator.

A Scouter's Book of Ideas

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

Mr. Morrison is a keen Scoutmaster who has collected a large number of useful hints and suggestions that have helped him in running his troop, and has added to them many interesting plans of his own. The popularity with other Scoutmasters of the note-book in which he recorded these ideas suggested their publication for the benefit of the Scout movement as a whole, and the present volume is the result.

The contents of the book cover the whole range of Scouting, and are arranged in sections in order to make reference easy. They will prove useful alike for Scout training and for greater occasions such as displays, concerts, camp fires and the customary Scout celebrations. An excellent selection of Scout games is included, and among other subjects dealt with are debates, handicrafts, the running of magazines, and the production of plays. Finally come interesting suggestions for talks to be given at a "Scouts' Own," and a list of useful books and pamphlets.

Every section of the book has proved its worth in practice, and a Scoutmaster who makes use of it, and follows the plan that led to its production, should have no difficulty in maintaining interest and keenness in his troop.

"The Story of the Ship"

By G. M. BOUMPHREY
(A. & C. Black Ltd. 2/6 net)

The story of the ship through the ages is briefly but well told in this book, which is one of the "How-and-Why" Series. The author takes us back to the hollowed-out tree trunks and simple rafts of the earliest years of navigation, and to the ships that sailed the Tigris and Euphrates some 8,000 years ago. He then traces the slow but steady development of the ship by the Phœnicians in the Mediterranean and the Vikings in Northern waters, and shows how the vessels of these early navigators formed the starting point of the long line of progress that culminated in the wonderful ships of the clipper era. The concluding pages of the book deal with the coming of the steamship, and its ultimate triumph over the sailing ship. From the unfortunate "*Great Eastern*" we are led to the monster liners of the present day with their powerful but smooth-running steam turbines, and the most recent developments in engines of the Diesel type.

The author has succeeded in packing a great deal of information into small space, and his descriptions are greatly assisted by a number of interesting drawings.

"The Coast of Treasure"

By L. G. GREEN. (Published by Putnams. 10/6 net)

The Coast of Treasure is the south-west coast of Africa, beneath the waters of which—according to Mr. Green—lie ancient gold and silver pieces and jewels hidden in skeletons of Dutch, Spanish, Portuguese and British ships, some of which were sunk six centuries ago.

Mr. Green has located these ships, and in this most interesting book he tells us of the treasures that are still washed up along the coast. He tells, too, of diamonds that lie buried in the shifting sands; of the legends of treasure and bravery that are associated with the various places on the coast; of brave ships and their precious cargoes; and of seamanship and piracy on the high seas.

Just below the mouth of the Kunene, which marks the frontier of Angola and the former German colony of South West Africa, lies a territory known as Kaokoveld. In this region there are lost tribes of mysterious natives, and bushmen who shoot poisoned arrows at the sight of a white man. Mr. Green travelled on the fringe of this country in 1928 and learnt much of the district and its inhabitants. He believes that somewhere here, there are many elephant graveyards similar to the lost Ivory Valley that lies inland in the Kalahari Desert. This legendary Ivory Valley is the great graveyard to which elephants are said to make their way when they are about to die. Each large elephant herd is said to have its own secret burial place, and Mr. Green is certain that there is such a one in the Kaokoveld because of two well-known facts—that natives appear from time to time with heavy loads of valuable tusks that have not been cut from newly killed elephants, and that dead elephants are seldom found. Mr. Green thinks that when the elephants know they are about to die "they vanish into the secret valley where the huge skeletons of their forerunners lie whitening in the sun."

In his final chapter Mr. Green deals with some of the islands off the African coast that he visited. He thinks that there is no more fascinating island than the solitary peak in the south Atlantic known as Tristan da Cunha, which is "still beyond the airship zone and the seaplane routes—one of the last of the desert islands of real life." The islanders are descendants of British soldiers and seamen and shipwrecked sailors of several nationalities. They are unlike any other people on earth. Most of them have jet black hair, and all talk a dialect of English such as is not heard on land or sea elsewhere. Although the men seem poorly developed at first glance, the visitor who climbs the peak of Tristan, nearly 8,000 feet high, will be left behind by his sure-footed island guides. The islanders, who are clever boat builders and good sailormen, are never really ill, and many of them live to be a hundred or more.

This is more than a book of adventure, and it deserves to be widely read, for it is written in a racy and refreshing style.

Islanders of Tristan da Cunha in one of their famous boats. From "The Coast of Treasure" reviewed on this page.

The Electrical Age

By V. H. L. SEARLE, M.Sc.
(Ernest Benn Ltd. 10/6 net)

The widespread application of electricity in recent years has brought about a revolution in industrial processes. Its effect in ordinary life has been no less remarkable, for we use it to light and warm our homes and, in the words of the author of this book, "it is becoming more and more the universal and non-temperamental domestic servant." Mr. Searle confidently expects the Electrical Age in which we now live to develop until electricity is the only form of energy employed, and he sets out to give an explanation of the manner in which this wonderful power has already influenced and multiplied our activities.

Mr. Searle begins with a short account of modern ideas of the materials of which things are made, and reveals the surprising fact that in one sense we have always lived in an electrical age, for everything around us is built up of electrons and protons, the minute negative and positive particles of electricity. He then turns to free space, which is practically empty, and this leads to a description of man's efforts to produce a vacuum. The pumps that have been developed for the purpose of removing air and other gases from vacuum tubes of all kinds are marvellously efficient, and the use of charcoal at the temperature of liquid air to absorb residual gas that cannot be pumped out is one of the wonders of modern science.

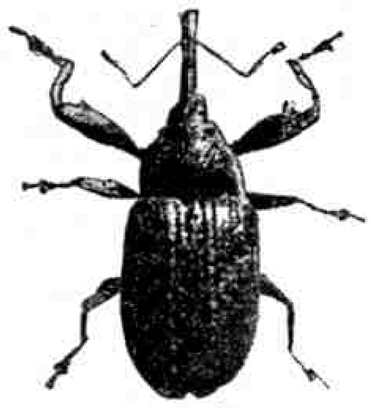
The following sections deal with the spectrum and X-rays. The visible spectrum is only a very small section of the amazing range of electro-magnetic vibrations now known to us. These vary from the very long waves employed in wireless communication to ultra-violet rays, X-rays, which are so short that they readily penetrate through ordinary matter, and the yet shorter cosmic rays. The production of X-rays by electrical discharges in vacuum tubes is fully described, and it is interesting to read of the varied uses to which these wonderfully penetrating radiations are now being put in medicine and industry.

To many readers the section on electricity in the home will be most attractive, for it explains the working principles and construction of such familiar objects as electric lamps, fires, irons, bells, and vacuum cleaners. The author emphasises the fact that, except perhaps in regard to heating, domestic electrical appliances are no more expensive to use than the devices that they are now superseding, while their cleanliness and their all-round efficiency, and the ease with which they can be installed and used exactly where required, are great advantages.

Electricity has been pressed into service also in the measurement of time. The electric chronograph is used in comparing astronomical clocks with the stars, and the synchronous electric clocks now becoming so common in our homes automatically maintain correct time under the direction of master clocks in central electrical power stations. In addition wireless signals enable those at sea to check their chronometers and thus to find their position accurately, a difficult matter before electricity dissipated the uncertainty that affected the readings of chronometers. This section also explains how scientists measure the incredibly short time during which two colliding billiard balls remain in contact.

Without electrical appliances it would have been difficult to reach the extremes of temperature so far achieved. These range from the cold of liquid helium, nearly 273°C below zero, to the heat of the electric furnace, and in each case electricity is concerned also in the means employed to measure the actual temperature. It was an electrical instrument that revealed the temperature of the surface of the Sun to be about 6,000°C. Mr. Searle explains how these instruments work and also gives an interesting description of the modern electric induction furnace. Lastly comes a section on the modern gramophone, in which electric methods of recording and reproduction are fully explained.

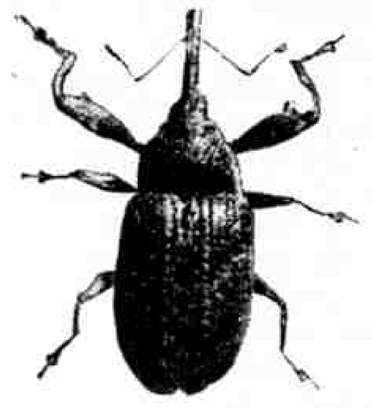
The attractiveness of the book would have been greatly increased by a generous allowance of photographs, for although the sectional drawings provided are interesting, they have a certain sameness.



Man Fights Insect Enemies

How Pests are Controlled

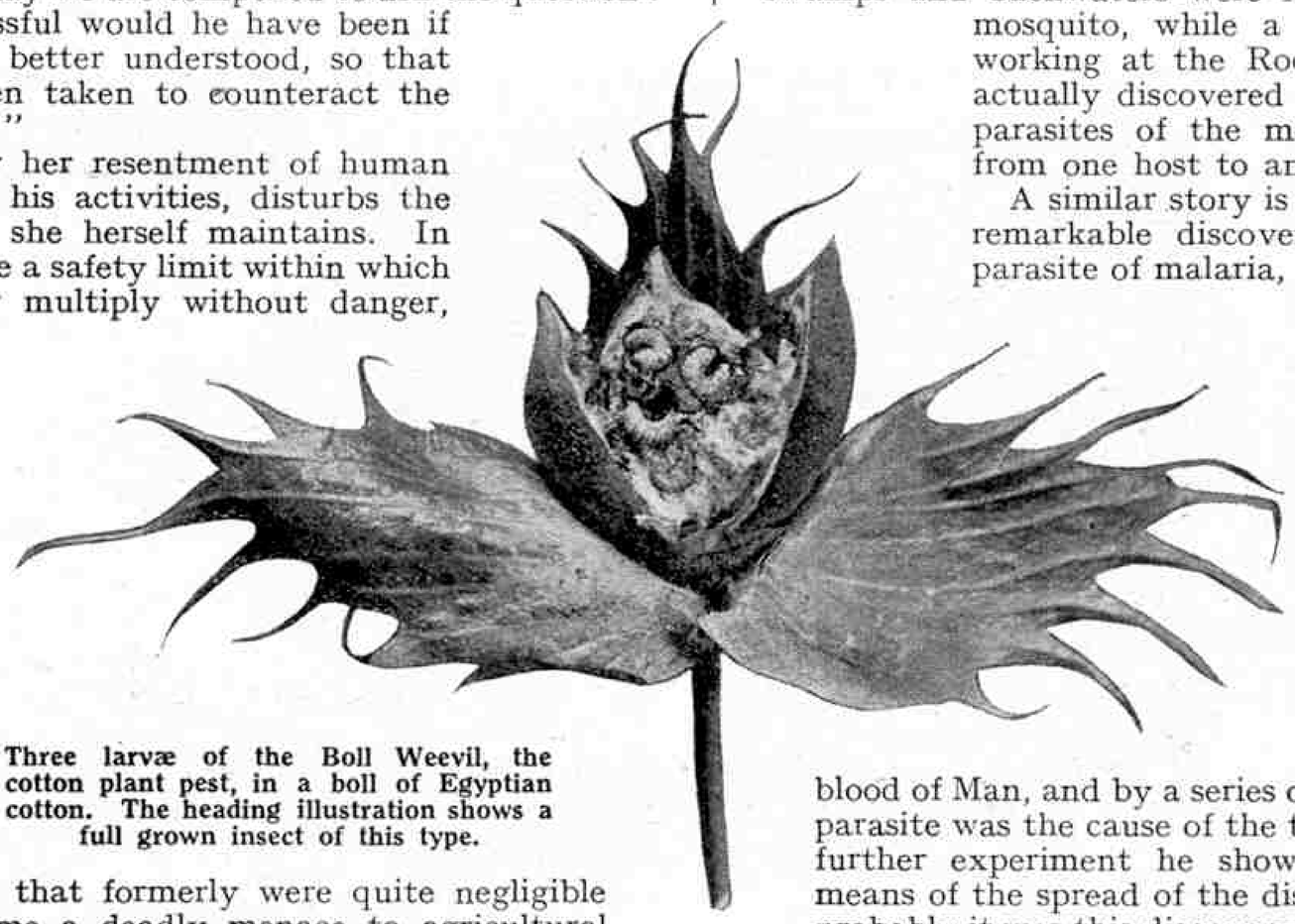
By C. Horton-Smith



IF the ages of industry and the science of applied entomology are compared, we are brought face to face with the fact that until recent times Man has striven blindly against unseen insect foes in his fight for mastery of the world's resources. Man certainly has made marvellous progress in the past, but in the light of the knowledge we possess to-day we are compelled to ask the question: "How much more successful would he have been if insects' habits had been better understood, so that measures could have been taken to counteract the attacks of insect rivals?"

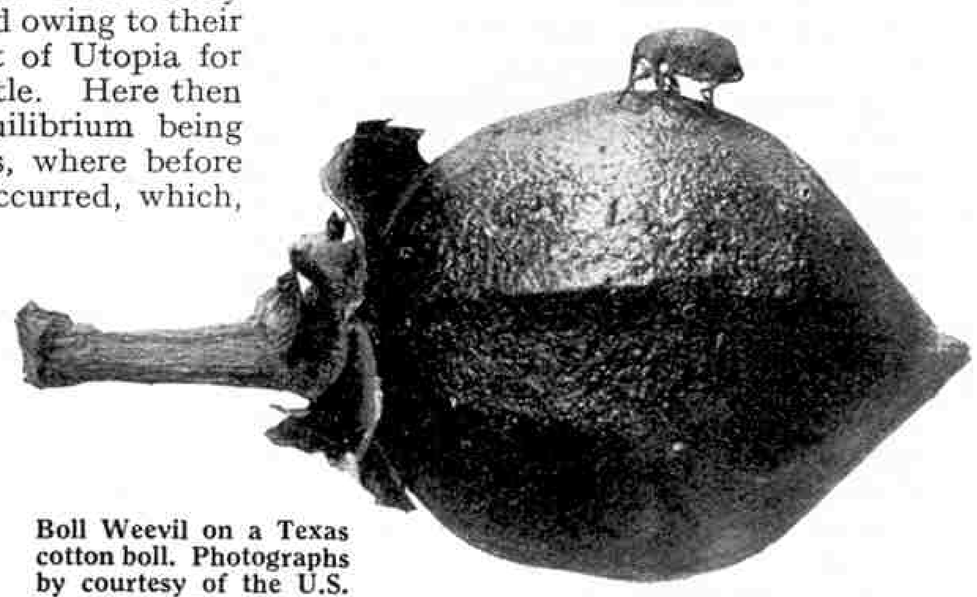
Nature begins to show her resentment of human intrusion when Man, by his activities, disturbs the natural equilibrium that she herself maintains. In Nature there appears to be a safety limit within which animals and plants may multiply without danger, each area, however large or small, possessing its own limit of safe increase for the species it contains.

In the light of this let us review some of the methods employed by Man in his everyday affairs. Perhaps the most obvious to most of us are those of agricultural practice, and it will be useful to quote a concrete case in order to show how in actual experience insects that formerly were quite negligible as pests have now become a deadly menace to agricultural interests. For this purpose we will select the case of the Colorado beetle of America, which has now been reported in other countries, including England. Originally this insect was perfectly harmless, feeding on wild plants of the potato family that were dotted about the countryside at the foot of the Rocky Mountains. Later, however, agriculturalists spread Westward, and cultivated potatoes on a large scale. The potato plants were closely related to the natural food plant, and owing to their intensive cultivation formed a sort of Utopia for the feeding and breeding of the beetle. Here then is an example of the natural equilibrium being upset by vast areas of food plants, where before only more or less isolated plants occurred, which, moreover, were separated from one another by numbers of unrelated plants unpalatable to the beetle. This transformation of the planting brought about a disastrous transformation in the numbers of the insects, which became so numerous as to form one of the world's major pests.



Three larvæ of the Boll Weevil, the cotton plant pest, in a boll of Egyptian cotton. The heading illustration shows a full grown insect of this type.

A similar reorganisation of natural conditions has accounted also for the cotton plant pest, the boll weevil.



Boll Weevil on a Texas cotton boll. Photographs by courtesy of the U.S. Bureau of Entomology.

Man, needing these products, and not having the space necessary to plant his crops thinly over wide areas, must take steps to fight the insect enemy on his own ground. What applies to crops applies also to Man himself. He, too, is a direct victim of many insects, and complications arise in those places where Man congregates into towns and settlements; and what applies to Man applies also to his domestic animals, his cows and his sheep.

A spectacular example of Man's progress being hindered by insects is provided by the great engineering project of the Panama Canal. Here it was a mosquito that carried the disease of yellow fever, and compelled the French engineers to abandon the work of construction and of the costly equipment associated with it. The mosquitoes drove the workers back again and again; yellow fever raged, and the victims of it died in hundreds. The contemporary accounts of the fight between Man and insect for the possession of the Isthmus make stirring reading—a story perhaps unrivalled in the history of engineering enterprise. Eventually science stepped in and studied the conditions prevailing. In the swamps and backwaters were found the breeding places of the mosquito, while a famous Japanese bacteriologist, working at the Rockefeller Institute in New York, actually discovered the cause of fever to be internal parasites of the mosquito itself that carried them from one host to another.

A similar story is that of the late Sir Ronald Ross' remarkable discovery that a mosquito carries the parasite of malaria, and subsequently Grassi's success in tracing out the life cycle of the parasite in the human disease.

Ross was undoubtedly one of the greatest benefactors of the human race, and a short account of his work will be of interest. The theory that malaria might be conveyed by the mosquito was first framed by Sir Patrick Manson. When out East he had already read of the discovery of Lewis that a filaria worm occurred in the blood of Man, and by a series of experiments he proved that this parasite was the cause of the terrible disease elephantiasis. By further experiment he showed that the mosquito was the means of the spread of the disease between man and man, and probably it was this discovery that led him to the view that the mosquito was responsible also for the spreading of the malaria parasite. Subsequently Ross, when on leave from the Indian Medical Service, met Manson in England. At that time circumstances made it impossible for Manson to leave England, and therefore he explained his theory to Ross, and eventually persuaded him to test it out. This was destined to be an historic meeting.

When Ross returned to India he applied himself closely to the problem. For a long time his efforts were doomed to disappointment, and yet his enthusiasm never flagged. Mosquito after mosquito was dissected and microscopically examined, but no evidence was forthcoming to prove that the insects were the carriers of malaria and were responsible while feeding for the injection of the parasites into the human body. He often spent eight hours continuously at the microscope, and the inevitable result of this overwork was that his eyesight became affected. He remained undaunted, however, and continued his researches for over two years, until one day he discovered small pigmented cells in the stomach of a mosquito, and recognised in them the insect phase of the malaria parasite.

In 1897 Ross succeeded in definitely establishing the relationship between the malaria parasite and the mosquito. Although this was a gigantic step forward, nothing was known of the life cycle of the parasite, and great difficulties attended the work in connection with the human disease. Birds also are subject to a type of malaria, however, and the parasite concerned is very similar in form to the one that causes the disease in Man. Ross therefore set out to trace the life history of the organism in birds and mosquitoes, and his efforts ultimately were crowned with success.

In spite of this there was still no justification for assuming that the same course of events was followed in the human species. Grassi, working in Rome, put the matter beyond dispute, however, and later his results were confirmed by two doctors, Sambon and

Low. These doctors shut themselves up in a mosquito-proof hut in one of the worst malarial districts in Italy. People outside suffered as usual from malaria, but the doctors inside remained free—thus proving that the disease could be prevented by the use of mosquito screens. This work was done under Manson's direction, and later he allowed Italian mosquitoes that had been brought to England to feed on two men who had never been out of the country, one of these men being his own son. They both contracted malaria, which definitely established the mosquito as carrier of the disease.

Grassi proved that malaria could only be conveyed by a female anopheline mosquito, and this explains why Ross was at first unsuccessful in the detection of the parasite. No doubt he spent much time in the examination of the wrong kinds of mosquito, and of both male and female insects.

It is to be regretted that fate did not permit Ross the honour of clearing up the human malaria question; nevertheless his work paved the way for ultimate discovery. His investigations showed the patience and perseverance of the true scientific enquirer. Although his work was not sufficiently recognised financially, great must have been the reward to him in the knowledge of the million active lives he had been instrumental in saving.

The measures employed by entomologists in the control of insects may be classified roughly as follows—physical and chemical control, mechanical control, and cultural and biological control.

Physical control is the sort of measure adopted in those cases where artificial raising or lowering of humidities and temperatures accomplishes the end in view; for example, by freezing, as with weevils in almonds, or by heating, as in the case of beetle-infected timbers.

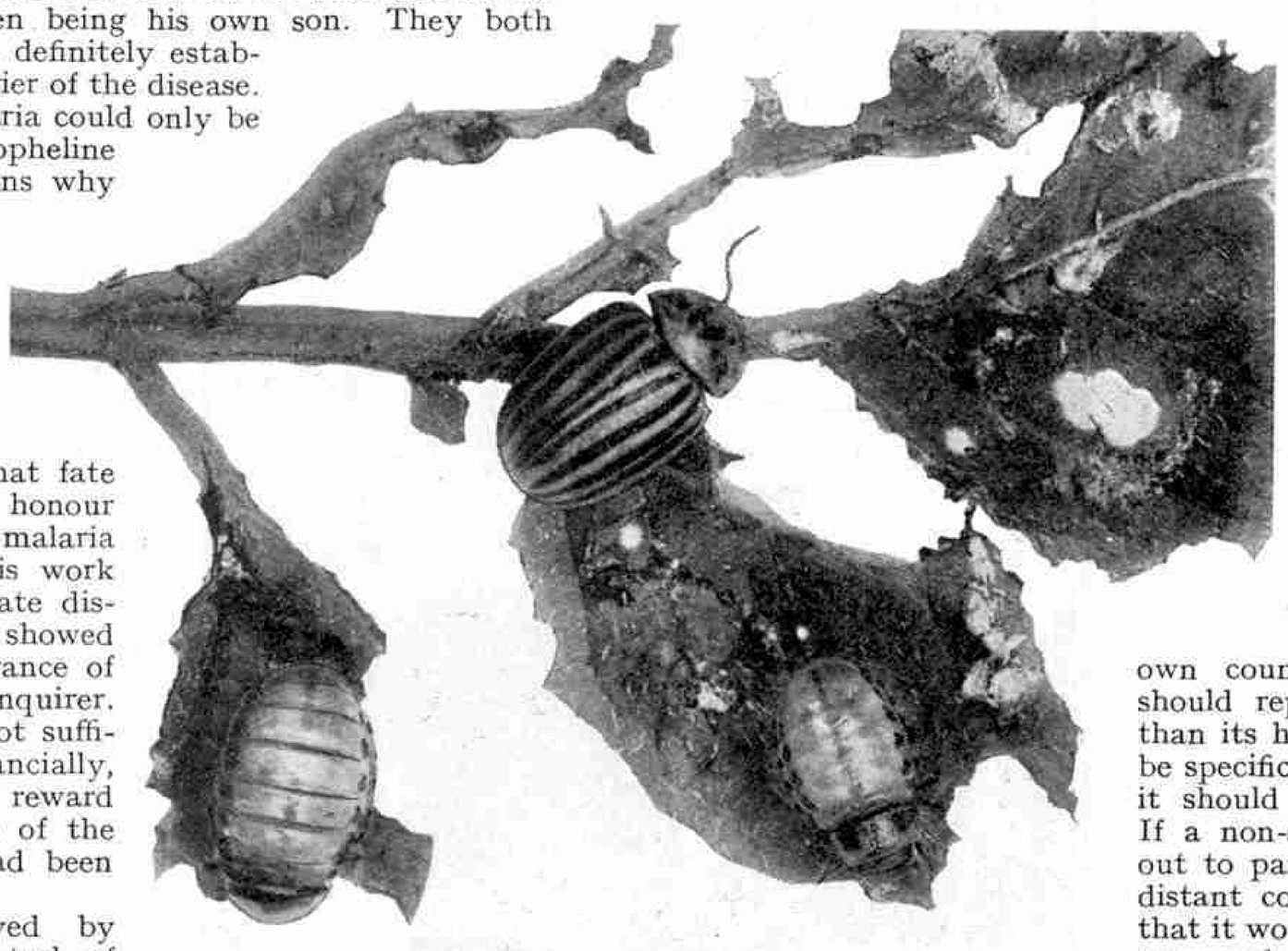
Chemical control involves the use of poisons that act either through absorption from the insect's stomach, or through contact. Stomach poisons can only be effective when the pest has the biting habit, and does not simply pierce the superficial tissues of a plant in order to imbibe the sap beneath, thus leaving the poison untouched on the surface.

Mechanical control involves the use of traps, grease bands round trees, etc.

Cultural control is mainly concerned with the regulation of crops in such a manner that they mature either too early or too late for insect attack. This method can scarcely be termed insect control, as it merely serves to evade the attack. Cultural control is concerned also with the establishing of plant varieties or strains that are immune to insect attack.

Biological control, or control by parasites, is a problem that, in essence, is entirely entomological. Although there are spectacular successes to its credit, its manipulation is a dangerous weapon in the hands of any but experts. It has produced completely unexpected results, and in some cases disastrous consequences. If successful parasite control is established, it is usually permanent, or at least it lasts as long as the pest host it is designed to destroy.

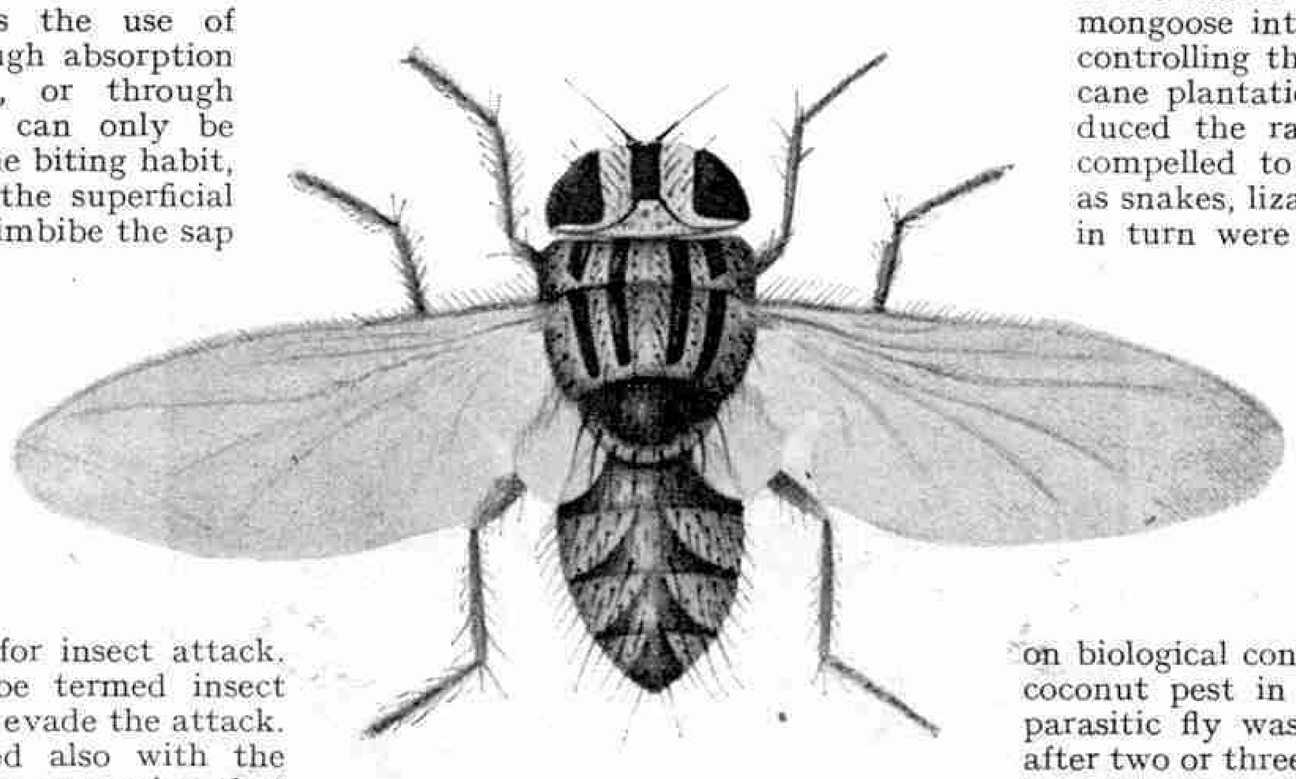
Pests abroad are often insects that have been brought into the country in cargoes. Set loose in a new land they often find conditions favourable to them, and above all an absence of the enemies that served to limit their numbers in their home country. The result is that they enjoy an enormous increase in numbers, and become serious pests. In addition they may vary their habits to the extent of invading new and allied crops. In their normal homes most insects are parasitised by other insects that usually belong to what are known as the Hymenoptera. The parasites lay their eggs in or near the developing larvæ of the host. When the parasite's eggs hatch out the larvæ proceed to prey on the host larvæ, and eventually kill a large proportion of them. The insect parasite thus serves as a very sure means of control. In the new country it is quite likely that suitable parasites do not exist, and so the larvæ of the host survive and develop into adults, which in turn lay eggs.



Colorado Beetles consuming the leaves of a Potato plant. Photograph by courtesy of the U.S. Bureau of Entomology.

At Farnham Royal there is a Parasite Breeding Station devoted to the rearing and study of insect parasites. This establishment undertakes when required to ship suitable parasites to any part of the Empire. Before this step is taken a number of factors must be considered. First of all there must be the certain knowledge that the parasite really does control the insect pest in its own country. Then the parasite should reproduce at a greater rate than its host and, if possible, should be specific in its habit, that is to say it should parasitise only one host. If a non-specific parasite were sent out to parasitise a certain pest in a distant country, it is quite possible that it would discover a more numerous and perhaps more congenial host, and entirely ignore the one with which it had been sent to deal. Such points must be considered before action is taken.

At the beginning of this article we spoke of the equilibrium that Nature normally maintains among plants and animals. The introduction of a new creature into a country causes a reshuffling of conditions that often produces very remarkable results. There is the classic case of the introduction of the mongoose into Jamaica for the purpose of controlling the rats that invaded the sugar cane plantations. The mongoose soon reduced the rats, and having done so was compelled to prey on other animals such as snakes, lizards and birds. These animals in turn were reduced, and in consequence the insects and ticks on which they preyed increased. The mongoose then became less abundant, with the result that its prey increased, the insects diminished, and so on until the balance was restored—not the original balance, for it now included the mongoose.



An enlarged photograph of the Ptychomyia remota, a parasitic fly introduced into Fiji to combat the Levuana Moth, a coconut pest. Photograph by courtesy of the Imperial Institute of Entomology.

A successful campaign on biological control lines was waged against a coconut pest in Fiji, the *Levuana* moth. A parasitic fly was successfully introduced, and after two or three years it was reported that the fly had reached all the infested areas and, provided that nothing unexpected occurred, it would prove effective for the control of the Levuana moth without the need for a further intensive campaign.

Similar investigations are being carried out in the case of the prickly pear in Australia and other well-known pests in various parts of the world. This process of control may be slower and less obvious than one by means of chemicals, but if entomologists find the solution, it is a permanent one, and costs considerably less than the annual sprayings and dustings employed in chemical control.

Knowledge of the living insect is essential in the elucidation of these problems. The entomologist must be familiar with the structure, life-history, habits and, so far as possible, the physiology of the insect to be controlled; he must possess a working knowledge of the infested product. Such equipment involves acquaintance with physical as well as natural science. The applied biologist finds his weapons in the results of the inquiries he makes into pure Science.

The Wailing Wall at Jerusalem

A Famous Jewish and Moslem Place of Worship

By Henry H. Marsh

THE photographs on this page are of the historic Wailing Wall at Jerusalem. Until recently the Wall was a subject of bitter controversy between the Jews and the Moslems, as each claimed the exclusive right to worship there. Eventually the dispute became so acute that the British Government, with the approval of the Council of the League of Nations, sent a commission to Jerusalem to determine the rights and claims of the two religions. With the co-operation of the Palestine Government a thorough and impartial investigation was carried out, and ultimately a compromise accepted by both sides was effected. A certain length of the Wall is now reserved for the Jews for their devotions, and the remainder is available to the Moslems, who are also responsible for keeping the whole area clean, both for themselves and for the Jews who worship along the pavement.

The historic Wailing Wall at Jerusalem, where the Jews pause to lament the loss of their Temple, and to pray for its restoration.

The Wailing Wall forms the western side of a large walled enclosure known as the Haram-esh-Sherif, or "The Place of the Temple," that is the site of the wonderful temple built by King Solomon. The grandeur and beauty of this, the first temple of Jerusalem, are referred to in the Bible and in various writings of early historians. The Haram-esh-Sherif is one of the best known and certainly the most beautiful of the various sights of Jerusalem, and it has a very interesting history.

About 600 B.C. Nebuchadnesar, King of Babylon, attacked and destroyed Jerusalem and its great Temple. Many of the inhabitants were carried away into captivity, and during the 50 years that elapsed before they were able to return, the Jews who remained in Palestine developed the habit of going to worship at the ruins of the Temple. After the exiled Jews returned to the Holy Land the Temple was re-built about the period 520-515 B.C., but it was again destroyed about 170 B.C., and remained in ruins for at least 130 years. Once more the Jews visited it yearly and lamented its destruction.

Another view of the Wailing Wall. Many of the stones have Hebrew inscriptions engraved or painted on their faces.

Herod the Great became King of Judea in 40 B.C. and reconstructed the Temple, but its glory was brief, for when Titus, who subsequently became Roman Emperor, conquered Jerusalem in 70 A.D. he wrecked the city and did not spare the Temple, only a part of the western wall surviving the savage treatment of his forces. Thus once again the sorely tried inhabitants of Jerusalem lamented the loss of their great Temple.

The Roman Emperor Hadrian 117–138 A.D., created Jerusalem a Roman colony, and his order forbidding the Jews from entering the city had much to do with their migration to many distant parts of the world. Although forbidden to enter Jerusalem, many Jews found their way back year after year. Climbing the Mount of Olives, they looked across sadly to the ruins of the Temple of Herod on Mount Moriah, lamented its destruction, and prayed that it might be restored again.

When the Arabs conquered Jerusalem about 637 A.D. they built Moslem holy buildings, known as Mosques, on the deserted Mount Moriah, and called the temple area Haram-esh-Sherif. The Jews, being again permitted to enter their beloved city, were able to visit the actual site of their vanished temple, and the western wall of the Haram-esh-Sherif became the scene of their lamentations and prayers. This spot is now known as the "Wailing Wall" or the Jews' Wailing Place. The Moslems give the Wall the name of Al Buraq, because at one place in it there is a small chamber or niche in which, according to tradition, Mohammed's horse Buraq was tethered when the Prophet visited Haram-esh-Sherif during his celestial journey.

The accompanying photograph gives an excellent impression of the great size of the blocks of which this ancient wall is composed, and of their rugged time-worn appearance. The gathering of the faithful is a typical one that may be seen any day, and it is interesting to note the variety of styles of dress.

Self-Torture of Hindu Fakirs

Remarkable Festivals at Singapore

ONE of the most remarkable spectacles to be seen in the East is that of the tortures self-inflicted by Hindu holy men or fakirs. At Singapore, for instance, there are elaborate religious festivals in which the ceremony of fire-walking plays a prominent part. On these occasions a bed of live coals is prepared, and religious zealots, who have prepared themselves for the ordeal by fasting and other forms of penance, walk or run bare-footed across the red-hot coals, apparently without receiving burns or ill-effects of any kind.

At other festivals the self-torture takes the form of thrusting nails or needles into the flesh, to such an extent that the devotee appears like a human pincushion. In some cases an elaborate framework is supported on long pointed rods driven into the flesh, an alternative arrangement consisting of an iron collar held in place by iron needles fastened in the body. It is a remarkable fact that the withdrawal of a nail or needle from the body of one of these enthusiasts is not followed by bleeding, the flesh seeming simply to close up over the hole thus made.

A Hindu Fakir at Singapore with dozens of nails thrust into his body and wearing spiked sandals. He has hooks in his back to which are attached cords to draw the decorated cart seen in the picture.

The following extract from a graphic description of a Hindu festival at Singapore is taken from an article on "*The Fire-walking Hindus of Singapore*," by L. Elizabeth Lewis, in the "*National Geographic Magazine*" for April, 1931.

"I pushed my way to the front of a tightly-packed group in order to obtain a closer view. Before me sat a Tamil, clad in a loin-cloth and silver pins. Two temple officials, one on each side, were preparing the martyr for his three-mile pilgrimage to the temple on Tank Road by thrusting pins into his flesh. His chest, his back, his forehead, his arms and thighs, were entirely covered with small, shining V-shaped pins. He seemed almost in a state of coma, and his eyes rolled in their sockets until at times only the whites were visible.

"Hardly knowing how I managed it, I found myself in the midst of another group watching the priests thrusting long spear-like needles through holes in the metal laths of a fan-like arch over another devotee. These needles, which were from two to three feet long, had to be fastened securely in the flesh of the chest and back in order to hold in place this heavy metal canopy. Through his cheek had been thrust a silver skewer, which protruded an inch or more on each side of his face.

"A follower placed before the devotee a pair of spiked sandals, which had sharp curved blades on all sides, and pointed nails an inch and a half long rising from the centre. He placed his bare foot under the strap which was to hold them on, and proceeded a few steps. Then I saw him kick first one off, then the other. The attendant quickly picked them up and again placed them in his path, but they seemed too much for him. He refused to wear them.

"Still another had small brass jars of milk hanging from the hooks. A ring was tied over the top of each jar. If a drop oozed out on the way he would turn around and start again. . . . Another had two huge hooks fastened into the skin of his back. He was hitched by these to an elaborately-decorated cart weighing from 10 to 20 pounds."

These ceremonies, which are decidedly unpleasant for a European to witness, are carried out in a spirit of intense religious fervour. It is firmly believed that the tortures are efficacious for the curing of diseases of all kinds, and for the acquirement of religious merit. Those who submit themselves to the various ordeals are worked up into a state of religious exaltation so intense that, for the time being at any rate, they appear unconscious of any feeling of pain.

The name "fakir" comes from the saying of the Prophet Mohammed, "El fakr fakhri," meaning "poverty is my pride." The Persian equivalent is the word "dervish," meaning "The sill of the Door"; that is, those who beg from door to door.

The accompanying illustration gives a good idea of a scene at Singapore with a fakir into whose body dozens of needles have been thrust together with hooks in the back for the attachment of cords by which he will draw a decorated cart. In addition the fakir wears spiked sandals. Incredible as it may seem in many cases a skewer is even thrust through the centre of the tongue apparently without any ill effects.

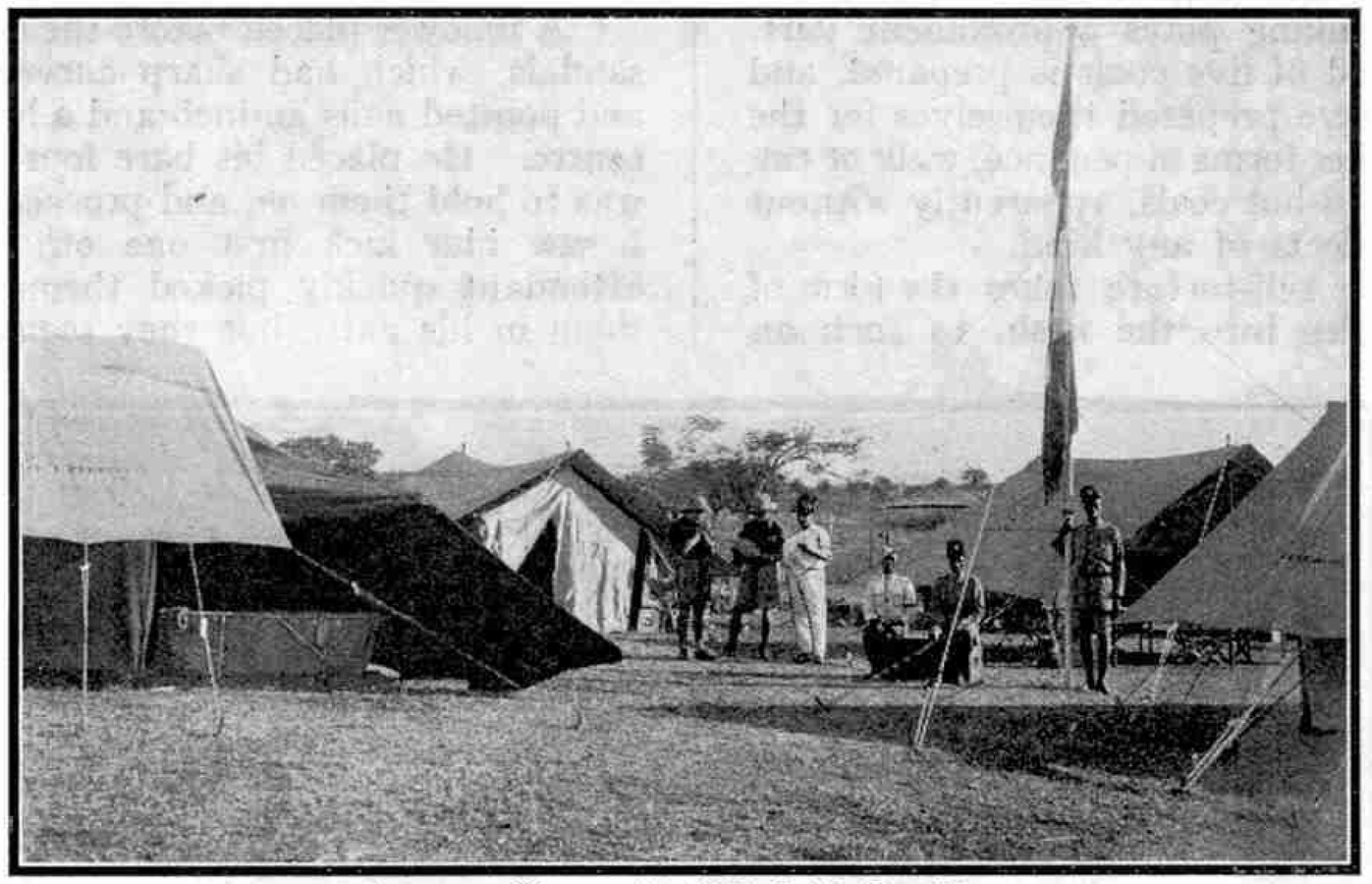
The "M'Tembo"

The Clown of the Equatorial Forest

By Commander Attilio Gatti

WHOEVER enters the equatorial forest seems to pass through a door into another world—a world that has existed intact and isolated since the dawn of life. He seems, in fact, to have stepped into some prehistoric epoch, in which he would not be greatly astonished to encounter a monstrous dinosaur crashing through the sea of vegetation.

This vast greenhouse is south-west of the Lake Kivu, in the heart of Africa, half-way between the Atlantic and the Indian Oceans, and half-way between Capetown and Cairo. The high mountains surrounding the lake are topped by a thick mantle of vegetation, stretching away as far as the eye can see. The section that is called the Tchibinda Forest is at the beginning of the great jungle, for the most part still unknown and mysterious, that extends for hundreds and hundreds of miles west towards Stanleyville and north towards the Ituri, forming a sort of precious frame for the three glittering sapphires, the Kivu, the Edward and the Albert lakes. This steaming tropical stronghold is the undisputed kingdom of the giant gorilla and the pygmy elephant, two of the rarest and least known of African animals. They seem to have chosen for their home just that corner of the world where Nature herself aids them in their evident desire to put an impassable barrier between their life and the life of every human being and, as far as possible, of every other being.



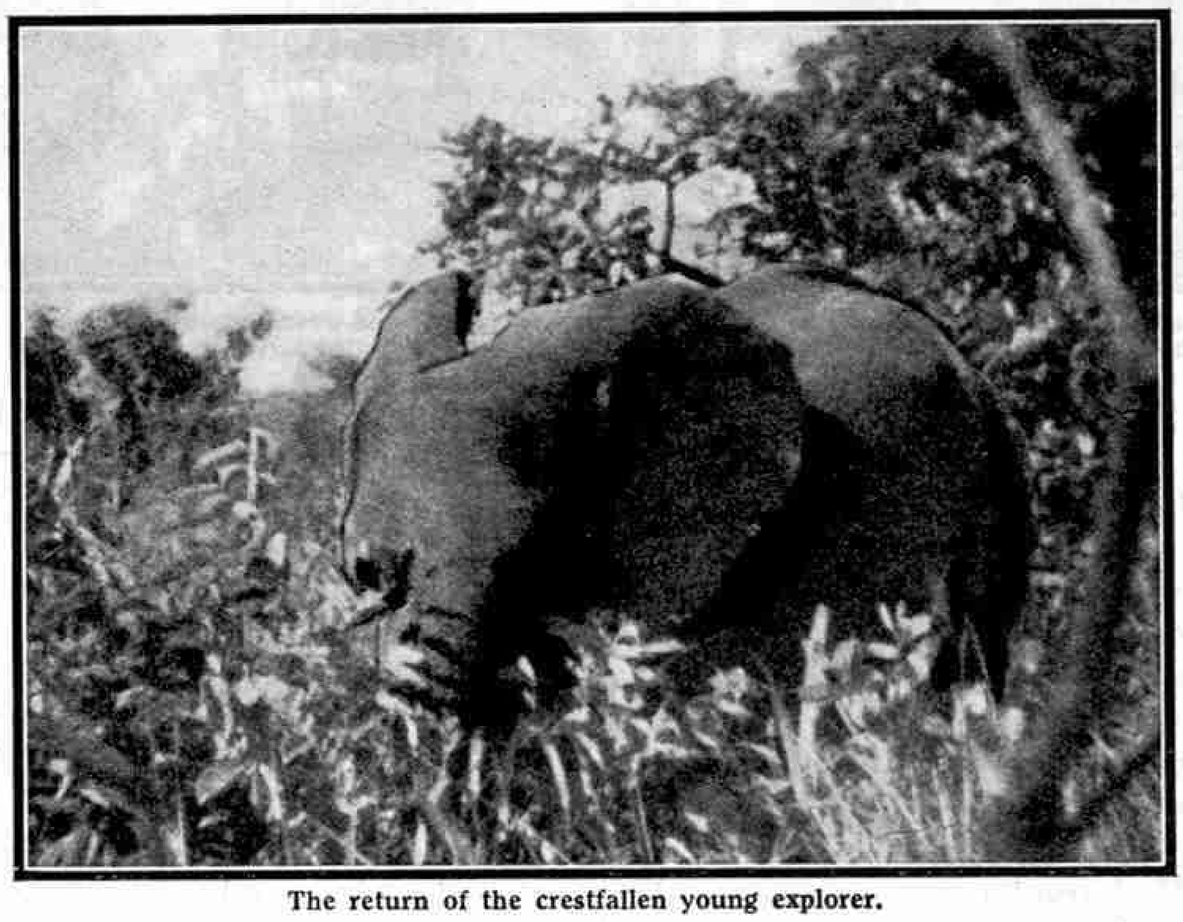
The camp of Commander Attilio Gatti's Expedition.

Life for the white man who invades this green inferno is strenuous, miserably uncomfortable, and exhausting. The feverish breath of the jungle seems to whisper in his ear hints of every known and unknown danger. Not a breath of wind passes through the thick curtain of foliage. The air, rarefied by the altitude, and the tremendous labour of each step through the tangled undergrowth, combine to cut his breathing and make his heart pound. After a few hours his sight grows dim and his ears are roaring. Thousands of stinging nettles, thorns and brambles pluck at him with vicious fingers, tearing his clothes, scratching his skin, and fraying his temper. Above all, the oppressive silence—where not a bird chirps, not the chattering of a monkey is heard, and not an animal disturbs a leaf in its movements, or snaps a twig underfoot—is nerve-racking beyond description.

I had good reason to appreciate this discomfort, for during my last expedition in Africa I spent several months in the Tchibinda Forest, and it was during this time that I made the acquaintance of the jolly little *m'tembo*, though it was to study the life of his neighbour, the great gorilla, that I had come to the forest.

One morning I set out for the forest, as was my custom, under the guidance of Kasciula, the diminutive, monkey-like Chief of the Mambuti pygmies who live at the edge of the jungle, and are the only natives that dare to penetrate it. Twelve other pygmies accompanied us, four of them carrying my two rifles and some sacks of instruments, food, cameras and so forth, while the others advanced before us, doing their best to force a passage through the almost solid wall of trees, bush and heavily-matted vegetation, and taking the utmost care to make as little noise as possible.

Now and then, at a sign from their Chief, several of them would vanish on short scouting trips, reappearing like ghosts from the thicket, always without a word, as if they had a religious fear of troubling the silence of the forest. I myself was doing no talking for two very good reasons. First of all, it was difficult to make conversation with the ten-and-a-half words of Mambuti that I knew at the time. Second, and more important, my breath was barely sufficient to keep up with the ridiculous short legs of Kasciula. Those deceptive-looking little legs proved extraordinarily swift and agile, and to follow them, in spite of all my African training, I had to use sheer force of will power, gritting my teeth and trying to dominate the distress of my breathing and quiet the tom-tom of my heart.



The return of the crestfallen young explorer.

Suddenly Kasciula stopped abruptly.

"*Bwana,*" he whispered, "*ico m'tembo*"—"There are the elephants."

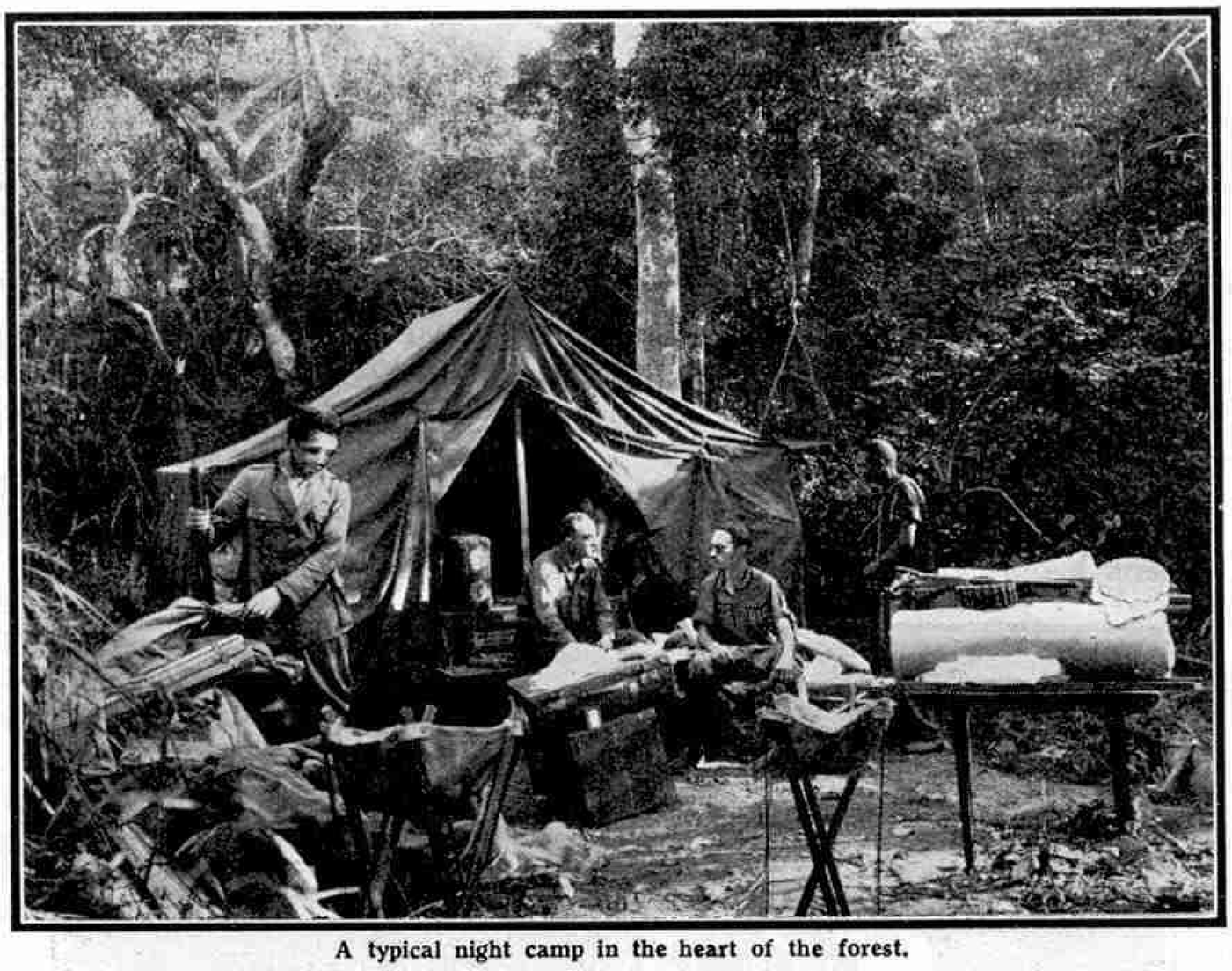
Through a little gap in the bushes I looked in the direction towards which he was pointing, and from which muffled noises were coming, like big stones falling in the water.

"*Udi m'tembo?*" I asked Kasciula—"Where are the elephants?"

He indicated to me the small valley at our feet. A little stream flowed through the high grass, forming a sort of pool, in which two elephants were happily paddling about. That pool must have been a favourite resort, for from the opposite hill a well-worn path descended sharply. From the top of the hill sounded various trumpetings, gay salutations to the companions already disporting themselves in the pool. In the suffocating silence of the forest these trumpetings were a welcome and pleasant relief—the first agreeable noise I had heard during many days; and they were followed by performances equally

agreeable and amusing.

A clumsy, greyish body appeared at the top of the path, cautiously advancing. Then a second, a third, and a fourth elephant emerged from the green mass of vegetation. The ground was not only very steep, but it must have been slippery as well; for the last *m'tembo* made a misstep, fell on his side, and started down the hill like a toboggan. He fell against the third elephant and toppled him over, and in their tumble downhill they picked up their two companions, rolling over and over in one grand melee of enormous ears, short legs and sinuous trunks waving in the air. With deafening squeals and trumpetings this huge animated toboggan skidded to the bottom of the hill and landed in the pool with a terrific splash.

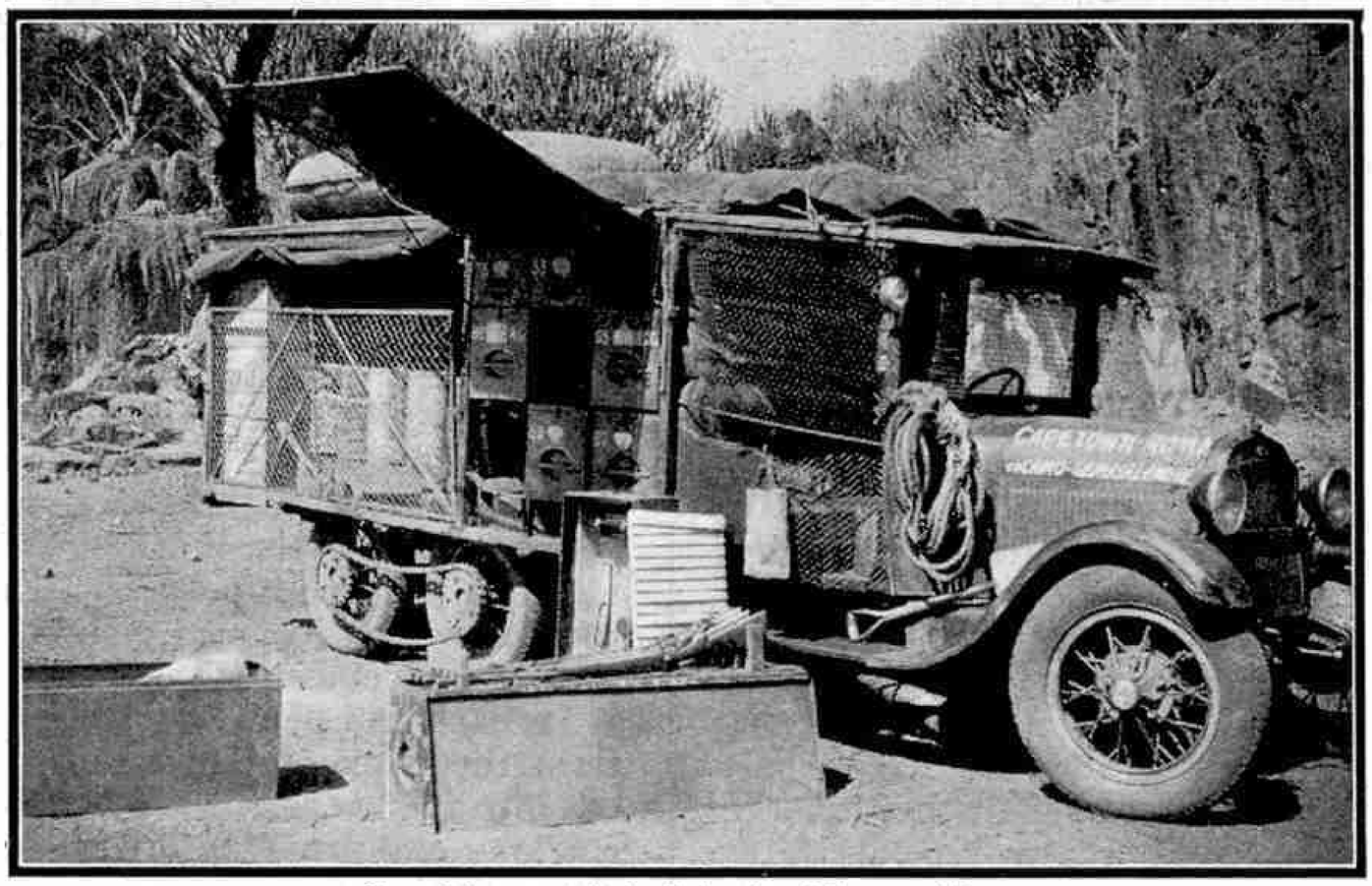


A typical night camp in the heart of the forest.

Entirely untroubled by this informal entrance, the original occupants of the pool rushed to greet the new arrivals, and with many squeals and trumpetings, and much shaking of huge grey bodies, they began to play like children in a swimming pool, or clowns in a circus. Yes, just like clowns; and "the clown of the forest" is the name I have given to *m'tembo* ever since.

Splendid climbers, droll in all their actions and extremely good tempered, the *m'tembo*, so much smaller than the normal elephant, seems to be the pygmy of his race, and for this reason appears to have a certain sympathy and a most peaceful relationship with his colleague, the pygmy of the human race.

Until a score of years ago, the pygmies, whenever they felt in the mood for a really royal banquet, were free to hunt the gorilla, the meat of which is for them the most succulent of all delicacies. For this reason they did not disturb the *m'tembo*, whose flesh is tough and unappetizing. Then, when the whites came, they instituted severe measures of protection for both the gorilla and the *m'tembo*, each of which is a very rare and rapidly disappearing specimen of African fauna. So the pygmies were obliged to be more careful than ever in respecting the lives of the little pachyderm of the forest, and *m'tembo*, not knowing the reason for this neighbourly courtesy, seems well content to repay it in kind.



One of the specially built trucks of the expedition.

After my first meeting with the elephants I often returned to the forest pool, partly because I could always be sure that my clowns would provide me with a pleasant spectacle full of variety and interest, and partly because I found it extremely convenient to avail myself whenever possible of the large and comfortable paths the elephants make—the only moments of comparative ease I ever experienced during the heart-breaking march through the forest.

In a high tree dominating the little "water-mirror" I had had the natives build a platform reached by a sort of rough ladder, and here during hours and hours I was able quietly to watch the games, the tricks and the antics of these pleasant creatures, and with the aid of powerful telephoto lenses to take photographs.

Naturally we tried to avoid making any noise, but after the first few days the *m'tembo* did not deign to pay us the slightest attention. Probably they had convinced themselves that there in the top of that tree some big climbing animal had taken the habit of going to rest, and although, because of their poor eyesight they could not see the newcomer very well, they must have decided that he was inoffensive, and that it was perfectly useless to lose time in smelling the wind with their curious trunks, or waving the enormous fans of their ears to capture every queer sound the new inhabitant might make.

And in perfect peace they continued to devote themselves to their normal pastimes. One plump fellow might be seen energetically excavating with his short tusks the shore of the pool until he found a tasty root which, with a sinuous movement of his trunk, he would bring to his small pointed mouth and devour with a grunt of satisfaction. Others, sucking up a good quantity of water or mud, discharged it on the head of a companion, or on their own backs, to provide a soothing refrigeration or a protection from the burning sun of the equator. More jovial natures occupied themselves with rolling over and over in the water, fencing and tusseling with each other; while the serious minded improved the time by giving practical lessons of every kind to their young ones.

One day one of these youngsters, taking advantage of a momentary lapse of attention on the part of his mother, decided to go on a one-man expedition in order to discover the real nature of those famous animals perched on the top of the tree and emitting such odd click-clicks and so many other noises that a respectable *m'tembo* never before had heard in the forest. We glimpsed him through the foliage as he climbed the steep bank in the direction of our tree, often slipping backward, and regaining his feet by a vigorous effort. His enormous ears seemed so much too big for his head that they gave him the ridiculous appearance of having borrowed his mother's ears for the occasion, and his bright little eyes were gleaming with mischief. Two or three times he stopped, looking back at the pool to be sure that nobody had noticed his truancy, then, satisfied, he resumed his climb like a naughty runaway boy.

Kasciula, near me on the platform, braced himself to steady the legs of the tripod of my camera, while I waited anxiously for the moment when the little *m'tembo* would come out from the thickness of the vegetation and give me a chance to get some good photographs of him. But just at that moment an acute yelp of mingled surprise and fright sounded beneath us; and that single yelp let loose a sudden pandemonium in that quiet angle of the forest.

At the foot of our tree a small black figure leaped up from the underbrush and started off in a crazy

(*Continued on page 690*)

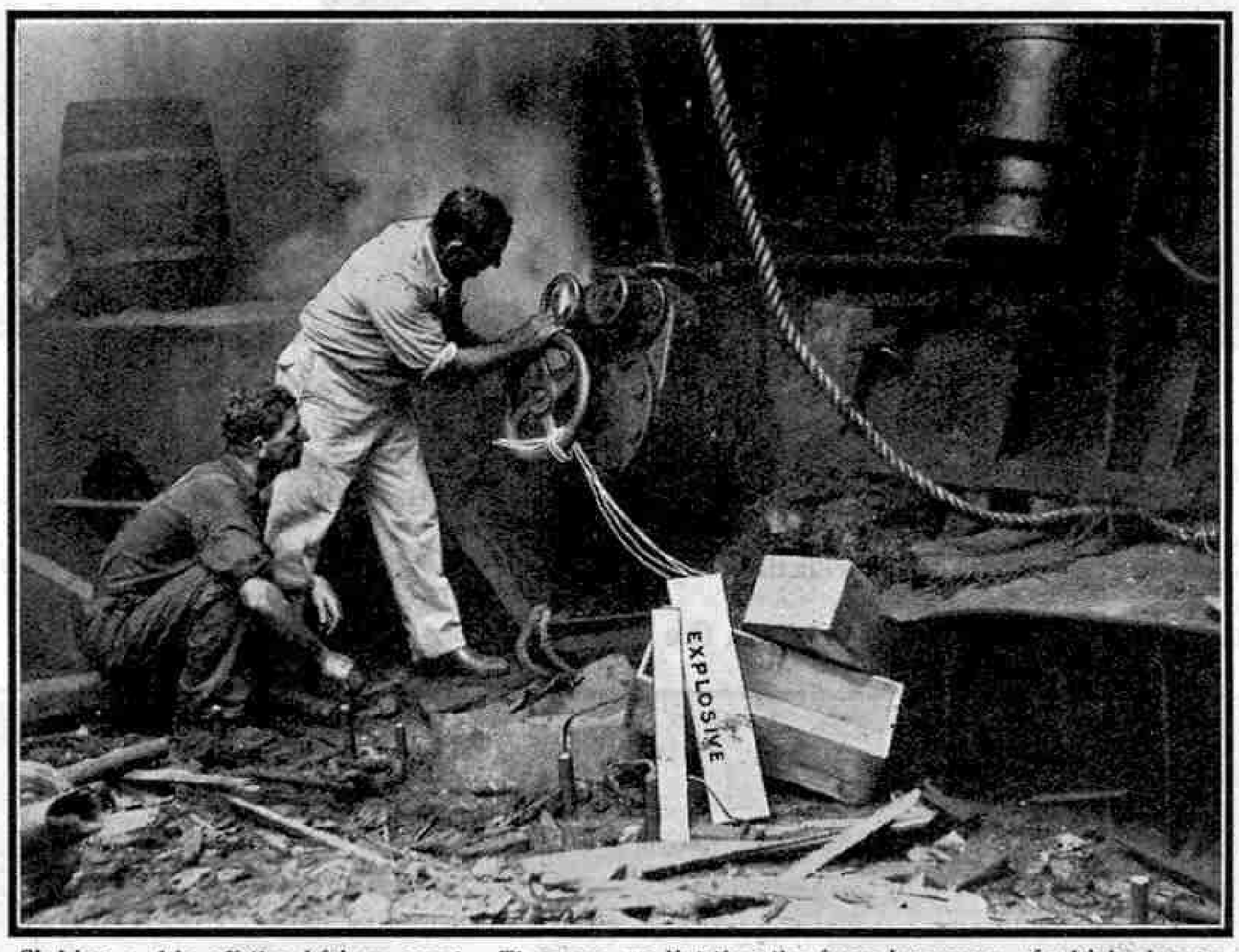
FROM OUR READERS

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

The End of the "*Istar*"

The "*Istar*" originally was a motor yacht owned by the Sultan of Zanzibar. Later she was converted into a floating "shark factory," but the venture on which she was employed was unsuccessful, and for many months she lay idle in Durban Harbour before being sold to ship breakers, who stripped her of everything of value. At length only the hull remained, and it was decided that this should be sunk at sea. One dull cloudy morning I boarded the tug that was to tow her out on her last voyage. She seemed reluctant to go to her own funeral, for her weight broke first a wire hawser, and then a strong cable before she was pursuaded to follow the tug at the end of a new cable twice as thick as the one previously tried.

When we were about five miles from the Harbour, the tow rope was cast off and the tug retired to a respectful distance, for the hulk was to be blown up by explosives in order to shatter it as completely as possible and cause it to sink. Thus there would be no danger of leaving the remains of the vessel to become derelict and a danger to navigation.



Sinking a ship off the African coast. The men are lighting the fuses by means of which charges of dynamite were exploded in order to shatter the vessel.

Two men set three charges of dynamite in the engine room and elsewhere, and sprayed the decks with paraffin. After lighting the fuses and setting fire to the paraffin, they hurriedly left the vessel and sought safety in the tug.

We stood in silence waiting for the explosions. After what seemed a very long interval the first charge of dynamite exploded, followed a few seconds later by the second. Slowly the "*Istar*" began to sink by the bow, and then a terrific explosion and a tremendous shower of debris told us that the third charge of dynamite had taken effect. Finally her stern rose out of the water, and she glided gracefully to Davy Jones's Locker, the spectators on board the tug remaining almost reverently silent, for parting from her seemed like losing an old friend. Even the spectacular nature of her end was scarcely sufficient compensation for the feeling that the destruction of the stout old vessel was a desecration. R. CAIN (Durban).

Bushfelling in New Zealand

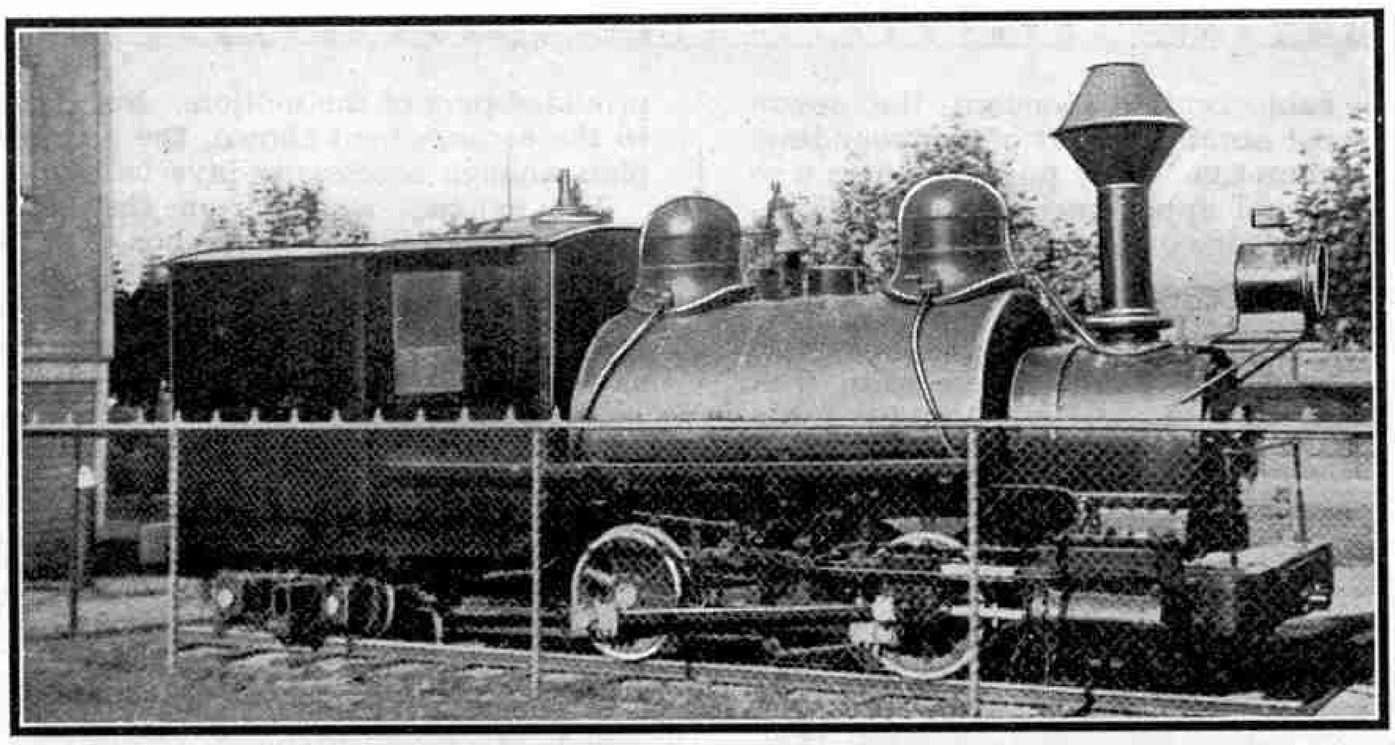
I spent two winters bushfelling on my father's farm between Taumarunui and Ohura in the North Island of New Zealand. The tools with which we worked consisted of axes, slashers and a saw. Slashers are like small bill hooks, and with these we cleared a strip of land of all small bushes and vines up to 2 in. in thickness. What are known as "supple jacks" offered the most difficulty, for their thick tangled stems are extremely tough.

We then began work on the big trees. These grow closer and taller than in an English wood or forest, and most of them are evergreen. They are dealt with in the manner that seems best adapted to their position. For instance, a large tawa tree on the bank of the stream running through the strip of land may attract our attention. One of us files the saw, while with the axe the other takes out a "scarf," or section on one side of the chosen victim. We then set the saw into the back of the tree, and a crackling, splintering noise begins as the long double-handed tool swings to and fro. Presently come two sharp reports and the tree swings over on the side of the scarf, where the breaking splinters set up a whining moan as the tree topples on to a mahoe, or whitewood, towards which its fall has been directed. At the first sign of movement we spring back to avoid accident.

Perhaps the next five trees are in line up the slope from the bank of the stream. If this is the case, we cut into the backs of the first four so that each is poised, cracking and groaning, over the one below it. Finally we scarf the top tree and cut into it with the saw on the upper side. Very soon it gives out the familiar warning sounds and crashes on to its neighbour. The two sway and groan like wrestlers, and in the end crash down on the next tree. This continues down the line, branches and splinters flashing and snapping, and dust rising to the accompaniment of noises like the firing of a Lewis gun in bursts and the tearing of calico. Finally there is a terrific crash and all the trees are down, while a cloud of dust races up the opposite hillside. W. CARTER (Okahukura, N.Z.).

A Veteran Canadian Locomotive

The accompanying illustration shows a pioneer Canadian tank locomotive that is to be seen in Hastings Park, Vancouver. Its name is "*Curly*," and it was the first locomotive to be employed in British Columbia. An inscription on a brass plate on the opposite side to that shown in the photograph gives a few details of its long career.



"Curly," the first locomotive in British Columbia. This pioneer engine is now on permanent exhibition in Hastings Park, Vancouver. Photograph by E. Worthington, Vancouver.

"*Curly*" had an interesting history before reaching British Columbia. It was first used by the French company that more than 50 years ago tried in vain to construct a canal across the Isthmus of Panama. Later it was employed during the building of the great sea wall at San Francisco, and was then taken north to help in the construction of the section of the Canadian Pacific Railway from Port Moody to Savona.

The Hastings Saw Mill Company bought "*Curly*" in 1888, and it then became the first locomotive to be employed in logging operations in British Columbia. In this capacity it continued to give good service until 1926, when it was reconditioned by the Canadian Pacific Railway Company and stationed on permanent exhibition in Hastings Park. This is an appropriate place for the veteran engine, for Vancouver, the third city in Canada, grew up round Hastings Mill, at which it began work nearly 50 years ago, and the Vancouver Harbour Commission have recently taken over the site of the old mill. The historic engine was presented for exhibition by the successors of the Hastings Saw Mill Company.

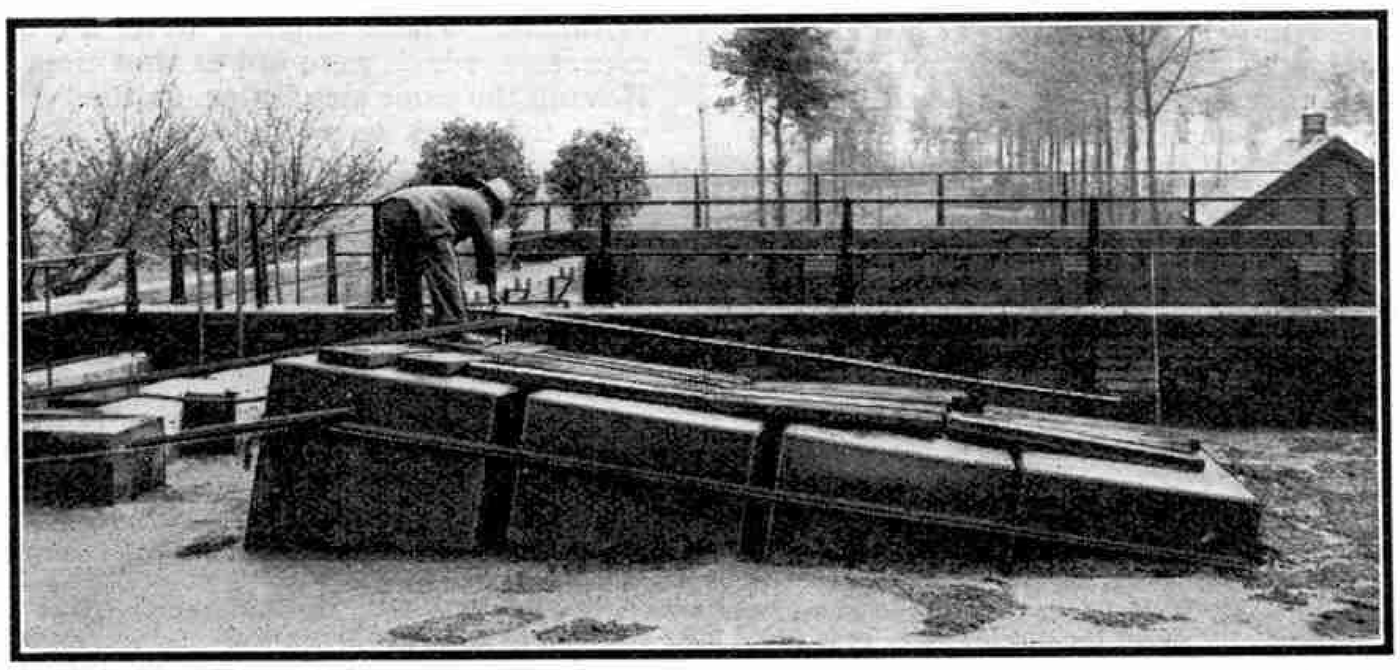
E. WORTHINGTON (Vancouver).

Illuminating Gas from Sewage

What is probably a unique gasworks belongs to Mr. J. Priest, Manager of the Sewage Works at Saltford, nr. Bath. Mr. Priest may really be said to get something for nothing, for he illuminates his house and laboratory, and sometimes heats them as well, from gas given off by the sewage.

When sewage sludge arrives at the disposal works it runs into tanks to settle, and is then pumped into a large tank, where its surface becomes covered with green slime. There marsh gas is formed, and bubbles of this can be seen bursting on the surface.

Mr. Priest has constructed a simple but effective gasholder in order to prevent the marsh gas from being wasted. This device consists of four inverted steel tanks, under which the gas is trapped; and the weight of the vessels gives the pressure required to force the gas through the mains that lead to the house. There is always sufficient gas to give good light in the enterprising owner's home, and at times the gas fires also can be supplied from this novel source.



A novel gasholder in which marsh gas generated by sewage is collected for use in lighting and heating the Sewage Works Manager's house. Photograph by V. Chamberlain, Bath.

V. CHAMBERLAIN (Bath).

An Indian Goldfield

The Kolar Goldfield is not as rich or as extensive as the more famous gold producing area of the Rand in South Africa, but is interesting, and I thoroughly enjoy my work in one of the mines there. The field is about six miles in length and 1½ miles in width, and gives occupation to nearly 20,000 workers of all grades.

Gold-bearing rock is extracted by means of compressed air drills, and the compressors that supply the necessary air under pressure are at suitable points near the shafts. They are cross-connected by means of extensive pipe lines and some of the compressed air mains are 12 in. in diameter. Other surface features include stamping mills and the plant in which the gold is extracted from the crushed rock by means of potassium cyanide, and there are also vacuum pumps, filter presses, agitators and settlers in addition to the winding systems, which are now largely electrical.

The greatest depth reached on the Kolar Goldfield is nearly 8,000 ft. and the mines are still being carried further. There are 10 main shafts, and the cages in one of the shafts are large enough to hold 60 men.

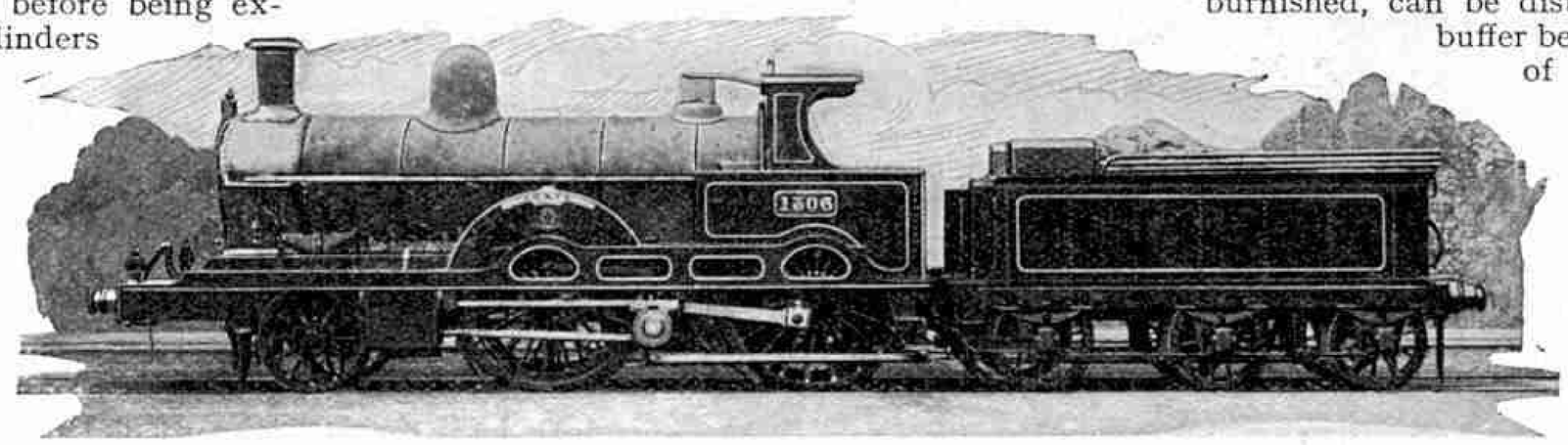
The Balaghat Mine, in which I work, has reached a depth of 5,300 ft. The main roads underground are lit by electricity, but the working places in stopes and headings are illuminated by means of candles and acetylene hand lamps. My duties as a member of the underground engineering department include the care of winders, pumps and fans, and the large compressed air mains. I go underground every day except Sunday, and prefer this to working on the surface, for it seems to me that in spite of the alleged danger of underground working there is less risk than in moving about the streets of a great city!

V. C. RISHWORTH (Kolar).

The Search for Locomotive Economy

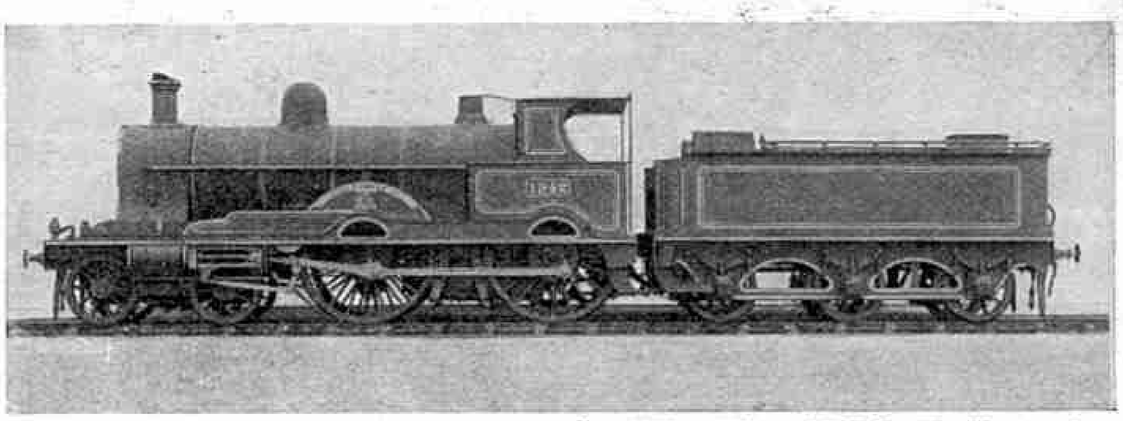
II.—Early Compound Systems

OF all the controversial subjects that concern the steam locomotive, one of the most notable is that of compounding. The term "compound locomotive" may puzzle readers who are familiar only with the external appearance of various locomotives, and while having a knowledge of their general principles, may not be conversant with the more advanced details of their internal arrangements. The word "compound" is used to describe a locomotive or steam engine in which the expansion of the steam is allowed to progress to a further stage than that ordinarily reached, before being exhausted from the cylinders after having performed work on the pistons. In a locomotive of ordinary "simple" design steam from the cylinders is exhausted directly into the atmosphere by means of the blast pipe. This steam may still be at a considerable pressure, and contain a useful percentage of heat units that are thus thrown to waste. The idea of the compound arrangement is to make use of this steam in another cylinder or cylinders after it has done some work in the first cylinder or cylinders.



A typical "Webb" three-cylinder compound locomotive. This engine, L.N.W.R. No. 1306, "Ionic," ran from Euston to Carlisle without a stop in 1895. Photos on this and the following page are reproduced by courtesy of the L.M.S.R.

As long ago as 1852 James Samuel, then Locomotive Superintendent of the Eastern Counties Railway, applied to a goods and a passenger locomotive a plan of continuous expansion introduced to him a few years previously by one of his drivers named Nicholson. The engines concerned had two cylinders with piston areas arranged approximately in the proportion of 1 : 2. At a certain point of the stroke, steam from the smaller cylinder was allowed to pass to the larger one, and expansion then went on in both cylinders at the same time. The results obtained from these locomotives were considered satisfactory, possibly owing to the poor performance of contemporary simple engines, but the scheme does not appear to have been pursued further. In 1866 David Joy, later famous for his radial valve gear, proposed a design of compound locomotive in which the high-pressure and low-pressure cylinders were connected to separate uncoupled driving wheels of different diameters, but he did not proceed with the idea although he obtained a patent.



A "Webb" four-cylinder compound locomotive "King Edward VII." The illustration shows the outside valve gear added after building, as related in this article.

In 1876 three two-cylinder compound locomotives were put into service on the Bayonne and Biarritz Railway. Two or three years later F. W. Webb, then Locomotive Superintendent of the L.N.W.R., who became such an ardent advocate of compound locomotives, experimented with this two-cylinder system in an old single-driver locomotive. This was named "*Medusa*," then No. 1874, originally of the familiar Allan "Crewe" design with outside cylinders; and as a two-cylinder compound it worked on the Ashby and Nuneaton branch for some time. As a result there started in 1882 what we may term the compound era, and this only ceased on the L.N.W.R. with Mr. Webb's retirement more than 20 years later.

Early in 1882 the first Webb compound locomotive, appropriately named "*Experiment*," left Crewe Works. It had three cylinders, two high-pressure ones outside and a large low-pressure one inside the frames. The high-pressure cylinders were connected to the rear pair of driving wheels. The arrangement can be seen in our illustration of No. 1306, "*Ionic*," and is typical of the first 80 three-cylinder engines. The valves of the outside cylinders were underneath, and on a few of the earlier engines a return crank provided part of the motion; but these were subsequently altered to the arrangement shown, the gear then following the usual Joy plan, though necessarily inverted.

The exhaust steam from the high-pressure cylinders passed through pipes in the smoke-box, forming an intermediate receiver that was thus subject to the heat of the smoke-box gases, and then it was admitted to the single large low-pressure cylinder between the frames. This cylinder was placed underneath the smoke-box, and its front cover that was invariably brightly burnished, can be distinguished below the buffer beam in our illustration of the compound locomotive "*Jeanie Deans*." Joy's valve gear was also used for the low-pressure valve, but the later engines had a slip eccentric for this purpose. The final exhaust took place in the usual manner to the chimney, and there were of course only two beats to each revolution of the driving wheels, as there was only a single cylinder exhausting to the atmosphere.

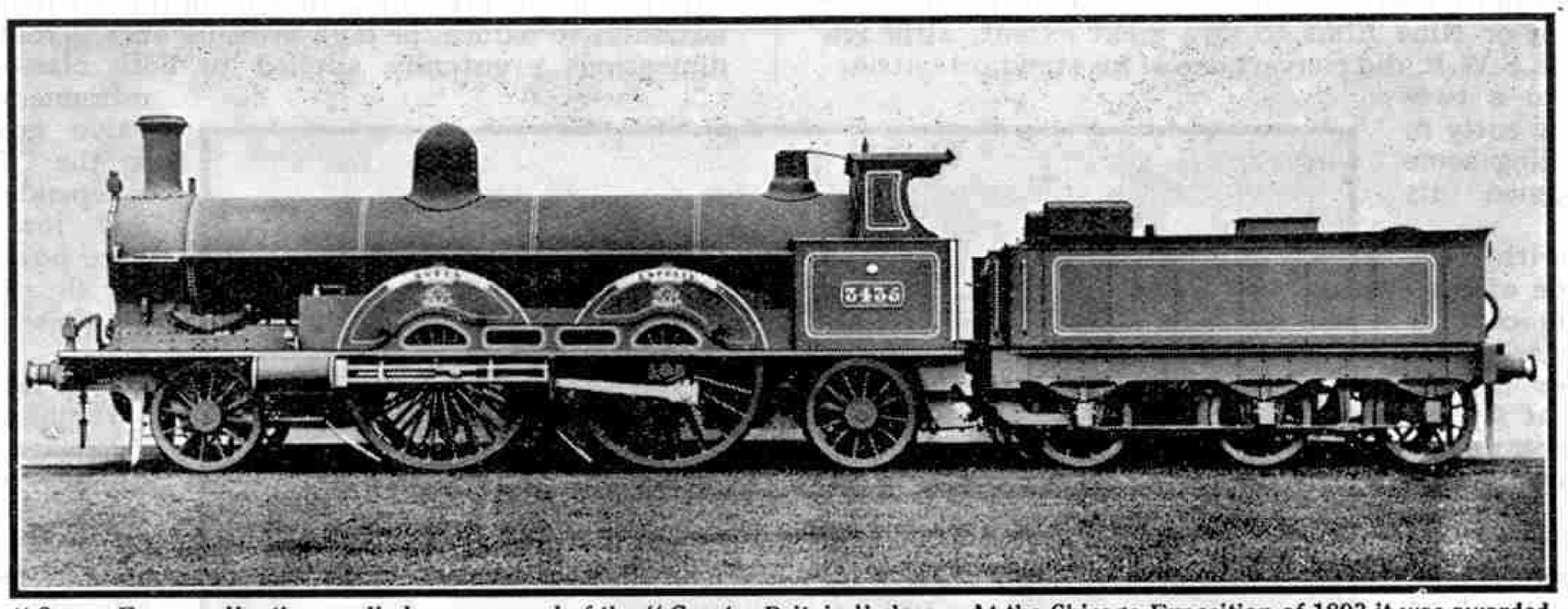
The low-pressure cylinder was connected to the crank axle of the leading driving wheels, but these were not coupled up to the trailing wheels, so that the high-pressure and low-pressure units did not necessarily work in unison. As "*Experiment*" had proved deficient in starting power, 29 subsequent engines, of which No. 300, "*Compound*," was the first, had larger high-pressure cylinders. These engines were used chiefly on the Irish mail expresses, which were not at that time particularly brilliant trains. Having the same size boilers as the "Precedent" class, which they were intended to replace, the "Experiments" were not very powerful or successful as compound engines, so that soon after the last of them had been built, there appeared the first of a new class of 40 "Dreadnoughts."

These "Dreadnoughts" were of the same general design, but had larger boilers working at a higher pressure, and smaller driving wheels, so that their starting qualities were improved. They were generally uncertain, but occasionally successful engines, and for 15 years they put in a great deal of "hard, heavy belting" on main line trains. One of them, in 1885, ran through from Euston to Carlisle with the 10 a.m. express, the average speed being 44.7 m.p.h., inclusive of stops, and the load 207 tons.

The next class consisted of only 10 engines, the reason for which seems strange, as they were by far the most successful of the Webb three-cylinder engines. These were the "Teutonic" class of 1889. One of them, No. 1304, "*Jeanie Deans*," which we illustrate, was shown at the Edinburgh International Exhibition of 1890, hence the name, which seemed exceptional, for the nine others had titles such as "*Coptic*," "*Ionic*," "*Gaelic*," "*Pacific*," etc. In connection with this Exhibition it is related that Mr. Webb proposed to run a special train from Euston non-stop to Edinburgh with one of his compounds, but the Caledonian authorities would not agree to the use of their line from Carlisle to Edinburgh in this manner. Further, when "*Jeanie Deans*" went to Edinburgh for the Exhibition, it was as part of a humble goods train and not even under its own steam.

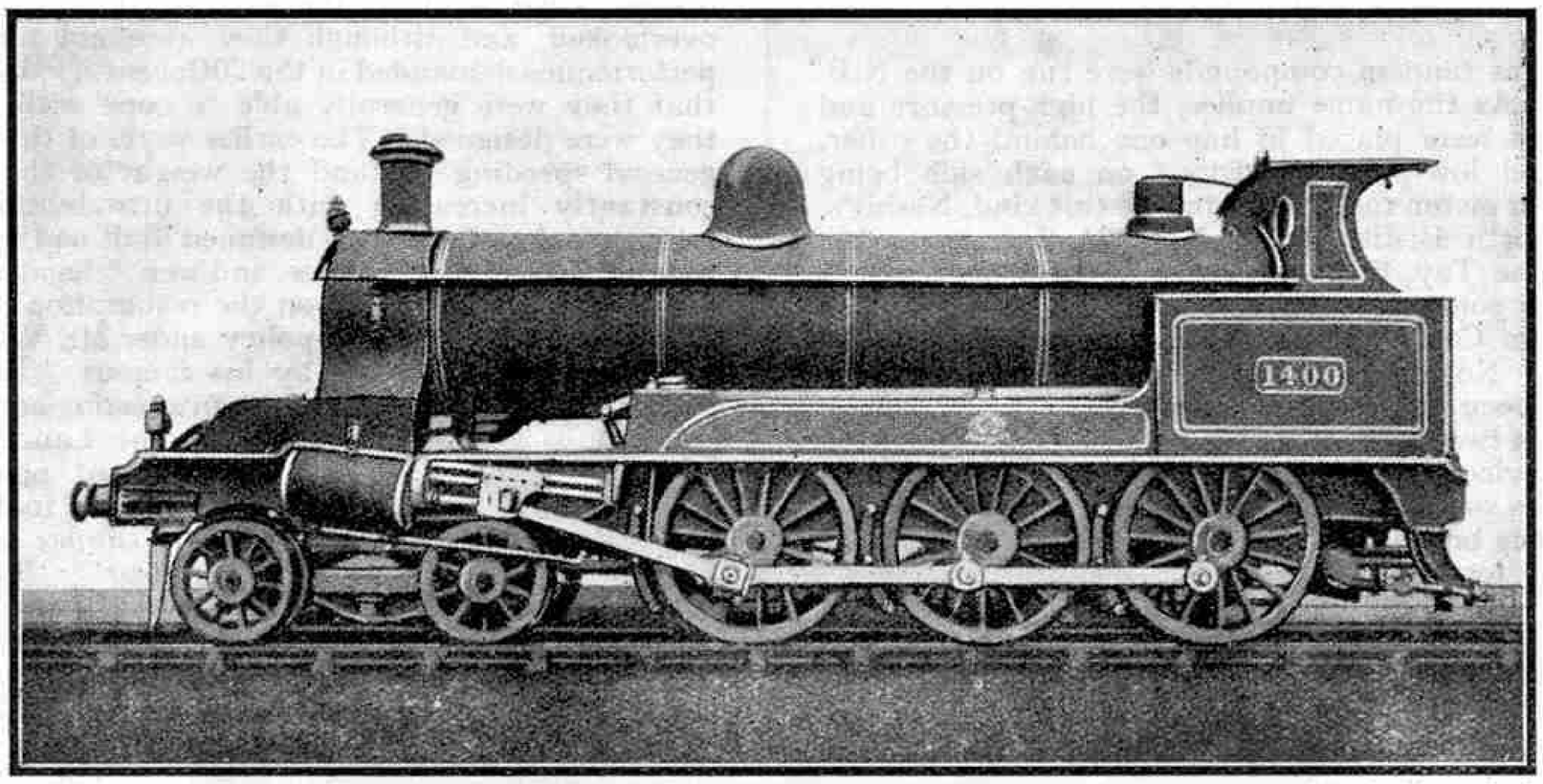
However, this indignity did not prevent this particular engine from attaining a special reputation when placed in regular service. From January, 1891, to August, 1899, it ran almost exclusively

on the 2 p.m. Scottish express from Euston—"*The Corridor*," as it was long known—and the corresponding return train from Crewe. The loads were heavy for those days, from 260 to 310 tons, but the engine dealt with them in a satisfactory manner. The length of the L.N.W.R. line from Euston to Carlisle was covered without a stop in 1895 at 51 m.p.h. by No. 1306, "*Ionic*." Good running was made also by No. 1309, "*Adriatic*," in the 1895 "Race to Scotland," an average speed of 64 m.p.h. being made when the 158 odd miles between Euston and Crewe were covered in 147½ minutes on the last night of the "Race."



"Queen Empress," a three-cylinder compound of the "Greater Britain" class. At the Chicago Exposition of 1893 it was awarded a gold medal, a reproduction of which appears above the number plate.

This series of 80 six-wheeled engines was succeeded by 20 eight-wheelers, unique in that they approximated to the 2–4–2 or "Columbia" type, which has never been used in this country for tender engines. The first 10 of these eight-wheelers had 7 ft. 1 in. driving wheels, as had the "Teutonics," and were known as the "Greater Britain" series. The second 10 were the "John Hick" class, which had smaller wheels, and were intended more particularly for the Crewe to Carlisle section. These engines had the worst reputation of any of the Webb compounds, but the "Greater Britains" did some good, some bad and much indifferent work, and in this respect resembled the earlier "Dreadnoughts." They were held to be very big engines at the time they were built. The boiler was of special design, long in the barrel, and fitted with a combustion chamber between the fire-box and the smoke-box. These engines had the high-pressure valve chests inside the frames, the valves being operated by Stephenson link motion. The low-pressure valve was worked by a loose eccentric, this having been introduced after the first three "Teutonics" had been built.



The last "Webb" four-cylinder compound design and the first L.N.W.R. 4-6-0. These engines were intended for mixed traffic work, but were tried on the heavy Scottish expresses in 1904.

A famous member of this class is illustrated, "*Queen Empress*," that was specially painted white in honour of the Diamond Jubilee of Queen Victoria in 1897. In 1893 it visited Chicago for the Columbia Exposition of that year, and in travelling under its steam for 1,500 miles on American railways it anticipated by 40 years the visit of the modern "Royal Scot" and its train to the World's Fair of this year.

The three-cylinder compound system was also applied to four tank engines. The first was a 4–4–0 "Metropolitan" tank, and another followed in general style the standard Webb 2–4–2 tank design with small driving wheels. For various reasons the Webb three-cylinder engines were not very good starters, and this rather prejudiced the success of the system for suburban work. The violent surging of the engines, as the big low-pressure cylinder came into action, was a familiar motion to habitual travellers on the L.N.W.R. of the period, and such efforts on the part of the "*Patent Engine for Suburban Work*," as the little 2–4–2 was inscribed, resulted in its being known familiarly as the "*Fore and Aft*." There was a similar but larger engine with 5 ft. 6 in. wheels and a curious tank design with a pair of leading wheels and six driving wheels, of which the two rear pairs, driven by the outside high-pressure cylinders, were coupled, and the other pair separately driven as usual. Although intended for goods work, this engine was used on the Manchester and Buxton passenger services, and finished up on the Northwich branch.

In 1892 the system was applied to goods tender engines after trials of the earliest L.N.W.R. 0–8–0 engines, one compound and the other non-compound, on corresponding trains. Over 100 compound 0–8–0s were built as a result. In these engines the coupling of the wheels overcame one of the defects of the Webb system as applied previously to passenger engines, but although these 0–8–0s were successful up to a point, they were converted to simple engines after Webb's retirement, when the three-cylinder passenger engines were quickly broken up as their boilers and cylinders gave out. Those of the goods engines that were converted with larger boilers formed the basis of subsequent L.N.W.R. eight-coupled designs.

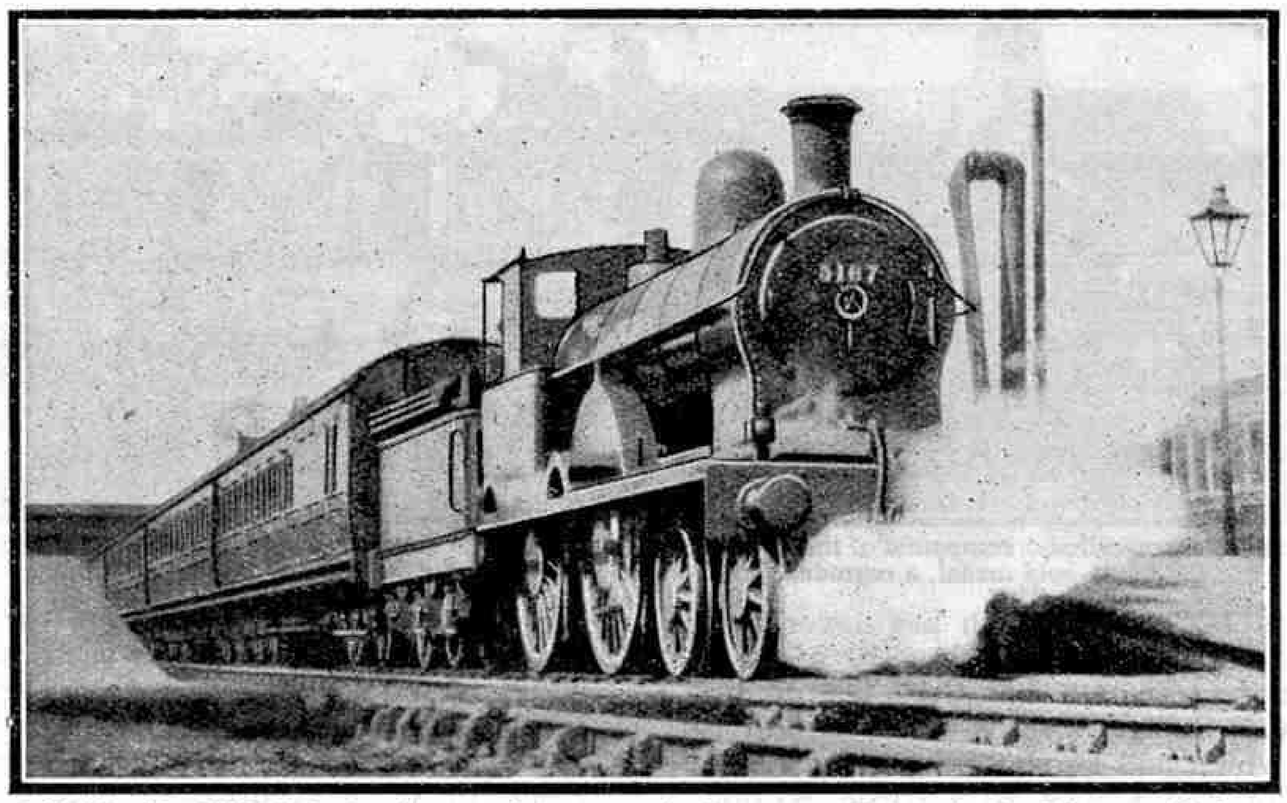
Considerable attention was given to compound systems as a result of Webb's efforts, and it probably will be news to many of our readers to learn that a Webb compound locomotive was actually built in this country for the American Pennsylvania Railroad. This was not built at Crewe, however, but by Beyer Peacock & Co. Ltd., of Manchester, to whom the necessary details were furnished by Mr. Webb. It was therefore exactly like a North Western "Dreadnought" when it left this country, except for the "cow-catcher," Westinghouse brake pump and a few minor details. The somewhat antique type of tender so long favoured at Crewe was not reproduced. The engine was in service only from 1889 to 1897, and was stated by the Pennsylvania authorities to have been "excellently well built and its fuel performance very good." It was not popular with the men, however, owing to the meagre cab accommodation common to L.N.W.R. and most British engines of that time. Quite possibly, too, they did not care for the occasional eccentricities shown by Webb compounds. Such engines might be humoured on the L.N.W.R., where official enthusiasm for the engines was the order of the day, but one cannot imagine a Pennsylvania "hogger" of the nineties having much sympathy with the only engine of its kind in America.

Some years previously, in 1885, ten compound locomotives, built in accordance with Webb's patents, were supplied to the Oudh and Rohilkhund Railway of India. Externally they did not resemble the Crewe engines as closely as the Pennsylvania locomotive, but the principles of their design and operation were the same. They never achieved much of a reputation, and were ultimately broken up. One survived till 1905, but it had been transferred to the North Western Railway of India and rebuilt by them as a 4–4–0 engine, although still a three-cylinder compound but on the "Riekie" system.

The Webb compounds certainly did not fail to obtain success through any lack of publicity. Examples were exhibited at

Liverpool in 1885, Manchester in 1887, Edinburgh in 1890, and Paris in 1900. The engine built for the Pennsylvania line and the Oudh and Rohilkhund engines were other instances, apart from the 1893 Chicago visit of "*Queen Empress.*" In this country the Manchester, Sheffield and Lincolnshire and the L.S.W.R. systems each arranged for a Webb compound to run comparative trials on their metals. Its exploits—the same engine No. 300 "*Compound*" being used in each case—cannot be said to have influenced practice at Gorton or Nine Elms to any great extent, although Mr. Adams of the L.S.W.R. did convert one of his standard outside-cylinder 4–4–0s to a two-cylinder compound early in 1888. After running some time it reassumed its original form.

Contemporary with Webb in the introduction of compounding to this country was T. W. Worsdell, who had served under him as Works Manager at Crewe. Later Worsdell took up the locomotive superintendency of the G.E.R., and then in 1886 of the N.E.R. He preferred the two-cylinder compound arrangement on the score of simplicity, and although his work should be remembered in connection with that of Webb as a pioneer of compounding in this country, we shall refer to it in the next article of this series. The Worsdell system on the North Eastern immediately preceded the evolution of the familiar and successful Smith arrangement. As the latter is still in use and, as modified at Derby, is so widely applied on the L.M.S.R., it will be more convenient to consider the Worsdell system with more recent practice.



L.M.S.R. No. 5167 "Jupiter" one of the now obsolete two-cylinder simple "Renown" class. Originally a four-cylinder compound it was converted to the simple arrangement in 1921.

What were known as tandem compounds were run on the N.B. and G.W. railways. As the name implies, the high-pressure and low-pressure cylinders were placed in line one behind the other, the high-pressure and low-pressure pistons on each side being mounted on a common piston rod. A system of this kind, Nesbit's, was applied to a North British 4–4–0 No. 224, famous as the engine involved in the Tay Bridge disaster of 1879, as a result of which it had spent some time at the bottom of the Firth. In 1886 it appeared from Cowlairs as a tandem compound with four inside cylinders. No details of its behaviour in this form appear to have been published, but in 1897 it was again rebuilt as a two-cylinder simple engine and was in service until 1919.

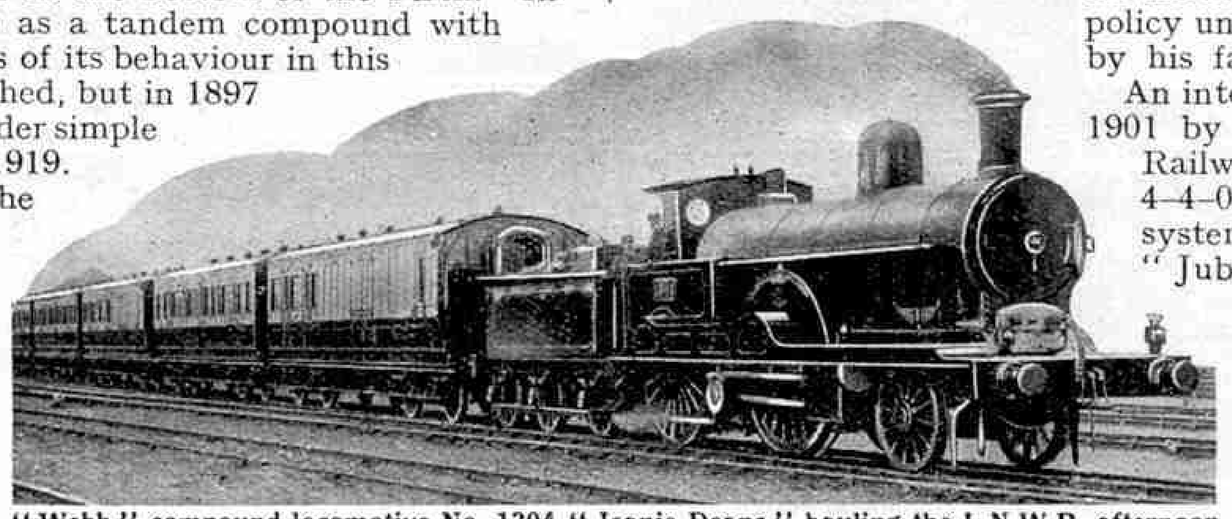
The G.W.R. engines were of the 2–4–0 type, one for the broad gauge and the other for the standard gauge. Several mishaps marked their careers as compounds, and they were speedily suppressed.

The idea of pitting against one another simple and compound locomotives of otherwise similar design seems to have appealed to Webb. In 1897 he built the first 4–4–0 express engines on the L.N.W.R., one a four-cylinder simple engine and the other a four-cylinder compound, named respectively No. 1501, "*Iron Duke,*" and No. 1502, "*Black Prince.*" They were remarkable in being fitted with an experimental arrangement of double chimneys. The smoke-boxes were divided by an internal plate, and a separate outlet was provided to each compartment, the two chimneys being combined in a single casing. As may be imagined, this arrangement looked extremely ugly. The failure of the simple design was inevitable, for the boiler, of similar dimensions to that of the "Dreadnought" and "Teutonic" classes, was expected to find steam for four cylinders 15 in. in diameter. In 1898, therefore, No. 1501, having previously been renamed "*Jubilee,*" became a compound also, and during the following two years 38 more such engines were built. These were Nos. 1903-40, "*Jubilee*" and "*Black Prince*" becoming No. 1901 and No. 1902 respectively. All the cylinders were in line under the smoke-box, and were connected to the leading driving axle. Two sets of inside Joy's valve gear operated directly on the low-pressure valve spindles, which were connected by rocking levers to the outside high-pressure ones. There was thus no means of providing a separate point of cut-off in the high-pressure and low-pressure cylinders, and in addition the cylinder proportions were faulty. The pressure of 175 lb. per sq. in. used in the first engines had to be raised to 200 lb.

Except for bigger boilers and larger high-pressure cylinders, the 40 engines of the "Alfred the Great" class of 1901-3 were similar. Whereas in the "Jubilees" it became necessary to enlarge the low-pressure cylinders, in the "Alfreds" it was deemed advisable to reduce the high-pressure ones so that the same cylinder dimensions eventually applied to both classes. After Webb's retirement separate outside valve gears were applied to the "Alfreds," so that independent high-pressure and low-pressure cut-offs were now possible. One of our illustrations shows one of these engines so provided.

In 1908 one of the "Jubilees," No. 1918, "*Renown,*" became a simple engine with two inside cylinders, and later many of these compounds of both classes were similarly altered. Another of our photographs shows a converted engine of this kind at work. Withdrawal of these engines, both compound and simple, has in later years been rapid, and they have now ceased to exist. It is of interest to recall that one of them, as a compound, No. 1974, "*Howe,*" was fitted with a superheater some years ago, but the experiment was not developed further.

In dismissing these engines as ineffective under modern conditions, their work in the early part of their existence is often overlooked, and although they were not up to the standard of performance demanded in the 20th century, it must be remembered that they were generally able to cope with the trains for which they were designed. The earlier years of this century witnessed a general speeding up, and the weight of the chief expresses was constantly increasing with the introduction of more modern rolling stock. Once their designed limit had been passed, therefore, the engines had little chance, and were relegated to secondary duties on the resumption of the non-compound policy under Mr. Whale, first exemplified by his famous "Precursors."



"Webb" compound locomotive No. 1304 "Jeanie Deans" hauling the L.N.W.R. afternoon Scottish express. This engine worked this train almost continuously for some years. Photo courtesy L.M.S.R.

An interesting conversion was made in 1901 by the Lancashire and Yorkshire Railway of one of their standard 4–4–0s to a four-cylinder compound system similar to the North Western "Jubilees." The external lines of the engine also were modified to resemble Crewe practice. It later reverted to its original simple condition, and was provided with a superheater.

The four-cylinder system was applied also to the L.N.W.R. 0–8–0 mineral design, and this had the effect of making the weight on the leading axle excessive. Mr. Whale therefore added a pony truck to some of them, thus converting them to the 2–8–0 type. During the passage of time these compounds, like the three-cylinder engines, have all been rebuilt as simples.

The first L.N.W.R. 4–6–0s were also four-cylinder compounds, and were introduced for fast goods and mixed traffic working. It is interesting to note that in the autumn of 1904 the "1400" class, as they were officially known, were tried on expresses between Crewe and Carlisle. They did not meet with much success on this work, although they were fairly useful in other directions, but they were quite outclassed by the later simple engines of the same wheel arrangement. These compounds were familiarly known to railwaymen as the "Bill Baileys."

In spite of long and extensive experiments, the Webb systems, both three and four-cylinder, were not greatly successful. While the engines generally embodied numerous ingenious features, their effectiveness was nullified by such faults as the uncoupled wheels of the three-cylinder passenger engines, and the lack of separate high-pressure and low-pressure valve gears in the four-cylinder compounds; and, in the main, insufficient boiler power.

American Railway Pioneer Honoured

T. D. Judah and the S.P.R.

AN event of unusual railway interest took place early this year at Sacramento, California. This was the unveiling of a monument to Theodore Dehone Judah, the first engineer of the Southern Pacific Railroad, and the man who pioneered the Central Pacific Railroad, parent of the present S.P.R., across the rugged Sierra Nevada Mountains.

Judah was born in Bridgeport, Connecticut, on 4th March, 1826. He graduated at the Rensselaer Polytechnic Institute at Troy, New York, and in 1854 went west to California to build the Sacramento Valley Railroad. This pioneer line of about 22 miles, from Sacramento to Folsom, was opened for traffic on 22nd February, 1856—Washington's birthday—eight years before any other railway was completed in California or on the coast. The completion of this line represented the first step towards the realisation of Judah's vision of a railway crossing the entire continent.

He prepared a scheme for a "Pacific Railroad," and tried to obtain financial support for it; but it was not until 1862 that he succeeded in doing this. In that year an Act was passed authorising the construction of the first trans-continental railway. Work on this line, the Central Pacific Railroad, was commenced without delay, and in spite of the enormous engineering difficulties that were encountered, it was steadily pressed forward to completion. Judah did not live to see it finished, for he died at New York on 2nd November, 1863, before the line had climbed the mountains.

Monument erected at Sacramento, California, to Theodore Dehone Judah, whose pioneer work led to the construction of America's first trans-continental railway.

The problems that the engineers of the Central Pacific Railroad had to face were described in our article "*The Gold Coast Limited*," in the "*M.M.*" for March, 1931. Two of the most serious difficulties were the extreme hardness of the granite rock of the mountains, and the heavy snowfall, which is said to reach as great a depth here as at any place in the Northern Hemisphere. In order to protect the line the engineers had to construct a vast series of snow sheds extending almost continuously for 20 miles. The "last spike" of the railway was driven on 10th May, 1869, at Promontory, Utah, where the line joined the Union Pacific Railroad.

The monument was erected by funds contributed by the officials and employees of the Southern Pacific Company, and it stands in the park facing the company's Sacramento passenger station. It is constructed of granite, and the stones that comprise it were brought from the summit of the mountains, and were taken from territory where once Judah tramped on foot seeking a pass over the summit. The central stone weighed 40 tons, and it was necessary to cut it into four pieces in order to transport it to Sacramento. There the masons united the pieces so cleverly that it would be impossible to tell that the stone had ever been cut.

The monument was designed by Mr. J. A. MacQuarrie, a well-known San Francisco sculptor, and the bronze bust, wreath, rails, tie and inscription were cast in the brass foundry of the Sacramento shops of the Southern Pacific Company. The unveiling ceremony was performed by Miss Janice Judah, great-great-grandniece of the pioneer. Additional interest was given to the ceremony by the presence of some of the old railroad employees. These included C. H. Lewis, aged 89, who in April 1869 helped to set up a world's record by laying 10 miles of track in one day; J. M. Graham, aged 89, sole survivor of the civil engineers who built the line of the Central Pacific; A. L. Bowsher, aged 90, who took part in the ceremony of driving the last spike in 1869; and J. O. Wilder, aged 80, and O. N. Cronkie, aged 85, who were with the surveying parties during the years 1865-68 when the line was being built across the Sierras.

The inscription on the monument commences as follows: "That the West may remember Theodore Dehone Judah, pioneer civil engineer and tireless advocate of a great trans-continental railroad —America's First—This monument was erected by the men and women of the Southern Pacific Company who, in 1930, were carrying on the work he began in 1860."

Synchronous Electric Motor—(*Cont. from p. 663*)

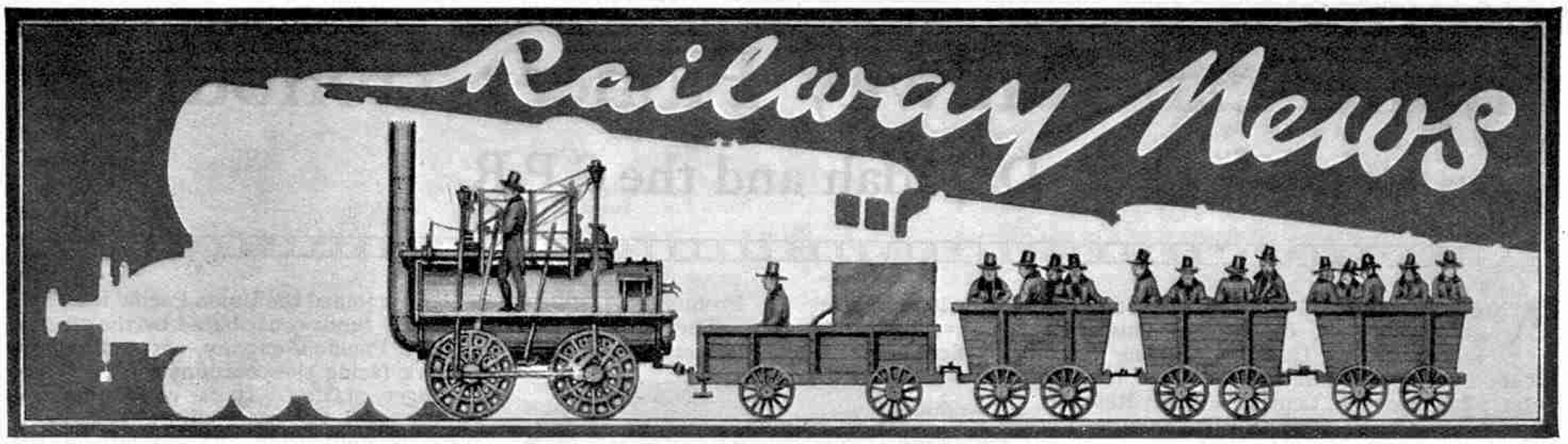
current to the field windings of the motor.

It will be realised that the task of transporting a motor of this size from the Rugby Works to the London Docks for shipment was no small one, and for the purposes of transport not only the stationary but also the moving elements of the machine were so designed that they could be split in two. Bulk as well as weight had to be considered, since the bottom half of the stator was approximately 30 ft. by 14 ft. by 6 ft., weighed nearly 27 tons, and when loaded overhung the side of the rail truck by 3½ ft. towards the 6 ft. way.

The huge stator was transported from the B.T.H. Works by the L.M.S. Railway, a special train leaving Rugby at mid-day on a Sunday. The train travelled via Ullesthorpe and Wigston Junction on to the Midland main line to London, through Market Harborough, Wellingborough and Bedford. The L.N.E.R. Rly. system was reached by Carlton Road Junction and South Tottenham, and thence the train travelled via Stratford Market to Victoria Docks, London.

Not only was the adjoining railway track blocked from Rugby to London, but at one London station the rails had to be slewed 12 inches for a distance of 40 yards to enable the trucks to clear fixed structures.

At the London Docks the two halves of the stator were handled by the 50-ton Port of London Authority Victoria Dock's crane, which lifted them into the hold of the British India steamer "*Mandala*" The remainder of the material, weighing approximately 114 tons, was shipped from Birkenhead Docks on the same day by the "*City of Calcutta.*" Both vessels reached Calcutta within a day or two of each other, and then this wonderful machine commenced another adventurous journey to the Jamshedpur Works, where it was finally assembled and set to work.



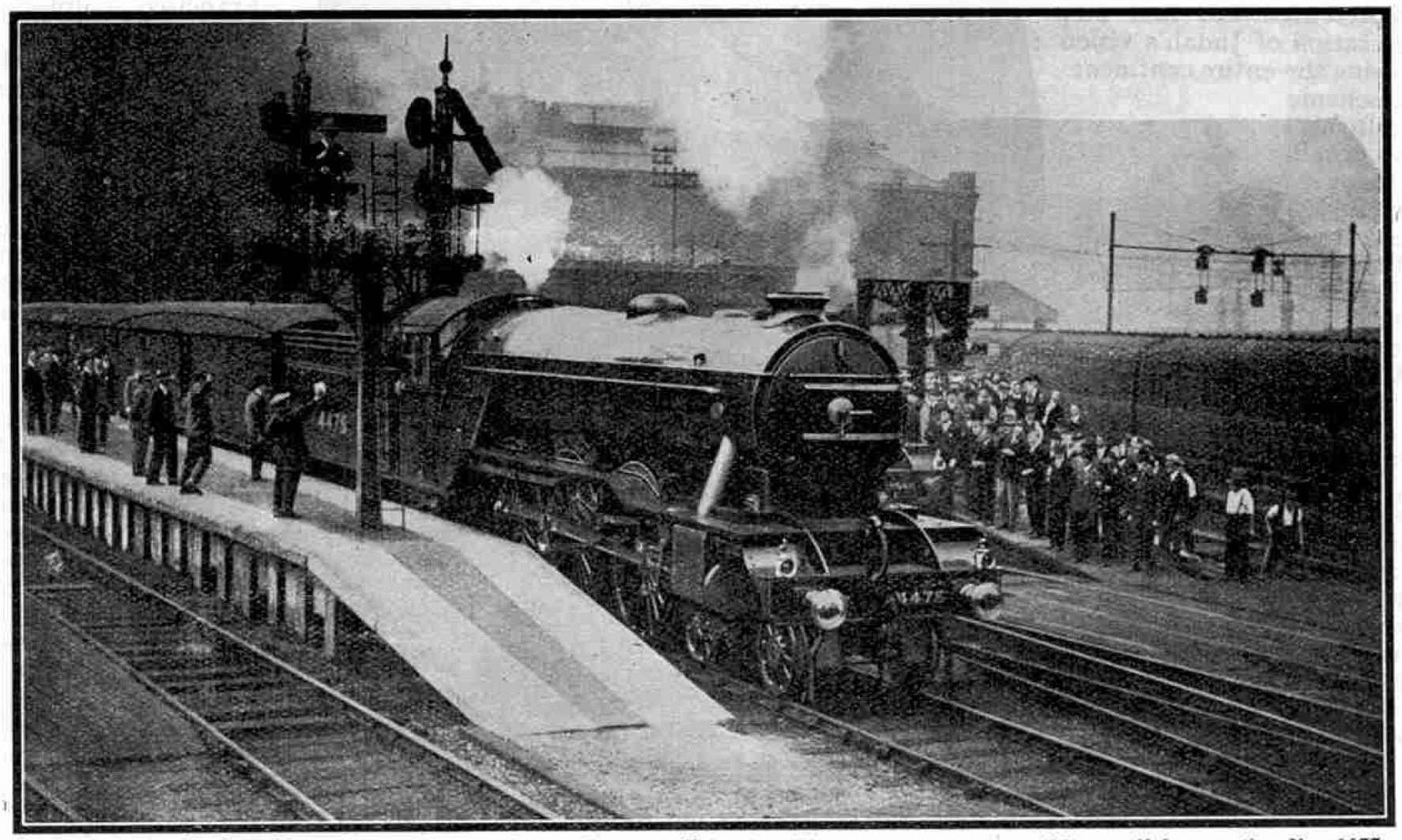
"*The Princess Royal*" in Regular Service

The L.M.S.R. "Pacific" locomotive No. 6200 "*The Princess Royal*," after several weeks of preliminary working and trial trips, is now settling down to regular express working. Following on its flying visit to London for exhibition at Euston at the end of June, the new engine spent almost a month in working trains between Crewe and Shrewsbury, Liverpool and Carlisle. On Sunday, 23rd July, a special test run was made to Carlisle when in addition to the dynamometer car that was coupled behind the tender, a train weighing 503 tons was worked with very satisfactory results. During the week following, No. 6200 was in the paint shop, from which it duly emerged arrayed resplendently in the standard maroon livery of the L.M.S.R. An enthusiastic correspondent who saw it at Crewe just fresh from the paint shop on Monday, 31st July, described it as looking "a treat." It is beyond doubt, a very handsome engine. As the biggest express locomotive on the L.M.S.R., it stands in a class by itself and is graded "7P."

Work is going forward steadily at Crewe on the two other "Pacifics" that are in hand there, and a new series of 2-6-0 "Mogul" locomotives is being proceeded with. Additional "Baby Scots" also are being built, and of these, No. 5901, "*Sir Robert Turnbull*," and No. 5925, "*E. C. Trench*," are already in service.

The advent of Mr. W. A. Stanier's "Pacific" on the L.M.S.R. has been followed quickly by the appearance of another new engine of his design. This is a 2–6–0, or "Mogul," built at the Company's works at Derby for use on the lines of the Northern Counties Committee (L.M.S.R.), Ireland. The first of the new engines, which was put into traffic in July, is numbered 90. Three more engines, to be numbered 91, 92 and 93, will complete the batch, which will form a valuable addition to the locomotive power on the N.C.C. lines of the L.M.S.R. An illustrated article describing the new locomotive will appear in an early issue of the "*M.M.*"

The works at Derby are engaged on a new lot of 10 standard 2–6–2 tank engines.



A notable occasion in railway history. "The Flying Scotsman" leaving King's Cross, drawn by "Pacific" Locomotive No. 4475, "Flying Fox," on the first non-stop run to Newcastle.

Engine Whistle that Would Not Stop

Mr. Harry Mison of Kentish Town, N.W., a veteran London driver of crack L.M.S.R. expresses, recently retired after 45 years' service at one engine shed.

Mr. Mison joined the former L.N.W.R. at Camden, N.W., running shed in 1888 and the whole of his career, in the course of which he has risen to drive such famous trains as the "*Mid-day Scot*" and the "*Mancunian*," has been spent at this depot. During the whole of his service he has never been involved in an accident incurring personal injury to anyone.

Both as fireman and driver, Mr. Mison took part in many notable speed feats on the L.M.S.R. main line, and on one occasion was presented to King Edward after firing the Royal Train from Euston to Rugby. He has a vivid recollection of a very unusual mishap that occurred when he was driving the "*Mancunian*," timed at an average speed of over 60 m.p.h. from Wilmslow (Manchester) to Euston.

"As we approached Rugby," said the veteran in an interview, "I opened the whistle to give the usual warning. When I tried to shut off the whistle I found it had jammed, and we tore through the countryside with the whistle screaming madly, it being quite impossible to stop it while running.

"So we had to stop specially at Rugby, and as the whistle still wouldn't stop we had to take our engine off and get another one which turned out to be a four-coupled locomotive some 20 years old. Nevertheless, with a 300-ton train we managed to cover the 82½ miles from Rugby to Euston in 84 minutes, and once we had the engine well under way, we maintained an average speed of 65 m.p.h. over the 60 miles from Roade to Euston."

"The latest types of engine," added Mr. Mison, "are more 'temperamental' and more complicated than those in use when I started on the railway, and the engine-driver's job demands a greater degree of technical skill and mechanical knowledge."

L.N.E.R. Locomotive News

From Darlington works a new 4–4–0 engine of the "D49" or "Hunt" class has been turned out. It is named "*The Middleton*" and numbered 283. It has rotary cam poppet valves.

Two further 4–4–0 engines of the G.E.R. "Claud Hamilton" class, Nos. 8802 and 8821, have been rebuilt in accordance with Mr. Gresley's designs.

One of the "Atlantic" engines of the former North British Railway, No. 9874 "*Dunedin*," has been scrapped.

Smart Running on Summer Services

The accelerated services of the present summer have produced some noteworthy runs although nothing of a sensational nature has been achieved. When the "*Scarborough Flyer*" of the L.N.E.R. made its inaugural run to the new schedule, the Gresley "Pacific" locomotive No. 4471, "*Sir Frederick Banbury*," with a train of 10 coaches weighing 325 tons, reached York 5 min. early, having covered the 188¼ miles in 190 min. From Hatfield to Doncaster, the 138¼ miles were done in 132 min., showing a speed of 62.85; while for the 44¼ miles between Hatfield and Huntingdon, an average of 75 m.p.h. was maintained.

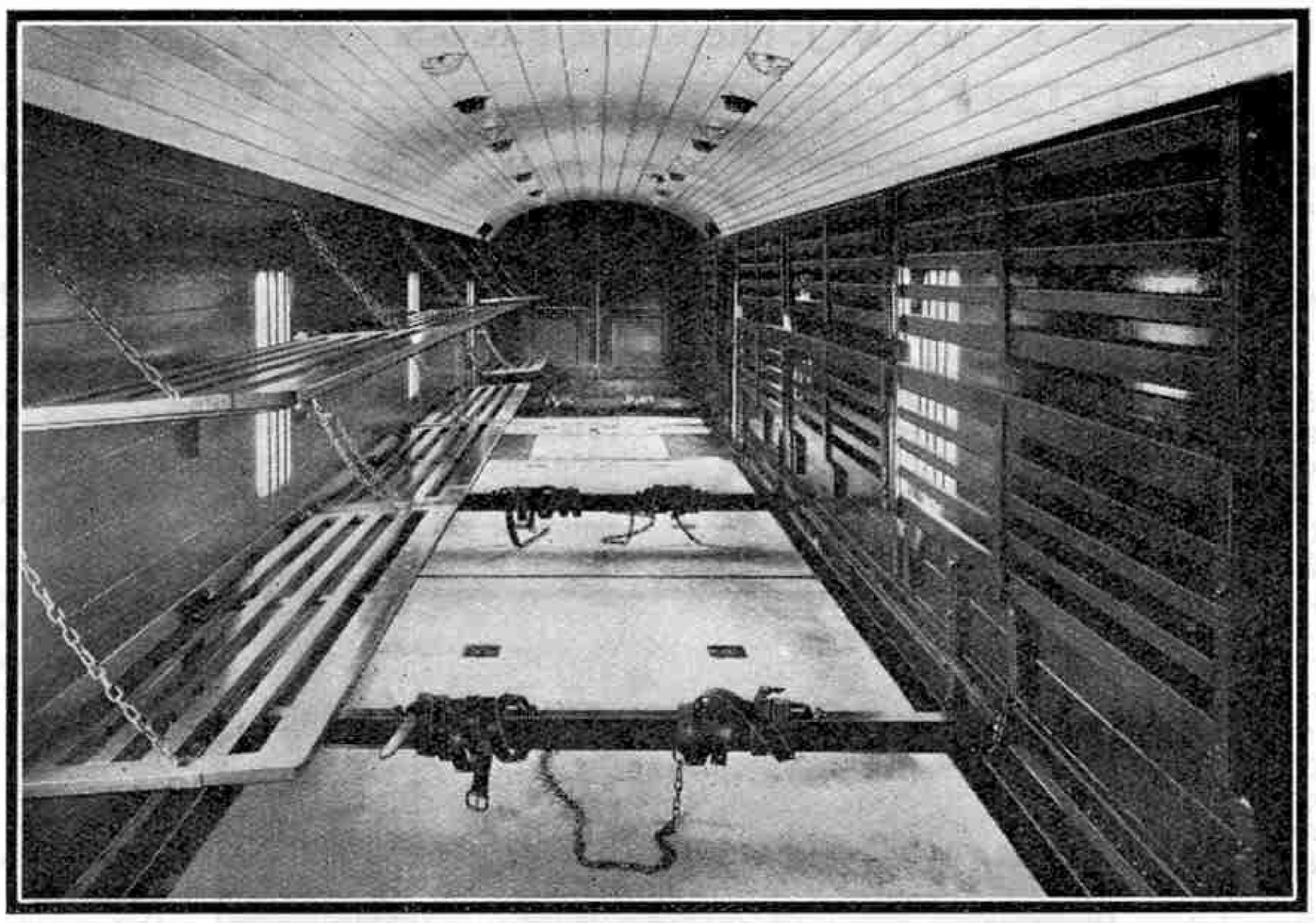
On the L.M.S.R. the new timings between Liverpool and Manchester and on the West of England main line have produced some brisk running. The 6.35 p.m. express from Manchester is now allowed only 35 min. for the 31.3 miles from there to Liverpool, which requires an average speed of 53.6 m.p.h. and gives the fastest regular schedule ever operated on this route. On the occasion of the first run, the train, consisting of six coaches, weighing 200 tons, and drawn by locomotive No. 6003 of the "Claughton" class, actually made the journey in 34 min. 39 sec. despite signal checks approaching Edge Hill, and maintained an average speed of over 54 m.p.h. The maximum speed attained was 76 miles an hour at Glazebury, and for 11 miles from Astley to St. Helens Junction speed exceeded 70 m.p.h.

On the West of England main line, where nine expresses to or from Birmingham have been substantially accelerated, a remarkable opening run was made by the 10.35 a.m. express from Bristol to York, which covered the 32 miles from Mangotsfield to Gloucester in 31 min. start-to-stop, at an average speed of nearly 62 m.p.h. The train weighed 250 tons and was in charge of Driver James of Bristol, a standard compound engine being employed. A maximum speed of 76 m.p.h. was twice attained.

Passengers on many of the Southern Railway expresses between London and the Kent coast, Bexhill, Hastings, Deal, Dover, Folkestone, etc., are gaining substantial benefits by the accelerations that have been made possible by the introduction on these routes of heavy express engines of the "King Arthur" and "Schools" classes. On all these lines, times have been cut and both holiday makers and business people have been given greatly improved services.

The famous "*Atlantic Coast Express*," which for some time past has left Waterloo at 11.0 a.m., now leaves at 10.35 a.m. every weekday for North Cornwall and North Devon. The present 11.0 a.m. express serves Exeter and Plymouth.

It is gratifying to know that many of the improvements introduced in the summer services will be continued through the winter and, indeed, made permanent.

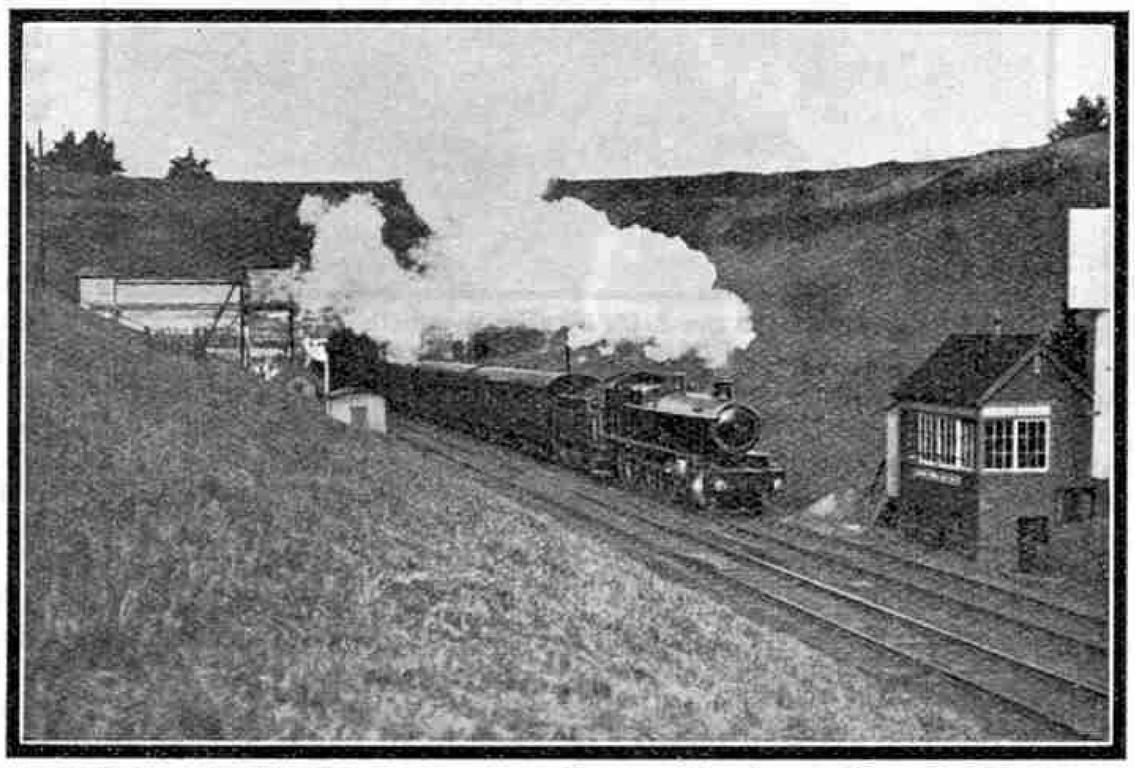


Interior of a new type of van recently put into service on the L.M.S.R. The folding shelves accommodate parcels, and adjustable wheel bars are provided to enable motor cars to be carried. There are double folding doors at the sides, and also at each end. Photograph by courtesy L.M.S.R.

An important feature of this year's programme has been the introduction of faster Sunday trains at more frequent intervals.

Completion of Piccadilly Railway Extension

The final stage of the northern extension of the Piccadilly Railway—from Enfield West to the terminus at Cockfosters—was opened for traffic on Monday, 31st July, thus bringing to completion the great scheme of "Underground" development that was described fully in the "*M.M.*" for April last. The throughout run of the tube trains from Cockfosters to South Harrow is just over 25 miles. The Piccadilly line, together with the other "Underground" electric railways of London, is, of course, now under the control of the London Passenger Transport Board.



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

S.R. Locomotive News

Another 4–4–0 express engine of the "Schools" class, No. 919 "*Harrow*," has just been released from the works at Eastleigh. This completes the whole programme for the "Schools" class engines for the present year. Four of the new engines, Nos. 913 to 916, are stationed at Eastbourne.

The 4–6–2 "Pacific" express tank engine No. 2325 was recently withdrawn for scrapping. It is, however, now back in service again, shedded at Eastbourne, and helping with the heavy holiday traffic. After further examination it was decided that certain necessary repairs should be carried out and the date of its breaking up postponed. This engine was designed by Mr. D. E. Marsh, Locomotive Engineer of the L.B. and S.C.R. and built at Brighton in 1910. It had outside cylinders of 21 in. diameter and 26 in. stroke, and driving wheels having a diameter of 6 ft. 7½ in., and was then regarded as an engine of exceptional size and power. It bore the name "*Abergavenny*" and although a thoroughly successful engine, only one more of the class was built.

Tank Engines from Swindon

The first five of a new series of 10 0–4–2 tank engines have been completed at Swindon and are numbered 5810 to 5814. Five 0–6–0 tank engines, fitted with condensing apparatus, are also in hand and will be given the numbers 9701-5.

The 4–4–0 engine No. 3414, "*A. H. Mills*," of the "Bulldog" class has been renamed "*Sir Edward Elgar*" in honour of that eminent musician.

S.R. Enterprise at Southampton

With characteristic enterprise and energy the Southern Railway is pushing forward the development of the great port of Southampton. A particularly notable advance was marked on Wednesday, 26th July, when His Majesty King George opened the new graving dock which is claimed to be the largest in the world. With a length of 1,200 ft. and a width at entrance of 135 ft., it can easily berth the largest liners at present afloat, or likely to be built in the future. In the construction of the new dock, 1,250,000 cu. yds. of earth were excavated and 450,000 cu. yds. of concrete used. When full it contains 58,000,000 gallons of water but it can be pumped dry in four hours. It has been named "The King George V Graving Dock."

An improvement has been made in the steamer services from Southampton to St. Malo. These now run at fixed times and not according to the tide, as formerly.

Fighting Famine in India

I.—How the Engineer has Reclaimed Deserts

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

THERE is no country in the world where the engineer has accomplished such wonders, and has been called upon to fight such stirring battles against the forces of Nature, as in India. There he has built a score of mighty dams, greater than those to be found on the Nile or in America; and has dug thousands of miles of canals or artificial waterways, as wide and as deep as the Thames, for the express purpose of combating famine, the great scourge of the land. India is indebted far more for her prosperity to-day to the labour of civil engineers than to any other body of men.

In order to appreciate fully the work of the engineers, a few details about this wonderful country are essential. India, including the native States, has an area of 1,800,000 square miles, about equal to that of Europe, omitting Russia, or more than 20 times the area of Great Britain. This territory has a population of 353,000,000, seven times that of the United Kingdom. In this vast area is engaged a corps of engineers, subjugating and directing the resources of nature for the benefit of a population equalling about one fifth of the human race. The canals and reservoirs they build wring abundant harvests from a reluctant soil, and the railways transport the produce from the more highly favoured to the less productive districts.

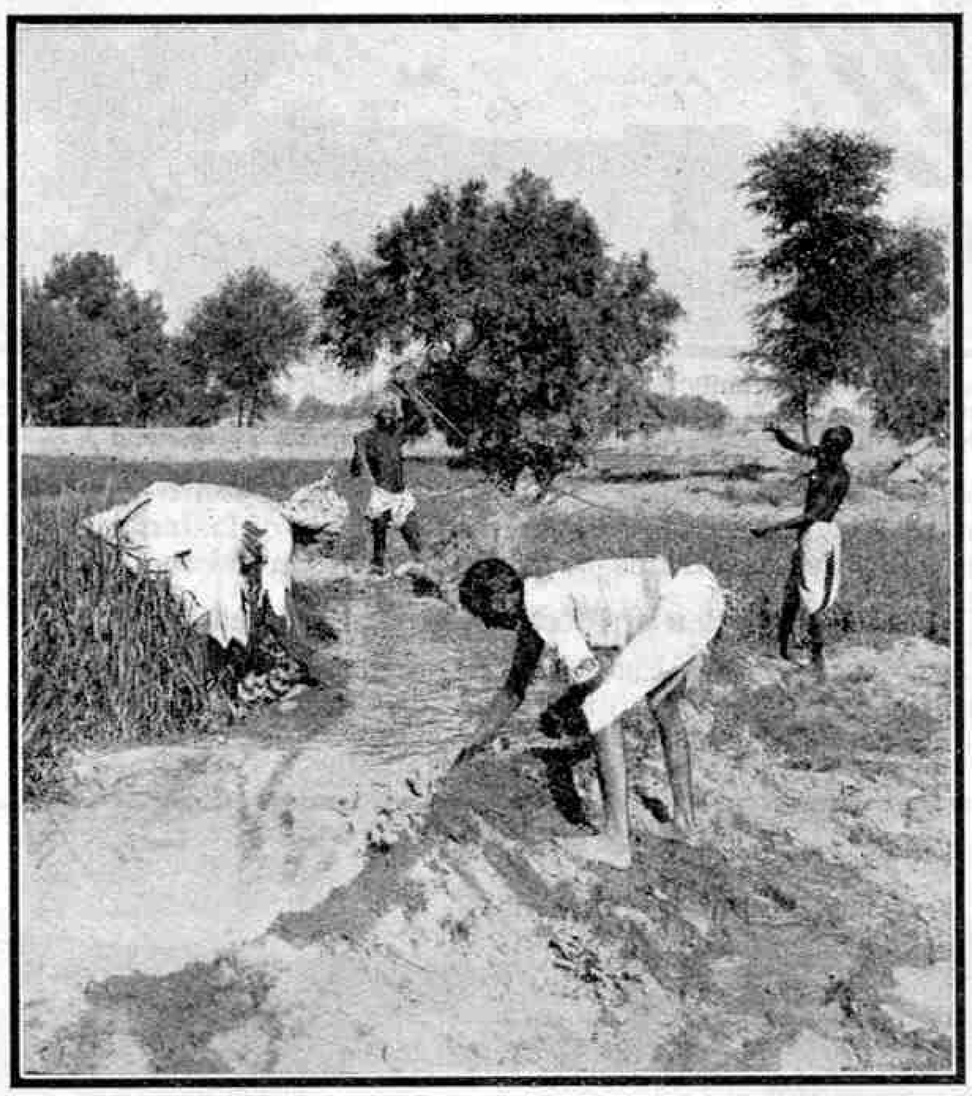
In the past, famines due to the failure of the monsoons, or seasonal rains, have been responsible for millions of deaths and have caused untold misery. In the famine of 1769-70, for instance, 3,000,000 people perished. From 1770 to 1790 not a year passed without a portion of this large empire being short of food to a more or less serious extent, and the year 1866 witnessed a terrible famine in the lower provinces of Bengal, Orissa and Behar, when more than 1,500,000 people perished.

The Bengal famine of 1874 carried off 1,000,000 people, and an equal number died in that of 1877. In 1896-97 there were 2,500,000 deaths from a similar cause, while the death-roll of the terrible disaster of 1900 reached over 3,000,000, no fewer than 85,000,000 people being brought to the verge of starvation owing to the failure of the rains. Scarcely a year has elapsed from that date to this without the Indian Government reporting vast tracts of territory where the crops failed, bringing millions of people almost to starvation, with the loss in some cases of many thousands of lives.

This is the evil that the irrigation engineer has set out to combat, and how well this scourge has been fought is shown by the fact that the Indian Government alone have spent £52,000,000 on irrigation work that has meant the reclamation of 28,000,000 acres of desert land. It has been money well spent, however, yielding a return of about six per cent. on the capital invested. It has not been a question of making two blades of corn grow where one did before, but of growing corn, rice and sugar where, without irrigation, the land would have remained a desert.

When it is stated that 65 per cent. of the population of this vast country are engaged in agriculture, it will be seen how important is the question of suitable irrigation. Unfortunately for the engineer, however, all kinds of irregular conditions exist. The chief of these are the extremely variable character of the rainfalls, the nature of the soil, and the kind of crops to be raised. The average rainfall for the whole of India is 42 in. a year, but it varies considerably, being as low as 5 in. in some districts and as high as nearly 500 in. in others. An area with an excessive rainfall is often much more difficult to tackle, from an engineering point of view, than a tract with normal conditions, for storages and run-offs for the heavy rains then have to be provided.

The nature of the soil and the kind of crops it is proposed to grow on the reclaimed land also have to be taken into account. For instance, cotton ordinarily does not require any irrigation, and very little even in years of drought, and barley only needs irrigation in a dry year. On the other hand, wheat requires a good supply of water, as also does the sugar-cane; and rice needs most of all. It is estimated that 1,000,000 cu. ft. of water are required to irrigate six or eight acres of rice-field, and a third of that quantity for wheat. Other crops cultivated are millet, jute, indigo, gingelly and linseed. Some of these are spring crops, others are harvested in autumn; and all require suitable soils and varying amounts of irrigation.



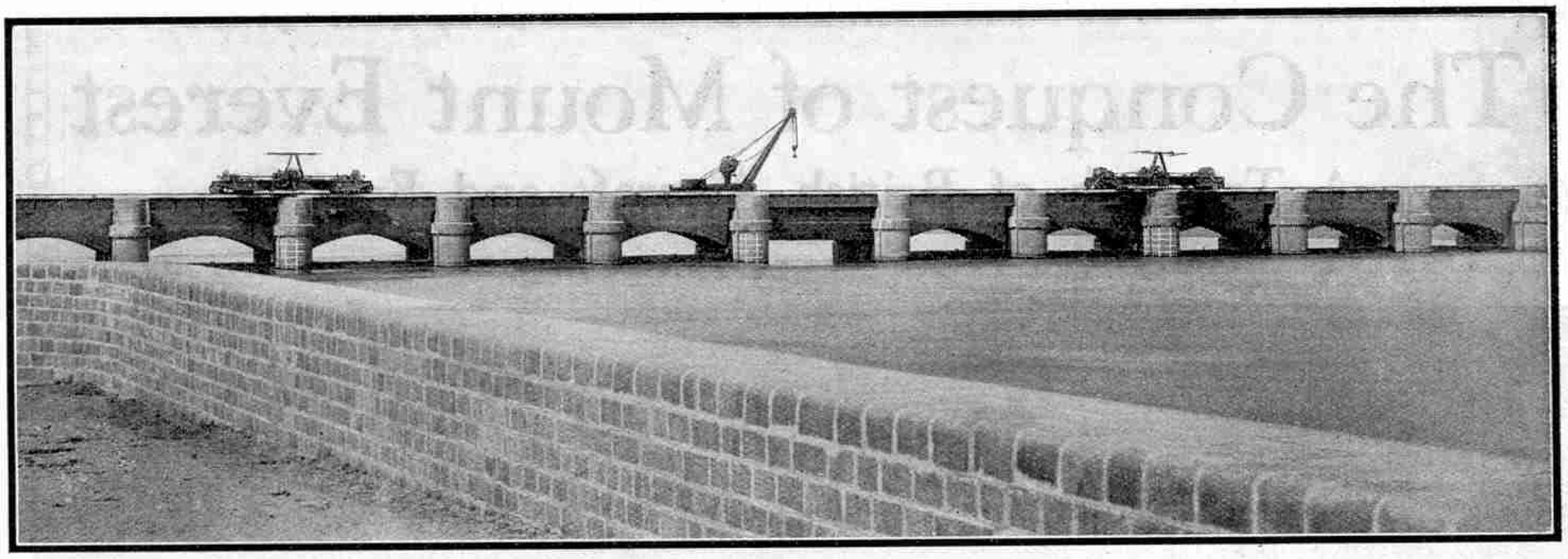
Natives irrigating Indian rice fields by primitive methods that were in use for centuries before British engineers began work in the country.

In addition to the character of the soil and crops, the natural dispositions of the land determine what kind of irrigation must be adopted. There are three great systems, in which the water is stored in canals, tanks and wells respectively. If we include the irrigation schemes that have been carried out by the ruling Princes in the various native States, and those due to private enterprise, we find that there are now 65,000,000 acres of irrigated land in India. Thus the area of artificially-watered territory is double that of England. Of this total area, 28,000,000 acres are irrigated by means of canals; 19,000,000 acres obtain water from wells, 10,000,000 acres from tanks, and 8,000,000 acres from other sources.

Irrigating canals are not mere ditches, for the main channels are as wide and deep as the largest rivers in this country. Two distinct types of canals are employed, and they are known as perennial and inundation canals respectively. The former draw their supplies from rivers at all seasons of the year, while the latter take water only when the rivers are in flood. In a perennial canal a weir is almost always necessary, and the erection of this often calls for much engineering skill. In an inundation canal a weir is not required, and at the close of the flood season a waterway of this kind runs dry and remains so until the next season's rains.

There are two other types of artificial waterways, the deltaic and the non-deltaic channels. Both these tap and distribute the waters from rivers, but they differ in regard to the distances that they convey it and the methods they employ. The deltaic canals are used when the bed of the river that is tapped by them lies only slightly below the level of the surrounding country. No great length of canal is then required, because the water can be distributed by gravitation. Canals of the non-deltaic group tap the rivers high up in their courses, where the bed lies much below the surface; and so they have to bring the water considerable distances to distribute it by gravitation, or in some cases by means of a moderate lift.

An excellent example of an irrigating canal is the Great Ganges Canal. With its distributing channels, this is 9,900 miles in length, and is responsible for the watering of 1,700,000 acres, a tract of land larger than the county of Devonshire. The main canal is 200 ft. in width and 10 ft. in depth, and it crosses four great torrents to serve a tract of country 360 miles from its head works. Two rivers, 200 ft. and 300 ft. in width respectively, are carried over it in masonry aqueducts, and it crosses the Solani Valley by means of an aqueduct and embankments $2\frac{3}{4}$ miles in length. At this point 7,000 cu. ft. of water pass each second, and the gigantic artificial



waterway is 12 ft. in depth and has a breadth of no less than 170 ft.

The Chenab Irrigation Scheme, in the Punjab, comprises some 2,800 miles of channels, spreading out over a tract of territory 4,650 square miles in extent—almost one-tenth the area of England, and half the cultivated area of Egypt. This large area was waste land and practically desert before the canal was made. The nature of the country made the laying out of the Chenab Scheme a very arduous task, for the survey parties had to work across vast stretches of totally uninhabited country, where the only source of water might be a brackish well 100 ft. in depth, and no supplies of any kind could be obtained. It was often necessary to remain in the field throughout the hot season, when the temperature rose to over 110°F. in the shade; and it will readily be understood that in these circumstances efficient organisation and much energy and determination were required from all concerned in the work.

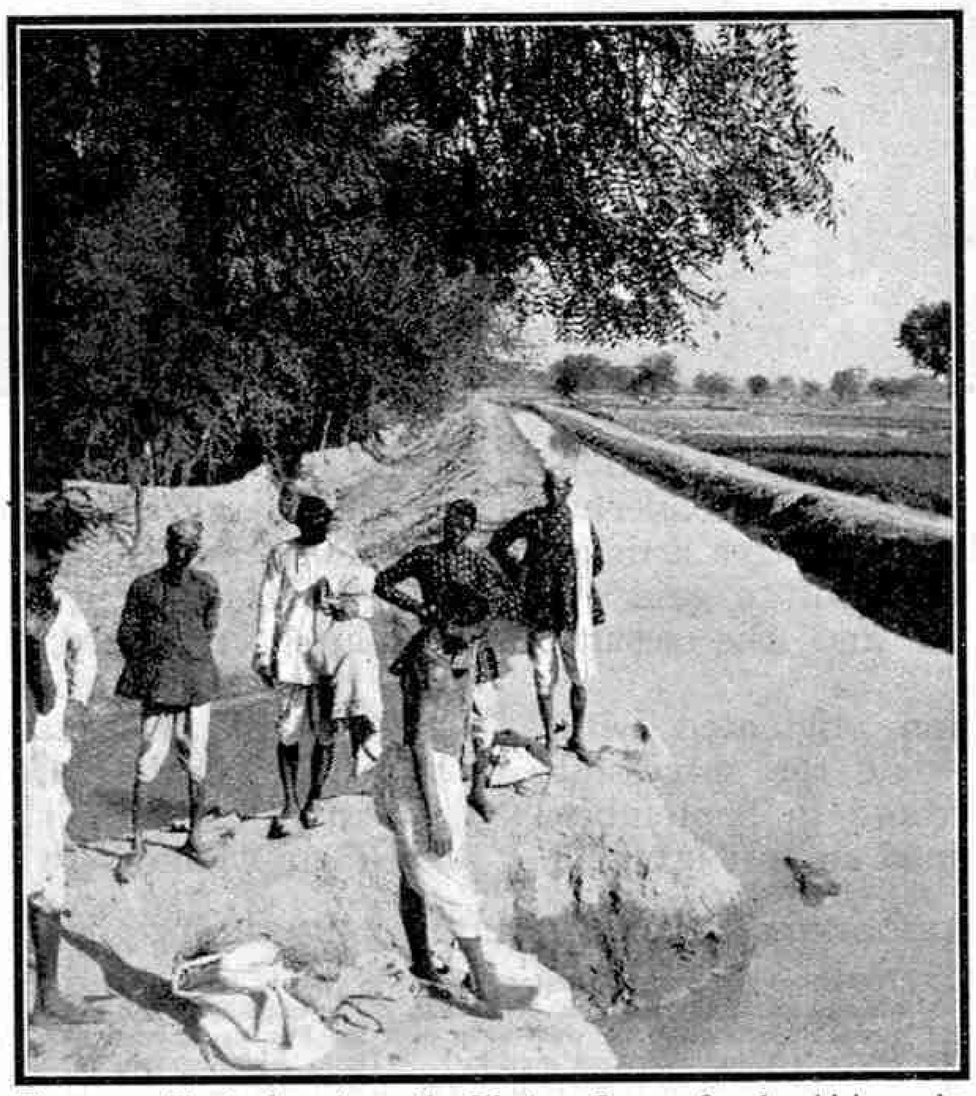
Thousands of natives were employed in the digging of the channels, the main one as wide as the Thames. They greatly feared the man-eating tigers that prowled round the camps at night, and armed sentries had to be posted at each camp after dusk to drive these brutes away. They succeeded in carrying off several victims, however, and caused panic among the men.

On this reclaimed land there are now hundreds of thriving villages and a population of over 1,000,000. Irrigation indeed has changed the Punjab from one of the poorest into one of the most prosperous of the Indian provinces. On its once barren plains there are now three great "colonies," or settlements, peopled from overcrowded districts elsewhere. The total area of these reclaimed settlements is 4,500,000 acres, roughly the size of Wales; and the value of the crops produced in a normal year is over £20,000,000. The colonists, who are mainly small peasant proprietors, constitute the most thriving rural community in India, and the benefit of the vast outlay has gone in large measure to the people themselves. The net profit to the provincial Government alone is over £1,000,000 a year.

As already stated, about 10,000,000 acres of land are irrigated from tanks. These are not tanks in the sense that we attach to the term, but are veritable lakes or reservoirs of vast extent. There is a dam in Mysore 142 ft. in height, built across a valley near Marakanave, that encloses a basin with an area of 2,075 square miles. When it is filled, which does not often occur, this basin contains 30,000,000,000 cu. ft. of water, and yet according to Indian reckoning it is only a "tank:"

The tanks are very numerous. There are more than 30,000 of them in the Madras Presidency alone, and in Mysore there are three or four to the square mile, the total being 40,000. They are a source of anxiety, because if a flood should burst one tank others in the vicinity almost certainly would be swept away.

Many of the tanks found in India are of great antiquity. For instance, those of Chingleput are said to be 1,100 years old, and they still irrigate areas of 2,000 acres and 1,000 acres respectively. Another famous tank, known as the Giant's Tank, was built in the 5th century, and the old embankments can be traced for 15 miles in the jungle. There are records of a large tank having been constructed in Ceylon 2,400 years ago. Before the country came under British rule, there were 50,000 large and small tanks and 30,000 miles of embankments in the Madras Presidency. The old earthworks were constructed by natives carrying small baskets of earth on their heads, and trampling them into embankments.



The upper illustration shows the Western Jumna Canal, which carries water a distance of 80 miles for irrigation purposes. Below is a small irrigating canal near Sikra, India.

The dams built by the modern engineer to form some of India's irrigation tanks are wonderful structures, easily surpassing in extent, and in the difficulty encountered in their erection, the great barrages of the Nile. There is the Tansa Dam, in Mysore, 1½ miles in length and impounding 300,000,000 gall. of water. It is virtually a lake 20 miles in length. Other wonderful structures are the Nira Dam, 3,000 ft. in length, and the Khadakvasia Dam at Poona, one mile in length.

The building of the dam across the Periyar River, in the Madras Presidency, was a particularly daring piece of work. This structure towers 178 ft. above the bed of the stream, is nearly two miles in length, and impounds 13,300,000,000 cu. ft. of water to supply the Madura district, an area of about 1,200 square miles. "This dam," says the engineer responsible for its inception, "had to be constructed in a river subject to violent and sudden floods, in an uninhabited tract of country, far from a village, very far from any railway, in the middle of a range of hills covered with dense forest and tenanted with wild beasts; where there are no roads, or even paths, and where the commonest necessaries of life are unobtainable; where malaria of a malignant type prevails and where the incessant rain for half a year was a constant deterrent to the importations of labour, and by its effect on the river rendered all work in the bed impossible for six months out of the twelve. The character of the environment may be gauged by the fact that for the first two years of construction, watchmen, with drums and blazing fires, had to guard every camp at night against the curiosity of wild elephants, which constantly visited the works, uprooting milestones, dismembering new masonry, treading down embankments, playing with cement barrels, chewing bags of cement and blacksmiths' bellows, crumpling up zinc sheets, kneeling on iron buckets and doing everything that mischief could suggest and power perform."

On one occasion an infuriated bull elephant dashed into a camp where 280 natives had retired for the night, trampling down the tents and scattering the workmen far

(Continued on page 690)

The Conquest of Mount Everest

A Triumph of British Aircraft and Engines

THE success of the Houston Mount Everest Expedition surpassed all expectations and the wonderful photographs obtained and the descriptive articles published in "*The Times*" permitted all to gain an appreciation of the hazards faced and the results obtained.

The first idea of this expedition originated with Col. Blacker and Col. Etherton, while the successful attempt on the world's altitude record in September 1932 with a "Bristol" Pegasus-engined aircraft brought the project within the bounds of practical politics, with the natural result that the choice of the expedition fell upon "Bristol" engines. From the information gained on the altitude record flight the Bristol Company were able to put forward their Pegasus engine with complete confidence, and to place at the disposal of the Westland Aircraft Company, the constructors of the aircraft, detailed information of the small but important modifications required for these extreme altitudes. Both of the engines used by the expedition were in all respects absolutely standard.

The two aircraft used, the Westland "Wallace" and the Westland "P.V.3," were two-seater army co-operation type aircraft of similar general characteristics, and were arranged and equipped to commence the flight at the same all-up weight of 4,960 lb. On this basis the maximum speed was 174 miles an hour at 15,000 ft. and the service ceiling 34,200 ft., giving ample margin for operation above Mount Everest, which has an altitude of 29,002 ft. at its summit. The superchargers fitted to these engines were in all details absolutely standard, the blower, which has a 10 : 1 gear ratio, being identical with that fitted to the Mercury V-S2 engine, and maintaining ground level power to 13,500 ft. Both machines were fitted with standard "Bristol" front exhaust rings and short chord ring cowlings, which were considered to be worth the extra weight involved.

The fuel system naturally received particular attention, and was simplified by the abolition of the hand pump, the standard "Bristol" engine-driven petrol pump being used for supplying the gravity tanks. Special precautions were taken to prevent the blocking of the fuel and oil tank vent pipes by ice or snow, the oil tank vent being welded to the exhaust pipe, while the fuel tank vents were pointed to the rear and situated within a small truncated metal cone arranged to provide an artificial high local pressure when in flight.

In view of the intense cold to be expected with temperatures down to –50°C., and its effect upon the personnel and material, satisfactory functioning of the electrical equipment was absolutely essential for the attainment of the object of the Expedition. The importance of avoiding extreme cold in the photographic

The above illustration gives an impressive view of the snow-plumed peak of Mount Everest soaring majestically. This remarkable photograph was taken over the Pegasus engine of the Houston Westland machine. "Times" photograph, reproduced by courtesy of "The Bristol Review."

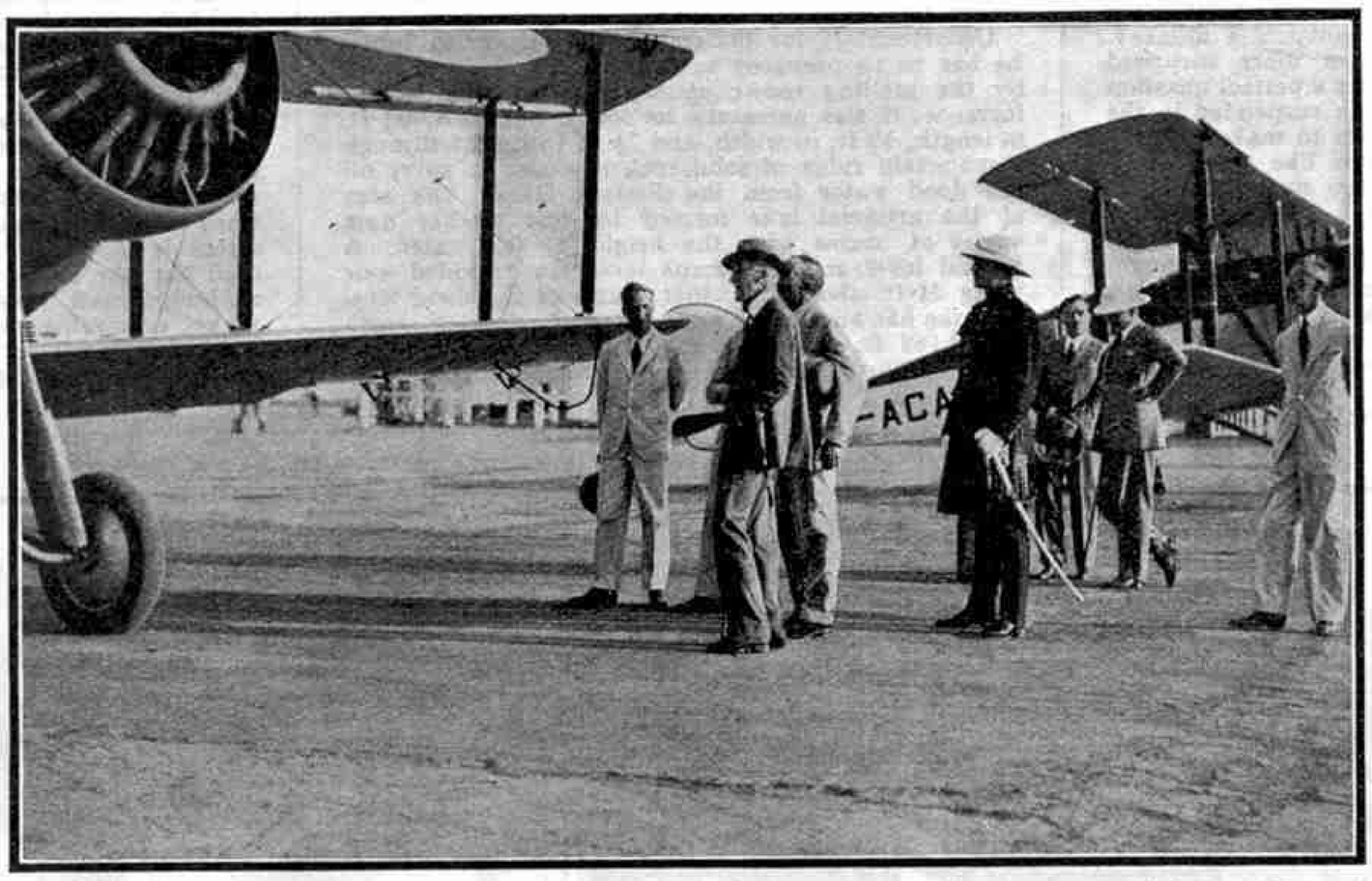
film magazine will be appreciated when it is realised that even at –20°C. the film becomes extremely brittle, and breaks if bent.

The heating current requirement for each machine was made up of 3.6 amperes total for the three oxygen cylinders, 25.6 amperes for the Eagle motor-driven survey camera, 7.6 amperes total for the two cine cameras, and 41.8 amperes total for the pilot's and observer's clothing, giving a combined total of nearly 80 amperes, or approximately 1,000 watts at 12-14 volts. This current was supplied by a 1,000 watt generator supported from the fuselage directly over the engine, from which it was driven by a "Bristol" flexible drive, an airscoop ensuring adequate air circulation for cooling the generator.

The Williamson Eagle survey camera referred to, and which was used for the vertical photographic work, is a very highly-developed piece of mechanical ingenuity. It is operated electrically, the driving power being supplied by a small electric motor that changes the film and re-sets the shutter. To start the camera the pilot switches on, having first set the time interval between exposures. A green light in front of him then shows that the camera is working, and a red light warns him that the exposure is about to take place. The magazine for the 5 in. camera contains 125 exposures, the area covered by each exposure varying directly with the height above the object photographed—hence the need for controlling the time interval between exposures.

The object aimed at with these elaborately fitted aircraft was to obtain a mosaic of a strip of ground about 35 miles long, and at its widest, 8 miles wide; including in this strip at one end the summit of Mount Everest and at the other certain accurately fixed points. On this strip was to be built up the oblique photograph obtained as a result of the cinema photography, thus providing quite a useful map of a wide area leading up to the southern side of Mount Everest.

The complete success of the expedition has been made known to the world by the personal narrations of the pilots and observers and the wonderful photographs appearing in the London "*Times*" newspaper, by whose permission we are able to reproduce a very small selection of the illustrations and a brief summary of the various flights.



Lord Willingdon, the Viceroy of India, inspecting at Delhi the machines used on the flight over Everest. "Times" photograph, reproduced by courtesy of "The Bristol Review."

The machines and engines arrived at Karachi on 7th March and, after test flights in the "Wallace" to 34,000 ft., and the "Houston Westland" to 35,000 ft., were flown on 20th March to the expedition's advanced base at Purnea, 160 miles from Everest. Adverse weather conditions with wind currents over the peak of 120 miles per hour delayed the attempt to fly over Everest, and it was not until 3rd April that, for the first time in history, the loftiest point of the earth's surface was surmounted by man.

Colonel Etherton handing over the special Everest mail that was carried over the summit in the Westland Wallace machine. "Times" photograph, reproduced by courtesy of "The Bristol Review."

The machines took off at 8.25 a.m., climbing slowly to 10,000 ft. in order to allow of testing the varied electrical equipment. After thirty minutes the forward emergency landing ground, 120 miles from Everest, was passed, and at 10.5 a.m. both machines passed over the summit of Everest.

In order that close-range photographs could be taken, the pilots, with supreme confidence in their engines, held the machines down to within 500 ft. of the summit, despite the "great wind allied with the immense overfall of air coming down over the crest," and the "ice rattling into the cockpit out of the great frozen plume of the mountain." Fifteen minutes were spent flying around and over the summit. Then, as the wind strength was very great and the margin of fuel small, both machines returned to the sweltering heat of the base camp, landing at 11.25 a.m., exactly three hours from the start.

In the official account both pilots pay the highest tributes to the splendid performance of the engines and aircraft, stating that the flight was carried out with no more fuss than an ordinary service flight at home. In the words of "*The Times*" leading article: "This is . . . success lifted to the point of triumph and simplicity at which it almost

(Continued on page 735)

The "M'Tembo"—(*Continued from page 677*)

flight. I had just time to recognize one of Kasciula's sons, a lad of about fourteen who must have been stretched out for a little nap on the ground when he was abruptly awakened by the alarming vision of an elephant almost upon him. Kasciula at the first sound let go his hold on the tripod and slid down the trunk of the tree with the agility of a monkey.

The little *m'tembo* seemed even more surprised than the boy, for he stopped, his face a perfect question mark, the huge ears and the trunk suspended in the air as if not knowing what decision to make. But—bang!—camera and tripod arrived like a bullet on his head. That certainly was too much, even for a young *m'tembo* on exploration. Indignantly he trumpeted, certainly intending to express all his male fury and defiance, but, humiliating enough, achieving only a sad toot, comically out of tune. And he surely was about to make a ferocious charge when Kasciula landed on the ground before him, like a creature falling down from the sky by some miracle.

Swift as an arrow, seizing the advantage of the hesitation shown by the poor young *m'tembo* in the face of so many strange events, the little old man dashed after his boy, continually appearing and disappearing in the thick vegetation. In a moment *m'tembo* regained his senses, and, deciding to finish his adventure with a heroic attack, charged through the underbrush like a small tank, with a grand crackling of trees and branches.

Alone in the top of the tree I was at a loss to know what was best to do. Certainly I could not hope to get down with the same speed and agility that Kasciula had shown. I took up a rifle and anxiously followed as best I could through the vegetation the progress of the chase. I divined more than saw where the boy was running, from the agitation he was causing in the foliage in his efforts to open a passage. I understood the position of Kasciula, who was now completely submerged in the undergrowth, from the shouts of encouragement he was giving to his son. But I could see that the small elephant was gaining more and more on poor Kasciula, and I began to realize that, horrible as it was to me to take the life of such a cunning young creature, I must decide to shoot him in order to save the old man. Reluctantly I took aim and put my finger to the trigger. Then something smashed against my tree so violently that it sent me with my legs more or less in the air, while a shot from my rifle rang in my ears and a furious trumpeting, really powerful this time, sounded at the foot of my aerial post.

Was it the strange sound of the shot or some threat of punishment perceived in the maternal trumpeting that stopped the little miscreant? I do not know. But as soon as I had regained my equilibrium I saw that the young *m'tembo* had abandoned his charge. With the most chastened air in the world, his big ears drooping back, his head down, he awaited the arrival of doom, while the shouting of Kasciula and his son disappeared far away. The mother elephant arrived like a projectile on the young sinner, and gave him such a prod with her tusk in the orthodox spot where a spanking should be administered that he jumped with a shrill squeal of pain. Then, without another sound, the mother turned and trotted back over the path she had come, the crestfallen young explorer following miserably at her heels.

But his tragedy was not yet finished, for no sooner had he arrived at the pool than all the relatives and the family friends felt it their duty to show him their most lively disapproval of his breach of their friendly relations with the pygmies. With a chorus of outraged trumpetings, from five, ten, a dozen trunks streams of mud and water deluged the poor little one, not gently as in play, but with a violence that almost submerged the young victim, and was certainly sufficiently vigorous to teach him a good lesson.

All of which, I suspect, goes to show that the pursuits of an explorer may be all right for silly human beings, but are distinctly against the best traditions of sound elephant sense!

Readers of this article, and that on "Old Man Gorilla," which appeared in the "M.M." for March last, will be interested to know that the author, the famous Italian explorer Commander Attilio Gatti, has now completed seven scientific expeditions to equatorial Africa. He has presented collections of wild animals to museums in many countries.—Editor.

Fighting Famine in India—(*Cont. from page 687*)

and wide. Before the brute could be brought to bay and shot he had killed two men. All that night search parties had to be sent out to bring in the scared natives, and it took all the persuasion of the engineers to induce the men to stick to their job and not to return home.

Unfortunately for the irrigating engineer in India, he has to be prepared to fight sudden floods caused by the melting snows upon the mountains. For instance, it was necessary to bore a tunnel 5,600 ft. in length, 12 ft. in width, and 7½ ft. in height through a mountain ridge of solid rock in order to carry off the flood water from the Periyar Dam. The area of the artificial lake formed by this mighty dam varies of course with the height of the water. A normal level and an escape level are provided, one being 31 ft. above the other; and at the flood level the lake has an area of 7,454 acres, the greatest depth being 162 ft. The water is carried from the great reservoir through canals over a distance of 86 miles to the Madura district, where 180,000 acres of desert land have now been reclaimed successfully.

The great Mettur Dam across the Cauvery River, India, mentioned in last month's "*M.M.*," is another instance of how engineering skill is making fertile vast areas of land hitherto unproductive.

(*To be continued.*)

This fine model of Fleet Street, with Ludgate Hill and St. Paul's Cathedral, designed by Mr. G. McConnell Wood, was exhibited by the London "Evening Standard" at the recent Advertising and Marketing Exhibition at Olympia, London. A specially interesting feature of the model is the large fleet of Hornby miniature Delivery Vans, Modelled Miniatures No. 22, which contributed greatly to the realistic effect of the scene. Our illustration is reproduced by courtesy of the "Evening Standard."

Portishead Power Station—(*Cont. from p. 657*)

of the marked rise and fall of the tide, the circulating pumps have been placed in deep pits. There they are below sea level, and no less than 100 ft. below the original level of the ground. They are driven by vertical motors placed 80 ft. above them, these and all other motors driving essential parts of the plant being installed at a level that is above abnormal tidal floods. The pumps themselves are always flooded, but their position has the great advantage that they derive assistance from the syphonic action of the pipes and culverts. The condensers are also located in the pits and are at a depth of 40 ft. below the generators. They are of the split type, and one half of each may be shut off for cleaning purposes without interfering with the operation of the turbines discharging into them. Sea water at an average temperature of 55°F. is circulated through them by the pumps.

The current generated at 11,000 volts is stepped up to 33,000 volts before reaching the switch room, a group of single-phase transformers being permanently coupled to each main alternator. It is then taken to the old station 11 miles away by means of six cables that have been specially manufactured by Siemens Bros. & Co. Ltd. These are paper insulated, and further protection is given by a lead covering, double steel-tape armour and jute wrapping. They are laid directly in the ground and covered by concrete slabs. On arrival the pressure is stepped down to 6,000 volts by means of 3-phase transformers.

MECCANO LUBRICATING OIL

Before commencing to operate a Meccano model, or to run a Hornby Train, all gears and bearings should be oiled thoroughly with Meccano Lubricating Oil. This oil is specially prepared and is of the right consistency for the purpose. Price per bottle 6d.

Meccano Ltd., Binns Road, Liverpool 13.

Model Building Contest Results (*Cont. from p. 703*)

obviated by the use of Flat Plates. In other details the model is well built and true to its prototype.

Pehr Andersin built a model of a quaint motor car of bygone days and won First Prize in the Overseas Section. All the main features of the original are faithfully reproduced in the model. The drive is taken from a Meccano Electric Motor housed under the bonnet, through a clutch and gear-box to the driving shaft, and from there to the back wheels by means of Sprocket Chains. The brake and gear levers are awkwardly situated inside the driving seat and testify to the discomfort that the driver, who was seated very high up, must have experienced when it was necessary to put the brake on! Considerable ingenuity is shown in the choice of parts used for the body. Chimney Adapters are used as lamps, and Windmill Sails and Braced Girders make admirable mudguards. The design of the body closely follows that of the real cars, but I think a little more care might have been taken in the actual construction.

A model that at first sight appears to be a new type of agricultural machine won a prize for J. P. Valeton. Actually it is a reproduction of a paddle steamer invented about 1785 by an American, John Fitch. It was built from a photograph of the original vessel, which appeared in a Dutch book, and its peculiar appearance is due not to any fault of the builder, but to his endeavours to copy the complicated machinery that propelled the actual ship. This comprised six mechanical paddles fore and aft, which were driven by a two-cylinder compound engine. It is not recorded that the vessel met with much success or what was its ultimate end.

An interesting model of an old time post-chaise was submitted by D. W. Johnston. Each of its four road wheels is excellently sprung, as also is the cab, the suspension of which is obtained by pivoting the front part of the cab to the frame, and hanging it from two coiled springs at the rear. The model is quite a life-like reproduction of one of these romantic old vehicles, which were used for carrying mails and passengers from town to town during the seventeenth and eighteenth centuries.

Famous Admirals—(*Continued from page 653*)

French ships moved up to screen her, however, and one of these, the "*Diademe*," Rodney sank with a single broadside. It was the "*Canada*," of 74 guns, and Hood's ship "*Barfleur*," that eventually forced the French Admiral to surrender. The first broadside delivered by the "*Canada*" swept the decks of the French flagship and killed 60 of her crew, and successive broadsides from the two British ships added to the casualties until only the Admiral and two men remained unwounded. De Grasse then hauled down his flag and surrendered to Hood. By this time four other French ships of the line had been captured, and only the approach of darkness saved many of the others. Four of the fleet escaped to Guadeloupe, five eventually reached Curacoa, and most of the remainder got to San Domingo. A day or two later Hood succeeded in overtaking a few of the fleeing ships, and captured two 64-gun ships of the line, a frigate, and a sloop. Rodney retired with his prizes to St. Lucia for repairs.

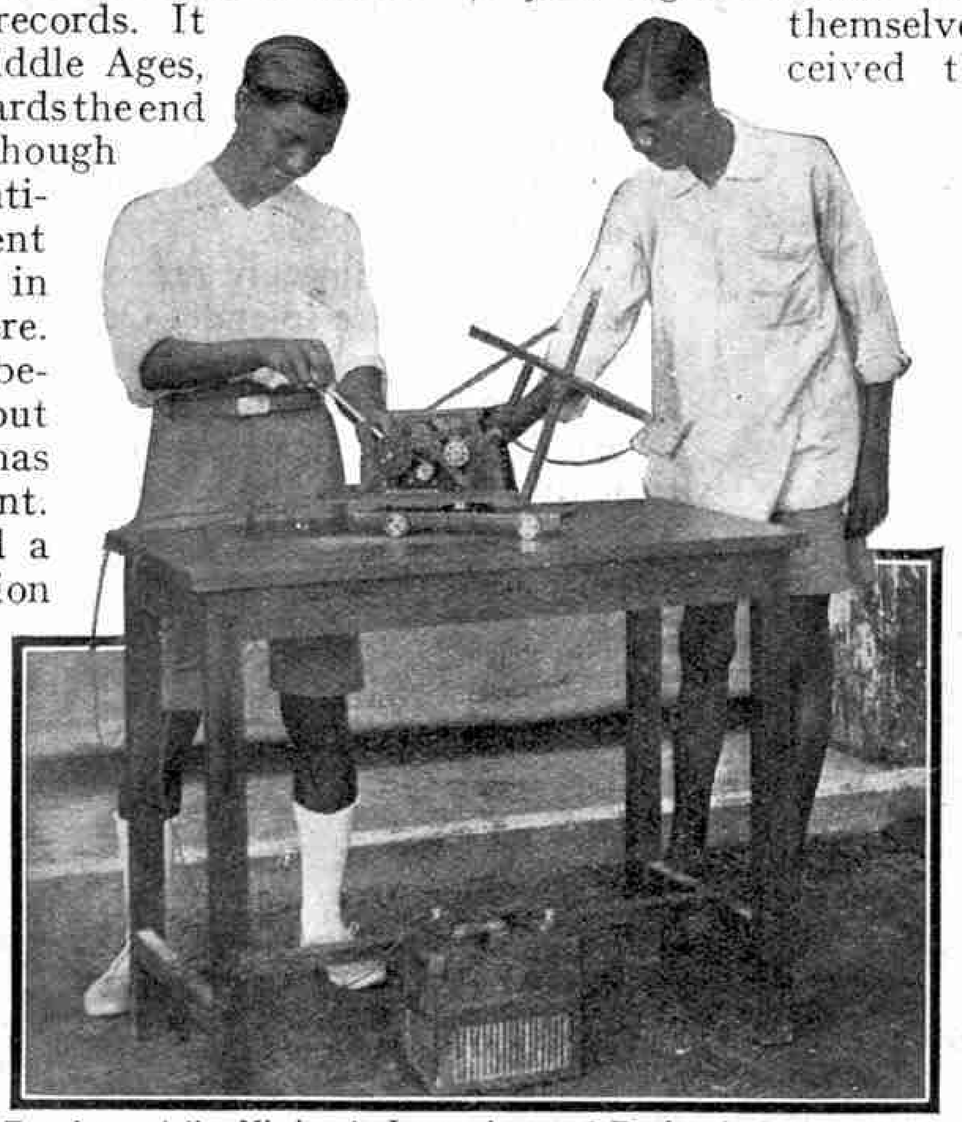
A series of misfortunes robbed Rodney of his valuable captures and also inflicted great loss upon his own fleet. These disasters began on the night of the battle, when the "*Cæsar*," one of the prizes, caught fire and blew up, with the loss of practically all on board. The other prizes, together with three badly damaged English ships of the line and a convoy of over 100 merchant ships, all under the command of Admiral Graves, sailed from Jamaica for England on 10th August, 1782. Very stormy weather was encountered however and, apart from the convoy, only one ship of the line and one prize ship reached this country. The "*Ville de Paris*" and another prize, "*Glorieux*," were lost with all on board.

Rodney returned to England in the same month and received a great welcome and many honours. The news of his important victory had preceded him, and he had already been created Baron Rodney of Rodney Stoke, Somerset, and voted by the House of Commons a pension of £2,000 a year. He did not continue in active service, and from the time of his return until his death on 24th May, 1792, he led a quiet country life.

Fighting a Dread Disease

Indian Boy Sufferers Use Meccano

ONE of the most terrible of the world's diseases is leprosy, which has existed since the earliest times of which we have historical records. It was common in Britain in the Middle Ages, but disappeared almost entirely towards the end of the 15th century. It still exists, though on a diminishing scale, in some Continental countries, and is prevalent throughout a large part of Asia, in certain parts of Africa, and elsewhere. For a long time the disease was believed to be hopelessly incurable, but in recent years medical science has made great progress in its treatment. Many cases are now curable, and a great improvement in the condition of a large proportion of sufferers can be brought about. A splendid work is being carried on in Asia by the Mission to Lepers, which is now operating in 18 countries at more than 100 stations, mainly in India, China, Japan and Korea. The object of the Mission is to provide for the spiritual instruction and temporal relief of lepers and the rescue of their untainted children, and to do all it can to bring about the extermination of the disease. At the Mission's various homes adults are treated, and boys and girls are cared for and taught a variety of useful occupations. Games and sports play an important part, and hobbies of all kinds are encouraged, among which it is interesting to note that Meccano is one of the most popular. We are sure that readers will be interested in the following notes by the Rev. F. W. Ross of the Raniganj Home, Bengal, taken from the Mission's quarterly magazine, "*Without the Camp.*"



Two boys at the Mission to Lepers home at Raniganj, India, with a Meccano bucket excavator they have just completed.

"In the office of one of the Mission's homes in India a boy is standing, apparently as healthy a boy as one could meet, but in this case appearances are deceptive because he has the beginnings of leprosy. There are two discoloured patches on his back where feeling is somewhat deadened and the doctor is saying, 'Yes Sona, it is so, but don't worry, we're going to put you right.' Sona will have to stay on here. Is it any wonder that there's a piteous look in his eyes? He was sent here to find out whether it really was leprosy, and I expect he was hoping all the time that it would turn out to be something unimportant and that he would be able to go back.

"It can be fairly lonely for a new boy at school, but at least he is surrounded by healthy people. Imagine the feelings of a young lad being admitted to a place where there are people crippled by the same disease which has just begun in him. This is where our Scouts can make themselves useful. Having previously received the hint, the Scoutmaster and another Scout arrive.

"'Hemendra, here's a boy who's going to be a smart Scout. He says he can swim, so put his name down for the competition next Saturday. Take him along with you and do your best to make him feel quite at home.'

"That will be their good turn for the day and they can do it far better than I can. A little later in the morning I'll find Sona putting a jig-saw puzzle together, or making a Meccano model, or else fascinated by the silkworms, and it isn't long before he decides that this isn't quite such a dreadful place as he expected. He finds that there are plenty of other boys like himself, he isn't a bit lonely, and when after a week or two we take his photo to send to his relatives the smile he shows is a perfectly happy one. Does that smile just come of itself or does it come by encouragement? Let's look round, we may find a reason for it.

Banku, who built the Plasticine elephant.

"On the verandah of the observation ward half a dozen heads are bent over something which is evidently the object of a good deal of consideration. Scraps of talk may be overheard. 'Yes, but if you put the bolt here it'll interfere with the corner bracket, and it's no good doing as Girish says because then the gears don't engage.' Then there's a turning over the pages of the book to consult the model.

"If we go closer we see that they are engaged on what is a favourite game with them, making a Meccano model, a difficult one requiring some thought. When it's finished they'll fix it to an electric motor run by an old car battery. They like to make things that work, windmills, cranes, elevators, bucket excavators and the like, much more interesting than mere stationary things like bridges.

"Plasticine is another familiar friend. They come at me, as merry a set of boys as one would wish to meet anywhere, with something on a board.

"'Well, who made this elephant?' Really not necessary to ask when one has noted Banku's dancing eyes and delighted face.

"'Yes, this is indeed the father of elephants' . . . I promise them a prize for the best tiger, and off they go gleefully discussing the offer."

MECC

MECCAUTO 5

MOTOR CAR C

Every boy who is keen on model building will ardently desire one of these fine new Motor Car Constructor Outfits. They are the latest Meccano development and they are sure to have an irresistible appeal for all boys.

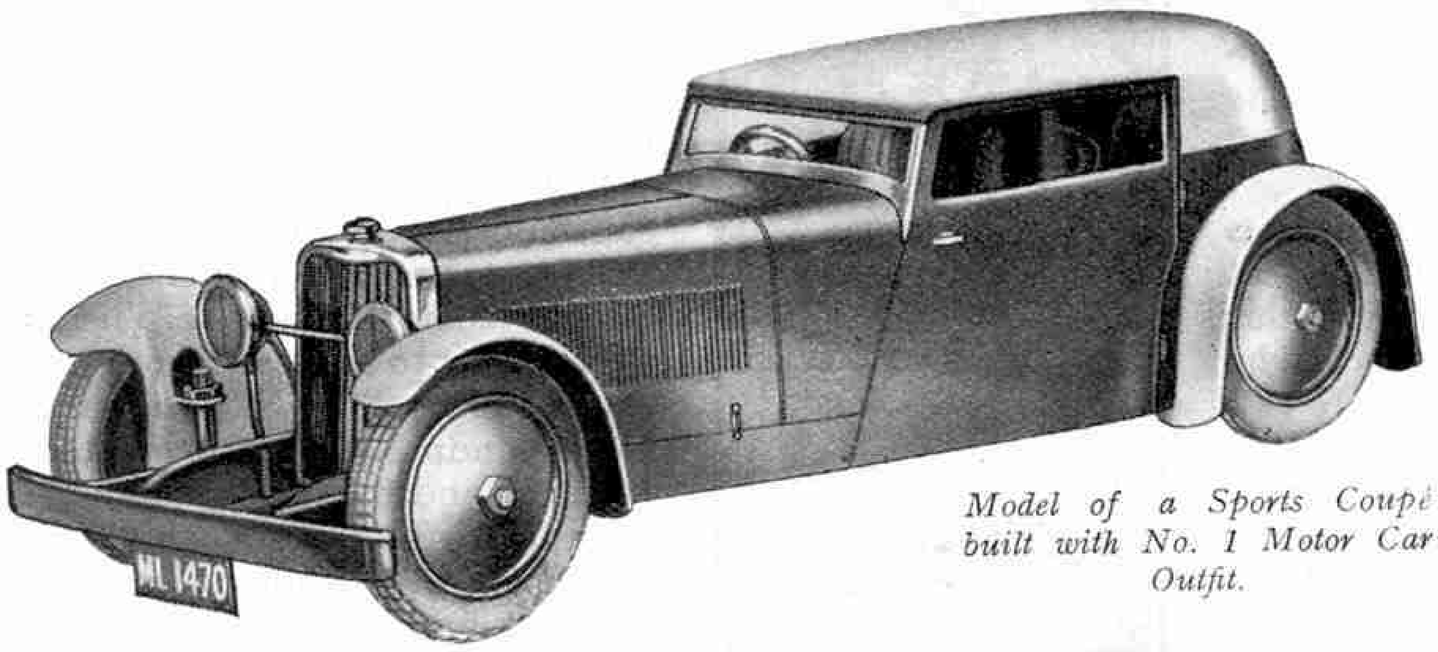
Perfect miniature reproductions of many different types of car can be built with these splendid Outfits including sports four-seaters, speed cars, sports coupés and others. All the models are fitted with a powerful clockwork drive and a steering gear that functions perfectly. The parts are finished in rich enamel and nickel-plate, the complete Outfits being masterpieces of miniature automobile craftsmanship.

No. 1 MECCANO MOTOR CAR CONSTRUCTOR OUTFIT

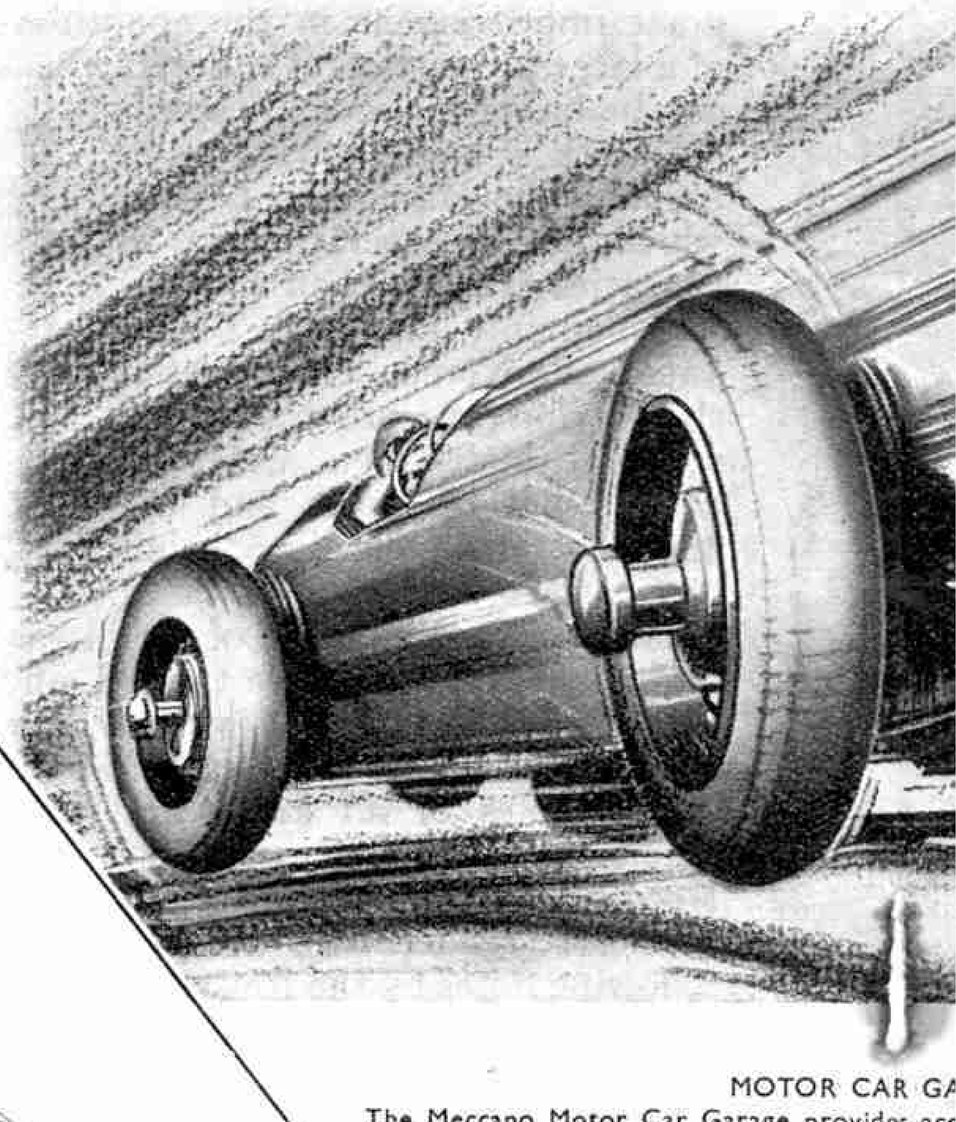
The motor car models that can be built with this Outfit are the finest you ever saw. Look at the example illustrated below and think of the fun you could have building this and other types equally graceful and realistic.

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**



Model of a Sports Coupé built with No. 1 Motor Car Outfit.



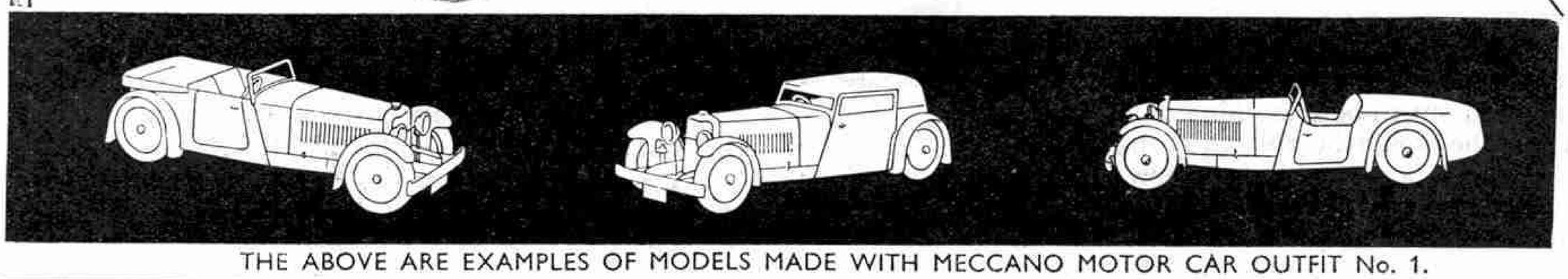
MOTOR CAR GA

The Meccano Motor Car Garage provides acc
car. It is strongly built, and its pebble-d
attractive appearance.

MOTOR CAR LIGH

This Lighting Set enables the headla
built with the 1933 No. 2 Motor Ca
lighted. Price

The Lighting Set cannot be u
Motor Car Outfit models
Headlamps (price 4d. each)
Board (price 6d.) a



THE ABOVE ARE EXAMPLES OF MODELS MADE WITH MECCANO MOTOR CAR OUTFIT No. 1.

Manufactured

MECCA
LIMITE
Binns Ro
LIVERPO
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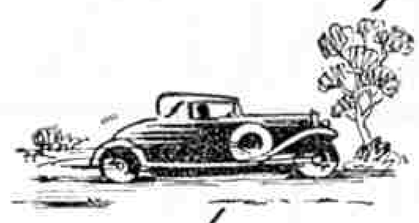
CANO

O 538189

CONSTRUCTOR



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. Make up your mind to get one of these splendid Outfits, and see your dealer about it to-day.

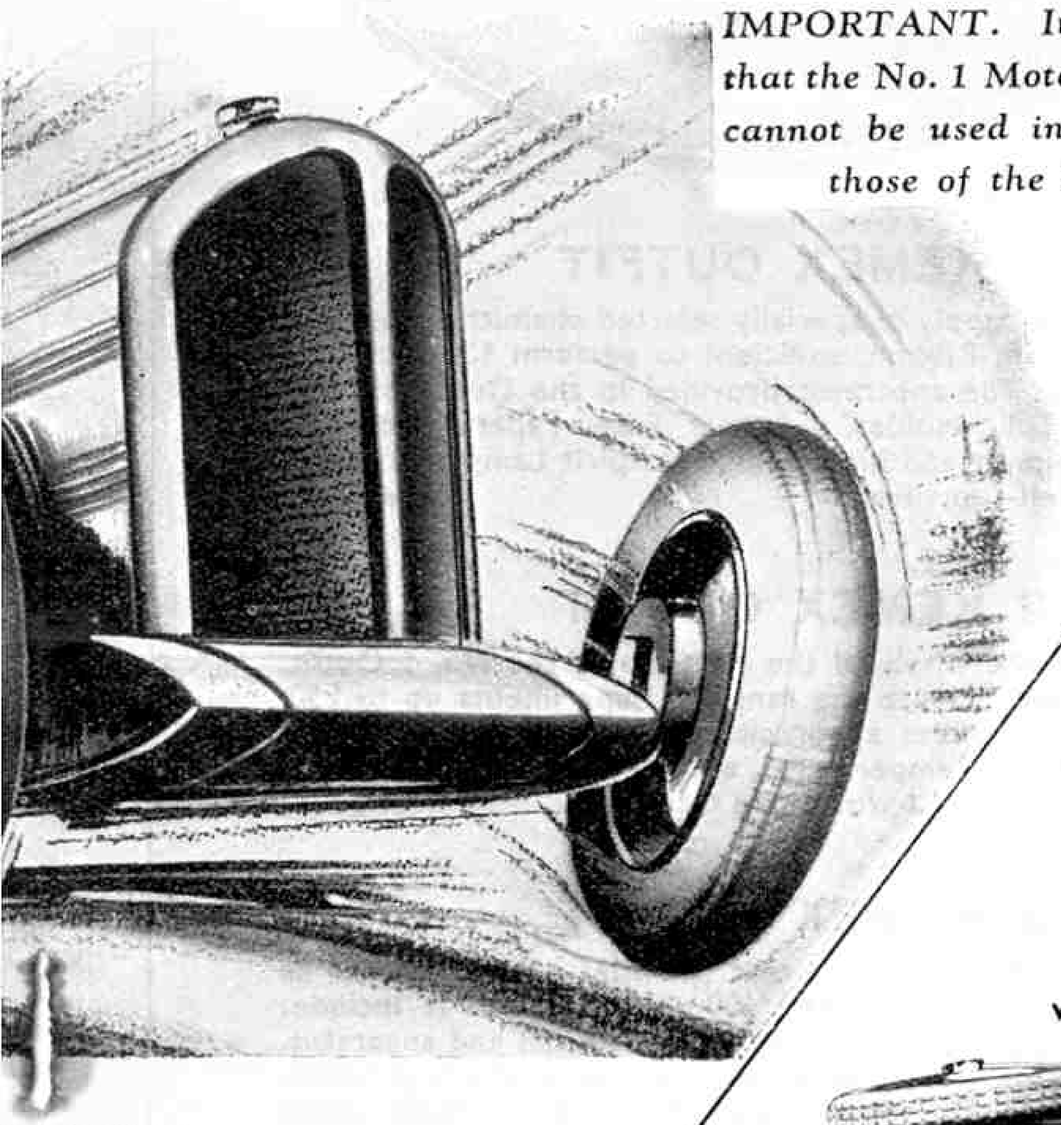
Each Meccano Motor Car Outfit is available in four different colour combinations—Red and Light Blue, Light Blue and Cream, Green and Yellow, and Cream and Red. In addition, the following parts will be available separately in the colours indicated. Body: Orange; Yellow. Wheels: Orange; Yellow. Wings: Orange; Green.

IMPORTANT. It should be noted that the No. 1 Motor Car Outfit parts cannot be used in conjunction with those of the No. 2 Outfit.

No. 2 MECCANO 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 invented for the delight of boys. Their handsome and realistic appearance may be judged from the illustration below.

No. 2 Outfit is available in four different colour combinations—Red and Bright 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/-**



Model of a Sports Car built with No. 2 Motor Car Outfit.

CAR GARAGE
ides accommodation for any model motor
pebble-dash finish gives it an extremely
earance. Price 7/-

R LIGHTING SET
e headlamps of Motor Car models
lotor Car Outfit to be electrically
. Price 2/6

ot be used with 1932 type
models unless the latest
id. each) and Instrument
e 6d.) are added.

factured by
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Road
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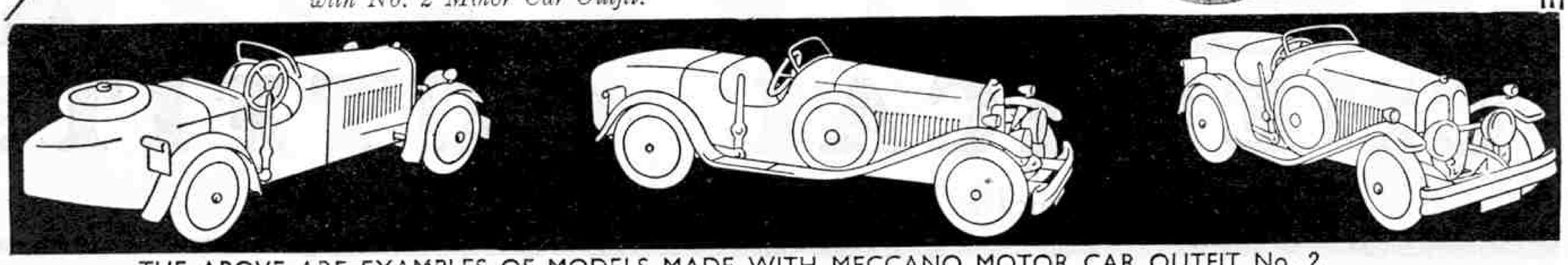


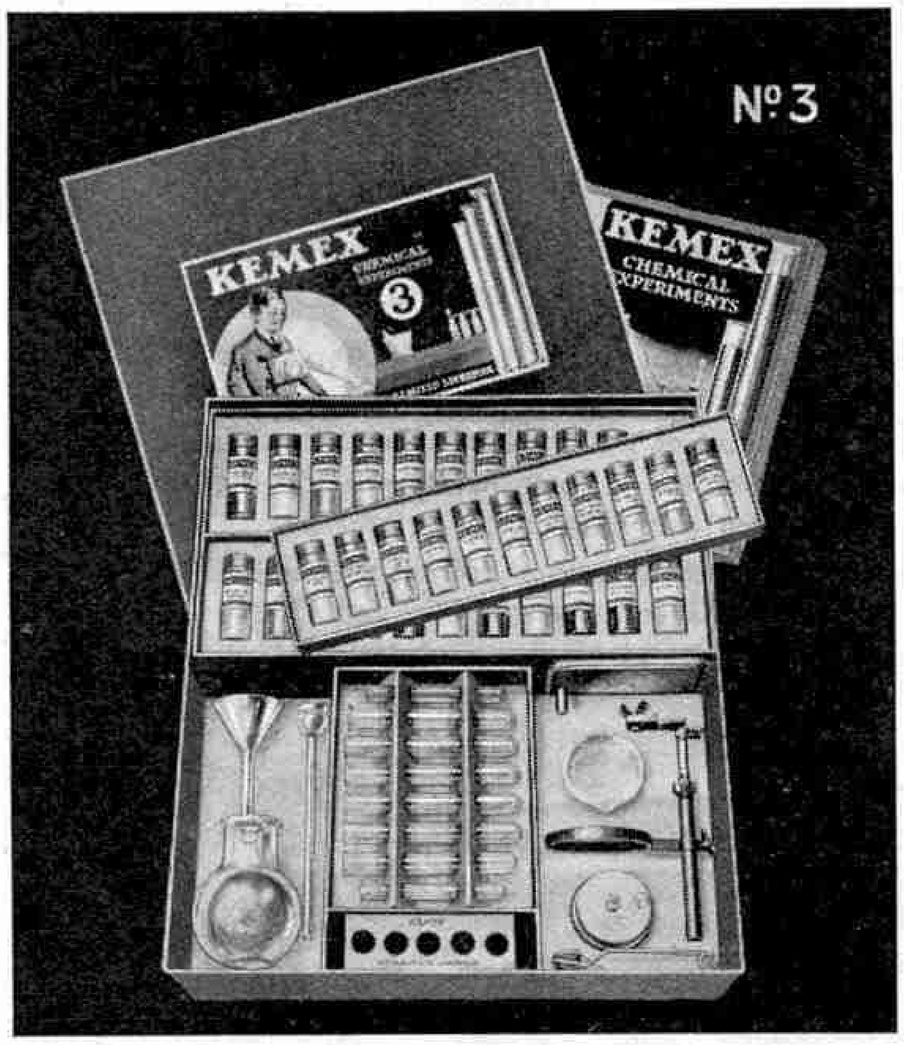
THE ABOVE ARE EXAMPLES OF MODELS MADE WITH MECCANO MOTOR CAR OUTFIT No. 2.

KEMEX OUTFITS
for chemical fun!

These new Kemex Outfits contain all the apparatus and materials required for a series of fascinating chemical experiments that will provide hours of fun. There is no difficulty and no danger. The chemicals are all non-explosive and non-poisonous, and conform with Home Office requirements.

With these Outfits you can perform for yourself hundreds of interesting chemical experiments—from producing invisible inks and preparing gases, to making a wonderful under-water "garden" in which chemical "plants" of different colours actually grow from crystals! Every experiment is fully described in a splendidly-illustrated Manual of Instructions.

PRODUCT of MECCANO LIMITED LIVERPOOL



No. 1 KEMEX OUTFIT

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 Funnel, Filter Papers, and Glass Delivery Tubes, with a simple and highly-efficient Spirit Lamp that makes the Outfit completely self-contained. Price **7/6**

No. 2 KEMEX OUTFIT

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 handsome Test Tube Stand, and the Kemex Evaporating Stand with Wire Gauze. Price **15/-**

No. 3 KEMEX OUTFIT

This is a splendid complete Outfit that provides a boy with all he requires to carry out between 350 and 400 experiments. It includes the contents of the No. 2 Outfit, with additional chemicals and apparatus. The latter includes a gas-generating apparatus, consisting of a large Wide-necked Flask with Thistle Funnel and Delivery Tubes. These items open up a series of experiments of outstanding interest. There is also the Kemex Universal Stand, by means of which the apparatus required for every chemical operation may be readily supported on similar lines to those adopted by actual chemists. Price **25/-**

KEMEX
CHEMICAL OUTFITS

Manufactured by MECCANO LTD., Binns Road, LIVERPOOL 13

What Chemists Do

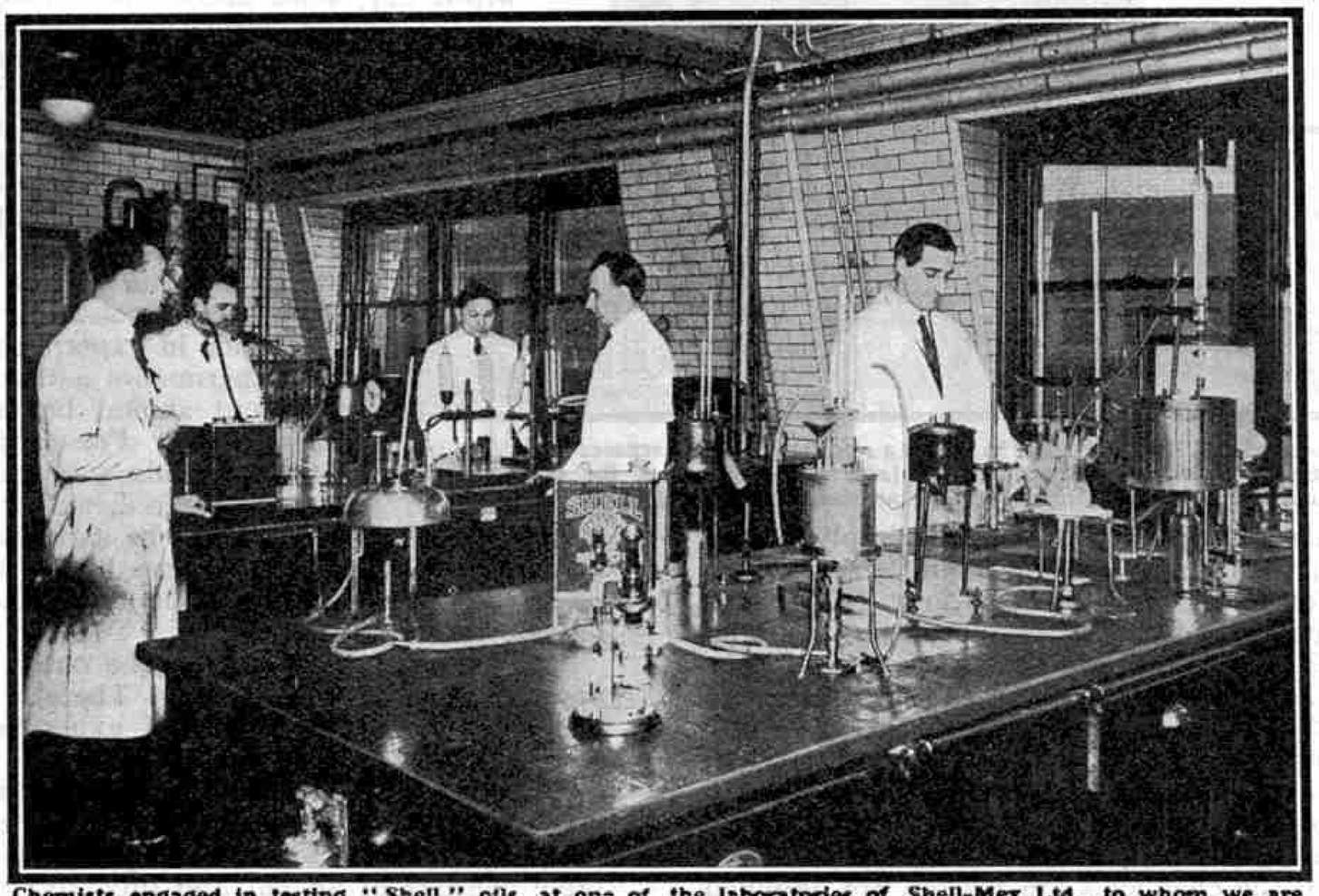
Experimenters Who Found Great Industries

TO most people a chemist is a man who presides over a shop that is notable for its peculiar fragrance, and for its mysterious little wooden drawers and arrays of bottles filled with attractive-looking liquids of various colours. A chemist of this kind is actually a pharmacist, and his main business is to compound drugs and chemicals into medicines in accordance with prescriptions sent to him. In this article we are concerned with the scientific chemist, whose mission is much wider. He probes into the secrets of the materials of which all things are made, and the whole world is his province. He is ready to test and examine anything dug out of the earth, or extracted from the sea or from the air, and his work is the basis of most of our important industries.

Let us see what such a chemist does. In the first place he is an analyst, that is to say he pulls materials to pieces in order to find what they are made of, and how they are built up. For this purpose he examines them with the aid of a microscope and other instruments, heats them, pours acids and other chemicals of all kinds on them, and forms his judgment on the basis of the clues these tests give him. This is very important work, and it takes many different forms. For instance, the chemist may be employed in an iron and steel works, a dyestuff factory, an oil and petrol refinery, or some great manufacturing concern. There he tests the raw materials employed, in order to ensure that they are of the requisite purity, and suitable for the changes they are to undergo in the giant furnaces, retorts, vats and autoclaves in which chemical operations are carried out on a large scale. Further, at every stage he analyses the products, in order to make sure that the changes are proceeding in a satisfactory manner.

The analytical chemist may be engaged also in the examination of foodstuffs and of drugs and other chemicals. Work of this kind is so necessary that analysts are specially appointed by local authorities for the purpose of ensuring the purity of water, milk and foods of all kinds, and for making special tests and analyses in the interests of the public. Occasionally this may include detecting the work of the poisoner, and the analyst often appears as a valuable ally of the police.

The chemist is more than the watchdog of industry, however. He is the creative magician who transforms unattractive and apparently useless stuff into beautifully coloured dyes, sweet smelling essences, and thousands of other wonderful products. The most amazing example of this is the transformation of coal tar, the dirty, black and evil-smelling liquid collected during the manufacture of coal gas. At one time this was a waste product and a nuisance to its makers, but in 1865 W. H. Perkin, a young English chemist, quietly working during his Easter holidays in a small laboratory he had fitted up at home, extracted a beautiful mauve dye from the unpromising liquid. This single experiment was the beginning of an entirely new industry that to-day is one of the most important in the world, for the work of chemists has revealed the existence of thousands of brilliantly-coloured dyes that can be obtained from coal tar products. These are far superior in every respect to the few dyes of vegetable origin previously in use, for they provide a greater range of colours, and are more brilliant and durable.



Chemists engaged in testing "Shell" oils at one of the laboratories of Shell-Mex Ltd., to whom we are indebted for our photograph.

Even the famous Tyrian purple of the ancients, which at one time was reserved exclusively for the use of the Roman Emperors, has been surpassed by the modern chemist. The old dye was obtained from certain shellfish found in the Eastern Mediterranean, and it would have been necessary to dissect about a quarter of a million of these tiny molluscs in order to obtain an ounce of the dyestuff! To-day it can be made readily from coal tar, but it is no longer used, for the chemist has replaced it by similar colours that are far more brilliant and attractive.

The research chemists on the staffs of great industrial firms take up promising laboratory experiments and work on them until they are transformed into successful industrial operations. Many of the magnificent results brought about in this way are achieved by team work, but the day of the lone chemist is by no means over. Only a few years ago, for instance, an English chemist working alone devised in a month a new process for the production of a certain dye that previously had been a German monopoly, and quickly developed it into a new industry.

Chemical Magic at Home

How to Use the Meccano Kemex Outfits

EVERYTHING in the world around us is built of chemical elements and their compounds. These compounds undergo ceaseless changes, and the study of these changes forms the basis of the wonderful science of chemistry. The Kemex Outfits have been introduced to provide apparatus, materials and instructions for carrying out a series of fascinating experiments, in which the secrets of chemical science are revealed.

The amount of fun that can be obtained from a Kemex Outfit is practically unlimited, but to get the best from an Outfit it is necessary to go about things in the proper way. A miniature railway set that is simply spread out on the floor anyhow, with trains running about without any method, is interesting for a little while, but soon it becomes wearisome and monotonous because it is not based on any kind of system. It is just the same with a Kemex Outfit. If the contents are simply tumbled out on a table and a few disconnected experiments are made, the real interest of the Outfit is missed, and its owner soon becomes tired of it. If, on the other hand, an Outfit is used with even a small amount of method, the original interest does not fade away, but increases with every experiment that is made.

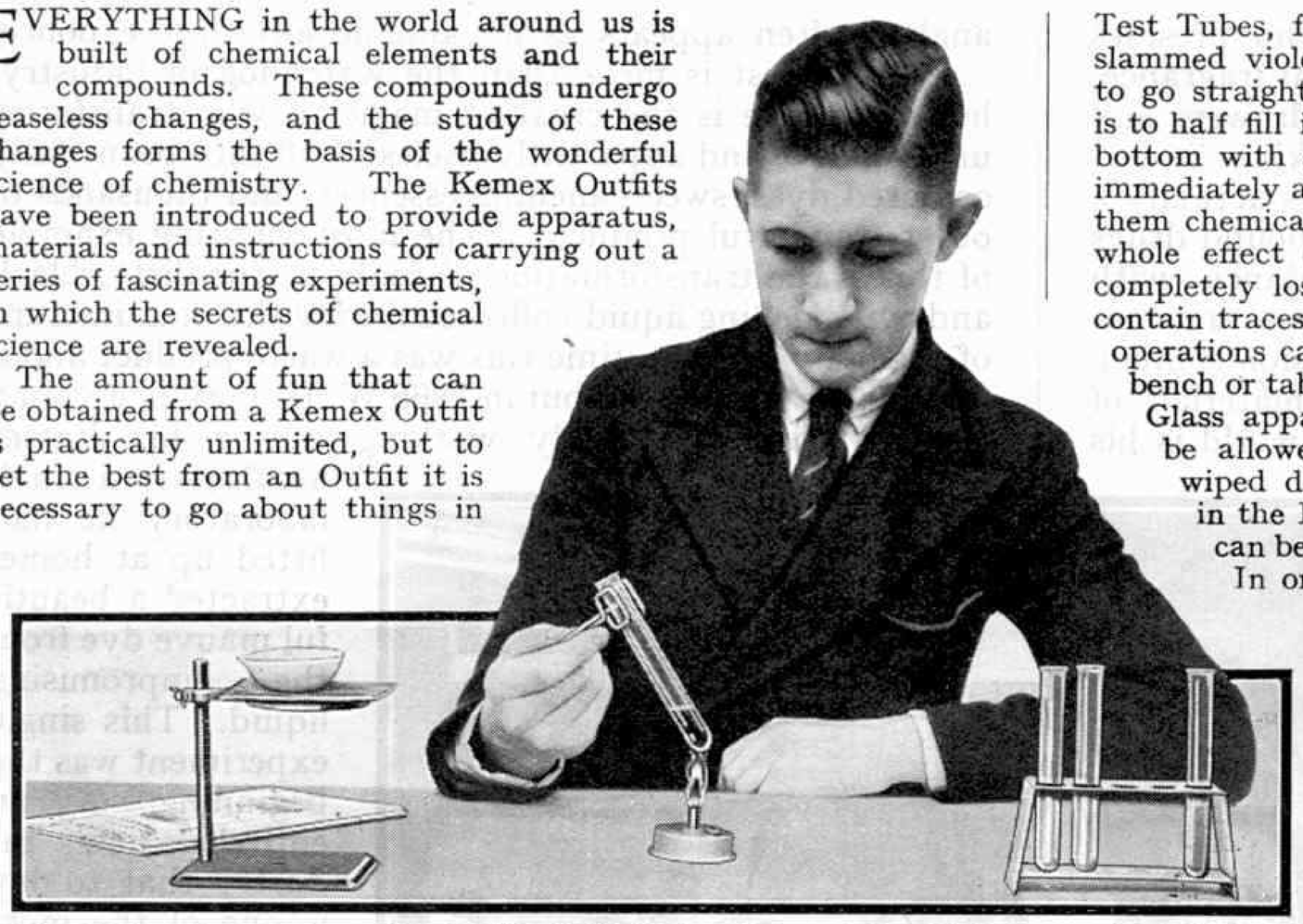


Fig. 1. A well-arranged experiment. The Test Tube in which a solution is being prepared is held in the correct position, with its mouth pointing away from the face, and the rest of the apparatus is within easy reach, but is not in danger of being accidentally knocked over.

The containers in which the chemicals are packed are designed to keep their contents out of contact with moist air, an important precaution with many chemicals. For this reason the containers should be opened only when part of their contents is actually required for use. As soon as the required amount of the chemical has been measured out, the cap or cover should be replaced and the container returned to its correct position in the box. The aluminium caps of the glass containers should be screwed down as far as they will go, in order that the tubes may be sealed properly by means of the small cork pad in the top of the cap. If open containers are left on the table they are almost certain to be knocked over and their contents spilled.

For most of the experiments described in the Kemex Manuals there is no advantage in using large quantities of chemicals, for small quantities give equally good results. The Scoop (Part No. K36) provides a measure of suitable size, and the instructions given for its use should be followed. In making experiments that are not dealt with in the Manuals, trials should always be made first with very small quantities of chemicals, otherwise a good deal of material is likely to be wasted. Those who have not had any previous experience in experimenting with chemicals will be surprised to find how small an amount of the various substances is sufficient to produce the required result.

The next important point is cleanliness. All glass apparatus should be rinsed out immediately after use, unless of course it is desired to keep the contents for a subsequent experiment. A stiff Test Tube Brush for cleaning the inner surfaces of glass vessels is included in each Outfit. In using this Brush a little discretion is necessary. Test Tubes, for instance, are fragile things, and if the Brush is slammed violently to the bottom of one it is more than likely to go straight through! The proper way to clean a Test Tube is to half fill it with water and then push the Brush slowly to the bottom with a screwing motion. If Test Tubes are not cleaned immediately after use it will be found much more difficult to make them chemically clean later. It should be remembered that the whole effect of many of the most interesting experiments is completely lost if the Test Tubes in which they are carried out contain traces of chemicals from previous experiments. Washing operations cannot be carried out very satisfactorily on the work bench or table, and by far the best place for the purpose is a sink. Glass apparatus should never be put away wet, but should be allowed to drain after washing, and then be carefully wiped dry, both inside and outside. The Flask included in the Kemex Outfits has a wide neck, so that a clean cloth can be rubbed over its inner surface without much difficulty. In order to dry a Test Tube, twist a corner of the cloth to a sufficiently small size and screw it gently into the test tube to the bottom.

A glass vessel that is dried with a cloth in this manner is not chemically dry, however, for no matter how much care is devoted to the wiping process, the surface of the glass still retains a thin layer of moisture. This of course is of no importance in experiments with solutions, and in such experiments a test tube that has been well rinsed out should be used without being wiped with a cloth. For certain experiments described in the Manuals a chemically dry Flask or Test Tube is required, and if the vessel has just been washed and wiped it should be carefully warmed to remove the last traces of moisture. A glass vessel that is to be heated should never be placed over the flame of the Spirit Lamp while its outside is wet.

If possible a special table, the older the better, should be set apart for experimental work. There is a great satisfaction when one is carrying out chemical experiments in knowing that it does not matter if anything is spilled. If a special table is not available and an ordinary room table must be used, precautions must be taken to prevent any liquid that may be spilled from reaching the table top. Perhaps the most effective cover for the table consists of an old and dilapidated tablecloth covered with several sheets of paper. In any case it is a good plan to have a cloth at hand to mop up any spilled liquid before it has time to soak through. With ordinary care accidents should be very few, but even if every precaution is taken one is almost sure to happen occasionally.

A little attention should be given to the layout of the apparatus in use, in order to avoid confusion. A good idea of a suitable general scheme may be gained from Fig. 1, in which the experimenter is preparing a solution by warming a chemical with water in a Test Tube. The Test Tube Stand is being correctly employed to hold the Test Tubes not in use, including one that contains liquid for an experiment connected with the one actually in

Fig. 2. A Delivery Tube being worked through a Cork by a slow screwing motion.

progress. It will be noticed that this Tube is placed apart from the empty Tubes, in order to prevent it from being taken up in mistake for a clean Tube. If the experimenter wishes to place the hot Tube in the Test Tube Stand, he should put a few strands of Asbestos Fibre beneath it. This will avoid the possibility of breakage caused by the rapid cooling of the glass brought about by contact with the metal of which the

Fig. 3. Checking apparatus before beginning the preparation of carbon dioxide from marble.

Stand is made. It should be noted that the Test Tube Stand itself is within easy reach, but at the same time is far enough away from the working place to avoid the possibility of its being knocked over. This is the case also with the Evaporating Stand, complete with Wire Gauze and Evaporating Dish, all ready for evaporating the solution that is being prepared.

An important point is the manner in which the Test Tube is being held over the flame of the Spirit Lamp. It will be seen that the experimenter is holding the Tube at an angle, with its mouth pointing away from him. Thus, if by any chance a little of the hot liquid should spurt out of the tube, it cannot reach the experimenter. The risk of such a spurt is very small indeed, especially if the test tube is gently shaken while the liquid it contains is being heated; but it is wise to take precautions against even this remote possibility.

Figs. 2 and 3 illustrate many important practical points in regard to the manner in which an experiment should be carried out. The experiment in progress is the preparation of carbon dioxide from marble, described on page 27 of the No. 3 Kemex Manual. In Fig. 2 the Wide-necked Flask, Thistle Funnel, and Delivery Tubes have been laid out on the table ready for fitting together to form the generating apparatus, and the Small Right Angle Delivery tube is being inserted in the Double Bored Cork. This operation is being correctly carried out. The Tube is held by the straight portion that is to pass through the Cork, and is being slowly and steadily worked into the hole by a turning movement. No attempt should ever be made to push a glass tube straight through a hole in a cork, for this almost inevitably results in breakage as the result of overstrain.

In Fig. 3 the Thistle Funnel has been passed through the second hole in the Cork, which is in position in the neck of the Flask. The large Right Angle Delivery tube has been attached by means of the Rubber Connection Tube, and the jar placed in position to receive the carbon dioxide. Alongside is the tube containing marble, and the experimenter is finally checking over the apparatus by reference to the illustration, Fig. 40 on page 29 of the Manual, before placing the marble in the Flask and returning the container to the box. By making this final check, and by reading the instructions carefully before actually beginning the experiment, he makes sure that the chemical changes with which he is dealing shall be carried out smoothly and without mishap.

The general layout of the apparatus is worth notice. The Spirit Lamp is easily accessible, but is not lighted, as it will not be required until carbon dioxide has been collected in the jar, or in one of the Test Tubes conveniently placed in the Test Tube Stand on the right. At the back of the table is the Evaporating Stand, and at the close of the experiment there will be no difficulty in pouring the liquid remaining in the Flask into the Evaporating Dish. Finally the box containing the rest of the Outfit is well placed towards the back of the table, and to the left, where its contents are handy but out of the way.

All the experiments described in the Kemex Manuals can be carried out by one experimenter, but there are occasions when the assistance of a friend is advisable. In any case it is much more fun to work with a friend, so that the various operations can be shared out, and the results of the experiments discussed.

An experiment in which the assistance of a friend is specially useful is in the preparation of oxygen from a mixture of Potassium Chlorate and Manganese Dioxide, as described on page 7 of the Manual included in the No. 1 Outfit, and page 10 of the Manual for the Outfits Nos. 2 and 3. This attractive experiment may be divided into two sections. In the first of these the gas is driven out of the mixture by heating it in a Test Tube; and in the second it is collected by the displacement of water. Fig. 4 shows two friends preparing the gas. The one on the right is concentrating on heating the oxygen mixture, and it will be noted that he is not holding the Spirit Lamp close to the Tube, but is arranging matters so that the upper part of the flame is below the mixture. His task is to heat the contents of the Tube uniformly and to regulate the flow of gas. If he heats too strongly, the bubbles of oxygen rush too quickly into the jar and make the task of the collector more difficult. On the other hand, if he allows the temperature to fall, the flow of gas will cease, and water then may rise up the Delivery Tube into the Test Tube and thus ruin the experiment. As he passes the flame backward and forward along the tube, therefore, he glances from time to time at the jar in which the oxygen is being collected, in order to regulate production. In the illustration the Test Tube is supported on the Universal Stand (Part No. K26). This simplifies his share of the experiment, but he will have no difficulty if the Universal Stand is not available and the Test Tube has to be held in the Test Tube Holder.

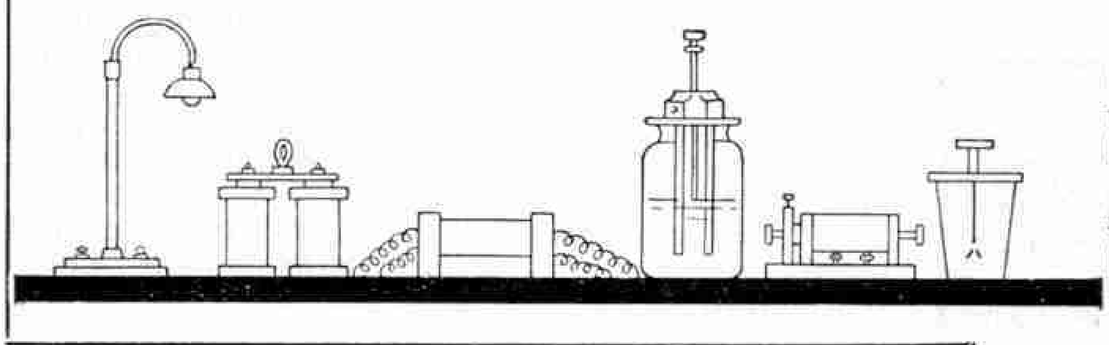
Now let us turn to his collaborator. In the illustration he is seen holding the jar in position. This is necessary, for when it is filled with gas it is liable to topple over. As soon as all the water has been displaced, the thin card that he holds in readiness in his right hand is slipped underneath the mouth of the jar, and the jar is lifted out and stood right way up in a safe place. A second jar is filled with water and placed in position to receive the gas, and while he is making the change the heating is stopped and the Delivery Tube lifted just clear of the water in order to prevent liquid from making its way into the Test Tube. A point to watch in this experiment is the level of the water in the basin. This rises as the water in the jars is displaced, and unpleasant results might follow if it overflowed! The assistance of a friend helps to prevent any disaster of this kind, for he is able to bale

Fig. 4. A case in which two pairs of hands are decidedly better than one! Preparing and collecting a jar of oxygen.

out a little of the water with a spare jar or any other vessel that may be handy.

In carrying out experiments with Kemex Outfits, the changes are brought about by means of a series of what might be called standard operations. These include the heating of liquids, the preparation of solutions, evaporation, distillation and other processes; and next month we shall explain the nature of these and describe how to make use of them for a variety of purposes.

ELEKTRON
ELECTRICAL OUTFITS



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

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

Elektron Outfit No. 1 Price 8/6

No. 1 ELEKTRON OUTFIT

Magnetism and Static Electricity

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

Price **8/6**

No. 2 ELEKTRON OUTFIT

Magnetism, Static and Current Electricity

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

Price **25/-**

No. 1A ELEKTRON ACCESSORY OUTFIT

An Accessory Outfit is also available that converts a No. 1 Elektron Outfit into a No. 2.

Price **16/6**

Elektron Outfit No. 2 Price 25/-

Manufactured by

MECCANO LTD.

BINNS ROAD
LIVERPOOL 13

Engineers Produce Artificial Lightning

Millions of Volts of Electrical Energy

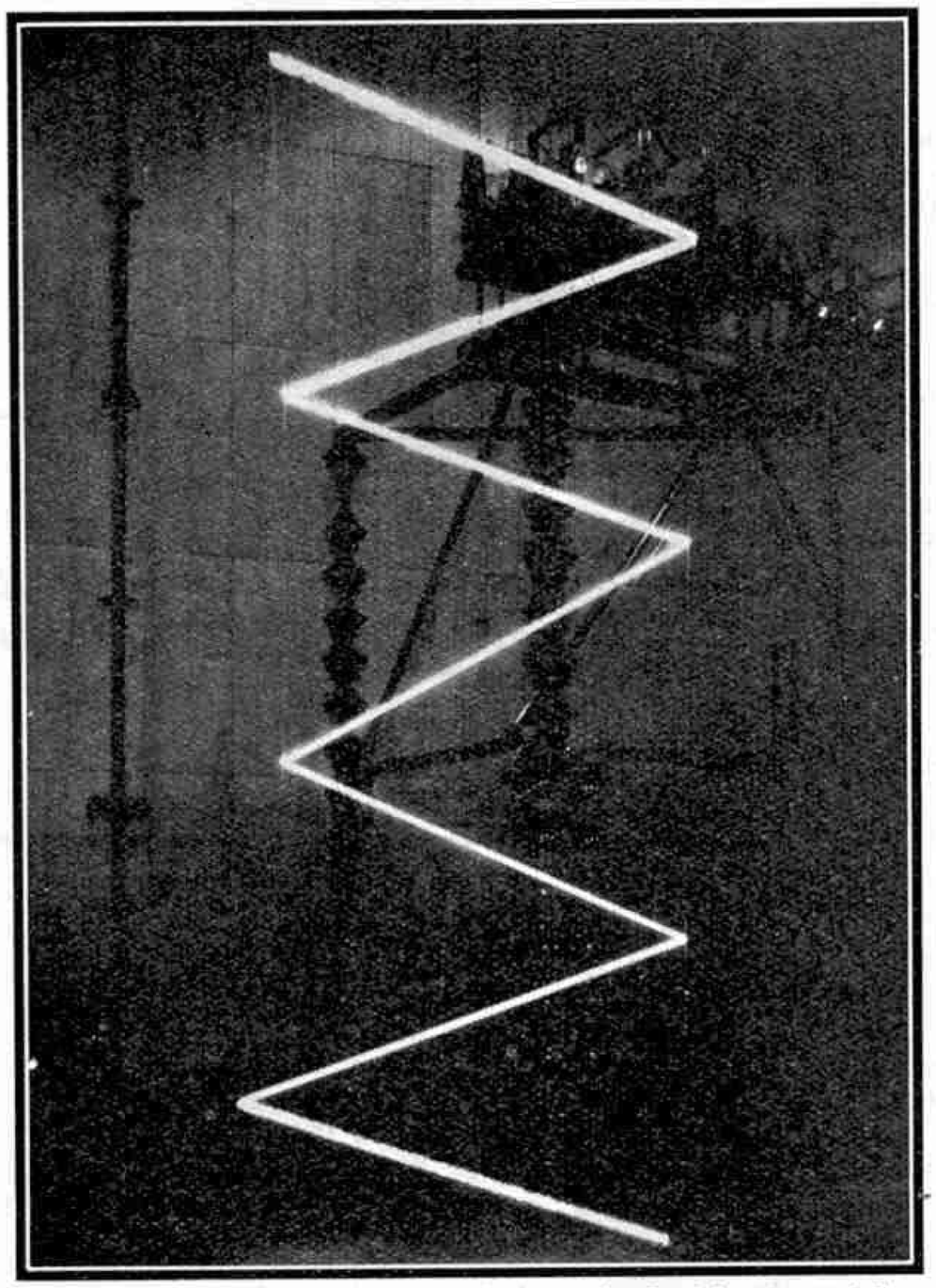
EVERYBODY is familiar with electric sparks of one kind or another. There is, for instance, the tiny spark to be seen at the contacts of an ordinary household electric bell. Feeble though this spark appears, it is capable of putting the bell out of action by melting the contacts, unless metal of high melting point is used. Then there are the sparks from electrical machines of the Wimshurst type, and from induction coils, which may be many inches in length. The voltage required to produce sparks of this nature is very high, that developed in an induction coil giving a 10-in. spark being 100,000 volts or more. These sparks shrink into insignificance, however, beside the greatest of all electric sparks—the lightning discharge. Lightning flashes may be several miles in length, and their voltage runs into millions.

There are now in use in many parts of the world long overhead wires for the transmission of high-voltage electric current. Such overhead lines are very liable to be struck by lightning, and when this occurs serious damage may be caused. The destructive power of a current caused by lightning appears to be greatly increased at the moment when the current reaches the power station at the end of the line. When a water wave reaches an obstruction it surges against it with great force, as we have all seen when watching the waves of a rough sea dashing up to a great height against a sea wall. The current produced by lightning in an overhead line is also in the form of a wave, and on reaching the end of the line it surges up to greater intensity, with disastrous effects on the generators or instruments.

During the past few years a great deal of attention has been given to the problem of protecting overhead lines from the effects of lightning. First of all it was necessary to determine the nature of the lightning surges as they occur on lines, and this has been done by means of automatic apparatus connected to lines during storms. Records obtained by an instrument known as the cathode ray oscillograph have been of great value in this direction. The Norinder automatic oscillograph, developed by Dr. Harold Norinder, a Swedish scientist and Consulting Engineer for the Westinghouse Electric and Manufacturing Company, U.S.A., may be connected permanently to an overhead transmission line, so that it will record any passing lightning disturbance, giving a complete picture of its rate of rise, its maximum value, its decay, and its duration.

In addition, the behaviour of the lightning on the lines and the effect of various protective devices had to be determined, and here a difficulty arose on account of the irregular occurrence of lightning flashes, which made systematic observation almost impossible. Engineers therefore set to work to produce lightning artificially, and although they have not yet succeeded in equalling natural lightning, they can now produce artificial thunderstorms of sufficient intensity for experimental purposes.

The result of all this research has been the development of lightning arresters of various forms. The function of an arrester is to protect against over-voltages that are dangerous to insulation, without causing disturbances in the system during operation; and the form of arrester that most nearly meets requirements is the valve type, such as the Westinghouse Autovalve arrester. This may be regarded as acting in a somewhat similar manner to a safety valve, which discharges under pressure and cuts off when the pressure drops.



A 3,000,000-volt artificial lightning discharge in the laboratory of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, U.S.A., to whom we are indebted for our photograph.

The accompanying illustration shows a flash of artificial lightning in the laboratory of the Westinghouse Company, which has done a great deal of pioneering work in the investigation of the effect of lightning on transmission lines. In this case the voltage artificially produced was more than 3,000,000. By discharging such enormous voltages in the form of lightning it is possible to determine definitely many facts regarding insulation, protective devices for high-tension lines, and other constructional details. One of the most important results of such experimental work is the development of facilities for protecting expensive power house and relay equipment, as well as ensuring more constant and dependable service at all points supplied by electric power companies.

The discharge is directed into the desired path by means of very fine thread-like wires, and it is possible to work out some startling designs in this manner. For instance, a zig-zag arc flashes along a 75-ft. length of the wire from near the roof of the great laboratory to the floor. This discharge is well shown in the photograph.

The New Meccano Elektron Outfits

Commencing to Experiment

ELECTRICITY is being employed on an ever-increasing scale for heating, lighting, driving machinery, wireless and many other purposes. Every Meccano boy should know something of this wonderful power and the Elektron Outfits have been specially designed to show, by a series of fascinating experiments, how it is generated, transmitted, and put to work to serve our every-day needs.

When an Elektron Outfit is first opened, its contents will be found to be carefully arranged in good order, and in particular, those parts that are likely to be broken are packed in a safe and proper manner. Most of them are contained in special compartments, and these should be their regular resting places when they are not actually being used in experiments.

Apart from glass rods, tubes and other breakable parts, the Elektron parts that require the greatest care are the Magnets. A magnet is a very delicate thing, for although it is made of material capable of withstanding rough treatment, it is easily robbed of its magnetism by careless handling, such as throwing it down on a table, dropping it on the floor, or allowing it to come into violent contact with other magnets. This will be readily understood when it is remembered that a magnet is believed to be composed of a large number of tiny molecular magnets, arranged with their north poles pointing in the same direction, as explained on page 9 of the No. 1 Instruction Manual. The effect of sudden shocks cause these tiny magnets to become disarranged, and thus reduce the powers of the large magnet built up from them. Bringing a magnetised piece of steel violently into contact with a second magnet produces a similar result.

It will be noticed that the magnets included in the Elektron Outfits are provided with small pieces of soft iron known as "keepers." It is important that these keepers should always be in position when the magnets are not in use. The reason for this is that a magnet unprotected by a keeper tends to lose its magnetic powers steadily, so that in time it becomes weak and practically useless. This loss of power is almost entirely prevented by the use of a keeper. The simplest form of keeper is the single piece of soft iron that is placed across the poles of a horseshoe magnet. The Horseshoe Magnet in the Elektron Outfit is packed with a Keeper in this position, and after every experiment it should be returned to its place with the keeper across its poles. A single bar magnet cannot be fitted with a keeper in this manner, and therefore it is usual to arrange them in pairs with opposite poles adjacent, and with a keeper across each end. The two Bar Magnets included in each Elektron Outfit are packed in this manner, and it will be noted that they are separated along their length by a piece of card. They should always be replaced in the box with their Keepers in position.

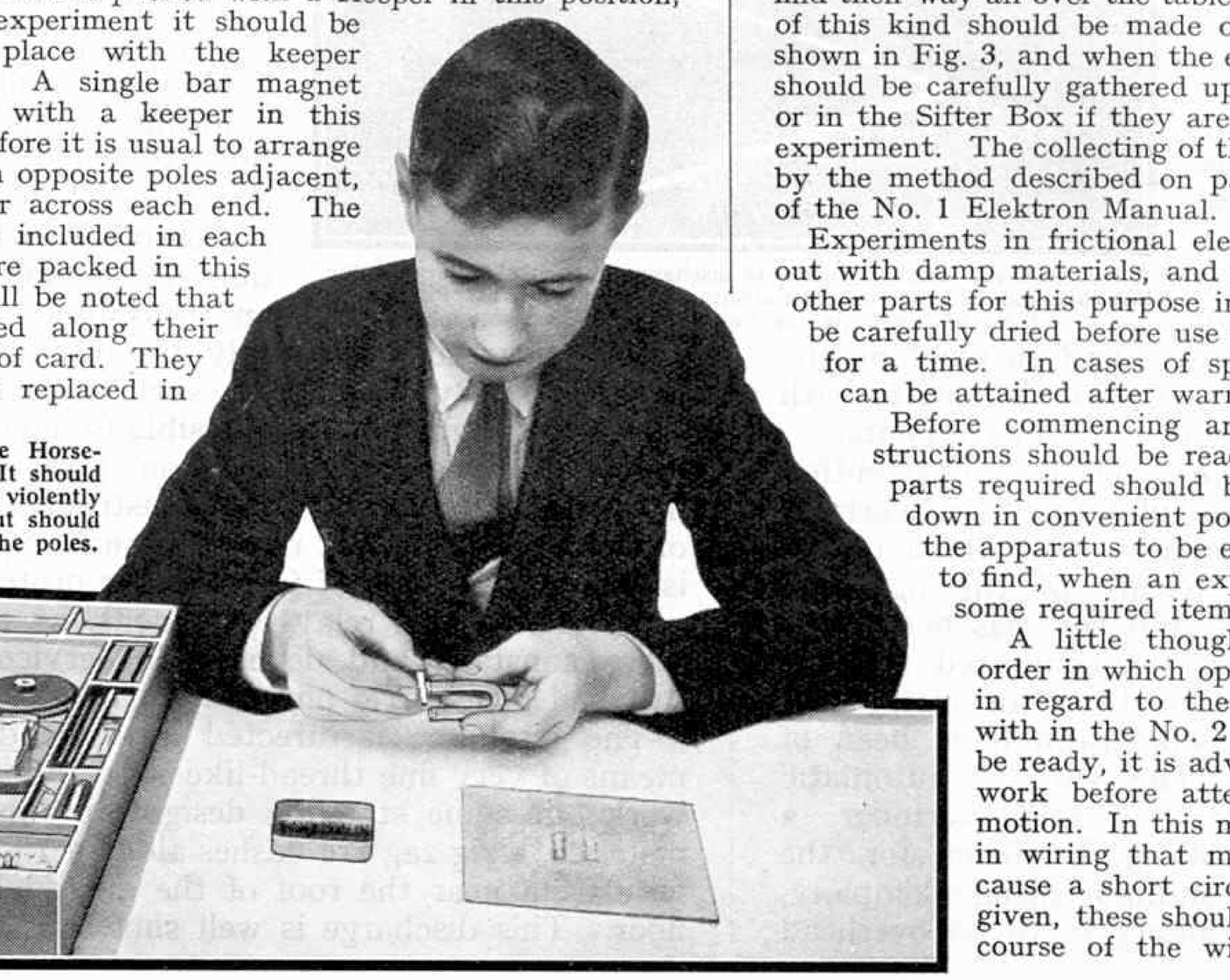


Fig. 1. Replacing the Horseshoe Magnet Keeper. It should never be allowed to slam violently against the Magnet, but should be slid gently across the poles.

Another point of importance must be remembered if the strength of the Horseshoe Magnet is to be preserved. It is a common practice with youthful and inexperienced owners of such magnets to demonstrate their powers by allowing them to attract their keepers from short distances. It is certainly very exciting to see a magnet suddenly drag a piece of iron violently towards it, but unfortunately the effect is to seriously weaken the magnet. Keepers should be brought gently into contact with the poles, preferably by a sliding movement, as shown in Fig. 1.

Fig. 2. Making the Potassium Bichromate solution for the Elektron Bichromate Cell. Other parts required are ready for use.

It is advisable to be as careful with other Elektron parts as with the Magnets, and it should be made a rule to replace each part as soon as it is finished with. It is no trouble to adopt this simple plan, and to do so has the desirable result that parts are never misplaced, but are always at hand, so that the experiments described in the manuals can be carried out at any time.

Special care is necessary in dealing with the Iron Filings that are used in so many fascinating experiments. Every owner of an Elektron Outfit will revel in making magnetic maps with various combinations of magnets and pieces of soft iron, but if he does not take care the filings will find their way all over the table and on to the floor. Experiments of this kind should be made on a sheet of good stiff paper, as shown in Fig. 3, and when the experiments are finished the filings should be carefully gathered up and replaced in the Glass Tube, or in the Sifter Box if they are required immediately for another experiment. The collecting of the filings is done easily and cleanly by the method described on page 3, and illustrated on page 4, of the No. 1 Elektron Manual.

Experiments in frictional electricity cannot readily be carried out with damp materials, and the Glass and Ebonite Rods and other parts for this purpose in the No. 1 Elektron Outfit must be carefully dried before use by keeping them in a warm room for a time. In cases of special difficulty, successful results can be attained after warming apparatus in front of a fire.

Before commencing any electrical experiment the instructions should be read over carefully, and the various parts required should be identified one by one and laid down in convenient positions ready for use in assembling the apparatus to be employed. It is always a nuisance to find, when an experiment is well on the way, that some required item is not at hand.

A little thought should be given also to the order in which operations are carried out, especially in regard to the more complicated devices dealt with in the No. 2 Manual. Even when all seems to be ready, it is advisable to check the constructional work before attempting to set one of these in motion. In this manner it is easy to discover errors in wiring that may spoil an experiment, or even cause a short circuit. Where wiring diagrams are given, these should be carefully compared with the course of the wires in the actual apparatus, the

path of the current being followed from the Carbon Plates or positive terminal of the Bichromate Cell, through the apparatus, and back to the Zinc Rod that forms the negative terminal.

In designing the Elektron Outfits special attention was paid to the provision of a convenient source of current, and the No. 1A and No. 2 Outfits contain all that is required to build up the Bichromate Cell that is used in almost every experiment with those Outfits. The Cell is easily made. The first step is to prepare a solution of Potassium Bichromate in a suitable vessel, a 1 lb. glass jam jar being exactly the right size for the purpose. The required quantity of the red crystals is measured out, and if possible crushed before adding to the correct volume of water, in order to hasten the process of solution, which is further assisted by stirring with the Glass Rod. When no more crystals remain undissolved the dilute sulphuric acid is slowly added. There is no danger in using acid of the strength recommended in the Manual, but care should be taken not to spill it, for it does not improve an experimenter's clothes! The mixing should be done with the jar standing in a sink, and the outside of the jar should be carefully rinsed with water and dried before the jar is placed on the table. The final step is to place the Cell Mounting in position, with the Carbon Plates partly immersed in the liquid, but with the Zinc Rod lifted out of it.

If a few drops of acid should happen to be spilled on the clothes, the places should be immediately dabbed with a piece of rag thoroughly wetted in ordinary household ammonia.

It is extremely important to note that concentrated sulphuric acid should never be employed in making up the Elektron Bichromate Cell. The acid should always be of accumulator strength.

When the various parts required in any experiment have been assembled, they must be connected to the Bichromate Cell. For this purpose the Connection Wire with glazed insulation is employed, and if the instructions given in the Manual for cutting it into suitable lengths are followed, the amount included in each Outfit will be found sufficient for all the experiments required. When a length of connection Wire has been cut off, the insulation should be removed for a distance of about $\frac{1}{2}$ in. from each end, and the black enamel scraped away from the wire to reveal the bright metallic gleam of the copper. The ends can then be looped conveniently round Bolts fitted with Terminals. A practical point that will lead to good wiring practice is to place the loop with the short end pointing in a clockwise direction. The result of this is that when the Terminal is tightened the wire is carried with it and held firmly in position.

Mistakes in wiring can scarcely be made if the instructions in the Manual are carefully followed, for these show clearly the course of the connecting wires. The wires should not be allowed to stray in all directions, but should be arranged in such a manner that they do not get in the way when the apparatus is being manipulated during an experiment. Wiring is always more easily checked if the crossing of two wires is avoided.

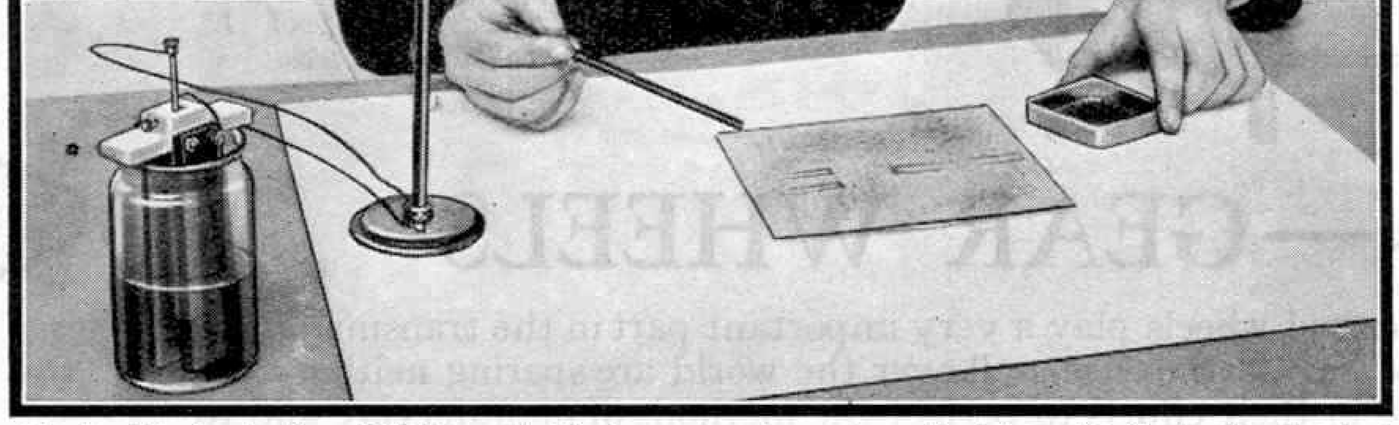


Fig. 3. The fascination of Elektron electrical experiments can be realised from this illustration showing a magnetic map being made. The Elektron Reading Lamp is being put to excellent use.

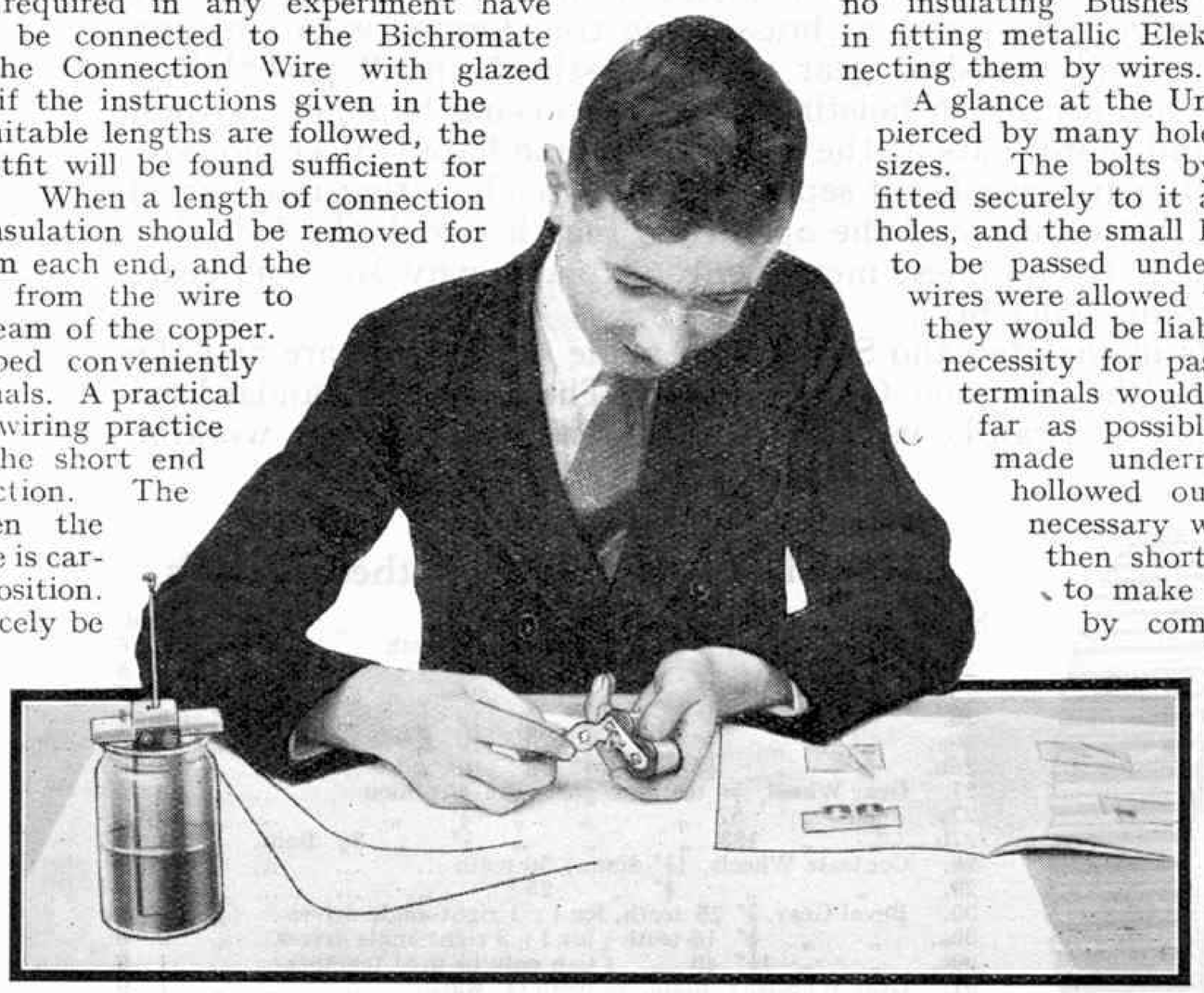


Fig. 4. Assembling a horse-shoe electro-magnet during experiments with the Elektron Outfit. The Zinc Rod of the Bichromate Cell is raised out of the liquid until current is required.

Current cannot flow from the Bichromate Cell unless the Zinc Rod is in the solution. The normal position for this rod is above the surface of the liquid, in which position no chemical action takes place, and there is thus no wastage of material. When everything is in order for the performance of a certain experiment the Zinc Rod should be lowered into the solution gently in order to avoid splashing. The key of the Switch, which forms a necessary and important part of practically every circuit, is then moved to the left in order to make contact and close the circuit. It will thus be seen that the Switch and the Zinc Rod between them form a double control of the current.

It is important to note that the Switch can be operated in one of two different ways. When current is required to flow steadily for a long period, the key is moved to the stop between the two brass strips. This brings the brass strips into electrical connection with each other and allows current to flow through the circuit in which the Switch is included. The key remains in this position, and current continues to flow until contact is broken by moving it back.

Sometimes only a momentary contact is required. This is the case, for instance, when the Switch is being used with the buzzer in telegraphy. Then the key is placed in a central position, with its handle above the brass stud sunk into the base of the Switch. In order to complete the circuit, and to allow the electric current to pass, the key is simply pressed down on to this stud. It springs back automatically when released, thus interrupting the circuit immediately. When the Switch is used in this manner, its action is that of a telegraph key and it can readily be used to transmit the short and long notes of the Morse Code.

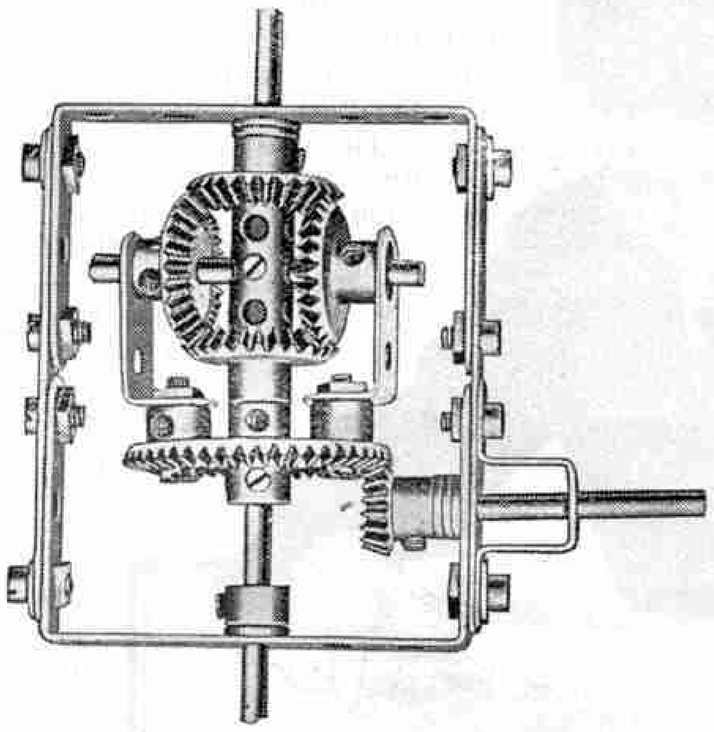
The Universal Base has been specially designed for use in constructing the electric bell, the shocking coil and other attractive electrical devices built with parts included in the No. 1A and No. 2 Elektron Outfits, and a clear understanding of the manner in which it is employed will be of great assistance to experimenters. It is moulded from bakelite, a substance that has the advantage of being non-conducting. For this reason no insulating Bushes and Washers are required in fitting metallic Elektron parts to it, or in connecting them by wires.

A glance at the Universal Base shows that it is pierced by many holes and that these are of two sizes. The bolts by means of which parts are fitted securely to it are passed through the large holes, and the small holes enable connecting wires to be passed underneath the Base. If these wires were allowed to remain on top of the Base, they would be liable to get in the way and the necessity for passing them round coils and terminals would give rise to confusion. As far as possible therefore connections are made underneath the Base, which is hollowed out in order to receive the necessary wires. The connections are then short and can be suitably placed to make it easy to check the wiring by comparison with the diagrams in the No. 2 Manual.

The wiring of one of these electrical devices is best left until assembly of the parts is complete. The only exception to this rule comes with the inclusion of the Connecting Link, which is employed in making the electrical connections of the bell, the buzzer and the shocking coil described in the No. 2 Manual. This Link is placed under the Universal Base, and care should be taken to have it in position when fitting the bolts that pass through the holes in its ends, for it could not be included afterwards without undoing part of the work of construction.

In any kind of electrical work it is a good plan to have on the table only the materials that are actually required for the experiment in hand. This simplifies operations, and goes far towards preventing mistakes. Particular care should always be taken that the Bichromate Cell is arranged so that it cannot be knocked over by an accidental jerk of the connecting wires.

MECCANO PARTS



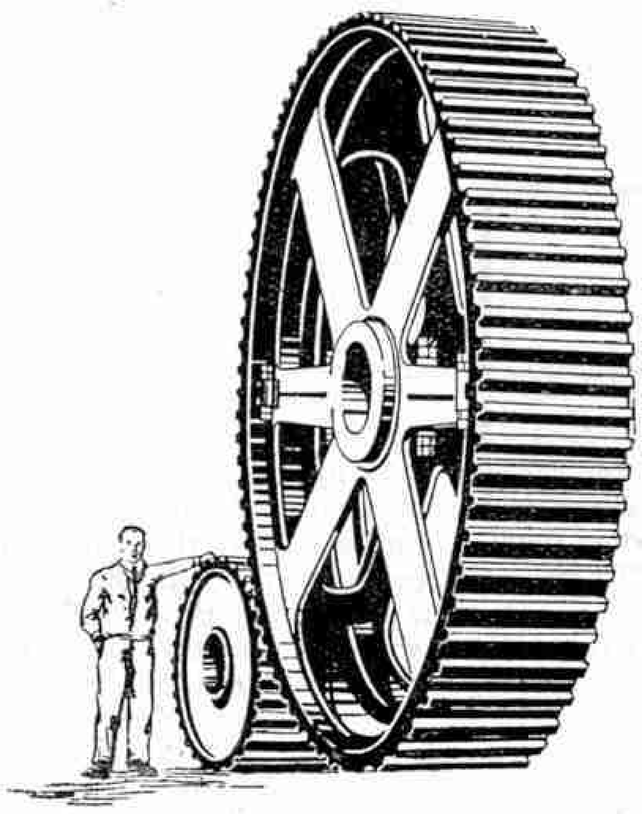
This illustration shows the differential gear from the Meccano Motor Chassis. This fine model has also a three-speed and reverse gear box, Ackerman steering, clutch, internal expanding brakes and all the other features of a real motor car. A beautifully illustrated leaflet is available that gives full instructions for building this splendid model. You can obtain a copy from your dealer, price 3d., or direct from Meccano Ltd., Binns Road, Liverpool 13, price 3d. post free.

4—GEAR WHEELS

TO-DAY toothed wheels play a very important part in the transmission of power, and engineering firms all over the world are sparing neither time nor trouble in their efforts to perfect the methods of manufacture and to improve the efficiency of gears of every imaginable size. Gear wheels are equally indispensable in Meccano engineering, and Meccano gears are made in much the same manner as are the gears used in actual practice.

We believe all Meccano boys would like to watch, say, a "No. 27" as it passes through the various stages of manufacture. It is certainly very interesting to observe solid pieces of brass being transformed with amazing rapidity into beautifully finished gear wheels destined, in all probability, to give years of hard service in hoisting loads or working hammers, lathes, engines, clocks, and motor cars at the bidding of some happy Meccano boy. Each tooth in a Meccano gear is cut separately by a machine that is a marvel of precision, and the accuracy of the operation, together with the fact that the wheels are made of the finest metals only, explains why Meccano gears work so smoothly and efficiently.

All the parts in the Meccano System are made with same care and the same accuracy as the Meccano Gear Wheels. They are all standardised and interchangeable and can be used to make hundreds of different working models.



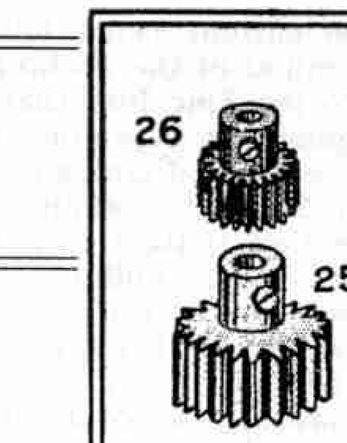
"WHEELS OF INDUSTRY"

Price List of Meccano Toothed Wheels

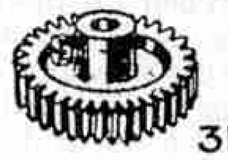
No.		s.	d.
25.	Pinion Wheels, ¾" diam., ¼" wide, 25 teeth ... ... each	0	6
25a.	" " ¾" " ¼" " 25 " ... ... "	0	8
25b.	" " ¾" " ¼" " 25 " ... ... "	0	10
26.	" " ¾" " ¼" " 19 " ... ... "	0	4
26a.	" " ½" " ¼" " 19 " ... ... "	0	6
26b.	" " ½" " ¾" " 19 " ... ... "	0	8
27.	Gear Wheel, 50 teeth, to gear with ¾" pinion ... "	0	6
27a.	" " 57 " " " ½" " ... "	0	6
27b.	" " 133 " " " ½" " 3½" diam. "	1	3
28.	Contrate Wheels, 1½" diam., 50 teeth ... ... "	0	9
29.	" " ¾" " 25 " ... ... "	0	6
30.	Bevel Gear, ½" 26 teeth, for 1 : 1 right-angle drives "	0	9
30a.	" " ½" 16 teeth } for 1 : 3 right-angle drives "	0	6
30c.	" " 1½" 48 " } Can only be used together "	1	6
31.	Gear Wheels, 1" diam, 38 teeth (¼" width) ... ... "	1	0
32.	Worms, for big reduction gear, etc. ... ... "	0	5
95.	Sprocket Wheels (for Chain gear), 2" diam., 36 teeth "	0	5
95a.	" " " " 1½" " 28 " "	0	4
95b.	" " " " 3" " 56 " "	0	6
96.	" " " " 1" " 18 " "	0	3
96a.	" " " " ¾" " 14 " "	0	3
148.	Ratchet Wheels, for Pawl and Ratchet Gear ... ... "	0	6
167a.	Roller Races, geared, 192 teeth } Can only be "	4	6
167c.	Pinions for Roller Bearings, 16 teeth } used together. "	1	0

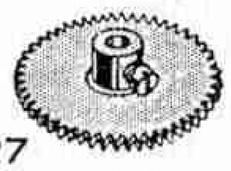
Ask your dealer for a complete list of Meccano Parts or write for a copy to

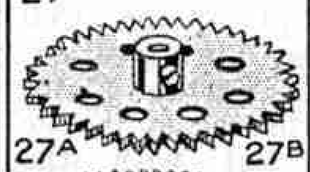
MECCANO LTD., BINNS ROAD, LIVERPOOL 13

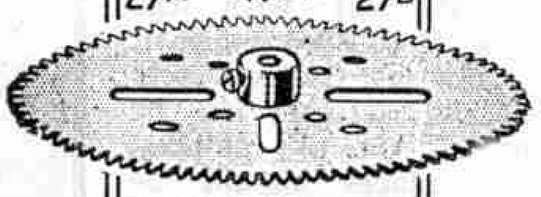


PINION WHEELS

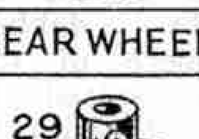


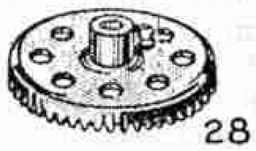




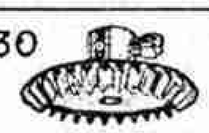


GEAR WHEELS

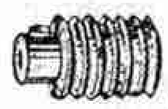




CONTRATE WHEELS

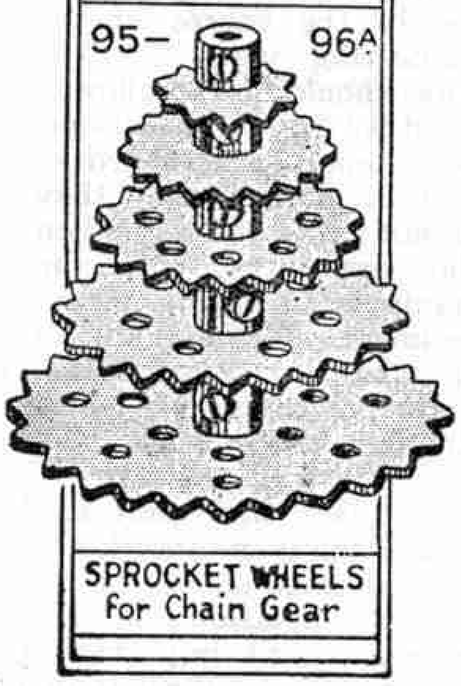


BEVEL WHEELS



WORM WHEELS

RATCHET WHEELS



SPROCKET WHEELS for Chain Gear

Model-Building Contest Results

By Frank Hornby

"Engineering of the Past" Contest

Relics of the past have a peculiar attraction for most of us, especially those of the early days of engineering. Now-a-days engineering wonders are so numerous that we pass them almost unheeded, but a hundred years ago even the most simple machines were considered very marvellous, and were regarded by some people as inventions of the evil spirits! Engineering in its infancy produced some very weird and curious objects, but as these were in many cases the forerunners of familiar modern engineering structures, they possess considerable interest to engineers and model-builders. I expected, therefore, that the "*Engineering of the Past*" Contest would attract a big number of entries, and I was not disappointed. Almost every kind of engineering relic is represented by the entries received, and I had a delightful time examining them, although I must confess that it was a difficult job to pick out the best! Before I describe some of the more interesting entries I give the lists of prize-winners in the various sections.

Section A (for competitors over 14)

FIRST PRIZE, Cheque for £3-3s.; W. Temple, Shanklin, Isle of Wight. SECOND PRIZE, Meccano or Hornby Goods value £2-2s.: M. McDonald, Dublin. THIRD PRIZE, Goods value £1-1s.: R. Sculpher, Tilbury, Essex.

FIVE PRIZES of Goods value 10/6: R. Lawford, Bexley-heath, Kent; G. Wilkes, Portsmouth; J. Matthews, Fillongley, Nr. Coventry; C. Wrayford, Moretonhamp-stead; G. Bunker, Grimsby.

FIVE PRIZES of Goods value 5/-: F. Taylor, Studley Priory, nr. Oxford; V. Palmer, Longueville, Jersey; C. Spencer, Warsash, Hants.; L. Hollyoak, Coventry; P. Robinson, London, S.W.1.

Section B (for competitors under 14)

FIRST PRIZE, Cheque for £2-2s.: H. Cowen, Hendon, N.W.4. SECOND PRIZE, Meccano or Hornby Goods value £1-1s.: P. Crosby, Blackpool. THIRD PRIZE, Goods value 10/6: R. Freestone, Gateshead-on-Tyne.

TEN PRIZES of Goods value 5/-: G. Parker, Bury St. Edmunds; R. Standlake, Burnt Oak, Edgware; J. Burdin, Longton, Lancs.; R. Wallis, London, S.W.12; R. Aikman, West Worthing, Sussex; D. Morton, Maidstone; J. Meldrum, Parkstone; J. Gillett, Ilford; J. George, Bordon, Hants.; C. Wood, Edinburgh.

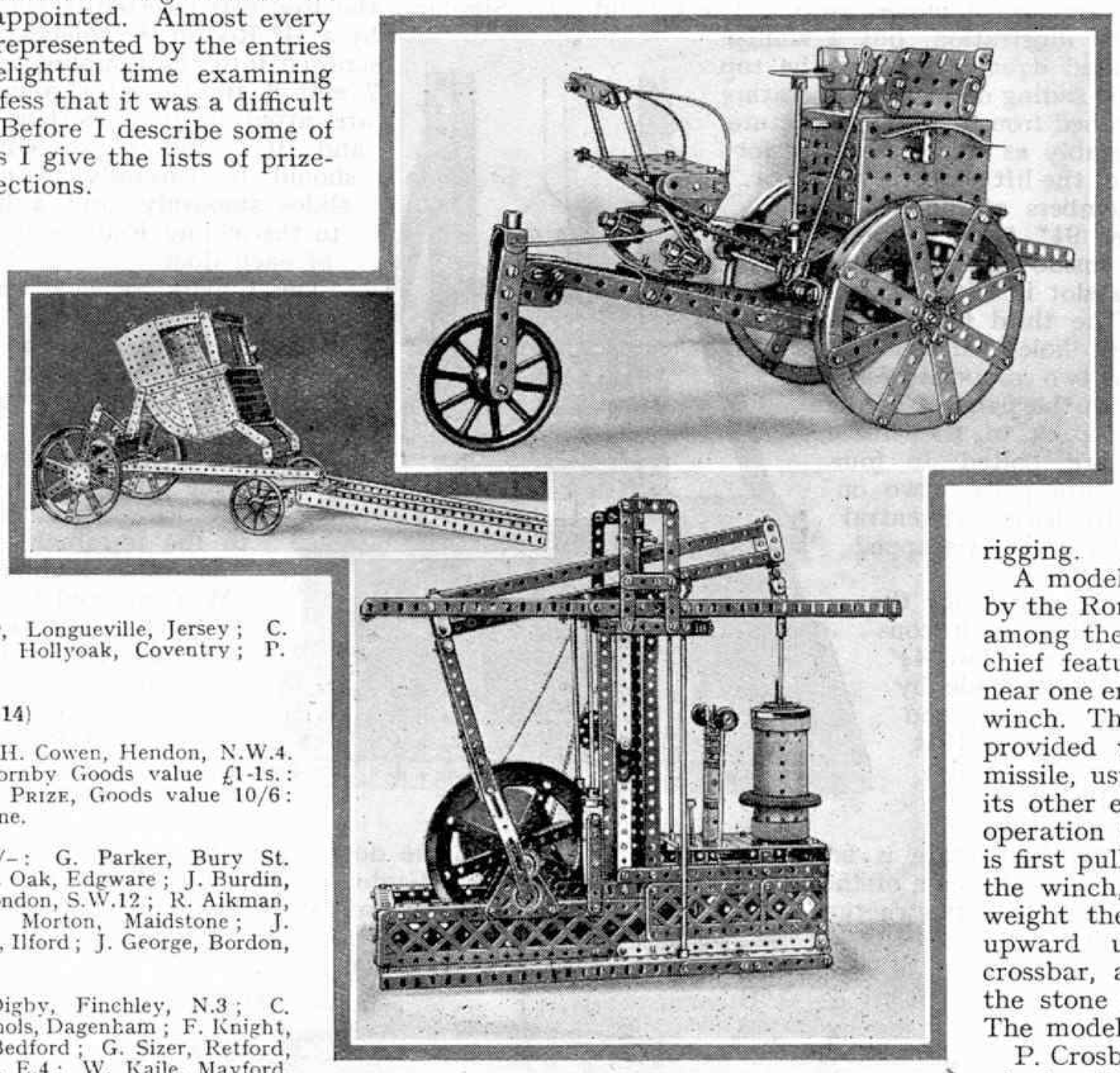
CERTIFICATE OF MERIT: B. Digby, Finchley, N.3; C. Jackman, Huddersfield; F. Nichols, Dagenham; F. Knight, Newbury, Berks.; D. Howe, Bedford; G. Sizer, Retford, Notts.; G. Knapman, London, E.4; W. Kaile, Mayford, nr. Woking.

Section C (for competitors living Overseas)

FIRST PRIZE, Cheque for £3-3s.: P. Andersin, Finland. SECOND PRIZE, Meccano or Hornby Goods value £2-2s.: J. Valeton, Almelo, Holland. THIRD PRIZE, Goods value £1-1s.: D. Johnston, Wellington, N.Z.

FIVE PRIZES of Goods value 10/6: W. Rausch, S. Rhodesia; C. Williams, Brisbane, Australia; M. Fearnley, Wellington, N.Z.; C. Lindh, Helsingfors, Finland; R. Ranikhetvala, Bombay.

FIVE PRIZES of Goods value 5/-: W. Scott, Montreal: W. Eggington, Melbourne; J. Smith, Toronto; H. Eustis, Port Adelaide, S. Australia; W. Jackson, Que Que, S. Rhodesia.



Time-honoured engineering relics reproduced in Meccano. (Top) Benz three-wheeler motor car of 1898 by W. Temple. (Centre) Post-chaise by D. Johnston. (Bottom) Double-acting Beam engine by J. Matthews.

First Prize in Section A was awarded for a particularly neat and clean-looking model of an old Benz three-wheeler motor car. It is a splendid copy of one of these time-honoured vehicles, and its details are clearly shown in the accompanying illustration. Readers will note the peculiar situation of the mudguards, and in fairness to the constructor of the model I think it is necessary to mention that this was the favoured position for the mudguards of the actual vehicles. It will be seen that brake shoes are fitted on the rims of the rear wheels.

Second Prize was awarded to M. McDonald for a model of the "*Northumbrian*" Locomotive. It is very realistic, and reminds one that there was a time when travelling was anything but a pleasure outing! Points that attracted my attention on first glancing at the photograph of the model were the neat way in which the Strips had been bolted together, and the total absence of ugly nuts on the outside of the model. This latter is a feature for which I always look, for a good Meccano engineer always takes care to hide all nuts as much as possible. Considerable ingenuity is shown in the design of the model, particularly in the rear springs and the steam dome. The former is made from a short Rod with a Collar at each end and a Compression Spring in the middle, and the steam dome consists of a pile of loose Pulleys of different sizes held on a Rod.

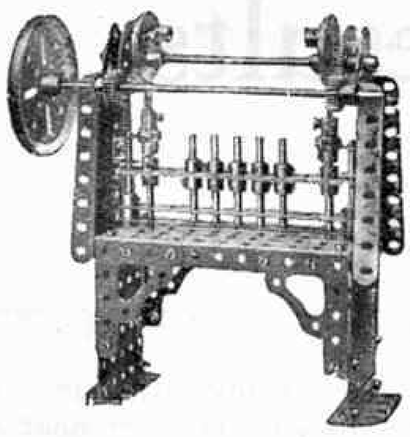
The model sent by R. C. Sculpher represents one of the earliest paddle steamers. The actual vessel was built at a time when ship designers doubted the efficiency and reliability of the steam engine, and as a safeguard provided their steam vessels with auxiliary sails. The model is built throughout in a very skilful manner, but I think that the use of thinner cord would have improved the appearance of the rigging.

A model catapult of the type used by the Roman soldiers was to be seen among the entries in Section B. Its chief feature is a big lever pivoted near one end and connected to a hand winch. The longer arm of the lever is provided with a receptacle for the missile, usually a large stone, and at its other end is a heavy weight. In operation the long arm of the lever is first pulled downward by means of the winch, and then released. The weight then pulls the lever sharply upward until it strikes a stout crossbar, and the sudden jolt shoots the stone forward at a great speed. The model is the work of H. Cowen.

P. Crosby won a prize with a model of the "Lion" locomotive, which was described and illustrated in the "*M.M.*" some time ago. Particularly interesting is the "haystack" firebox, and the method by which the boiler is attached to the framework. Considerable skill is shown in the choice of parts used for the wheel bearings. For these Crosby uses Cranks, the slotted holes in which serve as axle bearings, while Rods passed through their Bosses form the undercarriage.

Another interesting model is a reproduction of a steam "buggy," a curious machine that had a maximum speed of about 5 m.p.h. The model is complete with a Meccano driver, and judging by the expression on his face, he is highly pleased with the speed at which he is travelling! The boilers of these old steam cars were very cumbersome affairs when compared with the neat petrol tanks of modern motor cars, and the transmission was clumsily carried out by means of heavy chains. This model is the work of R. Freestone.

Among the remaining entries in the Home Sections is a neat reproduction of a double-acting beam engine of the type favoured by James Watt. It is fitted with sun and planet gear, and is shown in the accompanying illustration. The use of Braced Girders for the sides of the base unfortunately gives the model a flimsy appearance, which could easily have been (*Continued on page 690*)



Suggestions Section

Edited by "Spanner"

(293)—Automatic Opening and Closing Lift Doors (L. H. Willis, London, W.2)

In Fig. 293 is illustrated a model elevator or lift fitted with double doors that automatically open when the lift cage comes into position, and close as soon as it moves away. The ground floor only is shown in the illustration, but a similar arrangement can be operated equally well on the top or intermediate floors. The sliding doors with operating mechanism are shown detached from the main structure in Fig. 293a, and the assembly as shown is ready for fitting in position in front of the lift shaft on any floor.

The top and bottom members of the door frame are each built up of three 9½″ Angle Girders, two of which are secured one inside the other by their elongated holes, so that a slot is left between the two remaining edges. The third Girder also is attached by its elongated holes, and forms a channel section girder. The two composite Girders so formed are arranged with the pairs of Girders forming the slots at the back of the frame, and the front Girders are bolted to four 4½″×2½″ Flat Plates that are placed two on each side of the door to leave a central opening 2½″ wide. Each pair is overlapped three holes.

The slots at the rear form guides for the doors 9 and 10 (see Fig. 293a) each consisting of a 4½″×2½″ Flat Plate. Two 4½″ channel section girders are each made by bolting two Angle Girders together, and are bolted to the outer edges of the Flat Plates. Angle Girders are bolted also to the inside edges of the Plates and to the top and bottom members to form the door frame. A 2½″×2½″ Flat Plate is bolted at each end of the upper 9½″ Girder, and at the rear of these Plates are 2½″ Angle Girders secured to the lift shaft structure.

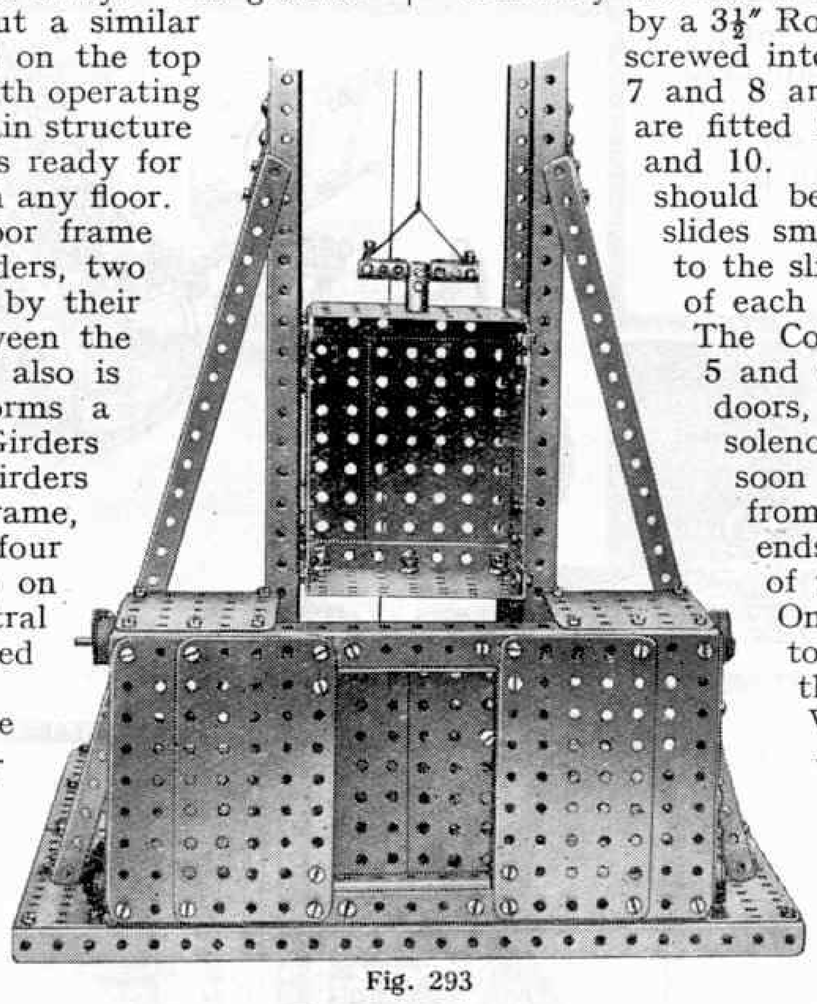


Fig. 293

Four Bobbins are fully wound with 26 S.C.C. Gauge Wire and covered with a protective layer of paper. The completed solenoids are shown at 1, 2, 3 and 4, and are clamped in pairs to each Girder at the end of the frame by means of a further 4½″ Angle Girder held down by 1″ Screwed Rods. Before finally tightening up the nuts on the Rods, the solenoids should be carefully lined up in pairs, 1 and 4 being in a direct line, and also 2 and 3. To do this an 11½″ Axle Rod should be pushed through the centres of each pair, and the solenoids adjusted until the rods slide quite freely. The holding nuts are then screwed down firmly so that the coils are securely clamped between the Angle Girders, and the Rods are removed.

A 6½″ Axle Rod 5 is inserted in the solenoid 1 and carries a Collar and a Coupling, the latter being fitted with a 2″ Screwed Rod 7 and a 3½″ Axle Rod that passes through the centre of the coil 4. This Rod is provided also with a Collar. Care should be exercised to ensure that the two Rods are in a direct line. Similarly the Rod 6 is inserted in the solenoid 3 and is extended by a 3½″ Rod in the solenoid 2, the Screwed Rod 8 being screwed into the Coupling as at 7. The Screwed Rods 7 and 8 are passed through Handrail Couplings that are fitted in the positions indicated on the doors 9 and 10. Before proceeding further the mechanism should be carefully tested to see that everything slides smoothly, and a little oil should be applied to the sliding Rods, and also at the top and bottom of each door.

The Collars at each end of the composite Rods 5 and 6 form stops to limit the movement of the doors, so that as the Rods are drawn into the solenoids the Collars strike the coil cheeks as soon as the doors meet, and so prevent them from overlapping. The Collars on the other ends of the Rods limit the outward movement of the doors.

One wire from the solenoid 2 is connected to the terminal 11, which is insulated from the frame by means of 6 B.A. Bushes and Washers, and the other wire goes to solenoid 4, the second wire from which is attached to the terminal 14. The solenoid 1 is connected to the terminal 12 and the coil 3, the second wire from the latter going to the terminal 13. It now remains to arrange the contacts by means of which the solenoids are energised, thus causing the doors to open and close; and to bolt the door frame into position. Two ⅜″ bolts 15 hold the lower Girder to the "floor," and the top of the frame is secured by means of 2½″ Angle Girders bolted to the 2½″×2½″ Flat Plates.

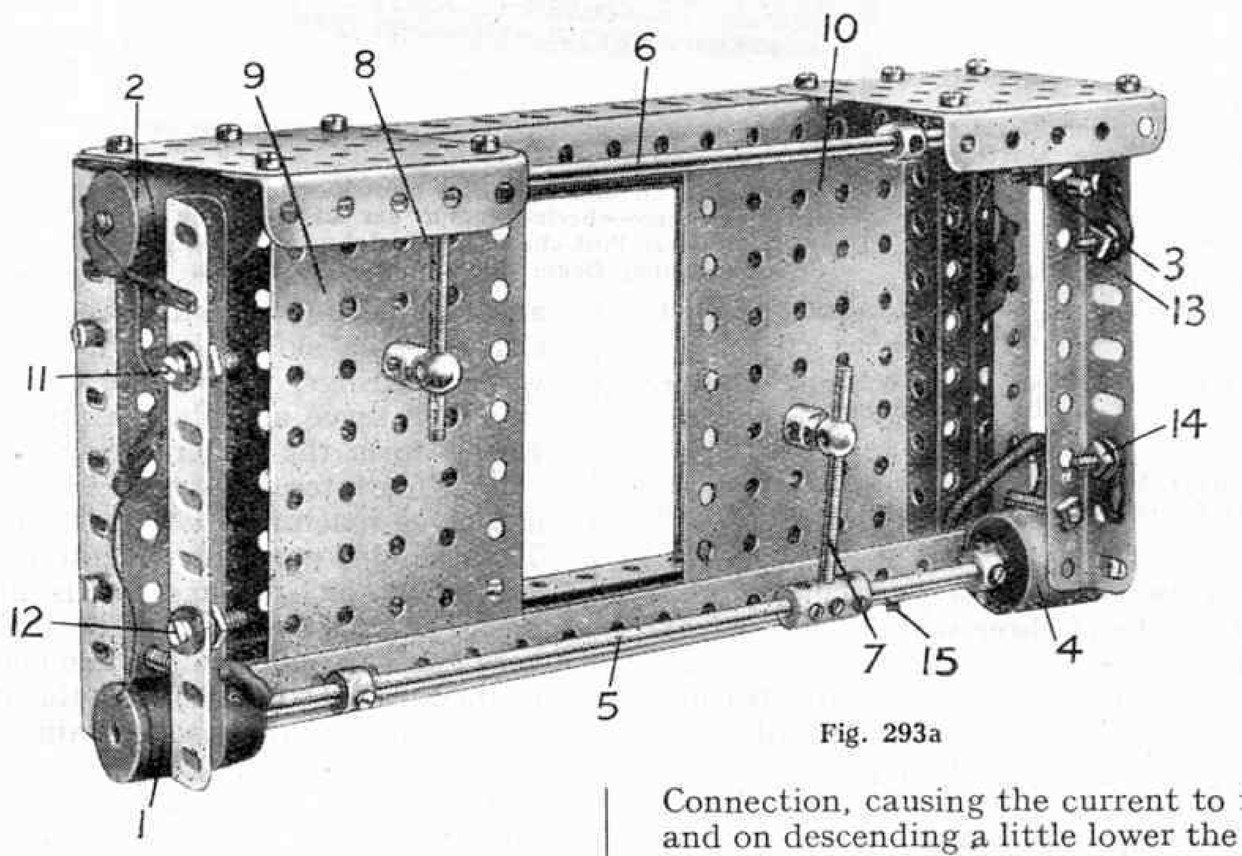


Fig. 293a

The lift is fitted at each side with a ½″ reversed Angle Bracket, and these are arranged to make contact with Pendulum Connections attached in a suitable manner to the lift shaft. The Pendulum Connections are insulated from the shaft. The one on the right-hand side is connected to the terminal 13, and the one on the left to the terminal 14. The terminals 11 and 12 are wired together and a connection from these is taken to the accumulator, the remaining terminal of the accumulator being connected to the frame of the model.

As the lift cage descends, the Bracket on the right-hand side touches the Pendulum Connection, causing the current to flow through the coils 1 and 3; and on descending a little lower the left-hand contact is completed, which causes the coils 2 and 14 to be energised, thus opening the doors. This contact should be placed so that the Angle Bracket touches it, and moves off again before the lift comes to rest, so that the current is cut off when the cage is stationary.

(294)—Self-Acting Brake for Cranes (H. W. Webb, London, N.22)

Safety devices now play a very important part in our everyday life, and in every branch of engineering many ingenious mechanisms are employed to minimise the possibility of accidents.

The device shown in Fig. 294 automatically applies the brake to the hoisting drums of a model crane immediately they are thrown out of gear with the driving shaft. The shaft 1 is slidable in its bearings and is driven from the power unit. It carries at its other extremity a ½″ Pinion that can be brought into mesh with a 57-teeth Gear carried on the Rod 2, or with a similar Gear on the Rod 3. The Rod 1 carries two fixed Collars, between which is a third Collar free to rotate on the Rod; and a bolt is inserted through the elongated hole of a Crank and fitted with a nut before being screwed into the tapped bore of the centre Collar. The nut locks the bolt in position and prevents it from touching the Rod 1, but should allow free movement of the Crank.

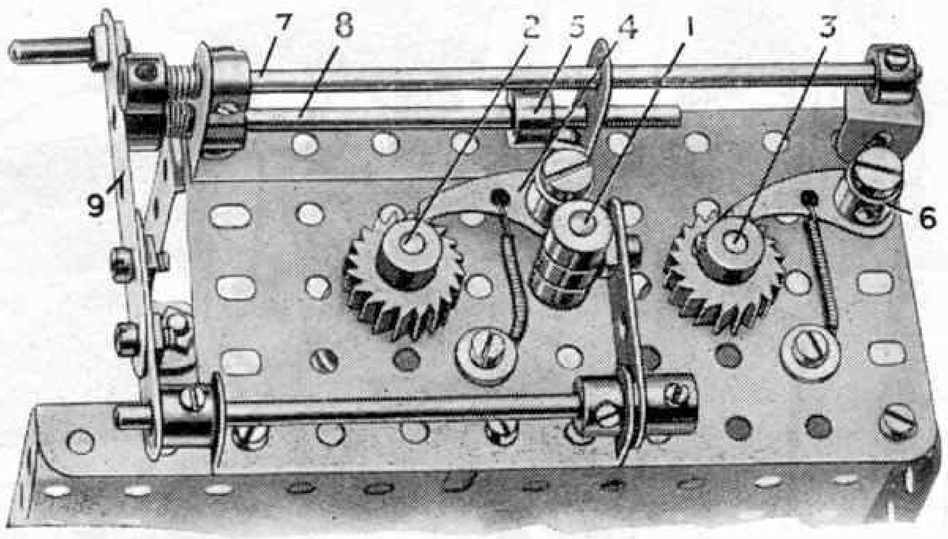


Fig. 294

The Crank is carried on a 3½″ Axle Rod that is journalled in a 2½″×½″ Double Angle Strip, and a second Crank is carried on the other end of the Rod. To this is bolted a 2½″ Strip 9 carrying a Threaded Pin and serving as the gear-change lever. By moving the lever to the left the Pinion on the Rod 1 is brought into engagement with the 57-teeth Gear on the Rod 2, and with the lever 9 in its right-hand position the Pinion is thrown out of gear and engaged with the Gear Wheel on the Rod 3.

Both driven Rods carry Ratchet Wheels fitted with Pawls 4 and 6 as shown in Fig. 294. The Pawls are held in engagement by short lengths of Spring Cord, and the Pawl 4 carries a bolt in its tapped hole. The bolt is prevented from gripping the Pivot Bolt by means of a nut, and the Collar 5 on a sliding 3½″ Rod 8 bears against the head of the bolt. The Rod 8 is free to slide in a 2½″×1″ Double Angle Strip, and carries at its outer end a Compression Spring and a Collar.

The pressure of the lever 9 overcomes the Spring, causing the Collar 5 to raise the Pawl 4 off its Ratchet Wheel. So long as the Rod 2 is connected to the power unit it is free to rotate in either direction; but when the lever 9 is moved to the right the Pawl 4 is released and prevents backward movement of the Rod 2. In the second position the lever releases the Pawl 6 by means of Rod 7. An Angle Bracket fixed on this Rod carries a Bolt, the shank of which is locked in the Boss of the Pawl 6.

(295)—Pump Operating Gear

(S. Jameson, Coventry)

The simple device shown in Fig. 295 is intended for converting rotary motion into to-and-fro motion. In actual practice similar mechanisms are employed for operating pumps, etc., the chief advantage of this arrangement being the saving of space normally taken up by the connecting rods. The Sliding Rod carries two Collars to which two 1½″ Strips 2 and 3 are rigidly secured with a space of about ¼″ between them. The Bolt 1, attached by means of two nuts to a Bush Wheel on the driving shaft, slides in the slot so formed. As the Bush Wheel rotates the Bolt slides to and fro between the 1½″ Strips, and at the same time the sliding Rod is pushed up and down. Turning movement of the sliding Rod should be prevented, and in this case Eye Pieces are used for this purpose, but the construction may of course be varied to suit individual requirements.

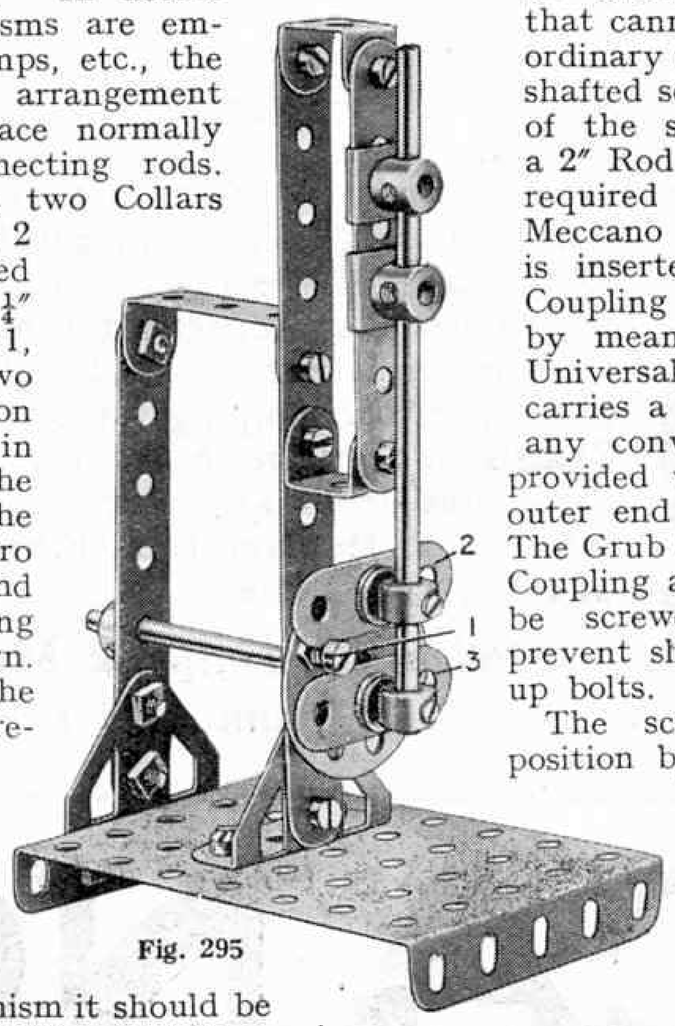


Fig. 295

In adapting the mechanism it should be remembered that the rigidity and freedom of movement of the sliding Rod depend on the distance between the Eye Pieces, which should be as large as possible.

(296)—Flexible Screwdriver

(A. W. Sheppard, Brighton)

The screwdriver illustrated in Fig. 296 will be found very useful for getting at awkwardly placed bolts that cannot be reached in the ordinary manner with a straight-shafted screwdriver. The blade of the screwdriver consists of a 2″ Rod filed at one end to the required thickness for fitting a Meccano bolt head. The Rod is inserted longitudinally in a Coupling and retained in place by means of a Collar and a Universal Coupling. The latter carries a Rod, which may be of any convenient length, and is provided with a 1″ Gear at its outer end to serve as a handle. The Grub Screws in the Universal Coupling and Gear Wheel should be screwed down tightly to prevent slipping when tightening up bolts.

The screwdriver is held in position by means of a Screwed Rod inserted in one of the tapped holes in the Coupling, and provided with a handle formed from two Couplings. In fitting the Rod care should be taken to prevent it from gripping the screwdriver blade, and for this purpose a nut should be locked against the Coupling. The tool can be used most effectively with the handle at about 30° to the blade. At a larger angle the Universal Couplings are liable to lock, and the extra strain imposed on the instrument causes the grub screws to lose their grip on the various Rods. When it is necessary to have a much greater working angle, the best plan is to fit a second Universal Coupling, the two being connected by means of a 1″ Axle Rod.

Fig. 296

Results of Suggestions "Voting" Contest

We are now able to publish the results of the Suggestions "Voting" Contest, in which readers were asked to select the four best suggestions published during 1932. Every vote received was recorded, and at the close of the Contest the number of votes for each suggestion totalled up. By this means the four most popular suggestions in each section were ascertained, and the votes of both Home and Overseas readers show that No. 273, Twin Coupled Electric Motors, by S. C. Buszard, is without doubt the most popular. No. 262, Safety Device for Hornby Points, holds second position in popularity, and No. 259, Electric Motor, the third position, in both Home and Overseas sections. In the Home Section, suggestion No. 267, Remote Control for Gear Box, was voted fourth in order of popularity, but in the Overseas Section the fourth most popular suggestion was voted to be No. 265, Electric Horn.

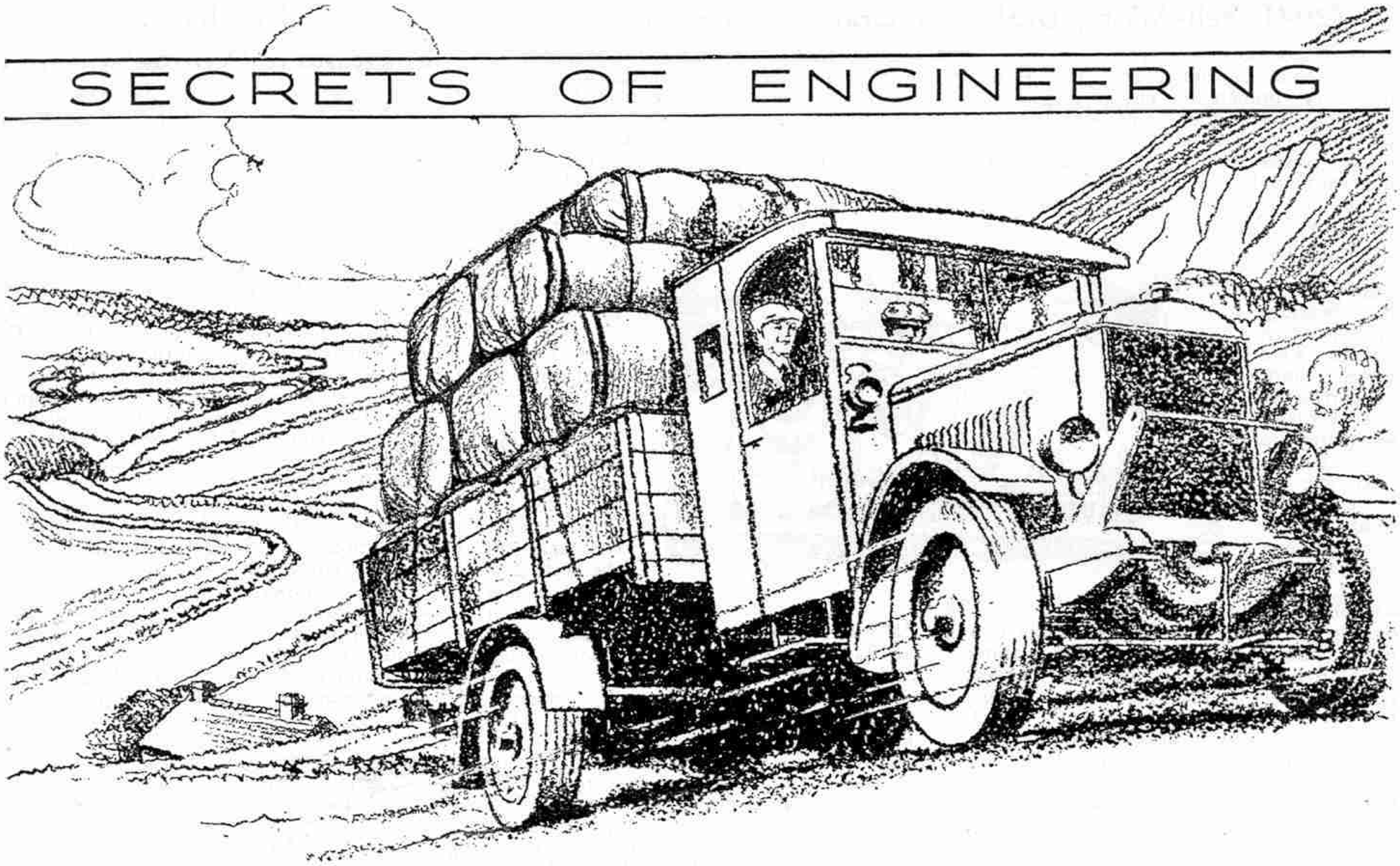
As no competitor succeeded in placing all four suggestions in their correct order, the prizes have been awarded to the nearest correct according to the number of points allotted to each entry. The Prize-winners in the Home Section are as follows:—First, Meccano parts value £1-1s.: P. G. Fishpool, Arundel, Sussex.

Twelve Prizes, each consisting of a copy of C. J. Allen's Book, *"Famous Trains"*: C. E. Wrayford, Moretonhampstead, Devon; G. K. Holland, Liverpool; E. J. Bickmore, Wembley, Middlesex; J. J. Horne, Moreton-in-Marsh, Glos.; I. Miller, Edinburgh; J. G. Fishpool, Arundel, Sussex; A. Goad, London, S.E.9; K. Costain, Bolton, Lancs.; I. C. Hatton, Leicester; R. F. Marshall, Cardiff; A. H. Davies, Swansea; J. S. Harris, London, E.4.

In the Overseas Section the Prize of Meccano parts value £1-1s. has been awarded to R. Atkinson, Punchbowl, N.S.W., Australia. Twelve copies of *"Famous Trains"* have been awarded to the following competitors:—D. Murison, Buenos Aires, Argentine; R. Garcia, Trinidad, B.W.I.; G. Müller, Vivorata, F.C.S., Argentine; R. J. Ranikhetvala, Bombay; J. Roberts, Sydney, Australia; R. Russell, Whangarei, N.Z.; D. J. White, Dunedin, N.Z.; J. A. Gomes, Bombay; D. Atkinson, Yalwal, N.S.W.; F. van Bulck, Brussels; R. Walton, Sydney, Australia; L. Simpson, Sydney, Australia.

A special prize of Meccano Goods value 10/6 has been awarded to S. C. Buszard, London, N.3, for suggestion No. 273.

SECRETS OF ENGINEERING

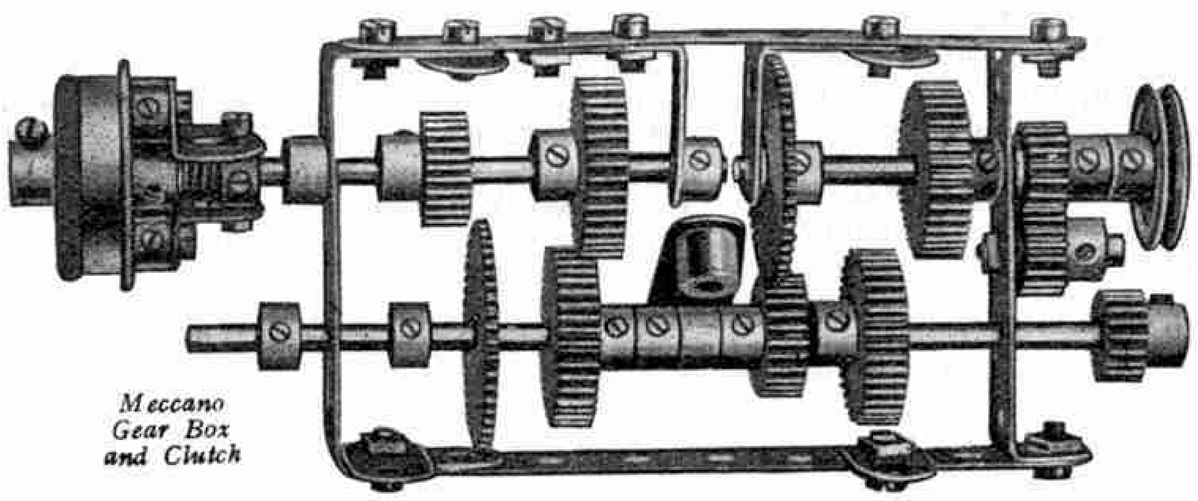


Why do motor cars have gears?

The power of a steam engine is increased by merely admitting more steam to the cylinders, and the full pressure of the steam is exerted at all engine speeds. An internal combustion engine, on the other hand, only develops its full power when it is run at high speed. When a motor car begins to climb a hill, the speed of the engine decreases as more power is demanded from it. The engine cannot provide this power unless its speed is maintained, and this is done by means of gears. The movement of a lever brings into play a new train of gear wheels between the engine and the back axle, and this has the effect of increasing the speed of the engine relative to that of the road wheels.

Mysteries hidden in the gear box!

The operation of the gears that are hidden away in the gear box of a motor vehicle is only one of the many interesting engineering secrets that can be learned by means of Meccano, which includes all the gear wheels necessary to reproduce practically every type of gear that is used in real engineering. A splendid example of the wonderful possibilities of Meccano is the gear box of the Meccano Motor Chassis illustrated here, in which are incorporated all the features of a real gear box. This model is so perfect in design and operation that it is used for demonstration purposes in many Schools of Motoring. Full particulars for building the complete Meccano Motor Chassis Model are contained in a special leaflet, obtainable from any Meccano dealer, price 3d., or direct from Meccano Ltd., Binns Road, Liverpool 13, price 3d., post free.



Meccano Gear Box and Clutch

Prices of complete Meccano Outfits from 1/3 to 415/-

MECCANO

MECCANO LIMITED — BINNS ROAD — LIVERPOOL 13

Competition for Models of All Types

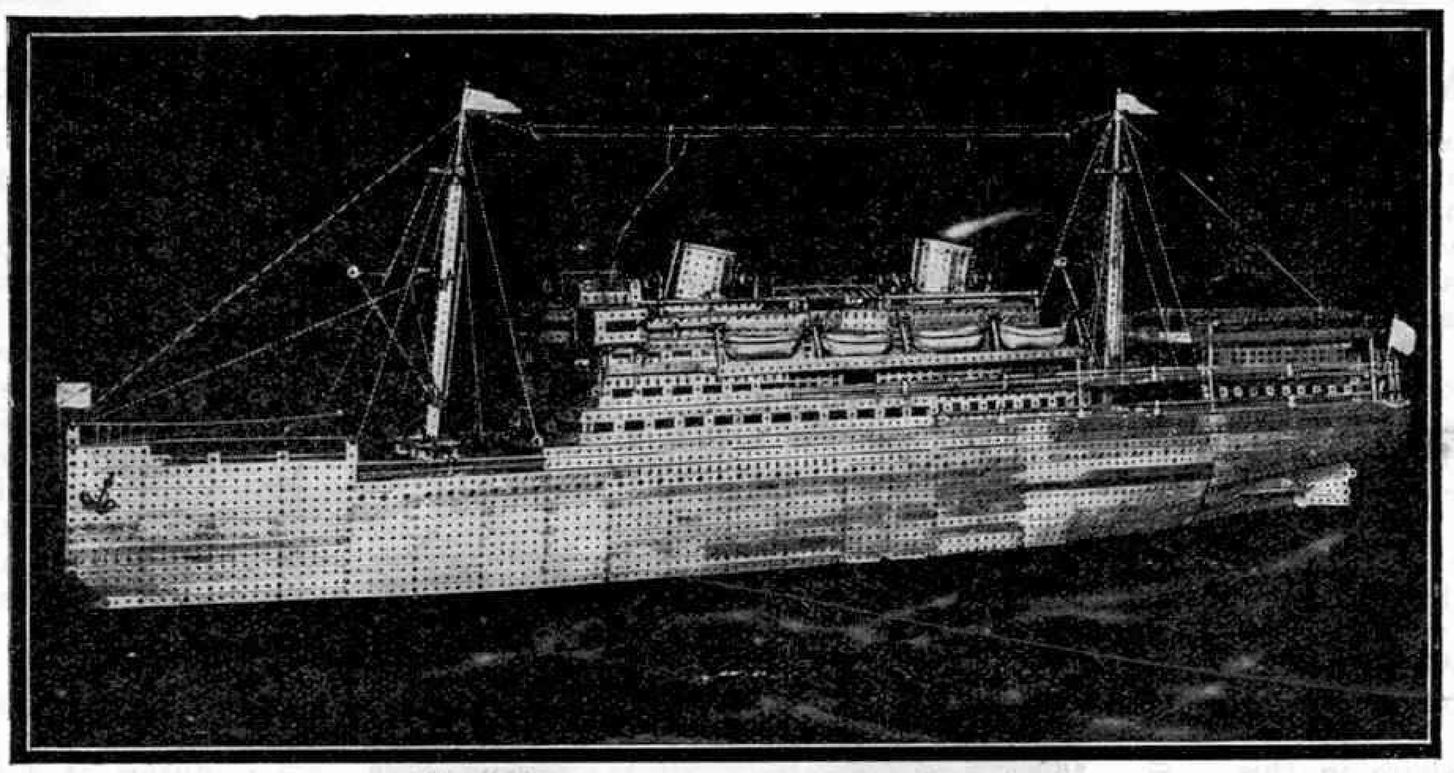
An Opportunity to Win a Big Prize

HAVE you ever won a prize in a model-building Contest? If you have, why not win another? If you have not, there is all the more reason why you should enter the contest announced here, for there is every possibility that you may win one of the fine prizes we are offering.

All you have to do is to build a Meccano model entirely from your own ideas. This may be of any type, and the only condition is that it must be your own unaided work. No matter where you live or what age you may be, you are eligible to compete in this Contest, and you will be allowed ample time in which to find an interesting and original subject and build it in Meccano.

You may use any size of Outfit in building your model, and you should not be discouraged if you possess only a small Outfit, because the judges will pay particular attention to good construction and neatness, and these qualities are often much easier to attain in a simple model built with a small Outfit than in a more complicated structure made from one of the larger Outfits. Try to find something really original as your subject. Originality will count far more than mere size alone, and there are thousands of interesting objects that have never yet been reproduced in Meccano.

After the model is built, the next job is to obtain a suitable illustration of it. This may be either a good photograph or a drawing, but a clear photograph is best if it is possible to obtain one. Write your age, name and address on the back of the photograph or drawing and enclose it, together with a brief description, in an envelope addressed "September" Model-Building Contest, Meccano Ltd., Binns Road, Liverpool 13.



A model of the unfortunate liner "Transatlantique." It was built by J. Willems, Antwerp, and won First Prize in a recent competition announced in the French issue of the "M.M."

Entries will be divided into two sections according to the ages of the competitors—Section A for competitors over 12 living in any part of the world, Section B for competitors under 12 living in any part of the world.

The Prizes are as follows:—Section A. First: Meccano or Hornby Goods value £3-3s. Second: Goods value £2-2s. Third: Goods value £1-1s. There will also be 10 prizes of goods value 5/–.

The Prizes in Section B are:—First: Goods value £2-2s. Second: Goods value £1-1s. Third: Goods value 10/6. Ten Prizes of Goods value 5/–.

Consolation prizes of Meccano Manuals and Engineer's Pocket Books, and a number of Certificates of Merit, will be awarded in each Section.

Successful entries become the property of Meccano Ltd., but photographs of unsuccessful models will be returned to the senders provided that a stamped addressed envelope of the necessary size is enclosed with the entry.

The closing date for both Sections of the Contest is 30th December, 1933, but entries should be posted as soon as they are ready. All prizewinners will be notified by letter, and a full list of the awards will be published in the *"M.M."* as soon as possible after the closing date.

It will be noted that we have used the word "original" in connection with suitable subjects for entry in this Contest. What is meant is that competitors should make every effort to find an "out of the ordinary" subject that so far as they know has not previously been reproduced in Meccano, and which does not appear in any of the Meccano Instruction Manuals or other publications issued by Meccano Ltd.

"Mechanism" Model-Building Contest

This is the first of a new series of model-building competitions in which competitors will be asked to design mechanisms suitable for specific purposes. As the subject of this competition we have chosen a repeater pistol suitable for firing percussion caps of the type sold in ribbon form for toy pistols. We have not yet seen a model of this kind built in Meccano, and we think that it will provide a very interesting subject, for it is one that offers great scope for originality in the use of Meccano parts.

To enter the Contest it is only necessary to design and build in Meccano a complete pistol, and then to take a photograph or make a drawing of it showing exactly how the firing and feeding mechanism operates.

The Contest is open to readers of all ages living in any part of the world. Entries will be grouped together in one section, but each competitor's age will be taken into consideration when the models are judged. Prizes will be awarded to the builders of the pistols that the judges consider to be the neatest and most compact, and which display the most ingenious ideas in the design of the firing and ammunition feeding mechanism.

It will probably be found that some of the more specialised Meccano parts such as the Handrail Support, Pawl, etc., can be used with great effect in the firing mechanism, and before commencing to build it will be well to study the Meccano illustrated lists carefully, and decide on those parts that are likely to be of most assistance in securing neatness and compactness.

Competitors who have not sufficient parts to build a complete pistol need only construct the firing and feeding mechanism. It should be remembered that in a mechanism of this kind compactness is the most important consideration, and this can only be obtained by using the most suitable parts.

Competitors should send with their entries a brief description of the mechanism so that the judges will know exactly how it works.

The prizes to be awarded are as follows:—First, Meccano or Hornby Goods value £2-2s. Second, Goods value £1-1s. Third, Goods value 10/6. Five Prizes of Goods value 5/–.

Competitors must write their age, name and address clearly on the back of each photograph or drawing submitted, and entries should be addressed to "Pistol Mechanism" Contest, Meccano Ltd., Binns Road, Liverpool 13. The closing date of the Contest is specially extended to 30th December, 1933. Any entries received after that date will be disqualified.

It should be clearly understood that all photographs or drawings of prize-winning models become the property of Meccano Ltd. Unsuccessful entries will be returned to the competitors provided that a stamped addressed envelope of the necessary size is enclosed with the entry. Stamps alone must not be sent.

The Ideal Meccano Club Member

Preparations for the winter sessions are now well in hand in every active Meccano Club. Officials are perfecting their schemes for the winter's programme in order that they may be able to submit plans at the forthcoming business meeting; and members are eagerly looking forward to taking up once more the familiar threads of life in the club-room, where they spend so many happy hours building models and taking part in other activities of a successful Meccano Club.

Much depends on the work done during September, for if thorough preparations are not made now, it is usually difficult to get things moving quickly and smoothly when actual meetings commence. While writing on this subject, I should like to emphasise the point that every member should take a share in this activity. It is not sufficient to attend regularly, build models with great zeal, and generally behave well. The ideal member, of course, does all these things, but in addition he is alert and eager to seize any opportunity of furthering the interests of the club as a whole.

There are many outlets for a keen member's energy. One is to think out means of improving the general organisation of the club, or of making its programmes brighter and more varied. Another is to keep a continual look-out among friends and acquaintances for recruits who are likely to add to the strength of the club.

Discretion in Recruiting

This is a matter in which discretion is necessary. One earnest member full of zeal for his new club is worth a dozen recruits who are content simply to attend meetings more or less regularly, and make no effort to display initiative or resource. Before enlisting any likely recruit a member therefore should make sure that he is adding to the strength of the club.

An excellent plan for ensuring that every member shares in club control is in force in the Streatham Park Branch of the H.R.C., the officials of which have retired for six months in order to allow other members to gain experience of their duties. The idea could be adopted with advantage in many Meccano Clubs. Sharing the responsibility for running a club will help a member to realise the trials and difficulties of official life, and lead him to appreciate the splendid work put in by those in charge of his club. In addition, the method creates a reserve of secretaries, treasurers and members of the committee, that will enable the club to be run efficiently if older and more experienced officials are compelled by circumstances to retire from club life, or are unable to continue to devote sufficient time to their duties.

Meccano Club Leaders

No. 67. Mr. T. E. John

Mr. T. E. John is Leader of the Mary Swanwick School (Chesterfield) M.C. The club was affiliated in December 1932 with Mr. C. C. Handford, Headmaster, as President, and under the skilful guidance of Mr. John has rapidly become an important feature of school life. Members concentrate on realistic model-building and handicraft work.

News from the Clubs

I hope secretaries will spare no effort to keep me in touch with their progress during the coming indoor sessions, in order to enable me to give due prominence to the work of their clubs. It is impossible for me to do justice to the splendid efforts of officials in arranging programmes, and to the loyal support of members, if I do not receive adequate reports.

If a secretary of any club finds that his duties are too numerous and arduous to enable him to write full reports regularly, he should delegate the duty to an assistant, whose election should be confirmed at the first business meeting to be held. Such a step has the advantage that it will give a younger member preliminary experience in official work, and help to fit him for secretarial duties at a later stage of his career.

Supplies of report forms will be forwarded immediately to all secretaries making application for them. Subscription cards and membership cards also are ready, and I wish to remind Leaders and secretaries of the value of these in organising a club on sound lines. The possession of a membership card, on which a copy of the syllabus is written or printed, enables a member to plan in advance his own contributions to the programme, whether these take the form of talks or lectures, entries in competitions, or special work in connection with Exhibitions and similar meetings. A subscription card is a necessity in all clubs, except those fortunate ones in which expenses are nominal.

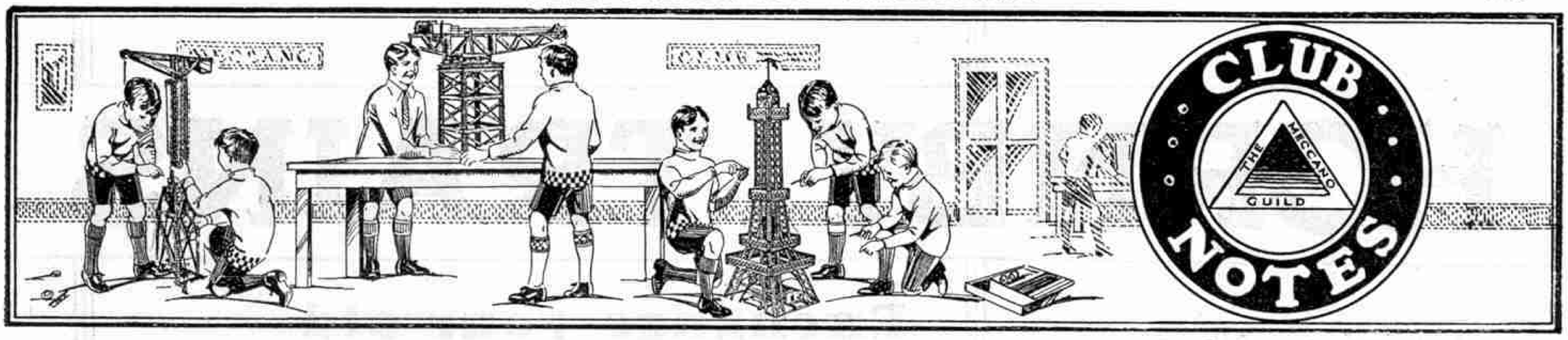
Merit Medallions

I also wish to give Leaders a reminder in connection with Merit Medallions. Two of these are available in each club for the summer session almost completed, and I shall be glad to receive nominations at the earliest opportunity. As I have often pointed out in these columns, any form of good work on behalf of the club is a qualification for this award, and the summer sessions offer opportunities for rewarding special activities that have added to the general well-being of the club during the outdoor season.

Proposed Clubs

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

BIRMINGHAM—P. G. Boosie, 16, Lyndhurst Road, Erdington.
NEW ZEALAND—E. Speers, 70, Cuba Street, Petone.
ROMFORD—Douglas Whipps, 23, George Street.



Colfe's Grammar School M.C.—At the first meeting of this newly-formed club, officials were elected and members decided upon the programme. One of the earliest meetings took the form of a visit to the R.A.F. display at Hendon, where the heavy rain failed to damp members' enthusiasm. Model-building Competitions have included a Simplicity Contest and one in which road vehicles were to be constructed. Entries in the second of these contests had to undergo tests for speed and hill climbing capacity. A Games Tournament has been held. Club roll: 51. *Secretary:* A. C. Akehurst, 24, Eliot Park, Lewisham, London, S.E.13.

St. Columba's (Sunderland) M.C.—Rambles have been the chief feature of the programme. These have included visits to Tunstall Hills, where members climbed the rocky cliffs; Cleaden Hills; and Ryhope Beach, the journey to which was made in a steam autocar. Other visits have been paid to Hylton Woods, and members had an enjoyable time on the Summer Excursion to Middleton-in-Teesdale. Bad weather compelled certain meetings to be held indoors, and on these occasions a programme of games was arranged. Club roll: 12. *Secretary:* D. Ferguson, 3, Edward Burdis Street, Southwick, Sunderland.

Sid Vale M.C.—Members took advantage of the fine weather to enjoy cricket matches and other outdoor meetings. One of these took the form of a model boat regatta, and another was a bugle chase, members tracking down two of their number, who were required to blow a bugle at intervals in order to indicate the direction they had taken. Club roll: 20. *Secretary:* S. R. J. Gliddon, Sheffield House, Sidmouth.

Wembley M.C.—The Club's Exhibition followed that of the associated Harlesden Methodist M.C., and was a great success, the large Hornby Train layout being particularly admired by visitors. Members were present at the recent Exhibition of the Holy Trinity (Barnsbury) M.C. Games have been played regularly during the summer and an open air Hornby Train layout has been operated. Club roll: 20. *Secretary:* D. Wenman, 4, Chalfont Avenue, Monks Park, Wembley.

Stamford Hill M.C.—Model-building was actively pursued in preparation for the Club's recent Exhibition, and in conjunction with the planning of a realistic Hornby Train layout, led to successful results. The chief summer recreation has been Cricket, matches being played against local teams. Club roll: 32. *Secretary:* D. Weitzman, 83a, Stamford Hill, London, N.16.

Laindon M.C.—Interesting results followed a General Knowledge Contest in which members were required to answer questions on model-building methods, railway working and elementary engineering principles. Members take a keen interest in wireless, and the wireless section is holding particularly interesting constructional meetings. The Meccano Simplicity Contest was won by a very realistic aeroplane. Outdoor activities have included exciting paperchases, and members have laid out a temporary garden railway, with earth embankments and cuttings where necessary. Club roll: 14. *Secretary:* A. G. L. Schofield, "Highfield," Inverness Road, Laindon.

Hornsea M.C.—Mr. R. W. Shooter, Leader of the Club, continues to arrange specially interesting evenings in which excellent use is made of his microscope, and cinematograph camera and projector. Games have been thoroughly enjoyable, cricket matches having been played against teams of non-members. On occasions the sides had as many as 22 batsmen each, but the number added to the fun! Interesting lectures have been given on electrical and wireless topics. A talk on "*Relativity*" at a special meeting of the "Scientists" attracted so much interest that many members of other sections attended. Club roll: 85. *Secretary:* P. Thom, 5, Alexandra Road, Hornsea.

St. Peter's (Wolverhampton) M.C.—An outdoor track for Hornby Train operations has been laid down and the performances of members' locomotives tested on it. When outdoor work was impossible, impromptu meetings were held in the Leader's rooms. At one of these the tour of "*The Royal Scot*" in America was discussed, and at another the Secretary exhibited a model aeroplane designed and constructed by himself. Club roll: 13. *Secretary:* V. Biddulph, c/o Westminster Bank, Lichfield Street, Wolverhampton.

Plymouth M.C.—An extra page has been added to "*The Gear Box*," which continues to include interesting articles that make it very popular. Subjects on recent Model-building nights have included aircraft seen at Plymouth, and Plymouth omnibuses and tramcars. An enjoyable visit was paid to the Friary Engine Sheds of the S.R. There the turntable and coaling stage were inspected, and the cab fittings of a large "Mogul" were explained by the driver. Club roll: 69. *Secretary:* G. Symons, 6, Holland Road, Peverell, Plymouth.

A group of the older members of the Plymouth M.C. and Branch of the H.R.C., photographed at their Annual Joint Exhibition. Mr. H. Shapcote, M.A., President of the two, is seen at the left of the back row, with Mr. W. J. Ellis, Leader, at the right of the same row. The Meccano Club was affiliated in October, 1926. Incorporation was secured by the Branch in April, 1929, and since then the two organisations have worked together in a very efficient manner, with "The Gear Box" as the official organ of both.

St. Nicholas (Sevenoaks) M.C.—Before the holiday season members overhauled club property and rearranged their lockers. Cricket matches have been played regularly. A visit was paid to the local gasworks, and models of devices seen on this visit are now being built. Club roll: 19. Secretary: J. Kemp, 2, Bosville Road, Sevenoaks.

AUSTRALIA

Melbourne M.C.—The Second Annual Exhibition was held in conjunction with the Melbourne Branch of the H.R.C. An excellent display of working models was made, including entries in a special contest for non-members. Models also were lent by Messrs. E. G. Page & Co., the agents of Meccano Ltd., in Australia, and Herbert Small Pty, Ltd., Melbourne. Hornby Train layouts were on view and operations on the electrical section rivalled giant blocksetting cranes, a lightship, a windmill and pump, an overhead crane and other attractive working models of interest to the 400 visitors. Another specially interesting event was a Lantern Lecture on "*Aerial Photography in the War*," given by Mr. Faulkner, when photographs taken during the War by the lecturer were projected on to the screen. The Melbourne Branch of the H.R.C. has now entered into closer partnership with the Club. Club roll: 40. *Secretary:* L. Ison, 8, Hayes Street, Northcote, N.16, Victoria, Australia.

Sydney M.C.—At the Autumn Exhibition excellent models won prizes in special contests. Other exhibits included eight Super-models constructed by Mr. A. Lord, President of the Club, among them being a loom, a carding machine, a reversing lorry, a clock and a ferris wheel. A second ferris wheel built by Mr. C. J. McCain was operated by a penny-in-the-slot mechanism. Receipts from Mr. McCain's ferris wheel amounted to £1 16s. 3½d., and it is reported that the machine did not work when the odd half-penny was inserted! Club roll: 16. *Secretary:* W. J. T. Watson, 595, Parramatta Road, West Leichhardt, N.S.W., Australia.

MAURITIUS

Mauritius M.C.—Affiliation has now been secured and several successful meetings have been held. Members built models for display in a Charity Festival at St. Joseph's College, and these were greatly admired by visitors. The chief activities have included model-building and visits, a tour of a Hemp Spinning and Weaving Factory being particularly interesting to members. Club roll: 30. *Secretary:* E. Gaud, 20, Remono Street, Curepipe Road, Mauritius.

NORWAY

Sandefjord M.C.—In a competition for the best model of a Hammerhead Crane, the prize—a copy of the Editor's "*Engineering for Boys*"—was won by A. Bertnes. On other Model-building evenings a model of a Tractor was demonstrated and the Secretary gave a Lecture on agricultural machinery. The parents of members attended a special meeting at which an account of Sir Malcolm Campbell's record breaking feats was given, followed by refreshments. Outdoor events included a 400 m. race. Club roll: 6. *Secretary:* T. Jacobsen, Jernbanealleen 5, Sandefjord, Norway.

SOUTH AFRICA

Malvern M.C.—In preparation for the sports meeting of the Transvaal Meccano Club's Union, articles on training for long distance running were read at meetings. Actual training was combined with enjoyable picnics, with the result that Malvern Club won the Silver Trophy offered for competition among the Clubs of the Union. Mr. Harris, agent for Meccano Ltd., in South Africa, presented the prizes and complimented competitors on the splendid spirit displayed. Camp Fire nights and social evenings also have been held. A very interesting visit was paid to the workshops of the Geldenhuis Deep Mines, where the Fitting Shop and other departments were closely inspected under expert guidance. Mr. Sykes, Leader of the Club, explained the uses of machines in the Blacksmiths and Boilermaking Shops, in which he is employed. A special demonstration of electric welding concluded the tour. An interesting debate on "*Mining v. Agriculture*" was marked by carefully prepared speeches on the part of the principals, and these were followed by an interesting discussion. *Secretary:* C. D. Slade, P.O. Box 8, Cleveland, South Africa.

Clubs Not Yet Affiliated

Toronto (Canada) West End Y.M.C.A. M.C.—An interesting opening meeting was devoted to a travelogue by Mr. H. Jones, Buffalo, in which moving pictures of Algonquin Park and fishing excursions were shown with sound effects. This was followed by a demonstration of Meccano models in which the parents of the members and other visitors were greatly interested. *Secretary:* Earl Granner, West End Y.M.C.A., Toronto, Canada.

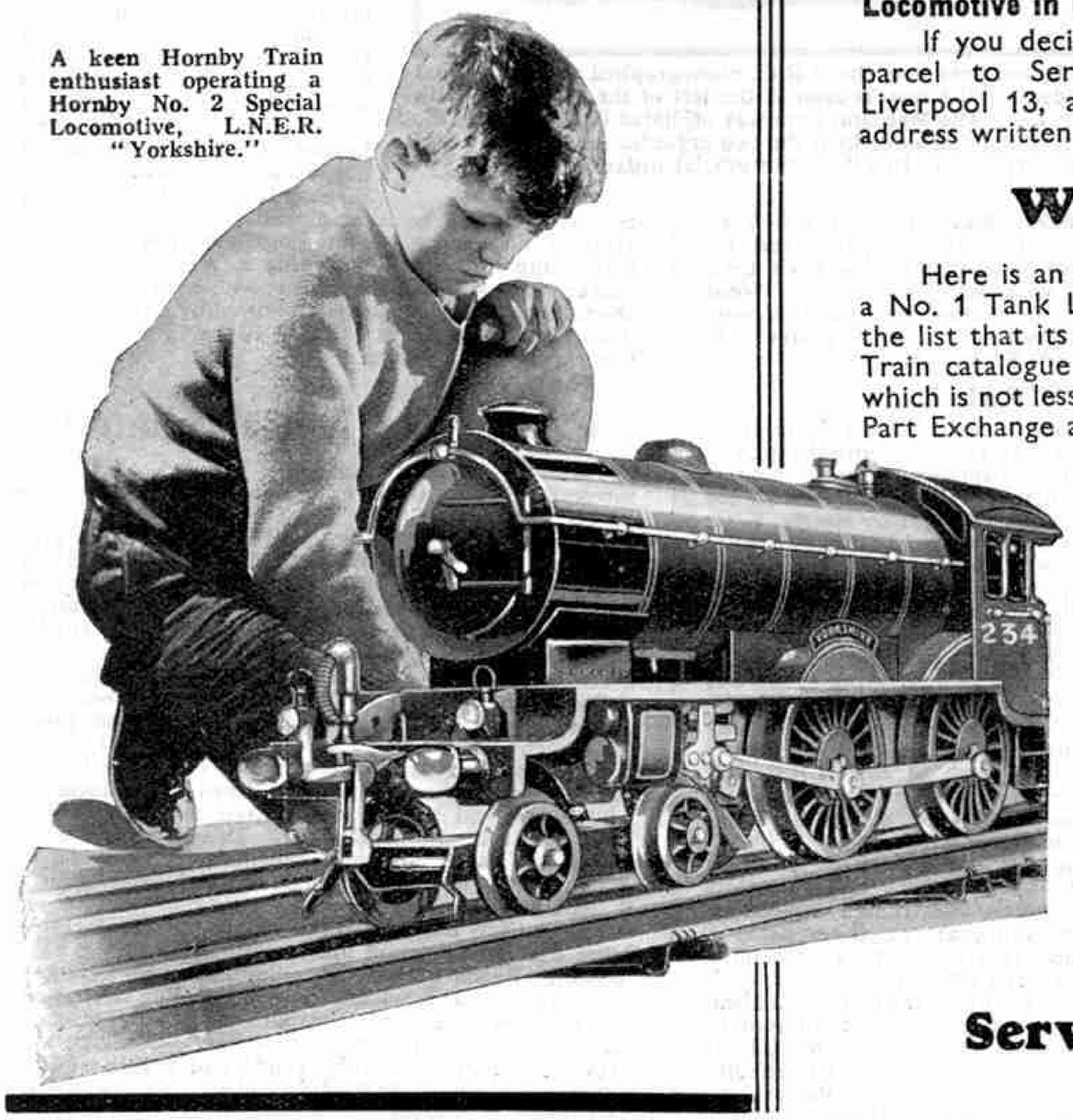
Pietermaritzburg M.C.—Interesting talks have been given by Mr. R. A. Holliday, Leader of the Club, on "*Photography*" and "*Models and their Uses.*" A Table Tennis Tournament has been held and great excitement marked a "Come and See" Night, when members rushed to various parts of Pietermaritzburg seeking the answers to questions asked by the member who introduced the item. A large club model of a road grader is now being built. This is true to scale as far as possible, and works realistically. *Secretary:* J. S. Mann, 82, New England Road, Maritzburg, S. Africa.

Petone (New Zealand).—A spacious and comfortable room has been secured and meetings are being held weekly. Benches for model-building have been erected and a permanent track laid down, including sidings on the wharves of a model harbour at which petrol is stored. A Cinematograph Show and Concert was organised in order to raise funds and a satisfactory return was obtained by the splendid efforts of members. *Secretary:* E. Speers, 70, Cuba Street, Petone.

HORNBY TRAINS

Part Exchange Allowances for Hornby Locomotives

CURRENT TYPES	
MO Locomotive	1/4
M1/2 Locomotive	2/3
M3 Tank Locomotive	3/9
No. O Locomotive	5/3
No. 1 Tank Locomotive	6/3
No. 1 Locomotive	6/3
LEC 1 Locomotive (Swiss Type)	7/6
No. 1 Special Locomotive	8/3
No. 1 Special Tank Locomotive	8/3
LST M3/20 Tank Locomotive (20-volt)	11/3
No. 2 Special Locomotive	11/3
No. 2 Special Tank Locomotive	11/3
No. 1 Electric Tank Locomotive, Permanent Magnet	12/6
LST 1/20 Tank Locomotive (20-volt)	12/6
LE 1/20 Locomotive (Swiss Type), 20-volt	13/3
LE 2/20 Locomotive (20-volt)	16/6
No. 2 Electric Tank Locomotive	18/9
No. 3E Locomotive	18/9
No. 3E Riviera "Blue" Locomotive	18/9
No. 3C Locomotive	13/9
No. 3C Riviera "Blue" Locomotive	13/9
Metropolitan C Locomotive	11/3
Metropolitan L.V. Locomotive	20/–
OBSOLETE TYPES	
M2930 Locomotive	1/–
George V Locomotive (These models were identical)	3/3
No. OO Locomotive (These models were identical)	3/3
M3 Locomotive	4/3
Zulu Locomotive	5/3
Zulu Tank Locomotive	6/3
No. 2 Locomotive	10/–
No. 2 Tank Locomotive	11/3
No. 1 Locomotive, fitted for Hornby Control	7/6
No. 1 Tank Locomotive, fitted for Hornby Control	7/6
No. 2 Locomotive, fitted for Hornby Control	11/3
No. 2 Tank Locomotive, fitted for Hornby Control	12/6
Metropolitan H.V. Locomotive	20/–



A keen Hornby Train enthusiast operating a Hornby No. 2 Special Locomotive, L.N.E.R. "Yorkshire."

Exchange your old Hornby Locomotive for a magnificent new model

Thousands of Hornby Train enthusiasts have already taken advantage of our wonderful Part Exchange offer and are now the proud owners of brand new Locomotives in place of their old ones. They know that the Hornby Part Exchange Scheme represents the finest and most generous offer ever made to owners of Hornby Locomotives.

Perhaps you, too, have a Hornby Locomotive that you have been using for some years and would now like to exchange for one of the fine new models featured in the latest Hornby Catalogue. If you have you should carefully study the range shown in the catalogue, and select the up-to-date Hornby Locomotive you want. Then, carefully pack up your old Hornby Locomotive and post it to us, enclosing your order for the new one and the necessary remittance. You can easily ascertain how much to send by deducting the part exchange allowance indicated in the accompanying list from the price of the new Locomotive, and adding 1/– for postage on the new model you purchase.

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

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

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

If you decide to send your old Locomotive to us address your parcel to Service Department, Meccano Limited, Binns Road, Liverpool 13, and be sure to enclose with it your own name and address written in plain characters.

What you have to do

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

You decide, say, to have a No. 2 Special Tank, the price of which is 25/–. Pack up your old No. 1 Tank and deduct 6/3 from 25/– (the price of the new No. 2 Special Tank), enclose a remittance for 18/9 plus 1/– carriage on the new Locomotive—19/9 in all. Send the Locomotive and the remittance to Meccano Limited, Liverpool.

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

Change your old Locomotive now!

MECCANO LTD.
Service Dept., Binns Road
Liverpool 13

Branch Notes

HOLYWELL (OXFORD).—Members decided that the old Branch track did not give sufficient scope for realistic working, and a new layout has been prepared. This consists of a main track and one branch line. One half of the main line is worked by L.N.E.R. locomotives ; L.M.S.R. and G.W.R. engines haul trains over the remaining section ; and the branch represents part of the G.W.R. system. Through train working with changes of engines provides excellent practice and splendid fun. The Oxford engine sheds have been visited. Secretary : M. Weatherall, 29, Holywell, Oxford.

BELFORT (CATFORD).—Members were greatly interested in operations seen in the various shops during a visit to the G.W.R. works at Swindon. Track meetings and Debates have been held. One of the subjects debated was the assertion that "*A signalman has a more responsible task than an engine driver.*" Secretary : J. H. Forth, "Gleneagles," 31, Ardock Road, Catford, London, S.E.6.

FIRST BOURNEMOUTH.—New quarters were taken up for the summer in order to enable an open air track to be laid down. Alternate meetings are devoted to track work. Other activities include Cycle Runs, and a member has kindly offered the use of a beach hut, which is appreciated by members. At present the Branch is without a Chairman, and the Secretary will be pleased to hear from anyone willing to take charge. Secretary : R. Common, 13, Uplands Road, Winton, Bournemouth.

GROVE PARK.—The programme consists of track operations, competitions, surprise items and tennis meetings, and refreshments are always provided at the long meetings held. The Tennis Tournament was won by one of the youngest members. At track meetings special attention has been paid to the formation of goods trains—a topic that has been the subject of competitions—and shunting. A Magazine known as the "*Grove Park Observer*" has been introduced. Secretary : B. C. Chandler, 29, Ellesmere Road, Chiswick, London, W.4.

WEST LEIGH (LEIGH-ON-SEA).—Regular talks on railway subjects are given, recent topics including superheating, valve gear and the chief features of the four British railway groups. Layouts to illustrate special types of railway working are planned and operated to timetable at each meeting, both clockwork and electric trains being employed. Outdoor track operations have been greatly enjoyed, particularly one representing a main line serving a dock system. General sports have played a great part in the summer programmes. Secretary : K. G. Cross, "Knowle Villa," 129, Southsea Avenue, Leigh-on-Sea, Essex.

A group of members of the Sandhurst Branch. Chairman : L. Green ; Secretary : F. Reed. The Branch was formed early this year, and incorporation was granted in April. Members have built up a very efficient layout, and Press reports of their activities have aroused great interest. Our photograph is reproduced by courtesy of the "Kent Messenger."

STREATHAM PARK.—A change of officials has been made, and this is to be repeated at intervals of about six months in order to give all members experience in Branch organisation. A special meeting was devoted to tests of members' ability in conducting operations. At this meeting the senior members were tested by means of a tight timetable on the Branch track, and junior members were required to carry out a series of simple operations in order to demonstrate their ability to "drive" a locomotive. At each meeting a layout representing the track between Euston and a large railway centre is laid down, and regular services operated on it according to timetable. Secretary : J. B. Cass, 161, Ribblesdale Road, Streatham, London, S.W.16.

CHARMINSTER (BOURNEMOUTH).—A permanent track has been laid down in the garage that serves as a Branch room. At each meeting members have been busy running trains, and carrying out alterations and repairs. Refreshments are provided at each meeting. The cycling section held enjoyable meetings during the summer, and cricket and rambles were arranged for other members. Secretary : B. Guttridge, Tudor House, Malvern Road, Bournemouth.

BLACKPOOL NORTHERN SECTION.—A low level goods yard has been constructed and the layout has been further improved by means of a level bridge that enables the track to be taken past the door of the Branch room. Timetable working has now been introduced. An Aviation Section has been formed. The top of a billiard table serves as aerodrome, and regular tests and contests are arranged for members' model aeroplanes. Secretary : R. G. Davidson, 14, Sutherland Road West, Blackpool.

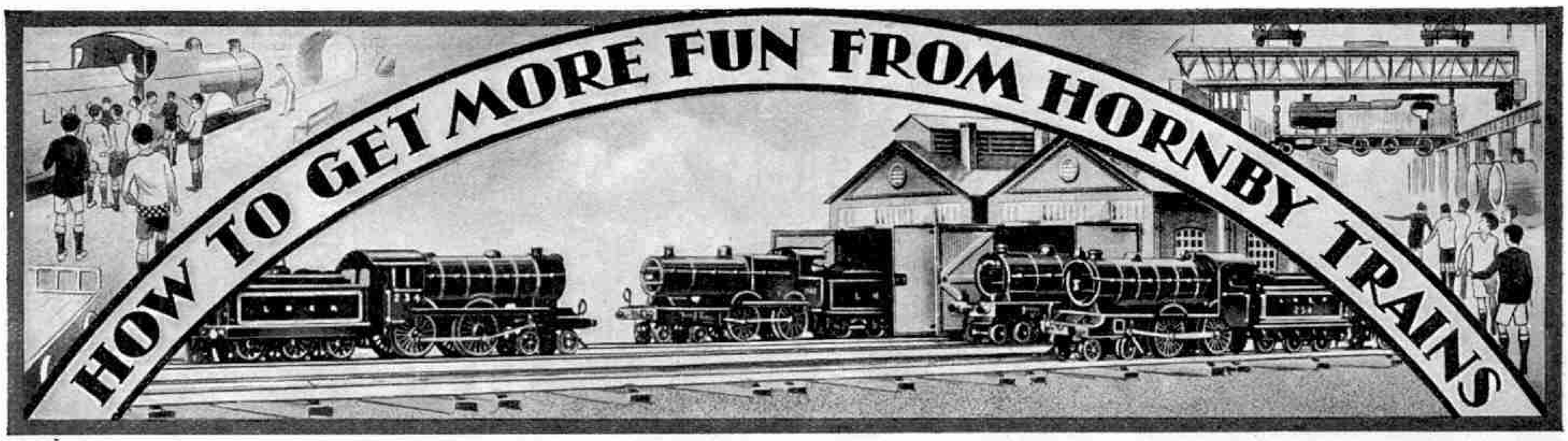
WEST DULWICH AND HERNE HILL.—A visit was paid to King's Cross engine sheds and Mr. E. P. Fisher, Chairman of the Branch, presented a prize for the best essay on this event. During the visit members mounted the footplates of "Pacific" and "Atlantic" locomotives, and inspected the automatic coaling plant. A scrap book for cuttings and photographs of railway interest has been started. Secretary : J. Nunn, 70, Herne Hill, London, S.E.24.

AUSTRALIA

WESTRALIAN.—Meetings are again being held regularly, twice a month. A permanent double track layout has been completed. This is used in the Branch room and, when weather permits, also in the open air. The track represents the L.M.S.R. line from Euston (London) to Glasgow, with a branch to Liverpool, and twelve locomotives maintain passenger and goods services on it. "Euston" is being provided with a glass domed roof, and its platforms are about 4 ft. in length. Secretary : S. H. Chittenden, 37, Hill Street, Perth, Western Australia.

Recently Incorporated Branches

246. SEFTON—D. S. Jessop, 1, Waverley Road, Liverpool 17.
247. GROVE PARK—B. C. Chandler, 29, Ellesmere Road, Chiswick, London, W.4.
248. MACCLESFIELD CENTRAL (BOYS') SCHOOL—Arthur W. Morlidge, 4, Blagg Street, Macclesfield.



LIX.—LUXURY TRAVEL ON HORNBY RAILWAYS

IN spite of the limitations of many miniature railways, it is probably true that most of them operate at least one "crack" express, and some even may boast of a series of them. Goods working, shunting, loading and unloading are extremely fascinating, and the operation to timetable of an intensive suburban service calls for smart work on the part of the operator; but there is always a distinct glamour about a miniature express train. This is particularly the case if the train bears Name or Destination Boards, for it then immediately assumes something of the importance that characterises its prototype. Again, such a train is usually made up of some of the best stock on the line, and it is invariably hauled by an imposing express engine.

A pilot locomotive backing on to a miniature L.M.S.R. express. The No. 2 Saloon Coach shown is fitted up to run as a sleeping car, as suggested in this article.

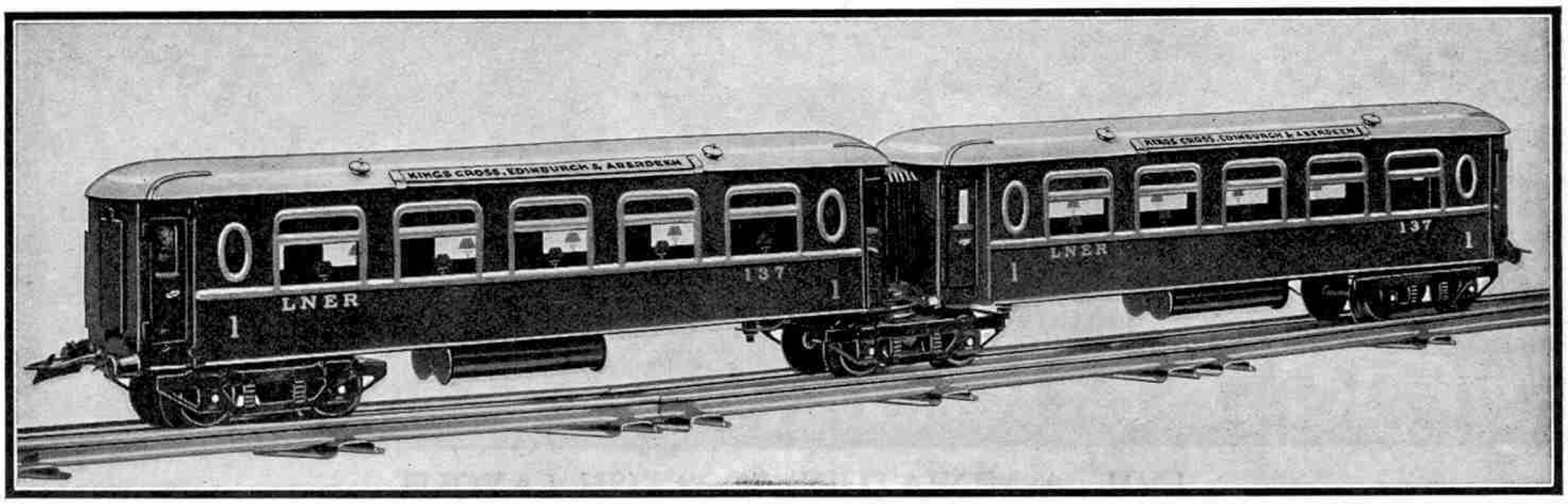
Even in this age of luxury travel it is somewhat surprising to find that the four groups between them operate no less than 261 Pullman cars, 600 restaurant cars, and 357 sleeping cars. In miniature the fine appearance and easy running qualities of Hornby Pullmans, particularly those of the No. 2 Special variety, make them great favourites with model railway owners. The whole range of Pullmans, even down to the little MO examples, is very satisfactory, and its completeness enables even the most simple system to operate an all-Pullman express with appropriate stock.

There is a good choice in the matter of real Pullman trains to represent. The S.R. have their "*Golden Arrow*" and their "*Bournemouth Belle*"; then there are the "*Thanet Pullman*" mentioned last month and the now electric "*Southern Belle.*" The famous "*Queen of Scots*" and the less known "*Eastern Belle*" of the L.N.E.R. are other examples, while there is also the "*West Riding Pullman,*" so popular with Yorkshire business men. Both these companies also make a practice of running Pullman Specials in connection with race meetings held on their systems. These sometimes involve special locomotive and Pullman train workings into districts where they are not usually seen.

The miniature railway manager, therefore, need not be at a loss for a representative Pullman working for reproduction on his own line. In addition, there is no reason why imaginary workings of Pullman trains or coaches should not be instituted, as these are frequently of great interest in miniature, and provide a change from the regular operations.

A great many trains are made up of ordinary stock but include one or two Pullmans in their composition. The well-known Folkestone trains of the S.R. are well served in this way, and for motive power on a Hornby railway the S.R. No. 2 Special Tender Locomotive is the very engine required. On the L.M.S.R. in Scotland Pullmans work in addition to the restaurant cars conveyed on through trains, so that in miniature trains formed of, say, L.M.S.R. Saloon Coaches, may have a Pullman added to obtain the same effect. The L.N.E.R. Continental trains from Liverpool Street to Harwich convey Pullmans, and an interesting instance of Pullman running is to be found on the Metropolitan Railway. Here the Pullmans are hauled by steam locomotives over part of their journey and by electrics over the remainder, so that the working is notable in several respects.

Whichever method of operation is favoured, therefore, there is plenty of choice in the particular train or service that is to be run in miniature. It will be of interest to mention that Pullman cars in Great Britain are built by the English Pullman Car Company, who

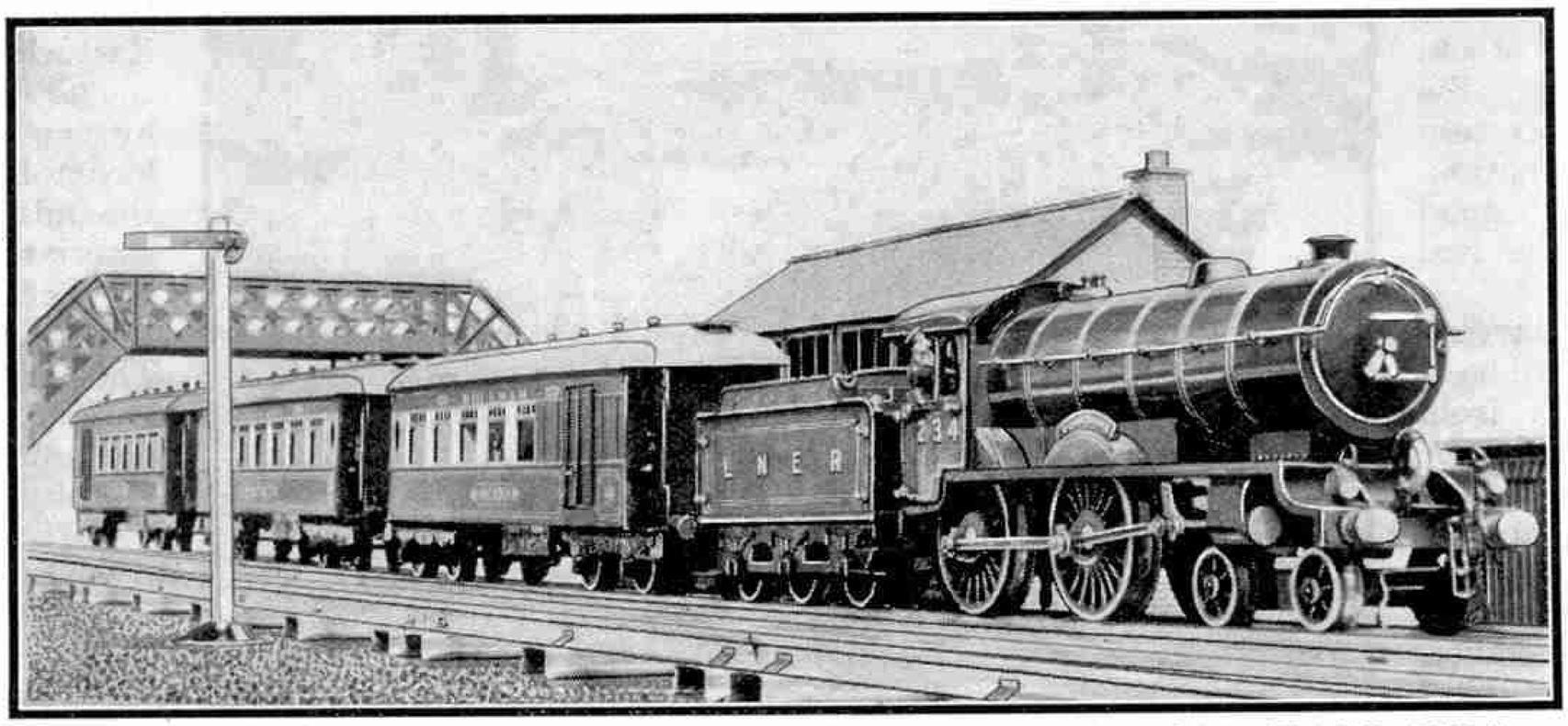


An articulated unit made up of two Hornby L.N.E.R. No. 2 Saloon Coaches. These may be arranged to represent vehicles with dining or sleeping accommodation as required.

pay to the railways concerned a rental for their haulage, and themselves receive the supplementary fares charged for the use of Pullman cars by passengers, and the profits from the catering. In Scotland the cars are available for meals without the payment of any supplement.

A surprising feature of the dining car services operated by the railways themselves is the long distances often covered by certain cars over the lines of other companies. Thus G.W.R. vehicles are found at Edinburgh and Southern cars at Birkenhead, while L.M.S.R. vehicles penetrate to Taunton, and those of the L.N.E.R. to Barry. This suggests inter-group working of considerable interest for miniature purposes, as previously mentioned in the case of Pullman cars. With the adoption of the open saloon type of coach, there is not so great a distinction between the appearance of dining and ordinary coaches, unless of course the kitchen compartment forms part of the dining car. This is a frequent arrangement, the first-class compartment and the kitchen being accommodated in one car, while the third-class passengers, owing to their greater numbers, have a whole saloon car to themselves. But where large numbers of meals are to be served, a separate kitchen car may be run in between appropriate dining cars.

Again, two cars may be employed, so arranged that the kitchens of each adjoin. This is a symmetrical arrangement, but of course where a single car only is used the kitchen may be arranged centrally. This is perhaps the best scheme for miniature railway purposes, as an unlimited number of coaches is not usually available, and it is desirable that the dining portion of the train shall not be excessive as compared with the ordinary passenger accommodation.



A Hornby all-Pullman train hauled by an L.N.E.R. "Yorkshire" Locomotive. The train is made up of No. 2 Special Pullman Coaches, which represent very well the luxurious stock used on many up-to-date trains.

The particular arrangement to be adopted on Hornby railways depends upon the coaches available, the haulage power of the locomotives, and the preference of the individual operator. The Hornby Series does not include any actual dining or kitchen cars of the four groups, but it is not difficult to adapt existing material in the shape of the No. 2 Saloons in a satisfactory manner. Readers will have noticed that the windows of kitchen compartments or cars are invariably different from ordinary windows. This effect can be obtained in the following manner, which has previously been described, but which may be repeated with advantage for the benefit of new readers. Strips of tracing or semi-transparent paper $\frac{5}{8}$ in. wide are cut. Their length will depend upon the number of windows to be covered, and may be settled by experiment. These strips are slipped in between the coach side and the celluloid "glass," and gently worked along into position. If this is done carefully until the window space is covered, the result will be quite pleasing. No adhesive is necessary, so that it is easy to renew the paper when required, or to convert the vehicle for ordinary use again.

The L.N.E.R., and the G.W.R. to some extent, make use of articulated kitchen and dining car units. The scheme may be applied also with success to Hornby stock, as shown in one of the accompanying photographs, and those interested in the scheme should refer to the April, 1932, "*M.M.*" This system of construction is also applied to L.N.E.R. sleeping cars.

Similar methods to those we have already described for dining vehicles may be employed to adapt Hornby Saloons as sleeping cars. In addition, their illumination by means of flashlamp bulbs and batteries might be carried out as suggested in the February, 1932, "*M.M.*"

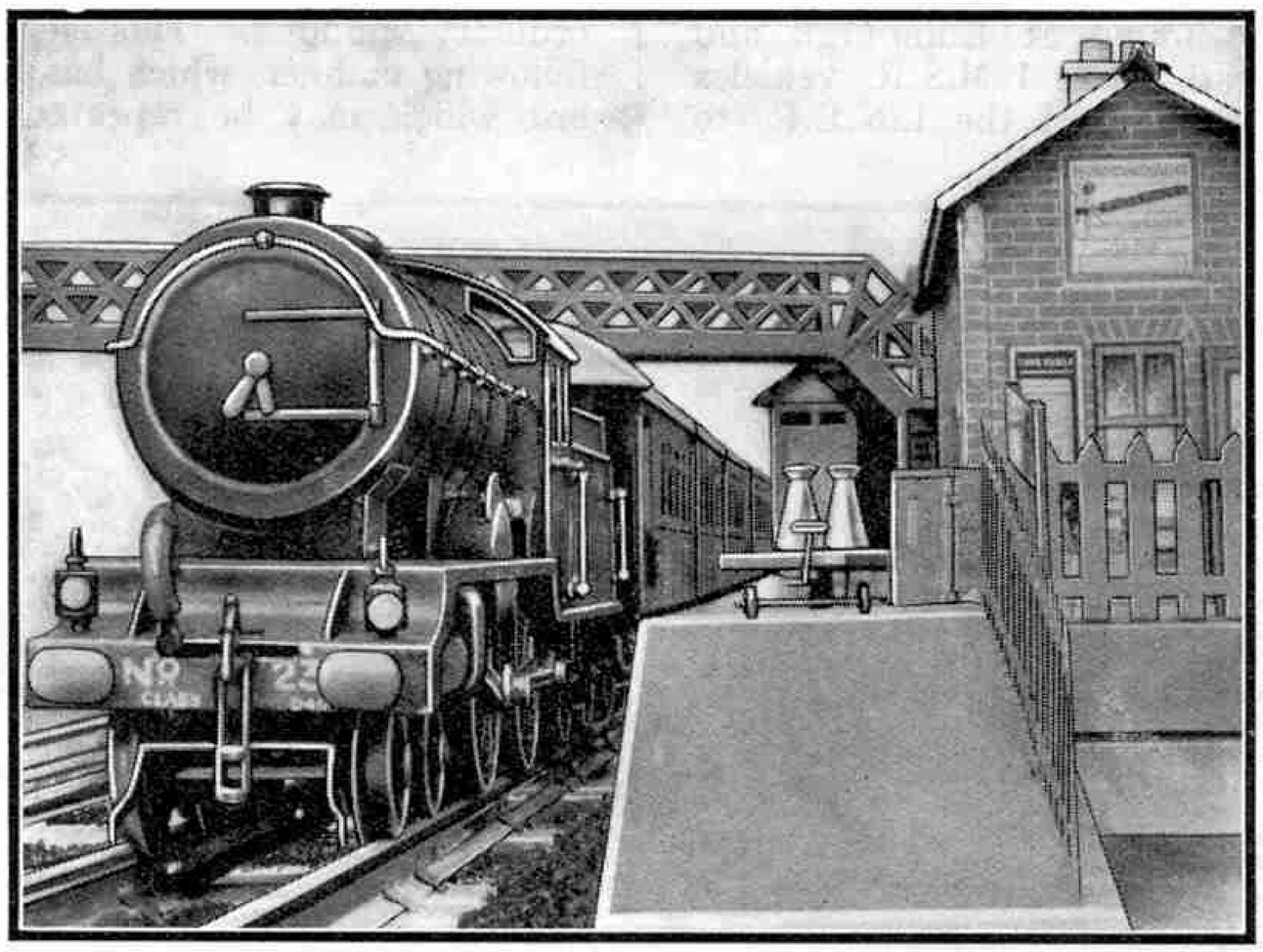
LVII.—A MINIATURE SCOTTISH LAYOUT

THE train working hints given in these pages from time to time are found particularly useful by readers who are not very well acquainted with the particular group or railway upon which they desire to base their layouts. In working out a general scheme for a line based upon actual practice, the question of space is usually a difficulty, with the result that many of the chief features of the route itself have to be neglected, although the final layout may be well arranged for convenient working. However, the performance of typical operations by the appropriate locomotives and rolling stock, together with the exercise of a certain amount of imagination, gives a very good impression of the real thing.

Of the many layouts and plans that we have received recently from readers, one of the most interesting is that shown in the accompanying diagram. This has been developed by an H.R.C. member, W. H. Watts of New Barnet, and is an L.N.E.R. concern, the section actually chosen being the former North British main line between Edinburgh and Glasgow. This is an interesting length of line for many reasons, as we shall endeavour to show in the course of this account of the miniature line and its possibilities.

Referring to the diagram, it will be realised that the general plan has been developed from our old friend the continuous oval track, with very interesting results. Although it is primarily a continuous line, one of the chief stations is a terminus, as is appropriate, since it represents Queen Street Station, Glasgow, the L.N.E.R. terminal in that city. The other, as Waverley Station, Edinburgh, is necessarily a through station, but it may be used as a terminal for traffic purposes, as is the case in actual practice. An interesting point is the way in which the platforms of Queen Street are situated actually in between the up and down main tracks. This separation of the latter enables them to be more effectively disguised when passing in the neighbourhood of the terminus, and also does away with the need for a complicated double junction where the station lines join up with the main tracks.

The chief engine sheds, carriage sidings and turntable are placed centrally, so that they are fairly conveniently reached from either station, and can be comfortably managed by the operators, who are normally four in number. The main sheds correspond to the Haymarket Depot at Edinburgh, and the smaller shed near Glasgow represents Eastfield.

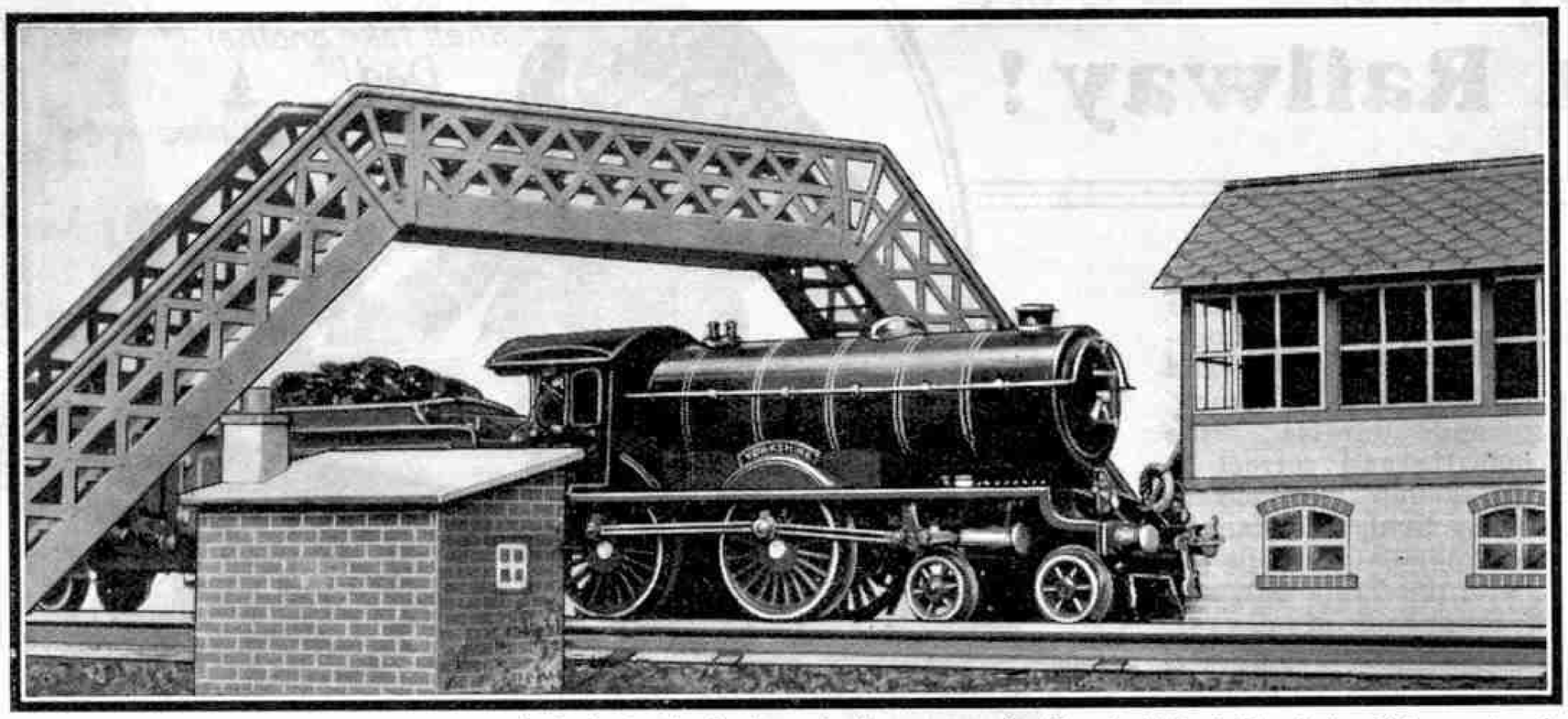


A Hornby Pullman express passing a wayside station. The train represents very well the L.N.E.R. "Queen of Scots," which provides a through service between King's Cross and Glasgow.

The line is worked by no less than 13 locomotives, and none of the misfortune usually associated with this number has yet overtaken any of them. The types employed are varied. For the important expresses a Hornby No. 2 Special "*Yorkshire*" Locomotive is appropriately used, and the other engines represent reasonably well the standard L.N.E.R. and the former N.B. classes that are used for different kinds of traffic.

A variety of trains can be operated on this layout, for in addition to the stopping and express trains of local importance there is the through running of Glasgow portions of, say, London expresses to be allowed for. Thus "*The Flying Scotsman*" from King's Cross carries a section for Glasgow, and this runs over the very length of line we are considering from a miniature point of view. For this purpose Hornby No. 2 Saloon Coaches bearing the Name Boards "*The Flying Scotsman*" should be used. The "*Queen of Scots*" Pullman express also runs over this line, and for its operation in miniature Hornby No. 2 Special Pullmans should be provided, each end of the train being duly completed by a composite coach of the same kind. For more local train services Metropolitan Coaches may be used, as closely resembling L.N.E.R. stock in colour and outline.

A particularly interesting example of long-distance through coach working is found on this section in the attachment to an Edinburgh express of a through coach from Glasgow to Harwich! This forms one of the several portions of the "*North Country Continental*" express. With it are found through coaches for Southampton, usually G.W.R. vehicles; and then there is the Glasgow portion of "*The Flying Scotsman.*" These various sections are in addition to the local coaches from Glasgow to Edinburgh. On a small scale a representative make-up after the engine would be a Metropolitan coach for the local passengers, then a No. 2 Saloon Coach in L.N.E.R. colours bearing the Name Board "*The Flying Scotsman.*" A No. 2 Pullman might represent the brown and cream Great Western Coach for Southampton, and finally another L.N.E.R. Saloon would provide accommodation for Continental passengers.



"Shire" class locomotives are used extensively in Scotland. In a similar manner the Hornby "Yorkshire" should be employed on a miniature Edinburgh and Glasgow line, as described in this article.

For the haulage of this train a "Yorkshire" would be the first choice, but any other suitable locomotive in the stud might be allocated to this duty if necessary. In actual practice, owing to the severe gradients leading out of Queen Street up to Cowlairs, it is the rule to provide a bank engine in the rear of any but the lightest trains. This will be an interesting piece of working to reproduce in miniature, but owing to curves, and the possibilities of buffer-locking occurring, it will probably be necessary to limit the activities of the "banker" to the straight track along the length of Queen Street platforms. Actually the assistant engine is detached at Cowlairs by a slip coupling arrangement. In miniature, therefore, it cannot be coupled to the train; but it must be retarded, and will thus drop behind as soon as its work is done. A Brake Rail or Brake and Reverse Rail will be useful for this purpose, and should be placed at the end of the platform, or other suitable spot, according to the particular layout in use. Care must be taken to see that the brake trip is not set until the leading engine has passed over it, otherwise the whole train will make an abrupt stop not called for in the working timetable.

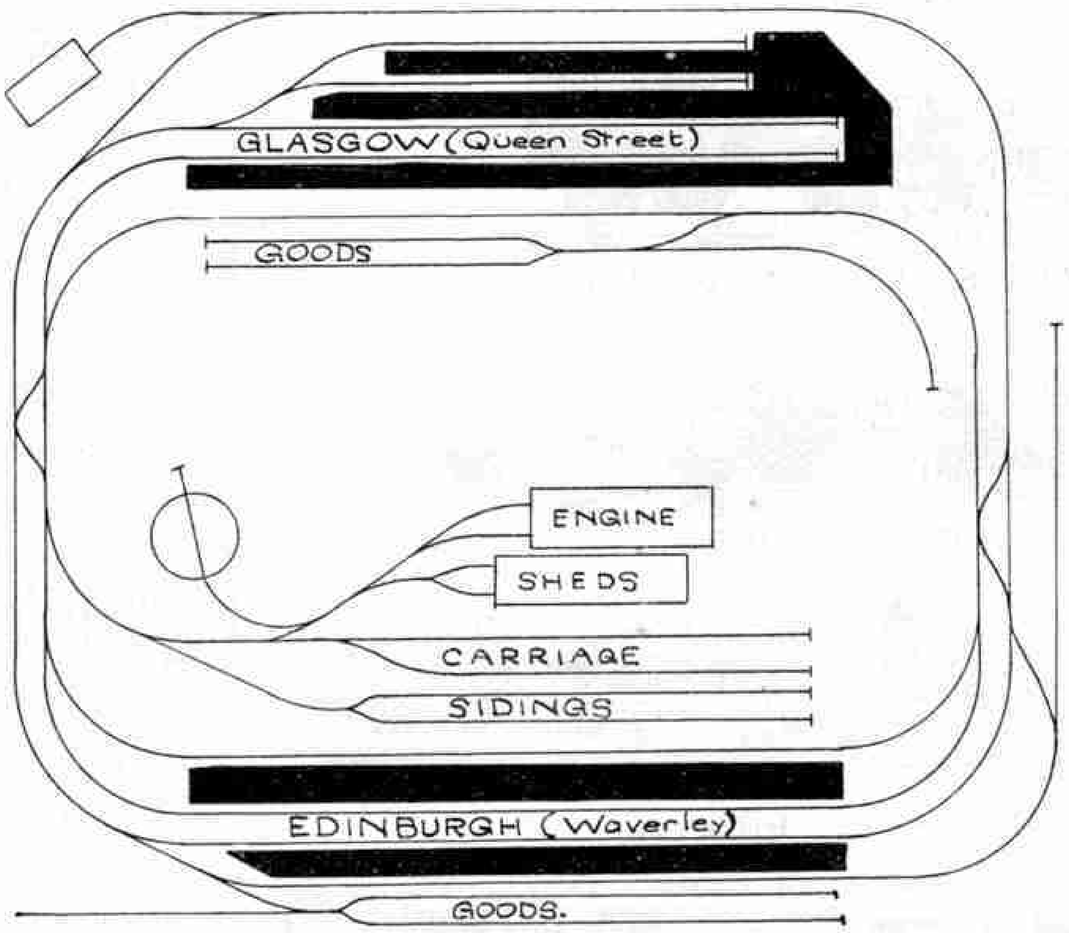


Diagram of the layout of W. H. Watts, New Barnet.

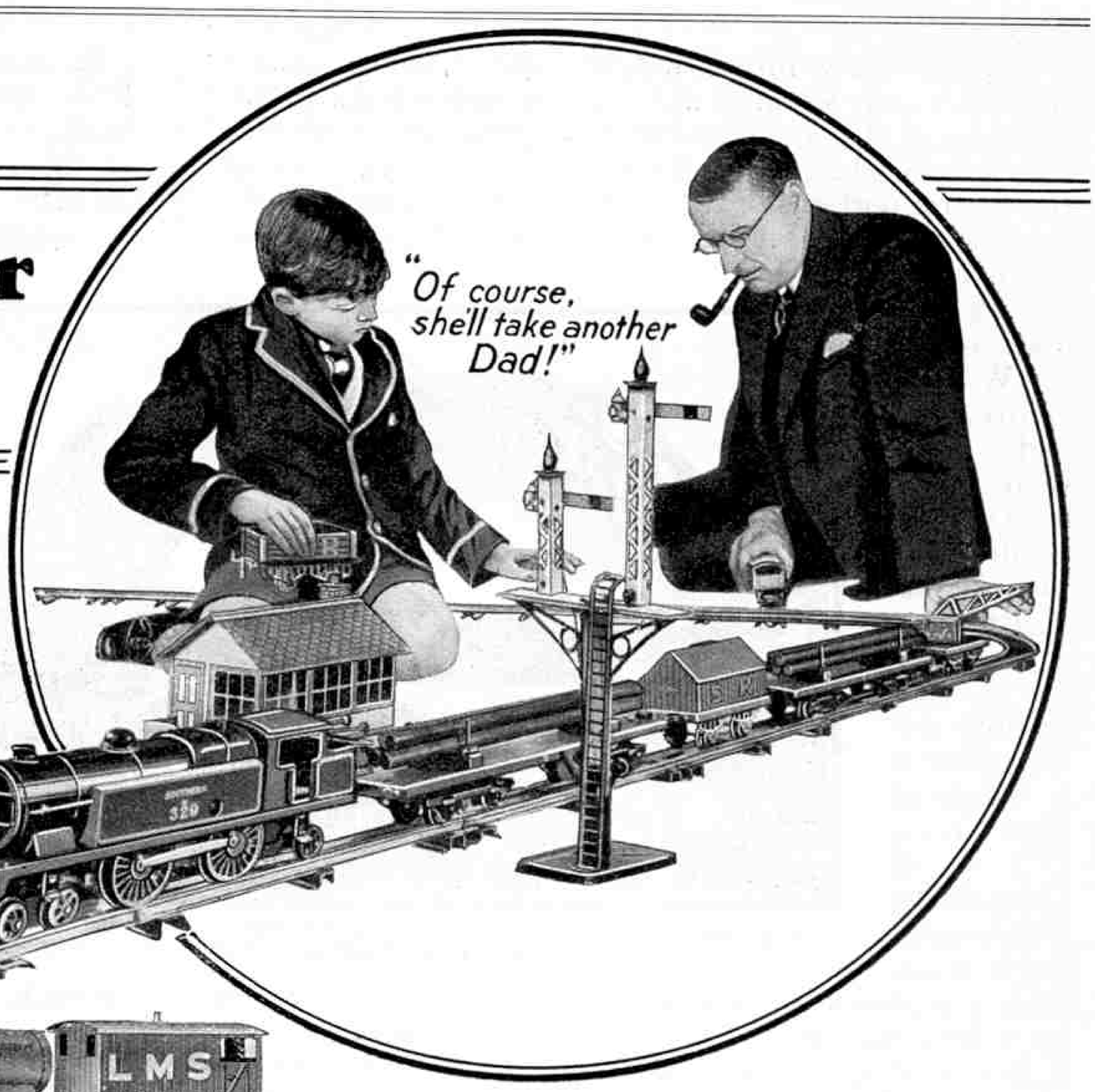
It may be mentioned that for many years—until 1908—trains were assisted up to Cowlairs by cable haulage, a winding engine being installed at the top of the incline. Readers keen on experiments may perhaps care to develop this idea, although it cannot be applied to the present layout very easily owing to the restrictions of space.

For the same reason the important intermediate stations of Falkirk and Polmont have not been incorporated in the plan, but the continuous nature of the layout allows the through station, normally "Edinburgh," to represent these or any other stations as required. The train mentioned previously, conveying London, Southampton and Harwich portions in addition to local traffic, calls conditionally at Lenzie Junction, and is required to make a regular booked stop at Polmont.

As regards the various features of the real route, there are tunnels outside both Queen Street and Haymarket stations, and also at Falkirk and Winchburgh intermediately. Then there is the notable Almond Viaduct between Winchburgh and the curiously-named station of Ratho. Falkirk Viaduct and the deep cutting at Croy may also be mentioned. Certain of these engineering works may be incorporated in a miniature Edinburgh and Glasgow line, according to the space and conditions of the layout and the fancy of the owner.

From the goods traffic point of view there is a concentration yard at Cadder, outside Glasgow, where shunting by gravitation is carried out. This is represented in the miniature layout to some extent by the goods sidings shown alongside Queen Street. As the shunting spur is curved, however, gravitation working is not performed there, but it is a feature of the other sidings alongside Edinburgh station. Here the shunting spur is straight and inclined upward from the sidings. A train may be pushed or pulled up the slope, and the various wagons are uncoupled in turn and allowed to run down by gravity into either of the sorting roads below. Such working gives a realistic representation of actual practice, and is very interesting to watch.

Boys, Run Your Own Railway!



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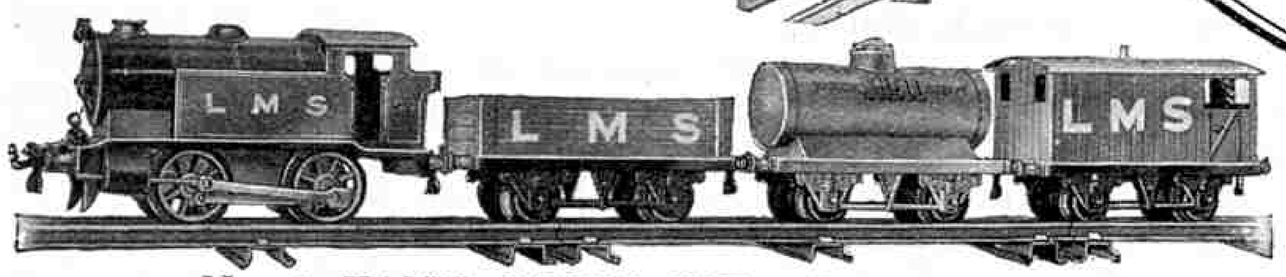

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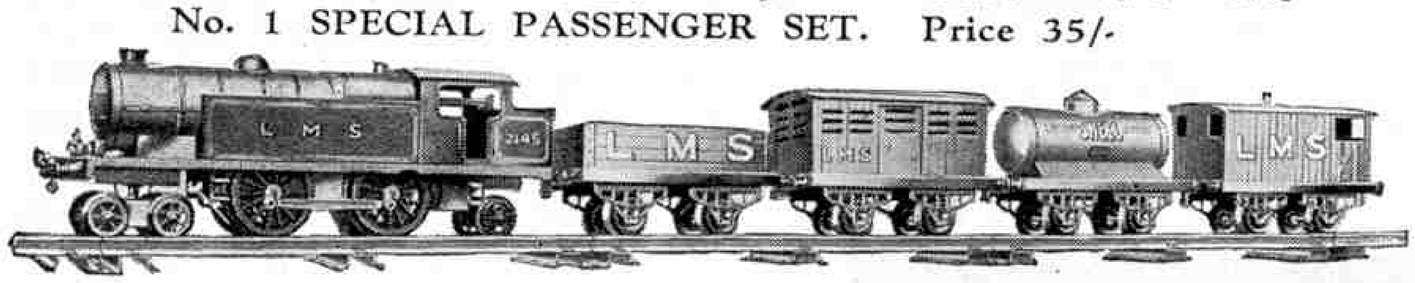

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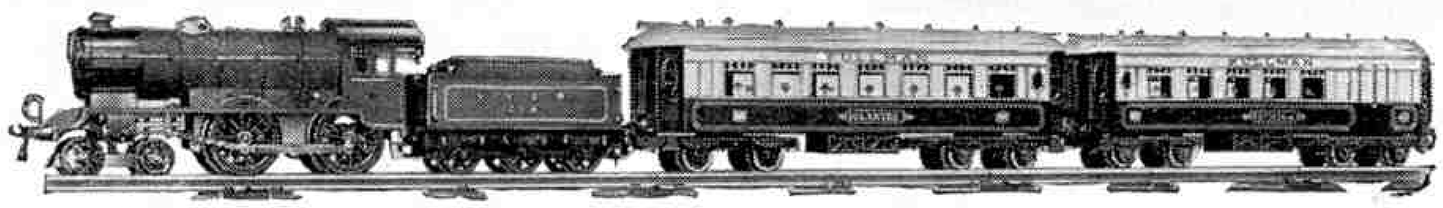

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H.R.C. COMPETITION PAGE

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

A MISSING WORDS CONTEST

Interest on the part of H.R.C. members continues to be maintained in the railway problems that are set before them each month on this page. From records kept of the entries to each competition we have found that among the most popular contests are those that give an opportunity for displaying knowledge of railway operations and practice, together with general knowledge and keenness in observation. The most successful of these have been those involving word-building or word-finding problems of railway interest, and this month we announce another contest of this type.

In the centre of this page is a panel containing three short paragraphs dealing with the general work of a locomotive crew in the preparation of their engine for its day's work and in its subsequent running. Certain words have been omitted from these paragraphs, and the place of each one is represented by a series of four dots. It should be noted that the number of dots bears no relation to the number of letters in the missing words.

Competitors are required to find the missing words, and write them down on a sheet of paper in the order in which they would appear in the photographs. It is not necessary to copy out the whole of the paragraphs.

CAN YOU FIND THE MISSING WORDS?

When an engine driver going on . . . . mounts the . . . . he first examines the . . . . gauge to ascertain the amount of . . . . in the . . . . . A brief glance through the . . . . will show the state of the . . . . , and the pressure . . . . is examined to see that the . . . . is making . . . . satisfactorily. This and the . . . . work of . . . . is shared by the . . . . .

The latter sees that the necessary fire . . . . are provided, trims the . . . . if required, and gets the . . . . into good order. The . . . . for . . . . the boiler are tested, ... cocks manipulated, and the . . . . apparatus generally tested, while the . . . . of the various . . . . parts is attended to. A good supply of . . . . must be available, for when an . . . . with a heavy . . . . commences its journey, or . . . . a . . . . , its progress is often . . . . by . . . . of the . . . . wheels. To assist their . . . . , ... is carried on the engine in . . . . , and is carried through . . . . on to the . . . . by gravity or . . . . power. In either case . . . . from the cab is afforded.

During the . . . . the . . . . are kept busy, for the . . . . has to manipulate the . . . . to the best advantage, keeping . . . . with due regard to . . . . and economy. The . . . . has to assist him in both these respects, because the . . . . level and steam . . . . must be . . . . without . . . . , and . . . . must be watched by him whenever . . . .

All the missing words are quite simple and straightforward, and there is no "catch" or anything unusual in the manner in which they are used.

The competition will be divided into two Sections—Home and Overseas. Prizes of Hornby goods (or any Meccano products as preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded to the four competitors in each Section who submit the most complete lists. In the event of a tie for any prize, neatness or novel arrangement of the entries will be taken into consideration.

When as many as possible of the missing words have been found the competitor's name, address and H.R.C. membership number should be written plainly on the sheet. This should then be enclosed in an envelope marked "*H.R.C. Missing Words Contest*" and addressed to Meccano Ltd., Binns Road, Liverpool 13. The closing date for Home entries is 30th September, and for Overseas entries, 30th December.

Railway Photographic Contest

With the approach of the end of the holiday season many H.R.C. members who have been busy with their cameras will be looking over the season's results in the shape of railway subjects. While engines and trains as a rule come in for a big share of attention, many members have varied tastes, so that scenes of general railway interest will also be included.

We are therefore offering prizes this month for the best sets of three photographs sent in by competitors. It is desirable that in each set the three photographs should have some connection with each other. For example, a locomotive arriving at a terminus might be shown in the first picture; the same locomotive on the turntable in the next; and the third might show its subsequent departure. However, members whose collections do not include such a connected set should not hesitate to forward their entries.

The contest will be divided into two Sections—Home and Overseas—and the four winners in each Section will be awarded Hornby Train material (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively. Envelopes containing entries should be clearly marked "*H.R.C September Photo Contest,*" and posted to reach Headquarters at Meccano Ltd., Binns Road, Liverpool 13, by 30th September. Overseas closing date, 30th December.

Railway Essay Contest

Railway operations during the summer months are of particular interest. Special trains and excursions often bring to a particular district engines and vehicles not usually seen there, while inter-group working brings about many locomotive and rolling stock exchanges of special interest.

During the holidays many members visit unfamiliar parts of the country, and therefore often come across interesting features in the strange railway surroundings. It is good fun to recall these features and to describe them as accurately as possible in a small number of words, and this month we invite readers to send in a description of not more than 500 words, of "*The Most Interesting Railway Feature I Saw During the Holidays.*"

The competition will be divided into the usual two Sections—Home and Overseas. To the competitors who submit the four best entries in each of the two Sections will be awarded prizes of Hornby Train goods (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively. A number of consolation prizes will also be awarded.

Envelopes containing entries should be clearly marked "*H.R.C. Railway Essay Contest*" in the top left-hand corner, and posted to reach Headquarters at Meccano Ltd., Binns Road, Liverpool 13, on or before 30th September. The closing date for the Overseas Section is 30th December.

COMPETITION RESULTS

HOME

June "Picture Puzzle Contest No. 1."—First: J. C. Button (10335), Crewe. Second: W. P. E. Beer (34796), Oundle, Northants. Third: C. E. Wrayford (5039), Moretonhampstead, Devon. Fourth: J. F. Aylard (25864), Old Southgate, London, N.14. Consolation Prizes: H. S. G. Darke (4461), Hampstead, London, N.W.6; R. Sutton (34561), Wolverhampton, Staffs.; H. Pollitt (8000), Accrington, Lancs.; W. S. Arnott (18451), Edinburgh; R. S. Dench (28187), Hall Green, Birmingham, 11.

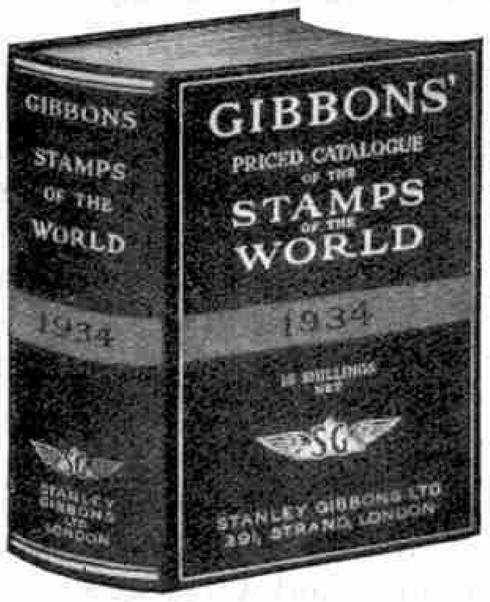
June "Photographic Contest."—First: J. C. Thorne (298), Maidstone, Kent. Second: S. Garbutt (30122), Altrincham, Cheshire. Third: S. Rhymes (13277), Longwood, Huddersfield. Fourth: F. G. H. Kennedy (25074), Bolton, Lancs. Consolation Prizes: A. Perkins (31395), Hastings; G. T. Porter (10259), New Barnet, Herts.; F. H. Jones (34409), New Barnet, Herts.; A. L. Down (17087), Maidstone, Kent; F. Hodson (9430), Bolton, Lancs.; W. B. Hudson (1733), Westham, Weymouth, Dorset; L. Parish (18054), Coventry, Warwicks.; R. Couling (28701), Southall, Middx.; A. A. Dobson (2571), Sherwood, Nottingham; W. P. E. Beer (34796), Oundle, Northants.; J. Everitt (542), Streatham, London, S.W.16.

OVERSEAS

March "Model Railway Photo Voting Contest."—First: R. Frayne (34299), Kalgoorlie, Western Australia. Second: A. J. Cramp (11438), Sydney, Australia. Third: R. A. Wragg (7913), Bandikui, Rajputana, India. Fourth: D. McLeod (29024), Richmond, Natal, South Africa. Consolation Prizes: J. A. Coates (23863), Quebec, Canada; O. Studd, Winnipeg, Canada; L. Charles, Capetown, South Africa; J. Fabrie (30032), Wijk-Maastricht, Holland; F. L. Bingen (28995), Wijk-Maastricht, Holland; A. Johnstone (16298), Piora, New South Wales, Australia; R. B. McMillan (9592), Melbourne, S.E.2, Australia.

April "Hidden Stations Contest."—First: G. Hallack (17578), Capetown, S.A. Second: D. J. White (9333), Dunedin, New Zealand. Third: J. G. Gnanadurai (1964), India. Fourth: H. C. Key (24764), Calcutta, India.

To-Day's the Day
September 1st



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THOMAS CLIFFE, COLWYN BAY.

For further stamp advertisements see page 736

Stamp Collecting

IDENTIFYING DIFFICULT STAMPS

The new collector often experiences considerable trouble in identifying the stamps of certain countries, and while the exercise of his natural commonsense will often put him on the right track, it is unfortunately true that only experience will enable him to recognise immediately the origin of every stamp that comes to him.

Bulgaria 10 Leva Olympic Games issue, 1931.

An amusing article that illustrates this often exasperating difficulty was published recently by "*The Liverpool Echo,*" under the title "*When You Want to Stamp Your Feet,*" and is reprinted here by kind permission of the Editor.

* * * * *

I am not a stamp collector. I never could be one to the extent of paying large sums of money for a secondhand scrap of paper, not on its merits as a work of art, but simply because it happens to be the only remaining specimen of its once common kind. But there is more in stamp collecting than that.

It all happened through a small boy. Somebody had light-heartedly given him a stamp album. Stamps were all he then needed—or so it was fondly imagined. We live and learn.

It was not so much that he pestered me for stamps. When he discovered that all I had to offer was the usual penny-plain, twopence-coloured British variety, his interest in me as a purveyor of stamps quickly evaporated.

But even at his early age he knew what he wanted. So he devised other uses for me.

The faith a small boy has in his senior would be pathetic were it not also stimulating. I found it altogether too stimulating, especially as I could not let him down. He believed in me.

He got the stamps all right—heaps of them—from all parts of the world. All that remained was to fix them in the album in their proper places. Would I help him?

This had to be discouraged. "All you have to do," I airily explained, "is to look on the stamp for the country of origin, and then 'look up' that country in the stamp album index. That will tell you all you need to know."

But —. I have since discovered that, by this simple rule, foreigners must have a very rough time seeking to trace the country of origin of our own British stamps!

In any case, the point had not occurred to my trusting young friend. Authority had spoken. He went ahead—but not for long.

"I can't find this country anywhere in the album," said he, handing me a particularly elusive stamp. The lettering, alone, was Greek to him. It was Greek to me. But was I going to confess that to him? Of course not.

Portuguese India 2 Reis St. Francis Xavier commemorative, 1931.

"Try Greece," I replied.

Beginner's luck, it *was* Greece. I felt pleased. But, alas, that wretched fluke finally established me as an expert in the eyes of my young friend. He "knew" that, henceforth, should I fail him, I was not really trying.

"What stamp is this?" he asked on another day.

It was a beautiful stamp, unlike any I had seen before.

Fearfully, I looked for the country of origin. Mercifully, it was there, in good, solid type. Not a bit shy, this country. "Republique Libanaise," I read. Some sort of French colony somewhere. Easy.

Russia 10 Kopecks Airship Construction Fund issue, 1931. Note the initials "CCCP," to be found on all Soviet Russian issues.

"You are not trying, my lad," I gravely reproved him. "Look up 'French Colonies.' You'll find it there."

He looked it up. "Not there!" he reported.

Awkward! But surely there was a way out? I tried again.

"Don't be so easily beaten," I urged. "When a thing isn't in one place it must be in another. There are several pages headed 'French Post Offices.' Look there."

"I have looked," he protested, a trifle hurt. "But it's not there."

Greece 4 Lepta Independence Centenary issue, 1930. The characters at the head of this stamp appear on most Greek issues.

Serious! Where on earth did the French hide their colonies—if any? Ha! A memory of the Great War. Africa!

I looked up Africa in the atlas. Again nothing doing. The nearest I could get to anything even remotely Libanaise was Libya.

Fortunately, I rejected that, by instinct. I have since discovered that Libya is Italian.

Would it, then, be Indo-China? No? Libanaise sounded neither Indian nor Chinese. Where else? I tried to give it up, but my young friend trustfully waited.

I took another glance at the stamp. Nay, there were several Libanaise stamps, all different, and all glowingly pictorial. There were artistic views of temples and fortresses and waterfalls and classic ruins. All named. Ha! This one—Baalbeck!

That seemed familiar. Hopefully, I turned to the encyclopædia which, previously, could only give me Libau, which is in Latvia.

At last I seemed to have tracked it. Baalbeck, I was assured, was a city of ancient Syria. Obviously, however, there was nothing ancient about Republique Libanaise, so I looked up the Syria of to-day. Again I got it. Syria, I read, was mandated to the French after the Great War. Still, Syria did not seem sufficiently Libanaise to me. I examined the map of Syria. There I found Lebanon.

Our old Bible-history Lebanon, complete, and up-to-the-minute, with postage stamps. Republique Libanaise, I breathed again.

What an escape!

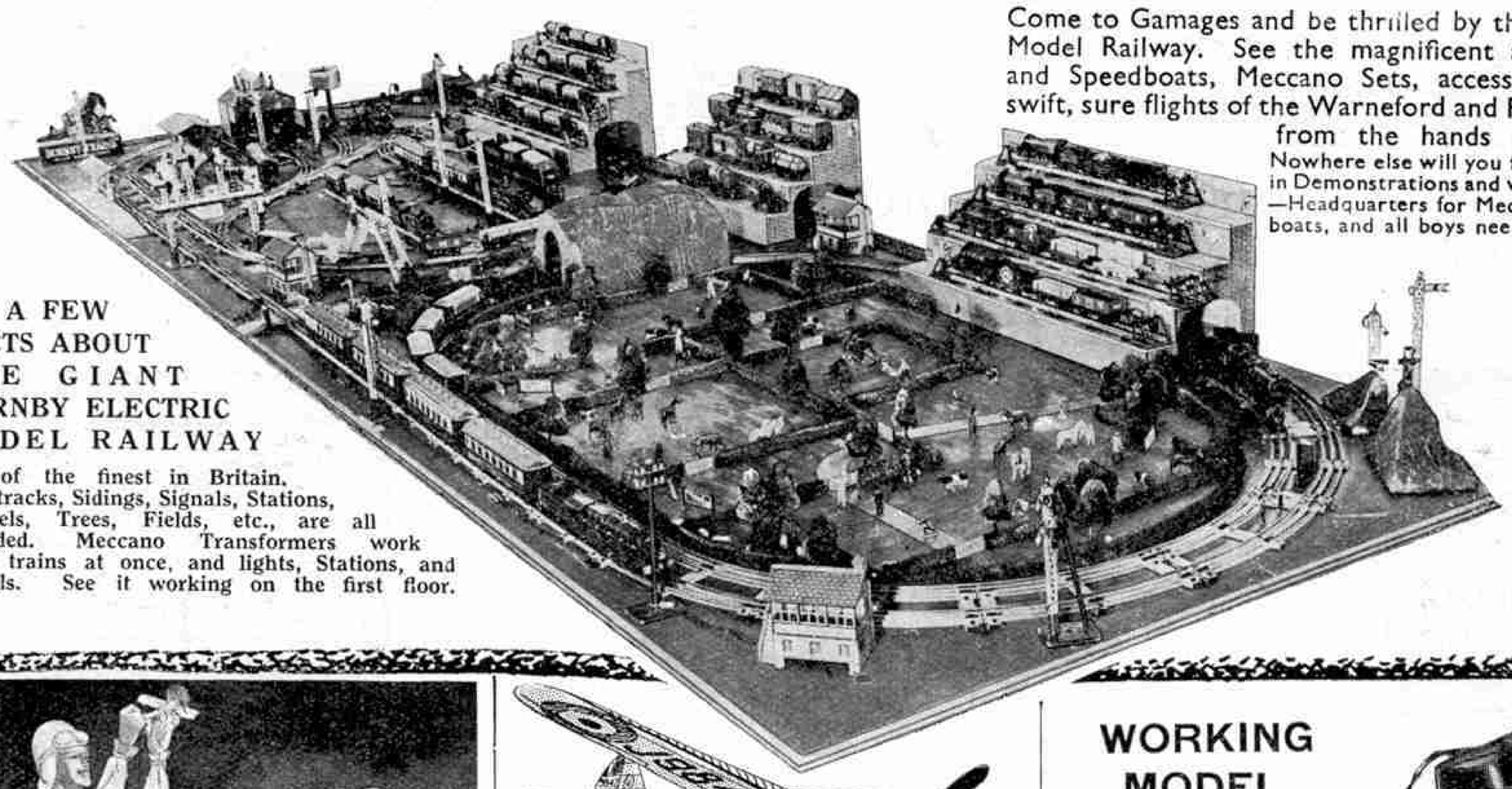
* * * * *

The problems that beset the author and his young friend will be encountered also by many of our younger readers who at this season are taking up stamp collecting for the first time. In our article next month, therefore, we shall explain methods that will help in identifying the stamps of the more difficult countries.

Many of these possess certain permanent features that enable them to be placed without hesitation when these characteristics are known.

Japan 8½ Sen Air Mail issue, 1929. The chrysanthemum, Japan's national symbol, appears on all Japanese stamps.

GREAT ACTIVITY AT MECCANO AND HORNBY HEADQUARTERS



Come to Gamages and be thrilled by the giant Hornby Electric Model Railway. See the magnificent array of Hornby Locos and Speedboats, Meccano Sets, accessories, etc. Watch the swift, sure flights of the Warneford and FROG Model Aeroplanes from the hands of the Demonstrators. Nowhere else will you find so much practical activity in Demonstrations and working models as at Gamages—Headquarters for Meccano, Hornby Trains, Speedboats, and all boys needs.

★ A FEW FACTS ABOUT THE GIANT HORNBY ELECTRIC MODEL RAILWAY

One of the finest in Britain. Two tracks, Sidings, Signals, Stations, Tunnels, Trees, Fields, etc., are all included. Meccano Transformers work three trains at once, and lights, Stations, and Signals. See it working on the first floor.

NEW HORNBY LOCOS FOR OLD!

Gamages specialise in the Hornby part exchange scheme for Locomotives. Write and ask us how you can obtain a new Locomotive for an old one—we will post you a leaflet with full particulars by return.

Gamages Flying Ground

We are model aeroplane specialists, and experts demonstrate all the thrills of this fine hobby at the Flying Ground — First Floor.

THE FAMOUS F.R.O.G. MODEL AEROPLANES

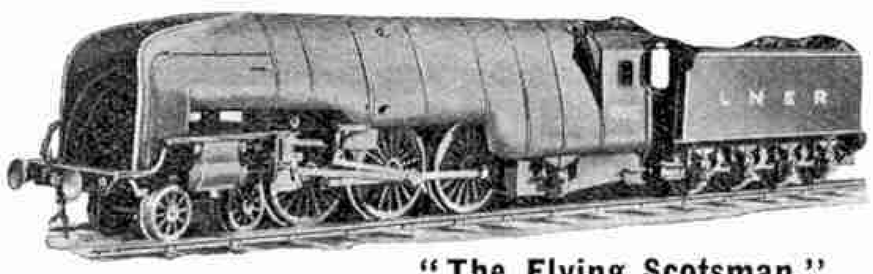
In various National Colourings

British Made. Illustrated is a "Frog" exact to scale model of the interceptor Fighting Mark IV with R.A.F. markings which are in actual colour. Will fly 300 ft. at a height of 70 ft. Rises straight off the ground. Also obtainable in the following national colours: Argentina, Belgium, France, Italy, Holland and U.S.A. Complete in patented container box.

Price each **7'6** Post 6d.

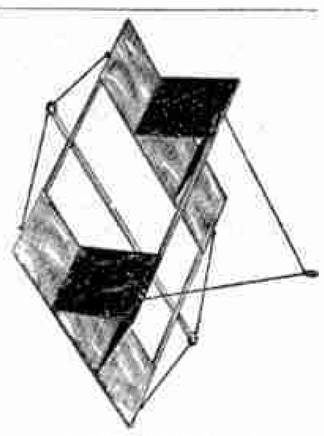
WORKING MODEL TELEPHONE

A replica of the latest type of Post Office Public Telephone. It consists of a polished Bakelite Pedestal and Telephone, and the Signalling Buzzer is housed inside the pedestal. Calling is entirely automatic; immediately the instrument is removed from its base the signal is given by the distant set. Although an ordinary pocket battery is used this wonderful set will give telephone communication up to one mile. Battery 4½d. extra. Price **25'6** Post 1/-
35 ft. Flex is supplied. Extra Flex—50 ft. 4/-; 100 ft. 7/6.



"The Flying Scotsman"

A wonderful Electric Model of the Giant L.N.E.R. Loco No. 10000. See it in the Model Railway Section. FIRST FLOOR.



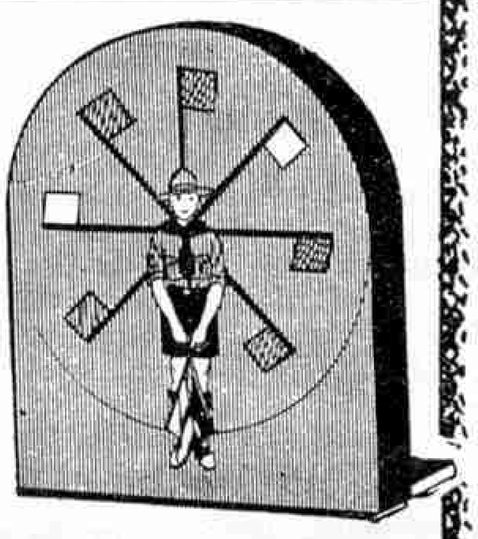
GAMAGES "ALTIKITE"

This Kite is a great flier and has been specially built for Gamages. Note the size, 25 in. × 25 in. It is undoubtedly the best value ever offered at the price. Price **2'-** Post 6d.

MODEL SEARCHLIGHT

Will throw a beam of light 40 ft. in the air. Strongly made and finished in black. Replaceable battery fits in base. Dimensions: Height to top of light, 4½ in. Size of base, 4 in. × 3 in. Diameter of lens, 2 in. Price complete with battery **3'9** Post 6d.

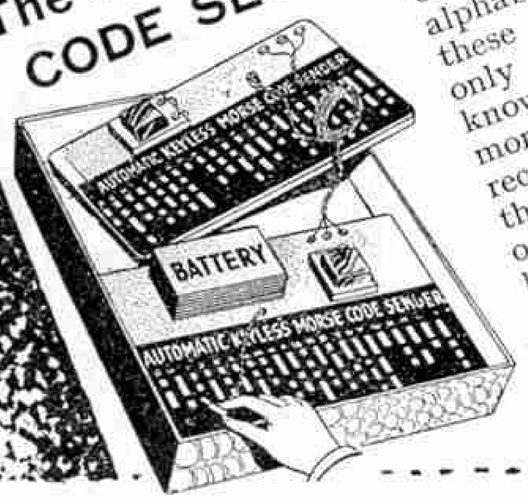
Electric Model Semaphore Signaller



It consists of a frame with the figure of a Scout printed upon it. At the back is a board bearing a number of metal studs, each of which represents a letter or symbol in the semaphore code. The operator simply touches with a terminal the stud required which is indicated by a printed letter, and the correct flags are illuminated. An ordinary pocket battery is used.

Price **7'6** Post 6d.
Battery 4½d. extra.

The very latest in MORSE CODE SETS



By means of the cleverly designed alphabetical board in these sets, boys with only the slightest knowledge of the morse code can send or receive messages. All that is required is an ordinary pocket battery. Price, complete with battery, **10'6** Post free.

GAMAGES

HOLBORN, LONDON, E.C.1

Telephone: Holborn 8484. *City Branch: 107, Cheapside, E.C.2*

THREE IN ONE

The new office boy had been instructed how to answer callers. Just before noon a man asked, "Is the manager in?"

"Are you a salesman, a bill collector, or a friend of his?" the boy inquired.

"All three," was the answer.

"Well, he's in a business conference. He's out of town. Step in and see him."

* * * *

Judge: "Prisoner at the bar, do you plead guilty or not guilty?"

Prisoner: "Not guilty, your honour."

Judge (sternly): "Have you ever been arrested before?"

Prisoner: "No, your honour, I never stole anything before."

* * * *

Passer-by: "Here's sixpence, poor man. It must be hard to be crippled."

Beggar: "Yes: but people used to steal money out of my cup when I was blind."

* * * *

Old Gentleman: "You're an honest boy, but the money I lost was a ten shilling note, not ten separate shillings."

"I know, sir; but the last time I found a note the man didn't have change to give me a reward."

* * * *

Boy: "What do people have candles on their birthday cake for, dad?"

Father: "Oh, just to make light of their age."

* * * *

Tramp: "Can you spare me a little cake, sir?"

Householder: "Why won't bread and butter do?"

Tramp: "Well, yer see, it's me berfday to-day, sir!"

* * * *

"Mary, my uncle in Venice is sending you a gondola. You'll have to learn to play it!"

"You silly, you don't play a gondola, you throw it over your shoulder like a shawl!"

* * * *

Magistrate: "You are accused of stealing a chicken. Have you anything to say?"

Prisoner: "Yes, your worship, I only took it for a lark."

Magistrate: "A lark! No resemblance whatever. Ten days."

* * * *

Milkman: "Yes, ma'am. I had my milk analysed only last week."

Housewife: "Did they find any?"

Milkman: "Find any what?"

Housewife: "Milk."

* * * *

Old Lady: "Aren't you ashamed to ask for money?"

Tramp: "Well, I am sometimes lady, but I think it's best. I got six months once for taking it without asking."

* * * *

Small Boy (outside post office): "Please, sir, would you mind licking this stamp for me?"

Gentleman: "Lick your stamp, indeed! Whatever for?"

Small Boy: "Well, you see, sir, I don't want to spoil the taste of my treacle toffee."

* * * *

"Well, Mrs. Jones, and how is Willy getting on with his French lessons on the wireless?"

"Well, Mr. Smith, he's been absent that often, I've written to his master at the B.B.C. about him."

* * * *

Small Boy (to fishmonger): "Have you any dry fish?"

Fishmonger: "Yes, sonny."

Small Boy: "Then give them a drink."

* * * *

Customer: "Three of those apples you sent me were rotten. I'm going to send them back."

Greengrocer: "That's all right, ma'am; you needn't send them back. Your word is as good as the apples."

A SLIDING SCALE

"Now, my man," said the American tourist on her first day in England, "what is the usual tip?"

"A bob," said the hall porter.

"Yes, my man—but what is a 'bob'?"

"A bob, ma'am, is half-a-crown."

"But what is 'half-a-crown'?"

"A half-a-crown, ma'am, is five shillings!"

* * * *

Mother: "Did you scribble this on the fence?"

Johnny: "Me? Do you think I'd *chalk* on a fence when I've got a pen knife?"

"I've looked all round it, foreman, and it don't say owt about not touchin' it." *Courtesy, "L.M.S. Magazine."*

"All you have to do," said the producer to the cinema star, "is to seize the woman in your arms, jump on top of a passing taxi, and from there to the fire-escape of the building in the corner. Then you must climb up to the sixth floor, drag her to the parapet, and, bracing yourself against a chimney, hurl her out into space. She catches a window-ledge in her fall, and—"

"S'pose I drop her?" ventured the actor.

"Well, you'll have to pick her up and begin all over again."

* * * *

Lady (staying in the country): "Is this milk from contented cows?"

Farmer: "Well, now, ma'am, to be honest, one of them did seem to be a little bit annoyed by the flies."

* * * *

Sergeant (sarcastically): "If you could only shoot as well as you can eat, you'd be O.K."

Recruit: "Well, what do you expect. I've been practising eating for 26 years, but I've only had this blinking gun a fortnight."

WELL DISGUISED

Pedestrian (to boy leading a skinny mongrel pup) "What kind of a dog is that, my boy?"

Boy: "A police dog."

Pedestrian: "It doesn't look like one."

Boy: "No, it's in the secret service."

* * * *

An old negro was burning the grass off his field. A wise young man stepped up and said: "Don't do that. It will be as black as you are."

"Nevah mind," came the reply. "It will grow up as green as you are."

* * * *

Boxing Instructor: "That was a half hook."

Pupil (nursing jaw): "Well you can keep the other half."

* * * *

Henry (entering his father's study): "Daddy, you said if I saved you two shillings you would give it to me, didn't you?"

Father: "That's right."

Henry: "Well, you remember you promised to give me two shillings if I passed my school examinations? I didn't pass, so I've saved you the two shillings."

* * * *

"You seem to enjoy watching your son play football?"

"Oh, yes!" answered Farmer Giles. "If he ever gets into the habit of working as hard as that, we may make the old farm pay yet."

* * * *

Visitor: "Your son is rather small for his age, isn't he?"

Fond Mother: "Oh, no; most boys of his age are overgrown I think."

* * * *

First Business Man: "I beg your pardon, but what is your name?"

Second Business Man: "Name? Don't you see my signature on the letter I sent you?"

"Yes, that's what aroused my curiosity."

* * * *

"Now I've had my revenge," said the shoe-shop proprietor to his friend, as a customer left.

"Revenge! How so?"

"Well, the young lady who just left is a telephone operator. I gave her the wrong number."

* * * *

Mr. Meekman: "Do you serve shrimps here?"

Waitress: "Yes, sir; we serve anyone."

* * * *

"Frightened of walkin' on that beam?" said the housebreaker's foreman to the navvy who was crawling on hands and knees over a fifty-foot chasm.

"No, frightened of walkin' off it," came the reply.

* * * *

Jackie (to departing relative): "There's no hurry, auntie. Daddy has put the clock a whole hour ahead."

* * * *

"So you've been to the doctor about your loss of memory. What did he do?"

"Gave me some tablets to take."

"Have you benefited from them?"

"Can't say that I have. You see, I forgot to take them."

* * * *

A farmer, visiting his son's college and wandering into a chemistry class, saw some students busy with retorts and test tubes.

"What are you trying to do?" he asked.

"We're endeavouring," replied one of the students, "to discover or invent a universal solvent."

"What's that?" asked the farmer.

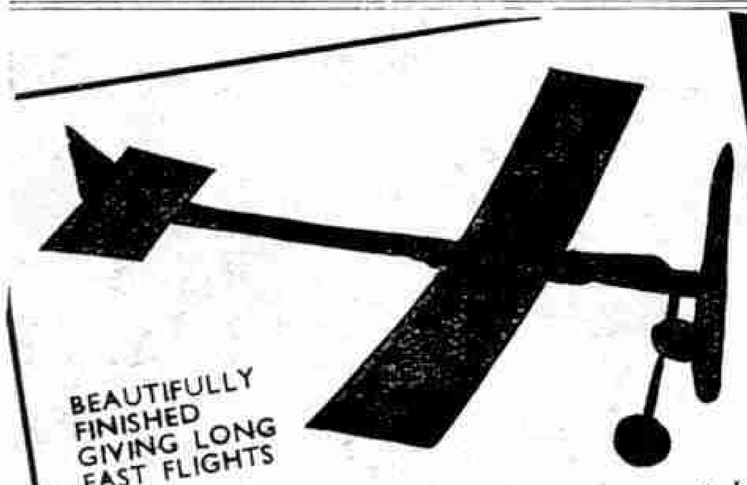
"A liquid that will dissolve anything."

"That's a great idea," agreed the farmer. "When you find it, what are you going to keep it in?"

* * * *

"Have you got the time?"

"Part of it: the hour hand's missing from my watch but t's ten minutes to something."



BEAUTIFULLY FINISHED GIVING LONG FAST FLIGHTS

● The "MOTH" Price 4/6

Length 19 in., span 18½ in., fitted patent double bearing and shockproof chassis, 8 in. hand-carved and balanced propeller, covered red proofed silk. A splendid flyer, and beautifully finished. At the price this model is undoubtedly the finest value ever offered. (Patent No. 296946.)

Weight, 1 15/16 ounces. Distance, 550 feet.
Speed, 15 m.p.h. Ceiling, 50 feet.
Rises from the ground.

OTHER FINE MODELS 1/6 to 5 gns.

● The "DEMON" Price 7/6

For Stunting. The "Sports Model."
Weight, 3¼ ounces. Distance, 850 feet.
Speed, 16 m.p.h. Ceiling, 80 feet.
Rises from the ground.

● WARNEFORD

ASK YOUR FRIENDS

CONFIDENCE—
IN MOST THINGS MEANS VICTORY—
● ALWAYS WITH A WARNEFORD
From all Good Stores, Toy and Sports Dealers
Fully illustrated price list post free on application to:

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FLYING AIRCRAFT
Dept. 21, GREENWICH, LONDON, S.E.10

Be well groomed not gummed!

● BRYLCREEM does not contain Gum, and cannot cause flake in the hair, or set it hard—yet it controls the hair perfectly.

● BRYLCREEM possesses definite properties which promote hair growth, eradicate scurf, and give lustre to the hair. BRYLCREEM is also better than Brilliantine and it goes further.

Avoid injurious substitutes.

Insist upon having

BRYLCREEM

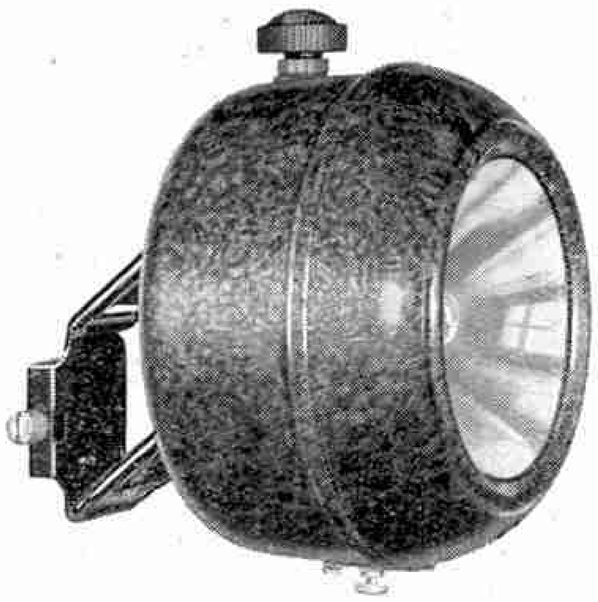
AT ALL CHEMISTS, HAIRDRESSERS AND STORES.
In the black screw cap bottle. 9d., 1/-, 1/6 and 2/6.
The County Perfumery Co., Bradford St., Birmingham.

Sells

NOWEIGHT

"LITALITE"

the Lamp that is different



● Fitted with silver-plated reflector, spring bracket and safe screw-on front. Takes standard battery. Ever Ready "800" or similar.
Price **6/9** with bulb.
Battery extra.

Ask to see this new electric Lamp. It is clean to handle, safe, and gives a brilliant beam.
Made in Black and an attractive reproduction of Walnut graining. Both colours are solid and cannot chip or peel off.

Bluemel's

List post free from
Dept. 27, Wolston
near Coventry

KIA-ORA

Will keep you on top of your form

Some fellows seem to "do things" so easily. But there's no magic in it—it's a matter of keeping fit. Take Kia-Ora, for instance—a glass during the "break" of a game or the day's school-work makes you feel brighter. Your mind works alertly—and your muscles follow suit. And it's not just a matter of a really pleasant drink . . . the pure fresh fruit juices in Kia-Ora are a real tonic—full of health and pep. So take Kia-Ora and "do things" better!

SQUASH 2/- large bottle
EXTRA STRENGTH 1/1 half-bottle

KIA-ORA
LEMON ORANGE
GRAPE FRUIT

Competition Corner

AN ENGINEERING JOKE OR STORY

Among the happiest jokes and yarns that we have published in our "*Fireside Fun*" pages have been those with an engineering flavour. We often recall with a chuckle the story of the American conducting his aunt, a visitor from an English country village, around the sights of New York. Proudly he drew attention to the blocks of huge skyscrapers. "Skyscrapers!" commented auntie, "How I would love to see one of them working."

The resemblance of steel frame buildings to giant Meccano models has been the origin of many good jokes. One that will be familiar to many of our readers, but which bears retelling, concerns a braggart American visitor and his "fed up" English host. Strolling along the Thames Embankment one afternoon the American spotted the rising steelwork of the County Hall, then in course of erection on the farther side of the river. "Say!" he asked, "What's that little shed yonder?" His host's chance had come. Quickly came the reply: "Drat that kid! He's always leaving his Meccano about!"

There must be many unpublished yarns of this type—not necessarily associated with Meccano—known to our readers, and with the object of securing these for use on our "*Fireside Fun*" page, we are offering prizes this month for the best Engineering Jokes and Stories. No restrictions are imposed upon the nature of the stories, except our usual ban on anything vulgar. They may be any length up to 150 words, and in the judging, all other things being equal, preference will be given to original stories.

The prizes will consist of Meccano products—this term includes all goods manufactured by Meccano Limited—to be chosen by the winners from the current catalogues to the value of 21/–, 15/–, 10/6 and 5/–. In addition there will be a number of consolation prizes to be awarded to the next best entries. Competitors may submit as many entries as they wish, but no competitor may receive more than one prize.

Entries should be addressed "Tall Story Contest, Meccano Magazine, Binns Road, Liverpool 13," and must reach this office not later than 30th September.

A separate set of prizes will be reserved for competition amongst Overseas readers, whose entries must arrive not later than 30th December.

The Editor reserves the right to publish any prize-winning story without further fee and will make suitable acknowledgment of any others used.

This charming portrait of a model railway enthusiast, taken through a mirror, secured First Prize in the A Section of the May Photo Contest for S. Garbutt, of Altrincham, Ches.

September Photo Contest

This month's contest is the last of the season's series, and those readers who have not yet taken part should make a point of submitting at least one of their holiday snapshots.

The contest is open to photographs of any subject, the only restrictions being that the exposure shall have been made by the competitor and that each print shall bear a title. Any make of camera plate film or paper may be used, and the developing and printing may have been done professionally. All other things being equal, preference will be given to entries that are solely the work of the competitor, of course

The entries from each of the usual two groups, Home and Overseas, will be divided into two sections, A for competitors aged 16 and over, B for competitors under 16. Prizes of Meccano products or photographic materials, as chosen by the winners, to the value of 21/– and 10/6 will be awarded in each section. In addition there will be a number of consolation prizes.

Entries should be addressed "September Photo Contest, Meccano Magazine, Binns Road, Liverpool 13," and should reach this office not later than 30th September. Overseas closing date, 30th December.

Unsuccessful entries will be returned if a suitable stamped addressed cover is sent for the purpose.

COMPETITION RESULTS

HOME

June Photo Contest.—First Prizes: Section A, J. Robertson (Dalmuir); Section B, P. Harris (Bray). Second Prizes: Section A, Miss D. Burton (Caterham Valley); Section B, D. H. Warner (Richmond). Consolation Prizes: P. T. Clarke (East Sheen, S.W.14); A. Perkins (Hastings).

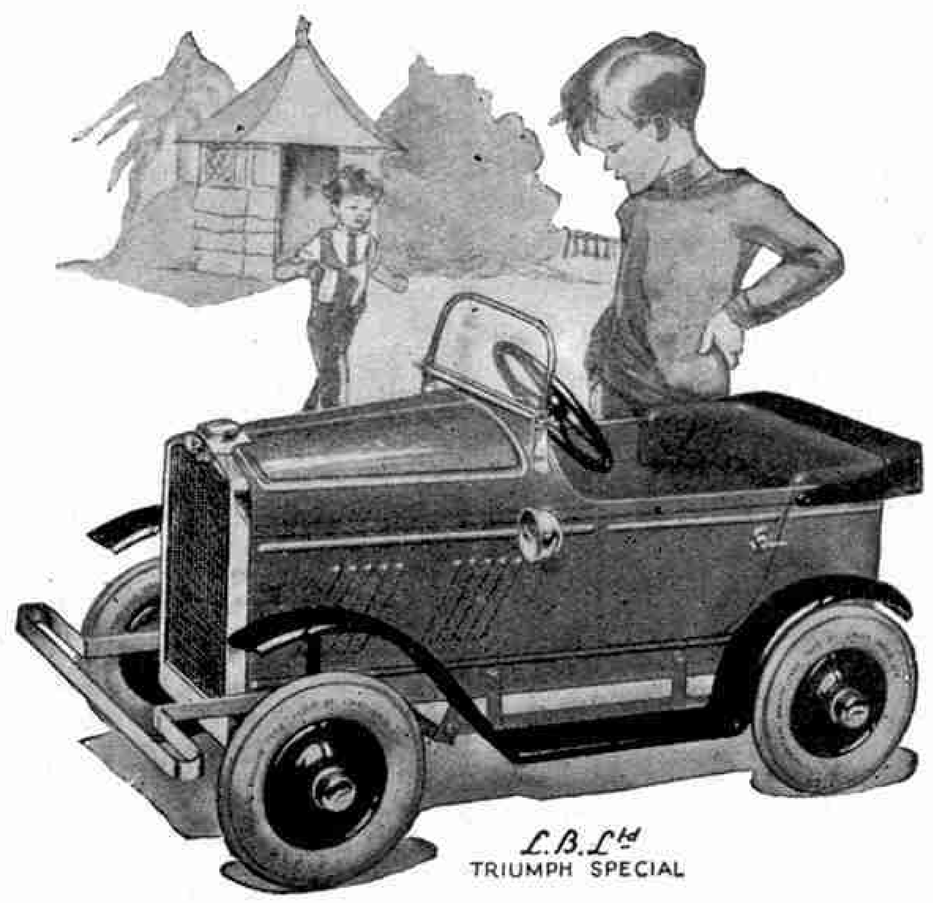
April Crossword Puzzle.—1. T. A. W. Green (Bournemouth); 2. K. N. McPherson (Edinburgh); 3. E. C. Day (London, S.W.7); 4. J. M. Southam (Lowestoft). Consolation Prizes: W. B. Acheson (Portadown); P. Bryant (Portsmouth); R. Hamilton (Glasgow); R. F. Nicholas (Portsmouth); F. E. Rehder (Dulwich, S.E.21); H. Rutter (Consett); T. G. Stevenson (Nottingham).

June Crossword Puzzle.—1. R. R. Henderson (Edinburgh); 2. D. M. Davies (Warminster, Wilts.); 3. J. M. I. Scott (Kettering); 4. K. C. Piper (Burgess Hill, Sussex). Consolation Prizes: C. Bartram (Wanstead, E.11); C. Evans (Hale, Ches.); E. Frith (Frodsham, Ches.); N. Midgley (Harrow, Middlesex).

A Selection of TRI-ANG (Regd.) Popular Cars

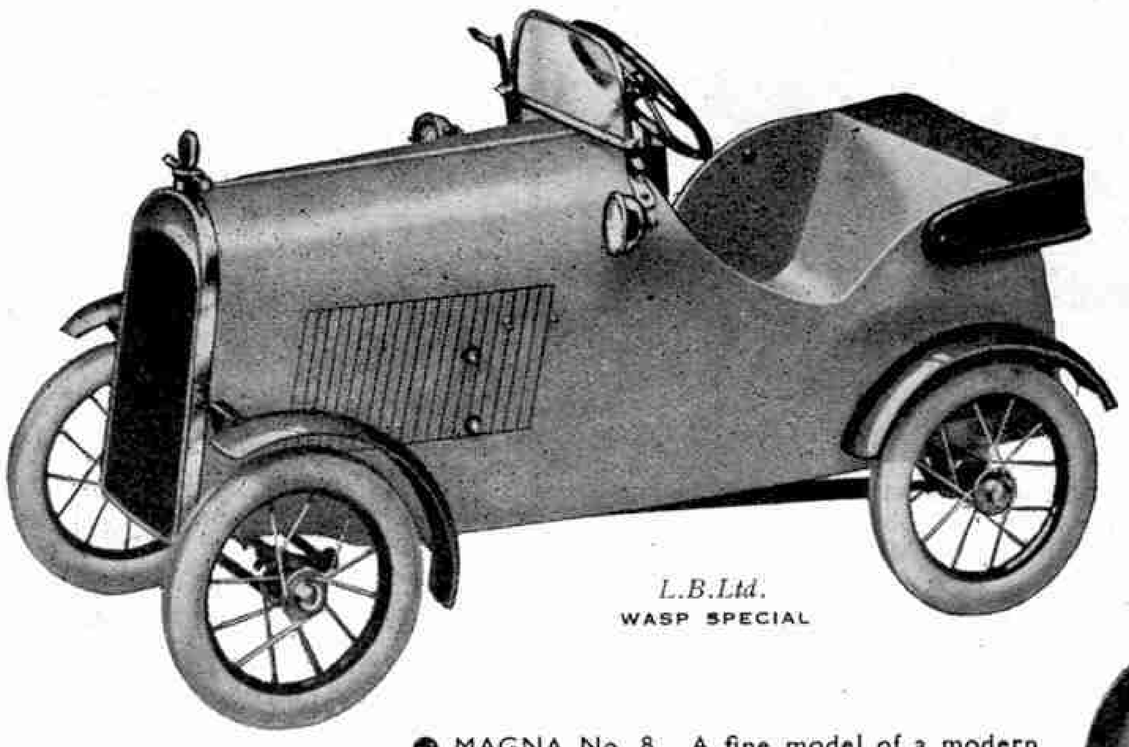
● COMET. Moulded steel body with plated radiator. Large balloon wheels with rubber tyres. Double crank drive with rubber pedals. Two dummy lamps and petrol and oil cans. Finished in red. 31" long.

17/11



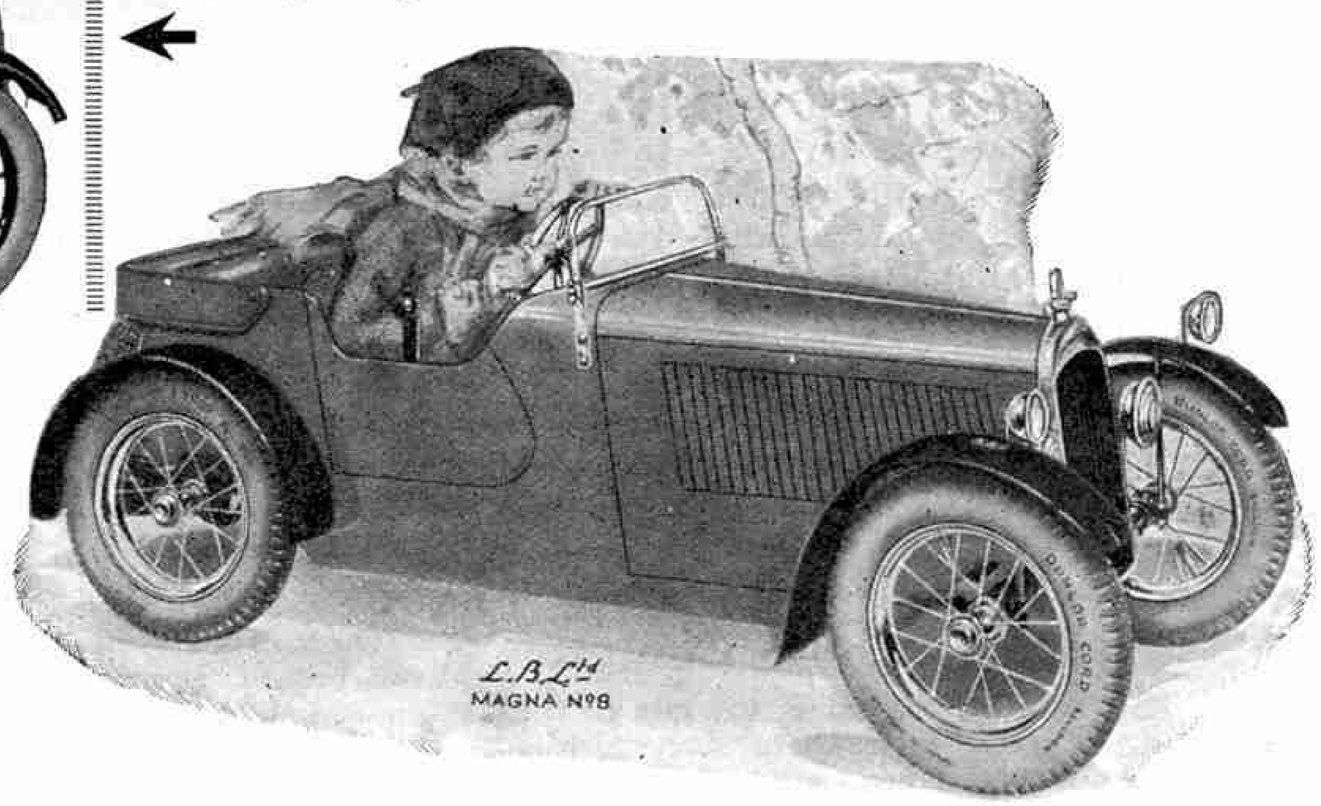
● TRIUMPH SPECIAL. A smart looking car with a reproduction of the Triumph Radiator. Double crank drive with rubber pedals. Comfortably upholstered back rest and dummy hood. Complete equipment includes two lamps, windscreen, large nickel-plated bumper. Steel balloon wheels with rubber tyres. Two lamps and petrol and oil cans. Side door to open. Painted beige with red lines and red wheels. Length 35 ins.

32/6



● WASP SPECIAL. Latest model of Sports Car with Bentley Type Radiator. Wire wheels fitted with thick white sponge rubber tyres, real automobile pattern. Equipment includes two electric lamps, windscreen, direction indicator, mechanical horn and four sports type mudguards. Body finished attractive orange colour with nickel-plated radiator shell and lamps. Length 37 ins.

45/-



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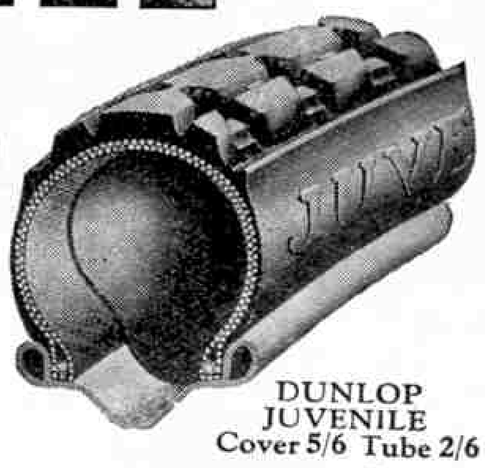

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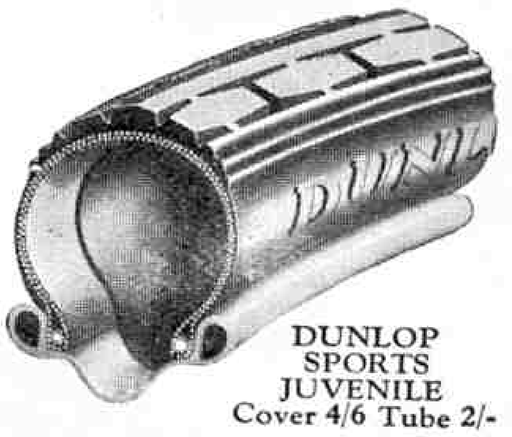

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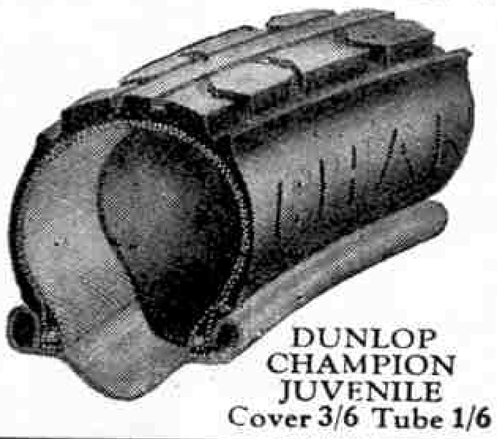

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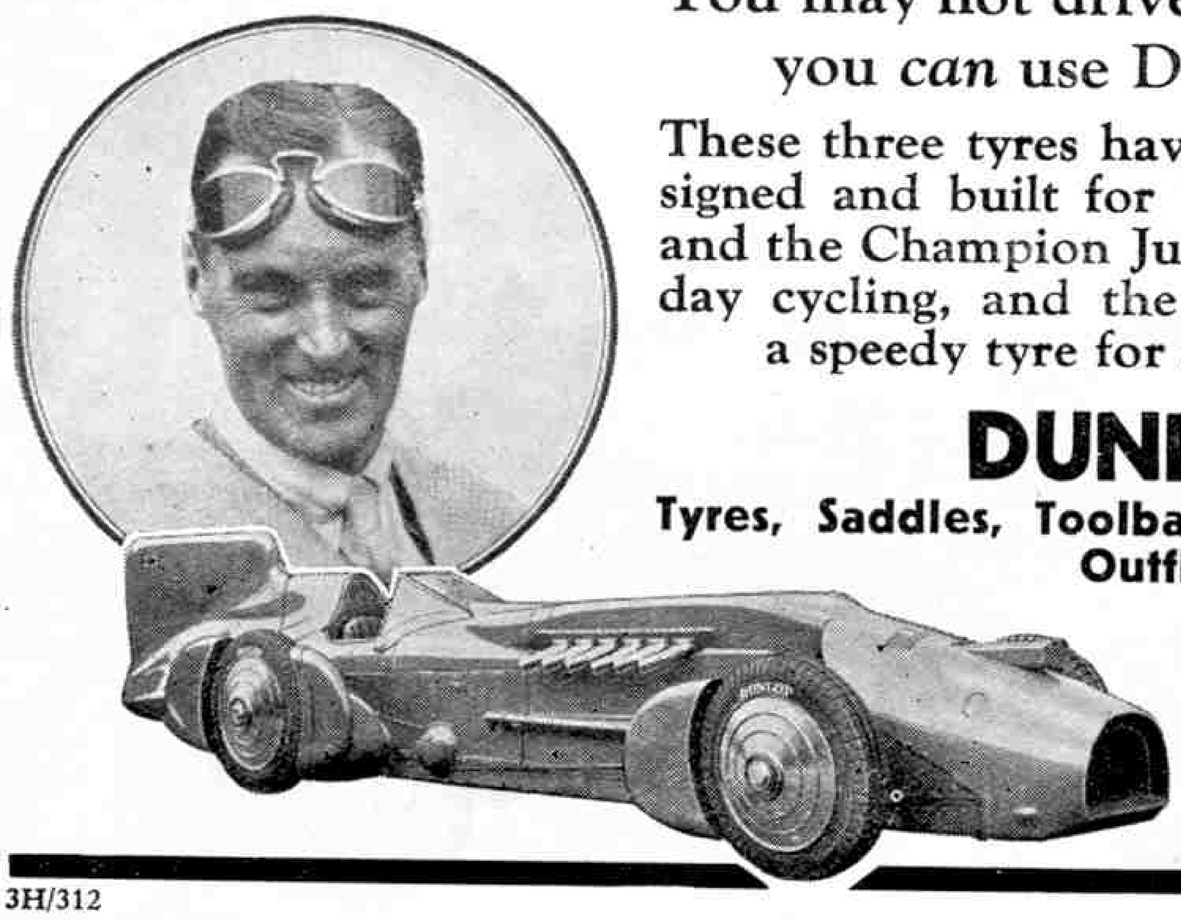

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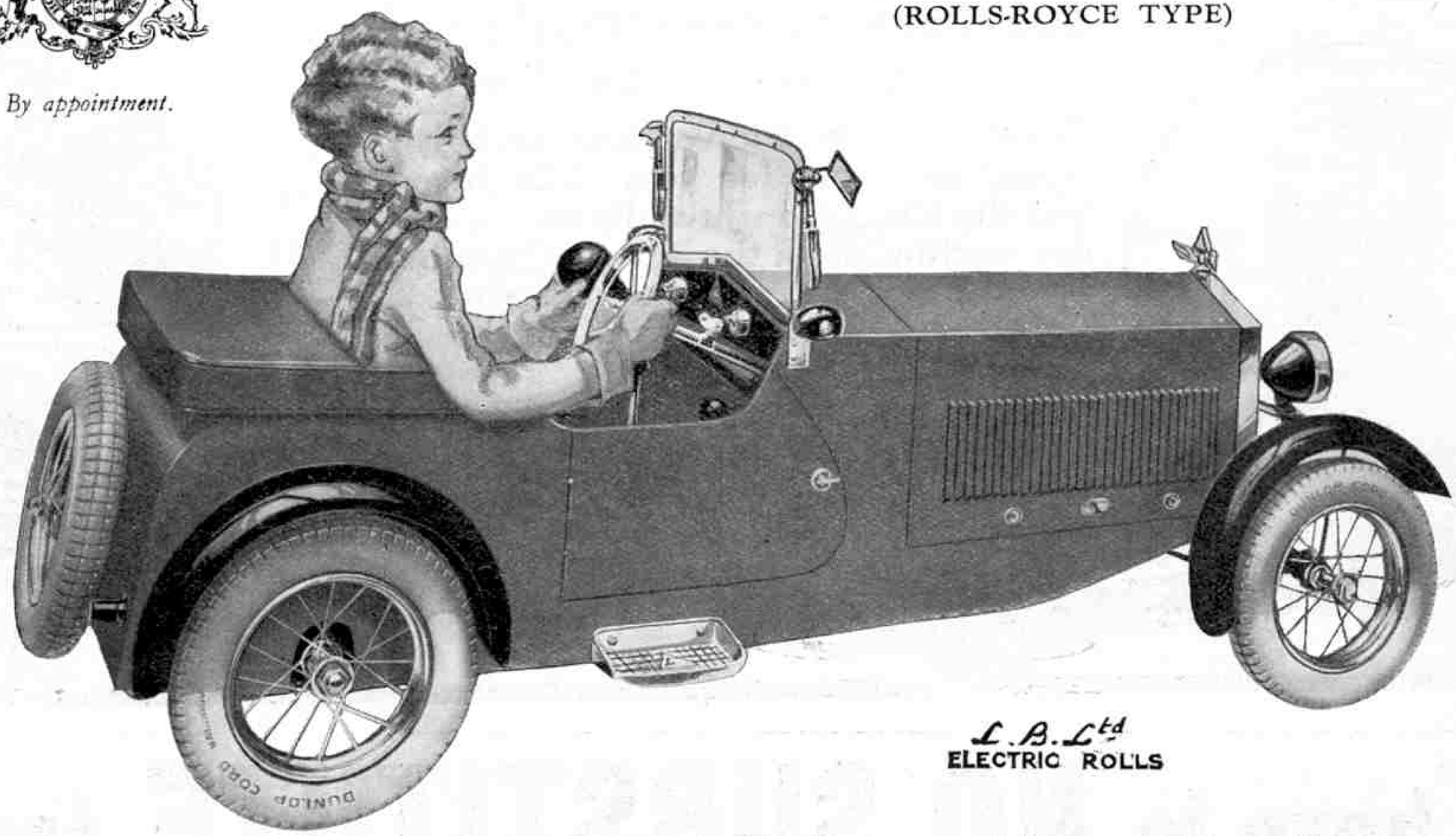

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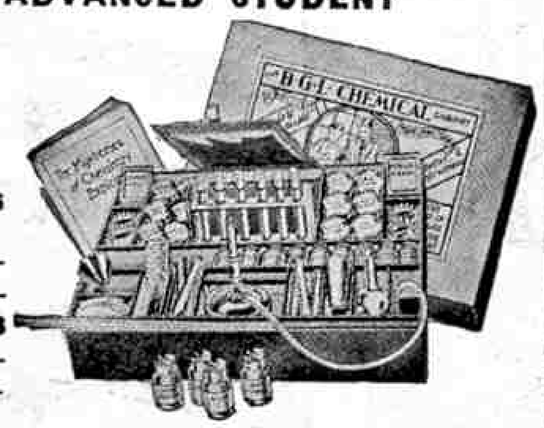

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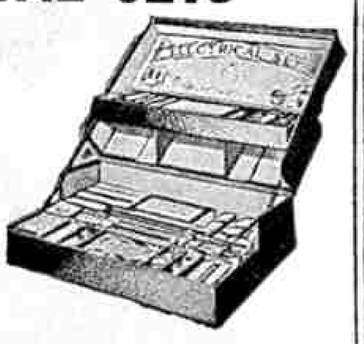

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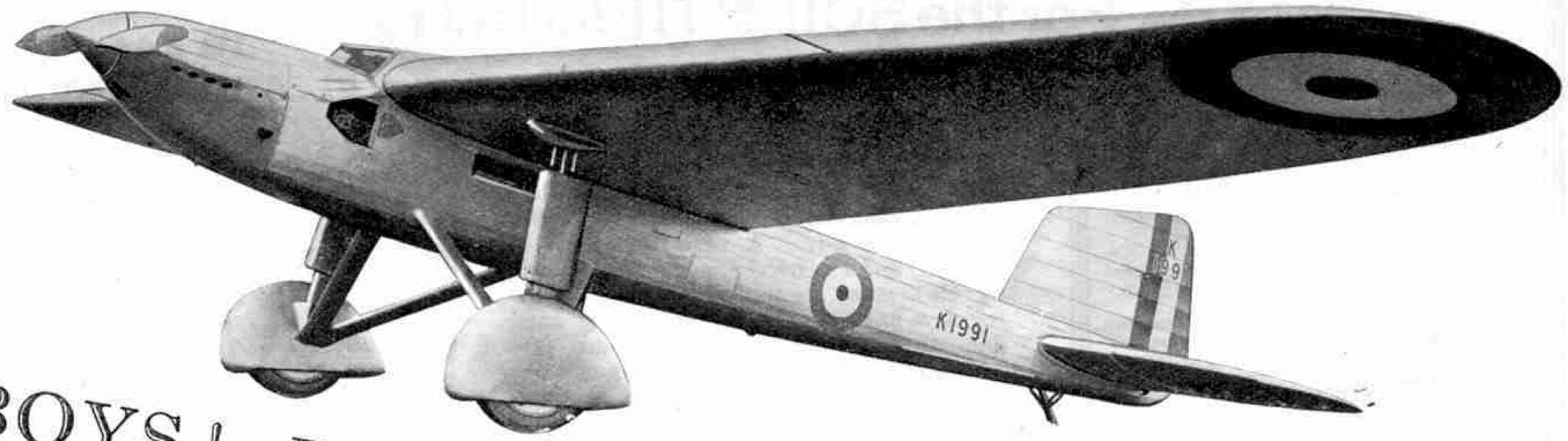

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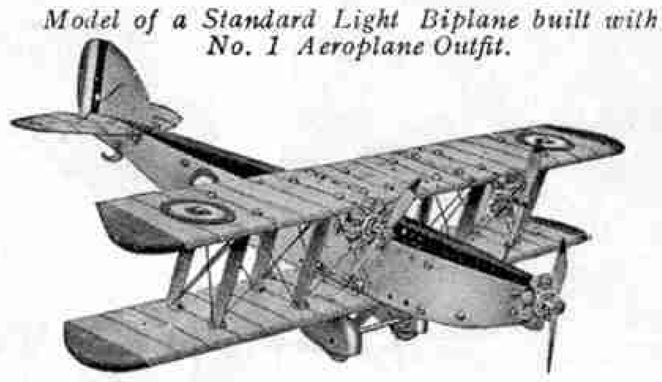

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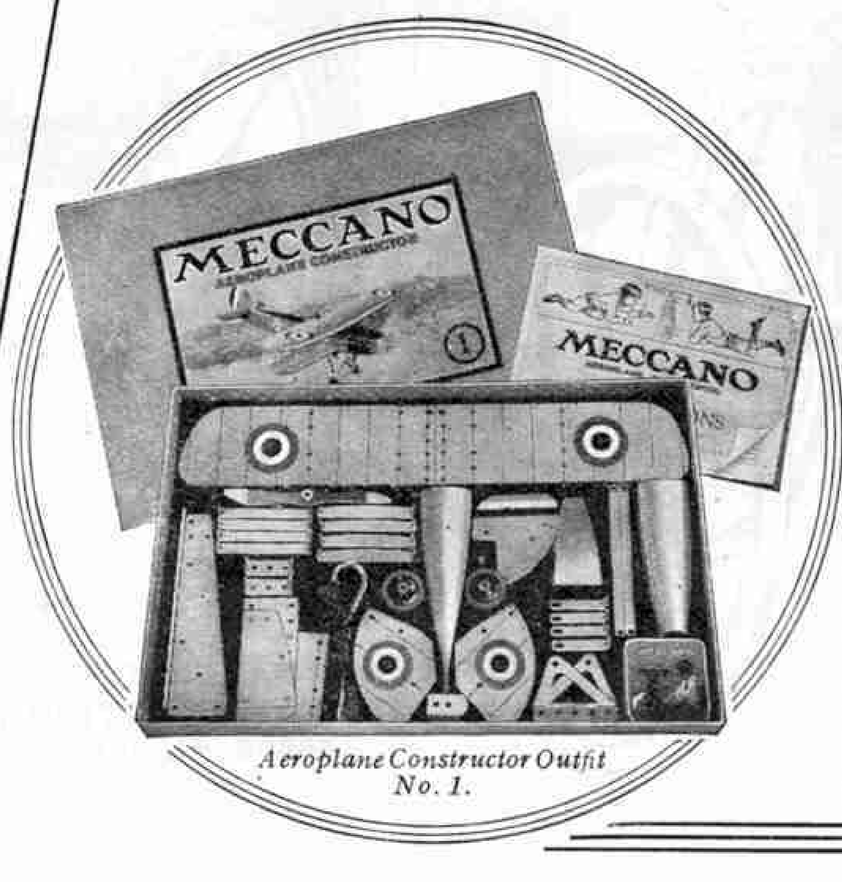

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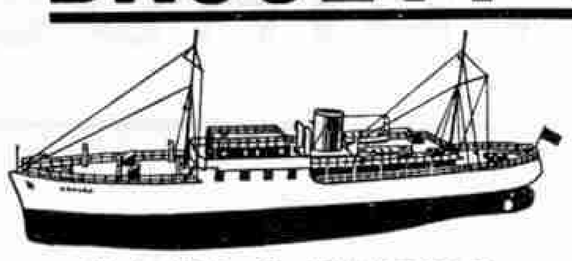

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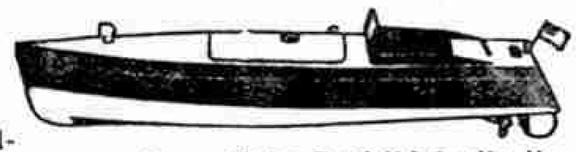

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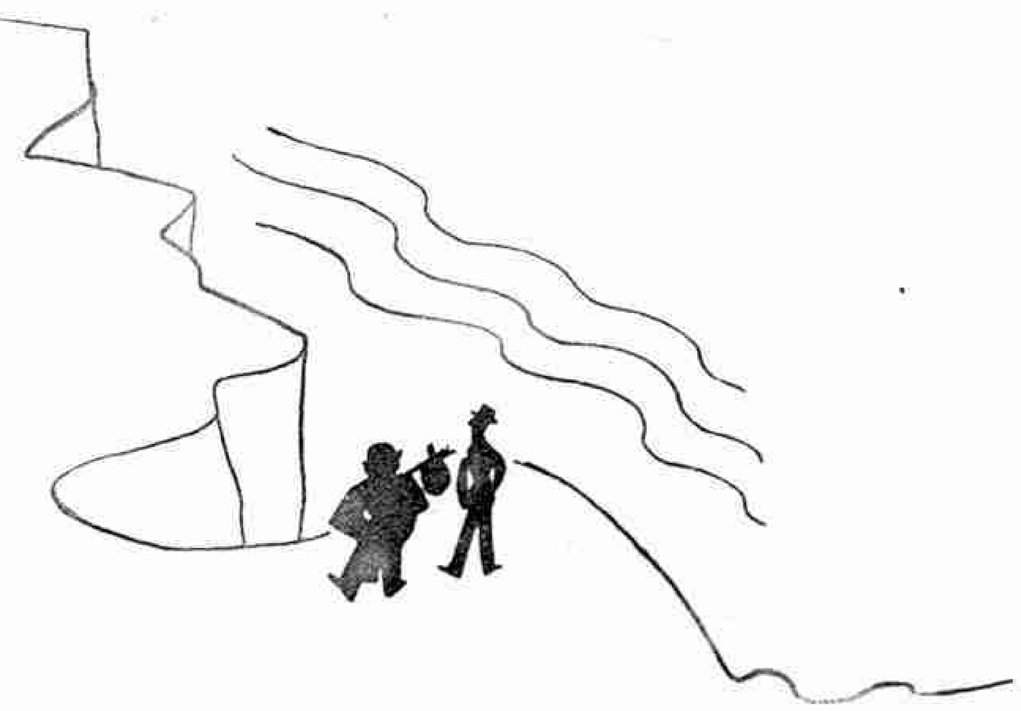

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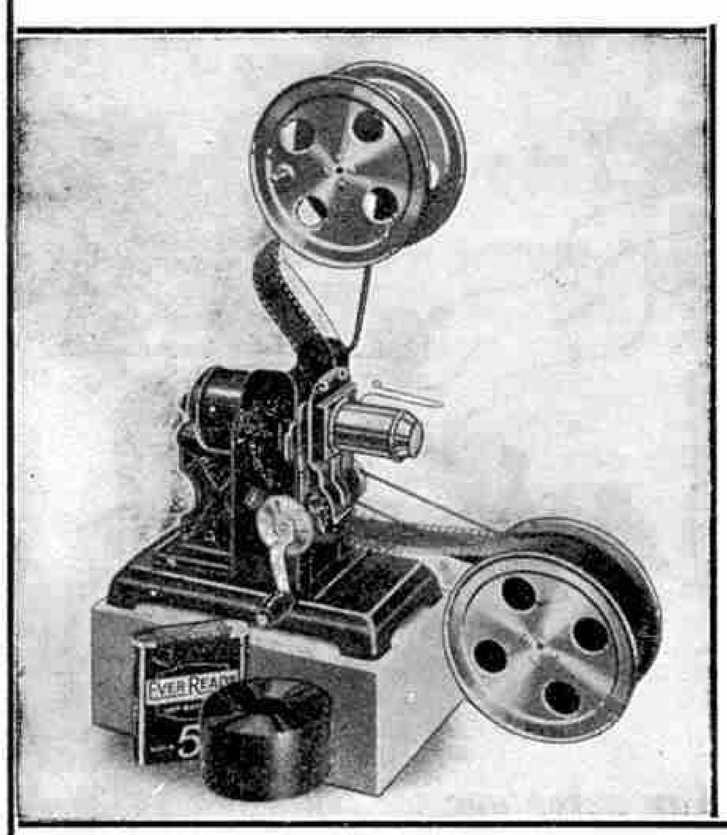

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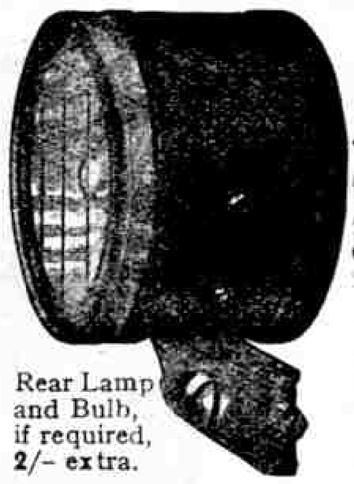

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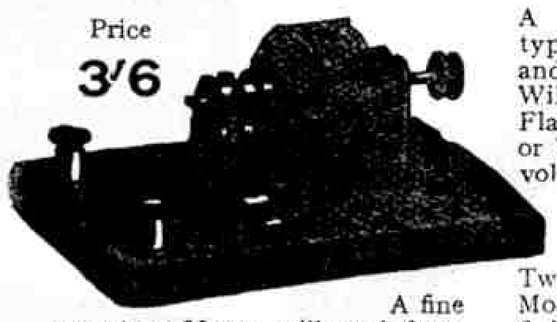

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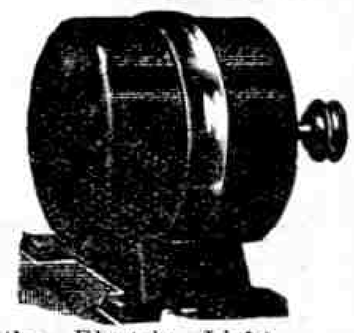

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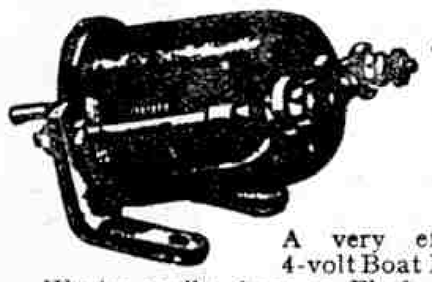

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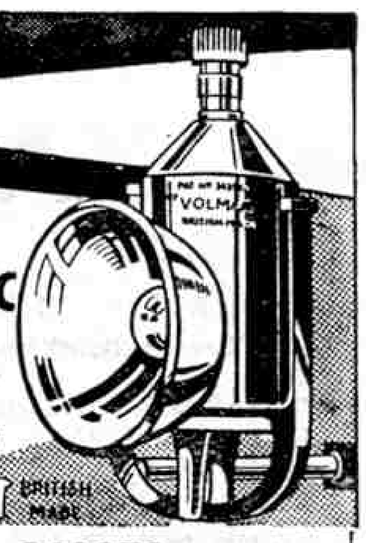

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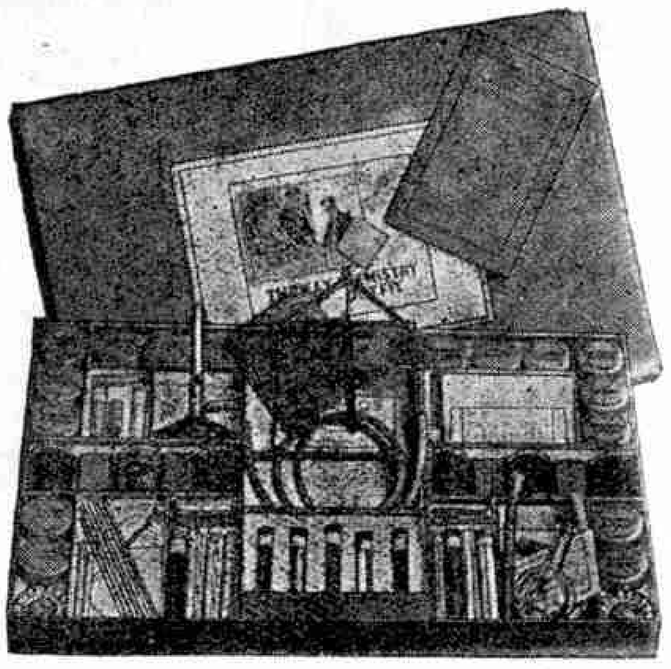

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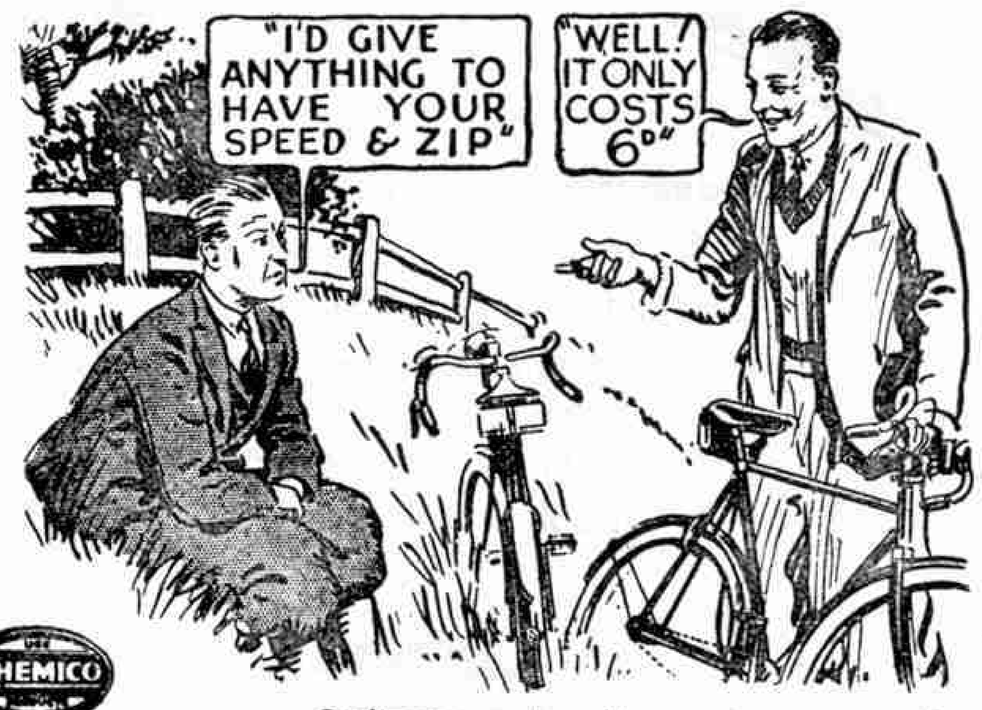

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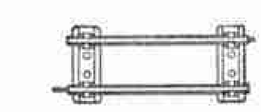
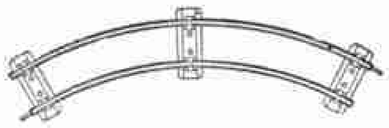
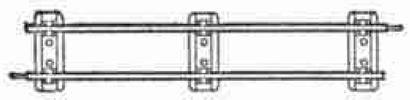


B½ *Straight Half Rail*

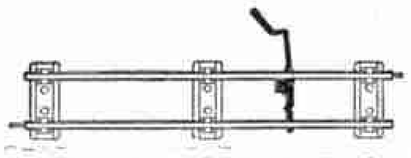


A1 *Curved Rail*

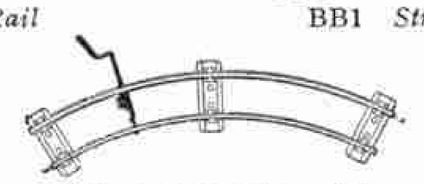
A1½ *Curved Hal Rail*



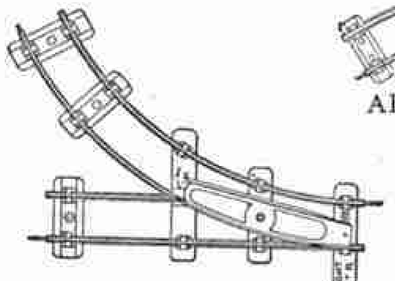
B1 *Straight Rail*



BB1 *Straight Brake Rail*

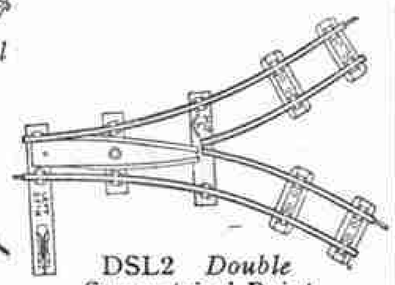


AB1 *Curved Brake Rail*



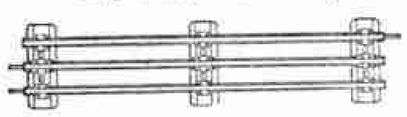
PR1 *Points (Right-hand)*

CR2 *Right-angle Crossing*

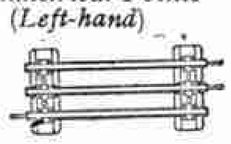


DSL2 *Double Symmetrical Points (Left-hand)*

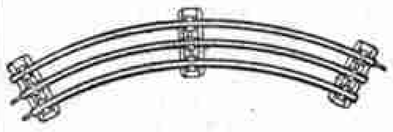
EA1½ *Electrical Curved Half Rail*



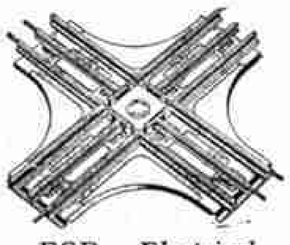
EB1 *Electrical Straight Rail*



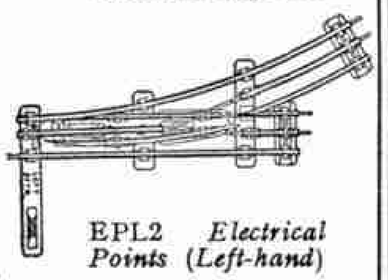
EB½ *Electrical Straight Half Rail*



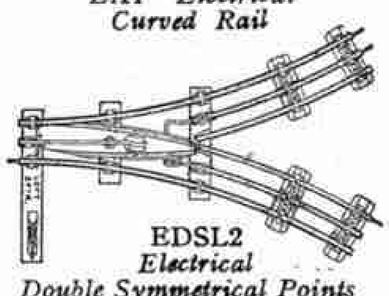
EA1 *Electrical Curved Rail*



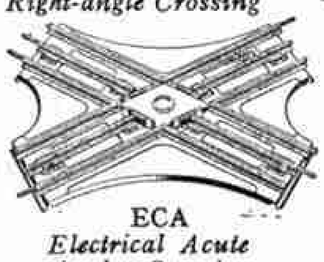
ECR *Electrical Right-angle Crossing*



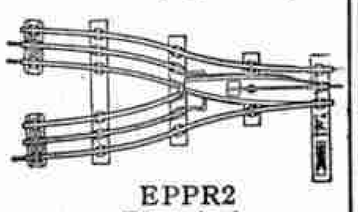
EPL2 *Electrical Points (Left-hand)*



EDSL2 *Electrical Double Symmetrical Points (Left-hand)*



ECA *Electrical Acute Angle Crossing*



EPPR2 *Electrical Parallel Points (Right-hand)*

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PL1	Left-hand points (1 ft. radius) ...		
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DSL2	Double symmetrical points, left-hand (2 ft. radius) ...		
CR2	Right-hand Crossings (2 ft. radius) ...	each	1/9
EA1	Curved rails (1 ft. radius)...	doz.	6/6
EA1½	Curved half rails (1 ft. radius) ...	doz.	4/6
EB1	Straight rails ...	,,	6/–
EB½	Straight half rails	,,	4/6
EPPR2	Parallel points, right-hand (2 ft. radius)	per pair	8/6
EPPL2	Parallel points, left-hand (2 ft. radius)		
EPR2	Right-hand points (2 ft. radius) ...	per pair	7/6
EPL2	Left-hand points (2 ft. radius) ...		
EDSR2	Double symmetrical points, right-hand (2 ft. radius) ...	per pair	8/6
EDSL2	Double symmetrical points, left-hand (2 ft. radius) ...		
ECA	Acute-angle Crossings	each	4/–
ECR	Right-angle Crossings	,,	4/–

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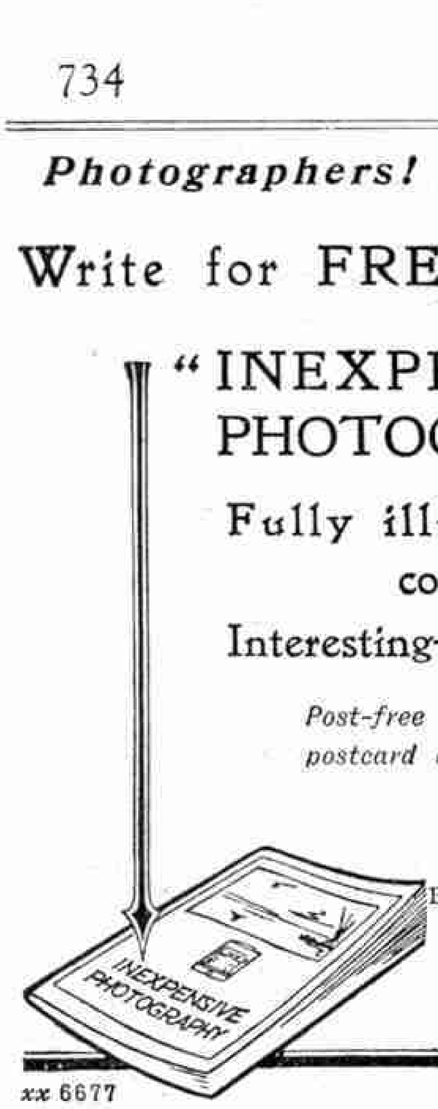

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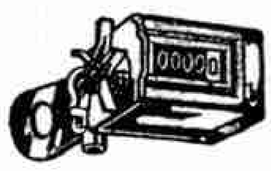

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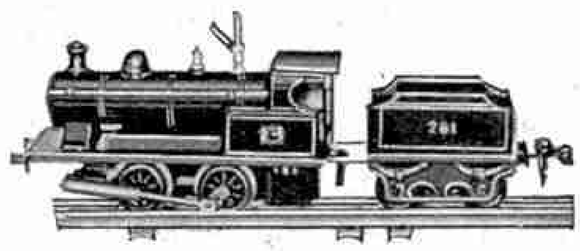

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Meccano enamel has been introduced to enable model-builders to convert nickel parts to colour or to touch up coloured parts should such treatment become necessary through mishandling. It is available in red, grey or green, each colour being identical in shade with the enamels used in the Meccano Factory for spraying Meccano parts.

Price per tin 8d.

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Mount Everest—(*Continued from page 689*)

recoils upon the undertaking. There is hardly a hitch to give the scale of the exploit, to give homekeeping imaginations the help that some may need to measure what has been accomplished on this journey." Some idea of the conditions can be obtained from the illustrations showing the impossibility of the terrain for a forced landing, and from Colonel Blacker's account of the great air currents experienced, which caused a loss of height of 2,000 ft. in a few seconds. When it seemed as though the aircraft was to be forced down on an almost indescribable medley of peaks, ranges and spurs, he says : "The alarm was short lived, for our fine engine took us through the great down-draught over the peak and again we climbed."

The supreme confidence in their engines and equipment engendered by the first flight was evidenced by the second flight over Everest, made in order to fill the gaps in the photographic survey on the first flight. This second flight, which was even more successful than the first, was carried out in disregard of orders and with uninsured machines, the justification given by Colonel Blacker being : "The engines were running admirably, the aircraft behaving perfectly . . . and grounds of personal risk now distinctly lessened by experience on the original flight."

Throughout the whole of the flight, including the 3,000 miles cross-country to and from Karachi, not the slightest trouble was experienced with the engines or their installation, and the box of spares which was taken to India has been returned unopened, and with its seals unbroken.

Financial support for the expedition was provided by Lady Houston ; Air Commodore Fellowes was the Leader of the expedition, Squadron Leader Lord Clydesdale, first pilot, Flight-Lieut. D. F. McIntyre, second pilot, and Lieut.-Col. L. V. S. Blacker, observer.

For permission to reprint this article we are indebted to the courtesy of the Edito r of '*The Bristol Review.*"

Stamp Advertisements cont. from p. 718

FREE. Fine set of Japanese. Request approvals from ½d.—10, Ward Street, West Hartlepool.

½d. Approvals. Wonderful selection. Post free.—N. Swain, 181, Crimicar Lane, Fulwood, Sheffield.

100 DIFFERENT STAMPS FREE. Send for ½d. approvals.—Cox, 21, Dennis Mansions, Westcliff.

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THE FIRST STAMP EVER ISSUED

was the British 1840 Penny Black. Against a P.O. **1/9** we will send you a genuine postally-used copy of this interesting stamp (cat. 6/-); for a further **5/-** you may have a copy of its companion stamp, the 1840 2d. Blue (cat. 20/-). Another "classic" which every Collector should have is the **Cape of Good Hope** 4d. blue **Triangular** (cat. 15/-), and a nice copy will be supplied at **5/-**. Superb approvals of any country against satisfactory English references or a deposit. **Full Lists Free.**
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from which you may select any 100 for 3/-. This selection is not made up of the thousand commonest stamps, but contains specimens priced by Stanley Gibbons up to 1/- each. For 3/- you have the opportunity of choosing 100 stamps of the catalogue value of 20/- or more.
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who collect stamps, should not delay in sending for my **4-a-penny** selections—the best there are.
L. D. MAYNARD
78, Richmond St., Southend-on-Sea

READERS' SALES

Splendid condition. Meccano Magazines, Dec. 1923 to Feb. 1927 inclusive. Best offer secures lot.—Taylor, Eastdene, Bramley, Surrey.

Wanted. January, February, March and April 1925 "M.M.'s" for an Australian. State price and condition to—Box 901.

Sale. Stanley Gibbons "Whole World" catalogue, 1932, good condition. Offers.—Cooper, "Roslyn," Friary Road, Finchley, N.12.

Sale. Meccano Magazines 1930 volume, good condition, spring binder, also stamp collection.—P. Doyle, 2, Auburn, Wexford.

Gauge "O" railway for sale, perfect condition. Railway and Engineering Books, Tug Boat Hull. Stamp for particulars.—E. Paul, "Glenora," Brentwood Road, Gidea Park, Essex.

Sale. Fretwork Machine, treadle drill, 30/- or best offer within a week. Also wanted, buy or exchange, Clarks' "Brea" segment.—Croxton, 303, Marsh Hill, Erdington, Birmingham.

Meccano Magazines. December 1925—October 1926, August 1927—June 1930, perfect. 6 for 1/6, 11/- lot.—Young, "Wayside," Cromer.

Sale. "Givjoy" cinematograph, "Modern Boys," "Triumphs," "Detective Weeklys," and other papers. List from—R. B. Marston, Hawthorn Rd., Shrewsbury.

Track for Sale. M.M.'s 1928—Aug. 1933, good condition. Offers?—L. Corke, 39, Lyncroft Gardens, N.W.6.

Pathé Home Movie Projector with super attachment, motor and resistance, £8. Pathé Kid Projector, super attachment and resistance, practically new, £2/2/0. U.P.K. Camera and Case, £1.—Donald Mackay, Courtfield House, Trowbridge.

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 6th of each month for following issue. Half-tone blocks up to 100 screen.

Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher copies. Sent free to advertisers booking one inch or over. Other advertisers desiring vouchers should add 8d. to their remittance and should order voucher copy at same time.

Remittances. Postal Orders and Cheques should be made payable to Meccano Ltd.

Ordering the "M.M." Overseas

Readers Overseas and in foreign countries may order the "*Meccano Magazine*" from regular Meccano dealers or direct from this office. The price and subscription rates are as above, except in the cases of Australia, where the price is 1/2 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 Ltd., P.O. Box 129, Paykel's Building, Anzac Avenue, 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.

READERS' SALES—Continued

Stanley Gibbons stamp catalogue, '32 or '33 issue, published at 15/-. good condition.—D. Eaton, 4, Brooklynn Dolla.

For Sale. 12 only, tete-beche blocks of four of the current Indian 1 anna stamp. Price 1/6 per block. "Indian Stamps."—Box 902.

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There are five splendid models, ranging in price from 3/11 upwards, each attractively finished and available in three different colour combinations. Ask your dealer to show you the full range of Hornby Speed Boats, or send to us for a copy of the Hornby Speed Boat leaflet in colours.

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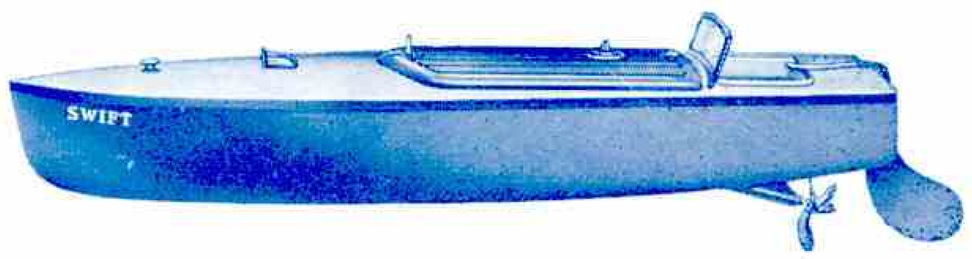

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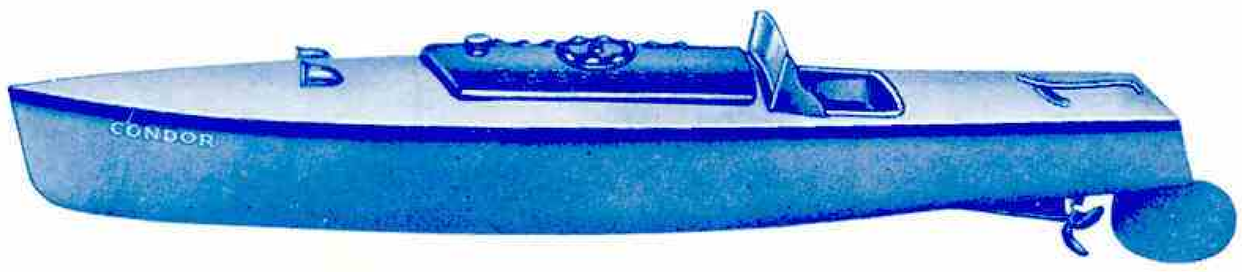

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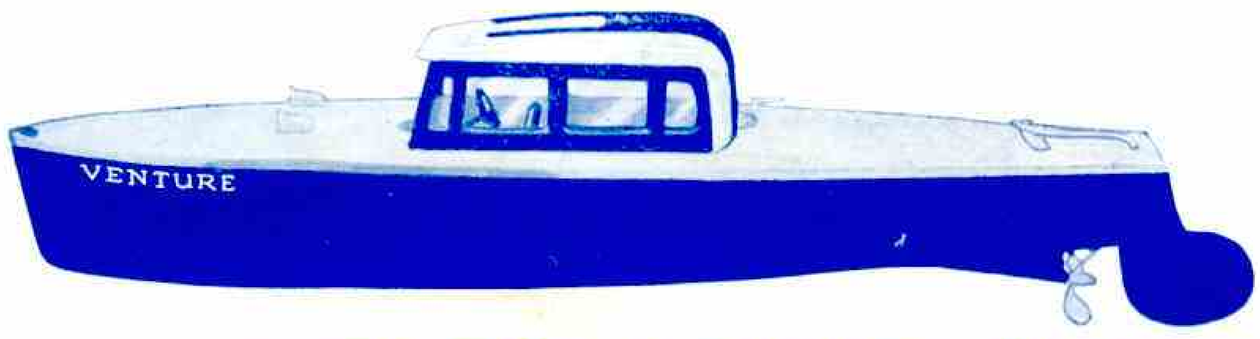

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HORNBY CABIN CRUISER No. 5. 'VIKING." PRICE 16/6

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.

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Pennants for Hornby Speed Boats Nos. 3 and 4 may be purchased separately from any Meccano dealer. Price 2d. each.

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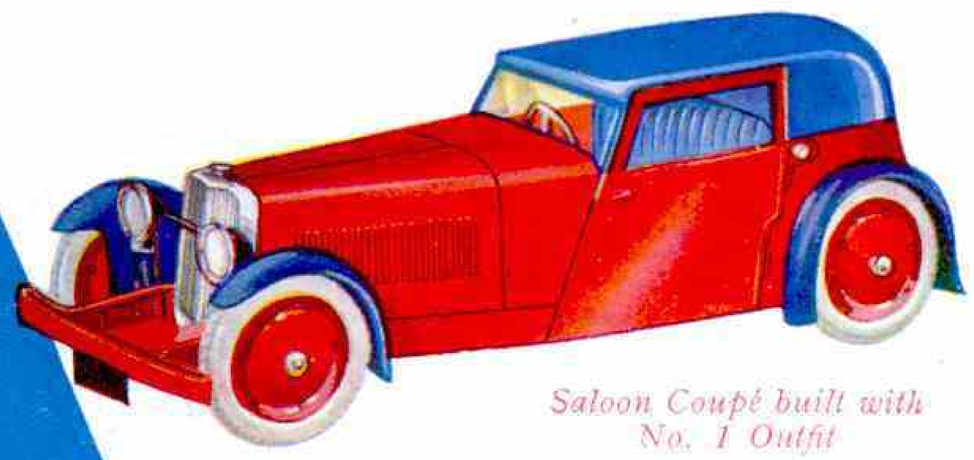
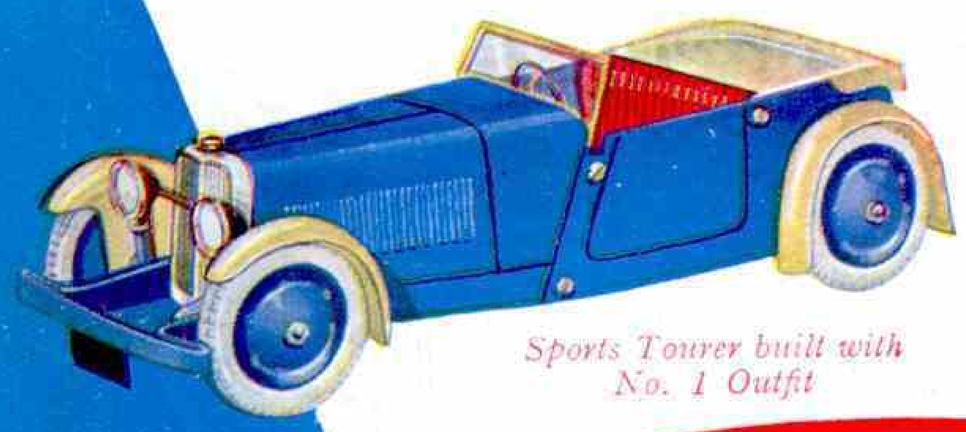
MECCANO MOTOR CAR

CONSTRUCTOR OUTFITS

Meccauto 538189



Saloon Coupé built with No. 1 Outfit



Sports Tourer 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.

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**

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Choice Range of Colours

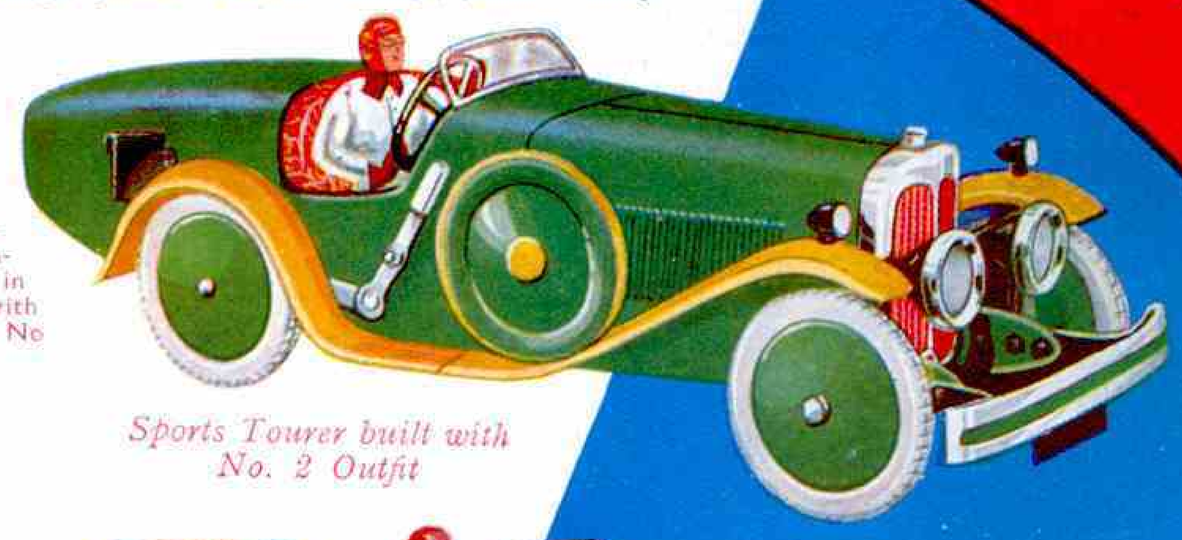
If extra parts in any of the standard colours are required they can be purchased from any Meccano dealer. In addition to the four standard colour combinations, the following parts are available in the colours indicated :—
Body Sections : orange, yellow. Wheels : orange, yellow. Wings : orange, green.

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/-**

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

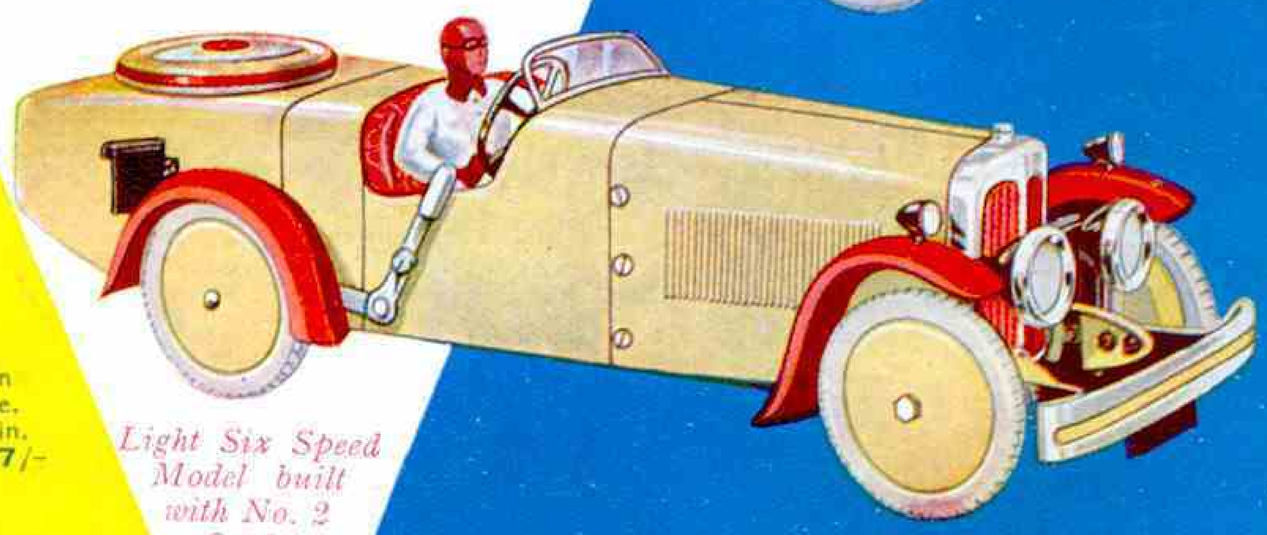
Motor Car Lighting Set

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**

The Lighting Set cannot be used with 1932 type Motor Car Outfit models unless the latest Headlamps (price 4d. each) and Instrument Board (price 6d.) are added.

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 7¼ in. Price **7/-**



Light Six Speed Model built with No. 2 Outfit

Manufactured by

Meccano Ltd., Binns Rd., Liverpool 13

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Printed by John Waddington Ltd., Leeds and London.