A Pair of Tame Fox-cubs

Orphan Foxes will make Novel Pets

by Gerald O. Rennison

WHEN out gathering mushrooms soon after daybreak in the fields near his home at Stamfordham, Northumberland, Mr. C. Arkle came across the two fox cubs shown in the accompanying photograph. They were lying in a very exhausted state, evidently having been without food for some time. Mr. Arkle came to the conclusion that their mother had been killed, and that they had left the "den" to search for food for themselves. He picked them up carefully and took them to his home, where a little warm milk soon restored the small orphans to activity.

After keeping them warm in the kitchen for a few days he put them in a small hen-coop on the grass in his allotment, with a nice warm little hutch for them to go into at night. The cubs are thriving well, and although chickens run past their hutch they seem to have lost all the mischievous instinct of foxes, and they never attempt to catch and kill the little chicks.

Silver Fox Farm in Scotland

It is a very interesting fact that the Canadian silver fox can be successfully bred in captivity in Scotland. Unlike the ordinary British fox, the silver fox has a skin that is of great value, unusually good specimens having fetched in the London market as much as £100.

The breeding of silver foxes for the sake of their skins is carried out on a commercial scale at the Ben Bhragie Silver Fox Farm, Golspie, Sutherlandshire. It has been found that for this purpose the climatic conditions in Sutherlandshire are as good as, if not better than those existing in Canada. Recently twenty-eight silver foxes destined for the Ben Bhragie farm were brought over by the liner "*Canada*" from Prince Edward Island to Liverpool. They stood the journey well and arrived in excellent condition.

Photographing a Nest

When you are out with your camera does it ever occur to you to try to take a photograph of a bird's nest? You may have to do all sorts of things to get a good photograph, as nests are often in very awkward places.

The one illustrated belongs to a Chaffinch and was taken one afternoon while on holiday. There were no birds in when I found it, and I learned afterwards that the nest was deserted. The camera had to be tilted downwards to get at the nest, which was very low, but by good luck the camera did not fall and I was able to accomplish my object. The exposure was 5 seconds, at F/26, 3 p.m. Group E of the Burroughs and Wellcome photographic diary.

In conclusion I would like to say that it is always desirable to have an exposure meter with you, as without one you are liable to make mistakes and get under-exposed negatives.

W. M. SMITH (Thackley, Bradford).

Eggs and Nest of Chaffinch

Stamps for Sale (See also page 230)

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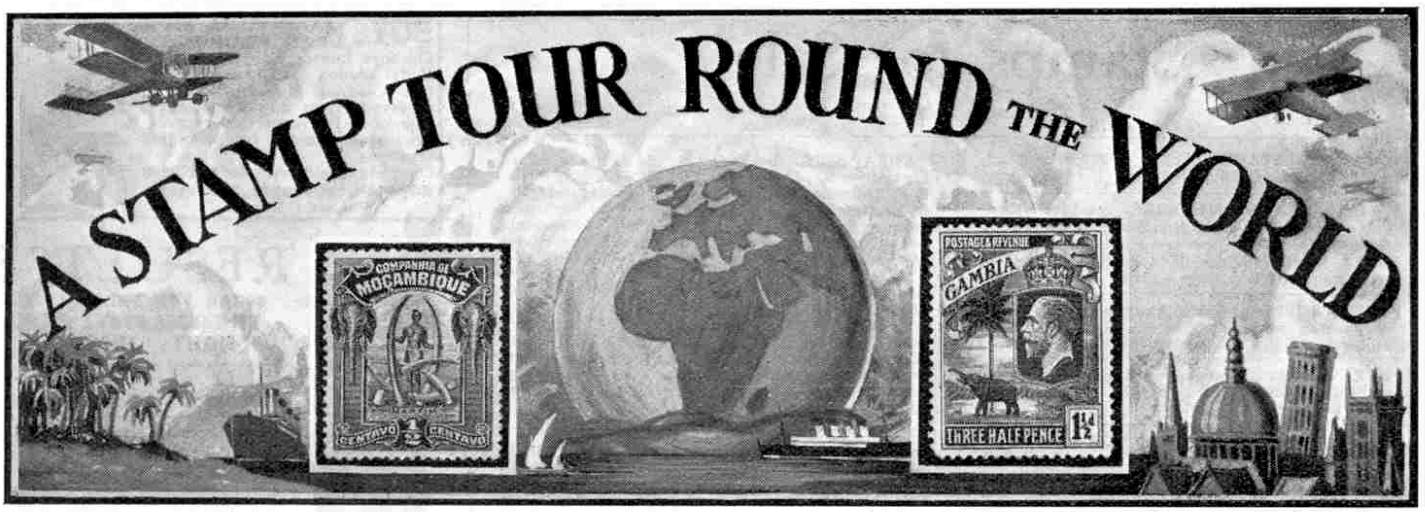

IX. AUSTRALIA AND SOUTH AFRICA

SYDNEY, to which we make our way after leaving New Zealand, is, of course, the capital of New South Wales. Few towns can rival its natural beauty and advantages. The famous harbour is divided into a number of inlets, the largest being over six miles in length. Sydney Harbour is the deepest, safest and most beautiful harbour in the world, and has extensive floating, dry, and other docks, capable of handling an immense amount of traffic.

In the eyes of advanced stamp collectors those stamps known as "Sydney Views" rank on a level with the famous "Cape Triangulars." The first Sydney View appeared in January, 1850. It was engraved by Robert Clayton, of Sydney, and was printed in red, at first on soft yellowish paper and later on hard bluish paper. A perfect unused copy could then be purchased for the price of one penny, but now only a medium unused specimen purchased from a stamp dealer costs not less than £75! The first issue appeared in four shades on the soft and two on the hard paper.

The original plate was soon discarded and in August of the same year a new issue appeared from a plate engraved by H. C. Jervis. The most noticeable difference was the addition of clouds in what had been, until then, a perfectly cloudless sky.

At the same time as the first 1d. value was issued there appeared a 2d. value of similar design engraved by John Carmichael. In the two years 1850 and 1851 five different plates were used, re-engraved by H. C. Jervis, and each distinguishable from the others.

A 3d. value also appeared in 1850, but there was only one die of this value.

Most, if not all, "Sydney Views" are beyond the means of the average collector and their possession is a dream but rarely realised. There is however one Sydney view stamp within the reach of all, namely, that issued as the 1d. value in the 1888 series. It appeared in three sizes of perforation, two watermarks, and two shades so that this value also lends scope to specialisation by skilful collectors.

The Glories of Tasmania

Sydney is the only Australian view so far depicted on postage stamps and we now turn southwards until we come to Hobart, Tasmania. Hobart (shown on the 2d. 1900 and following issues), is the capital of Tasmania and stands on the low hills at the foot of Mount Wellington (1d. of the same series), the famous peak, 4166 ft. in height, whose summit is often snowclad. At Port Davey at the south-west corner of the island is Spring River shown on the 3d. value of this series. In the interior of the island is Lake St. Clair (5d. value) standing at the foot of Mount Gould.

Tasmania is an island of mountains and plateaux and Lake St. Clair is one of the many freshwater lakes on the central plateau. As is natural in so mountainous a country, there are many waterfalls, two being shown in the same series of stamps. That on the 4d. value shows Russell Falls and that on the 6d. shows the Dilston Falls. The 2½d. value shows Tasman's Arch, a huge natural arch of rock worn into its present shape by the passage of the river below through untold ages.

Via The Indian Ocean to Africa

Rejoining our ship at Hobart, we again set sail and now turn westwards for a distance of about 4,000 miles until we arrive at Reunion, a small island and French colony in the Indian Ocean. Situated 400 miles S.E. of Tamatave, the chief port on the eastern coast of Madagascar, Reunion is also near Mauritius, being 130 miles south-west of Port Louis, the capital of the British colony. Reunion itself is oval in shape and has a greatest length of 45 miles and a greatest breadth of 32 miles. It consists of two sets of volcanoes that have raised themselves above the floor of the surrounding ocean at different times, and the whole island is a mass of volcanic cones, several of which are active.

St. Denis, the capital of the island, is shown on the 20c. to 75c. values issued since 1907. It lies on the north coast of the island, has a fairly large population and several fine public buildings. St. Pierre, at the south-western corner of the island, has a small artificial harbour and is shown, with the Crater Dolomieu, on the franc values issued since 1907. Although eruptions of the various volcanoes are comparatively frequent they are not often of a serious nature.

From Reunion we sail north around Madagascar and arrive at our first port of call in Africa—Zanzibar, the great distributing centre for the eastern seaboard of Africa. A view of the port was shown on the values from 10 to 200 rupees in the 1908 series, issued by the British protectorate of the same name and of which Zanzibar is the capital. The town has a population drawn from all parts of Africa, a considerable trade being done in ivory, gum copal, hides, skins, cloves and copra. Most of these goods come to England, with the exception of the copra which goes to Marseilles. India supplies Zanzibar with nearly all her imports, these being chiefly foodstuffs, amongst which rice predominates.

Turning southwards we come to Mozambique, really part of Portuguese East Africa. Although few definite view stamps of this district have appeared as yet, the Mozambique Company, who administer the districts of Manica and Sofala, have issued a very fine series showing the various occupations and products of the district. This series was issued between 1918 and 1921 and consists of eighteen values, all of different types. These types in order of value, commencing with the lowest, the ¼ cent., represent: native village (illustrated here), ivory, maize, rubber, sugar, river transport, tobacco, Port of Beira, one of the chief towns (illustrated here), coffee, oranges, cotton, sisal, Beira railway, the Court of Justice, cocoanut, tannery, cattle, and,

(*Continued on page* 231)

Stamps for Sale

(*See also page* 228)

1,000 MIXED STAMPS 7d., 1/- or 2/6.—Cranwell, 55, Cowslip Road, London, E.18.

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A Stamp Tour Round the World—

(*Continued from page 229*)

lastly, the arms of the Company. From this list it will be seen that the country has a large variety of products.

The Victoria Falls

The British South Africa Company, now Rhodesia, have produced one of the most beautiful of all stamps, that showing the Victoria Falls, illustrated here. It was issued in 1905 to commemorate to a certain extent the completion in April of that year of the railway bridge that now spans the river Zambesi within the sound of the Falls.

The Victoria Falls were discovered on 17th November, 1855, by David Livingstone and named by him after Queen

Victoria. They are the greatest waterfalls in the world and where they fall into a huge chasm 300 ft. in depth the river is over 1,800 yards in width. The chasm into which the river leaps lies at right angles to the river's path and varies from 80 to 240 ft. in breadth. Although it would thus seem that excellent views would be obtainable from the far side of this chasm, this is only the case during the dry season when the river is low, since at all other times the whole chasm is surrounded by vast columns of vapour.

The waters leave the chasm by means of a narrow gorge, not more than 100 ft. in width, about three-fifths of the way from the western end of the barrier wall. Thence the river flows into and along the Grand Cañon, under the railway bridge, through a huge zig-zag course over 40 miles in length. Its almost perpendicular walls are 400 ft. in height, their top being the same height as the river before it reaches the Falls.

The railway comes from Bulawayo and is part of the Cape to Cairo railway scheme. The bridge is 650 ft. in length, having a main arch with a span of 500 ft. The rails are 420 ft. above the level of the river when it is at low-water level.

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NEXT MONTH:—

THE CAPE, St. HELENA and MOROCCO

A Clever Forgery

In 1872–73 a notable attempt was made to defraud the Post Office by the issue of a forged stamp belonging to Great Britain. The stamp in question was

the 1/– value of the 1867–80 issue, a green stamp with a large uncoloured letter in each corner. In this stamp the plate number is placed half-way up each side of the stamp in white figures on a coloured ground. The forgeries bear the plate number " 5," the genuine copies of which plate number were first issued during 1871.

During the two years 1872 and 1873 many thousands of these forged 1/– stamps were used on telegrams handed in at the London Stock Exchange Post Office. The forgeries were excellent representations of the original—indeed they were sufficiently good imitations to deceive the officials at the Post Office for many years. The forgery was not discovered until 1898, twenty-six years after the stamps were used! Even then the discovery would not have been made had not Mr. Charles Nissen, a collector who specialised in the stamps of Great Britain, noticed a peculiarity in some of the stamps he was examining and comparing. Closer inspection revealed the forgery, but it was, of course, hopeless to attempt to discover the perpetrators of the fraud after so many years had elapsed. The printers had evidently expected that the telegrams and stamps would be destroyed in the usual way, never thinking that the stamps would be torn off and saved for collectors.

The Reason for "Corner Letters"

No doubt many of our readers have wondered why the early stamps of Great Britain have letters in their corners, and why there are so many different combinations of these letters.

Until the Queen Victoria Jubilee issue of 1887 all the stamps of Great Britain had these letters in their corners. In the issues previous to 1858 these letters appeared only in the two lower corners of each stamp, but after this date they appeared in all four corners, the letters in the upper corners being the reverse of those in the lower corners. The extra letters were added in this manner so as to make it more difficult for dishonest persons to piece together unobliterated portions of stamps with the idea of making up stamps that could be used again—a profitable trick that had soon been learned after the introduction of adhesive stamps.

The use of letters in the corners was brought about by Sir Rowland Hill, who thought that if anyone made forgeries of the stamps they would be most likely to print the stamps singly and not in sheets as the authorities did. Accordingly, Hill introduced these check letters, arranging them as shown below.

The first stamp in the uppermost row was lettered AA, the second stamp in this same row was AB, and the third AC, and so on along the row until AL was reached on the last stamp of the top row. The second row began with BA, and so on through the sheet, the full sheet reading:

1st row—AA. AB. AC. AD. AE	...	AL
2nd row—BA. BB. BC. BD. BE	...	BL
3rd row—CA. CB. CC. CD. CE	...	CL
.....		
19th row—SA. SB. SC. SD. SE	...	SL
20th row—TA. TB. TC. TD. TE	...	TL

Thus each stamp in the sheet had a different set of letters by which, incidentally, its position on the full sheet could be identified. Thus if a forger printed his stamps singly from one die, they would all have the same corner letters. To make it worth while to forge stamps of so low a value as 1d., a considerable number would have to be printed, and Sir Rowland Hill relied upon the fact that the large number of stamps passing through the post, all with the same particular corner letters, would attract the attention of the officials and lead to the discovery of the fraud.

A Picturesque Stamp

This splendid production might be said to complete the pictorial series of Jamaica issued in 1921, although it appeared for the first time in 1922. The centre, in black, shows a view of the Town and Harbour of Port Royal (about 1850) and consists mainly of a number of sailing ships. The frame, in blue, consists of an anchor in each upper corner, and the usual medallions. The stamp is line-engraved and printed in sheets of 40, in five rows of eight, on paper watermarked multiple script "CA" and Crown, perforated 14 by a single-line machine.

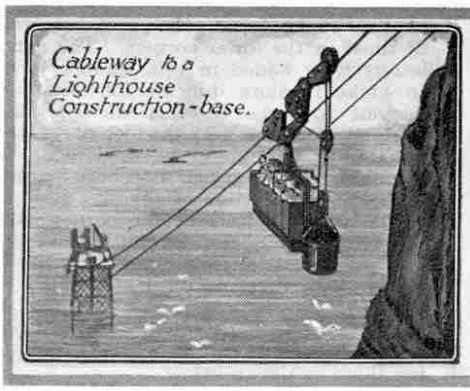
IN REPLY

R. Bentley (Frodsham).—There are three types of garter watermarks in the 4d. Carmine Great Britain of 1855 to 1857. These are of three sizes, the two larger ones are not easily distinguished, however.

L. Norton (Bournemouth).—The stamp you send belongs to Negri Sembilan, one of the Federated Malay States. Its catalogue value is 1/6.

A. Grant (Hammersmith).—The stamps of the Cape of Good Hope were overprinted British Bechuanaland, both in black and in red. There are a number of varieties, and an error in the overprint is catalogued showing the omission of the "B" in "British."

L. Bailey (Newton-le-Willows).—A chalk surface paper has a peculiar shine on its surface. Paper of this type was used for printing most of the values of 1902 to 1910 Great Britain and Colonies. It was used to safeguard the stamps, as although printed in fugitive inks they were found unsatisfactory and chalk surface paper was therefore introduced in addition.



Engineering News of the Month

New Thames Bridges

Lambeth bridge is to be reconstructed and in its new form it is expected that it will relieve Westminster bridge of a great amount of traffic and so prevent the congestion at Vauxhall.

Further up the River, new bridges have also been suggested at Twickenham and Teddington. It is claimed that these bridges would relieve the congestion of summer and holiday traffic at both Richmond and Kingston.

* * * *

Australian Order for the Clyde

The Australian Government has placed an order for two cruisers with Messrs. John Brown & Co. Ltd., Clydebank, at an approximate cost of £4,250,000.

* * * *

Cork Houses

We have recently read a good deal about concrete houses and in the March "*M.M.*" we described a new departure in steel houses. Now comes news of houses constructed of compressed cork. These houses, which are being built near Deal, have a steel framework to which are attached slabs of compressed cork from two to four inches thick. The outside of the cork is coated to a thickness of 1½" with concrete applied by means of a cement gun. It is claimed for cork houses that they are not only fire-proof and sound proof, but they act also as heat insulators.

* * * *

The New Piccadilly Circus

The reconstruction of the Underground station in Piccadilly is now being carried out. Since the present station was opened in 1906, the number of passengers has grown from 1½ to 18 millions per annum. The new station will be 15 ft. below the ground level, and oval in shape. Nine lifts will serve the platforms and there will be a wide subway with smaller subways giving connection with seven parts of Piccadilly Circus. The new station will be capable of dealing with 50 million passengers yearly.

* * * *

Preventing Waste of Water

Recently an investigation was organised in America with the object of reducing water waste. It is amazing to learn that several leaks in excess of 50,000 gallons a day were discovered, whilst one was found to be an unchartered 3 in. blow-off valve in a reservoir which was wide open and was discharging 700,000 gallons of water daily.

Huge Dock Scheme

A £13,000,000 scheme is in hand by which it is hoped to make Southampton docks the biggest in the world. The scheme in its present form includes some daring engineering plans. First it will be necessary to reclaim the mud on the foreshore over an area of two miles. Next the River Test will be dredged to give a passage even at low water for the greatest ships afloat. Two huge dry docks, with five jetties, are then to be built. The docks will be capable of holding at the same time ten such giants as the "*Aquitania*" and "*Majestic.*" The scheme will take the Southern Railway about ten years to carry out and at the moment is held up by the refusal of the owner of the mud to sell it!

The main dock is to be built on a similar plan to the New York docks, the five jetties will be of reinforced concrete, each 1,000 ft. in length by 260 ft. in width. On these will be erected double storage sheds equipped with the latest machinery for loading and unloading liners.

Great developments are planned for the reclaimed land. Here a new railway line is to be built, linking up with the present line running completely round the new ground, and within this loop factories, workshops and warehouses will be erected.

* * * *

Mishap while Testing Bridge

A serious accident recently attended the testing of a bridge on the Goole and Selby line. The bridge is comparatively new and was being tested by the Bridge Stress Committee. An engine had run across the bridge at high speed and had come to rest about a mile on the other side. Another engine followed at even higher speed, but after crossing the bridge it was not pulled up in time to avoid collision with the first engine, with the result that the driver of the latter was seriously injured.

* * * *

A Loss to Engineering

Engineering lost a prominent authority in the death (on 2nd of April) of Sir William Mitchell Ackworth. Sir William, who was the leading authority in this country on railway economics, was born at Bath in 1850 and was in his 75th year at the date of his death. Educated at Uppingham and Oxford he served for 18 months as the tutor of the ex-Kaiser, and returning to this country was called to the bar in 1890. His great interest in railways was aroused in the first instance by reading Frances' "*History of Railways.*" Sir William was appointed a member of the Royal Commission on Railway Accidents in 1899 and he was a strong opponent of the nationalisation of the railways.

New "Beam" Stations

The Postmaster General states that the high-power wireless station at Rugby is expected to be completed in about eight months' time. A smaller station for communication on the "beam" system with a similar station in Canada is expected to be completed in October next. Orders will be given for the erection of additional "beam" stations for communication with India, South Africa, and Australia, as soon as definite arrangements for corresponding stations had been made by the Indian and Dominion Governments.

* * * *

Engineering Scholarships

The council of the University College of Southampton have decided to award two open exhibitions in engineering to candidates who may or may not be resident in the district. The awards will be made on the recommendations of the Board of the Engineering Faculty without formal examination, provided the candidates have matriculated and are prepared to study for a degree in engineering.

* * * *

More Gas for Coventry

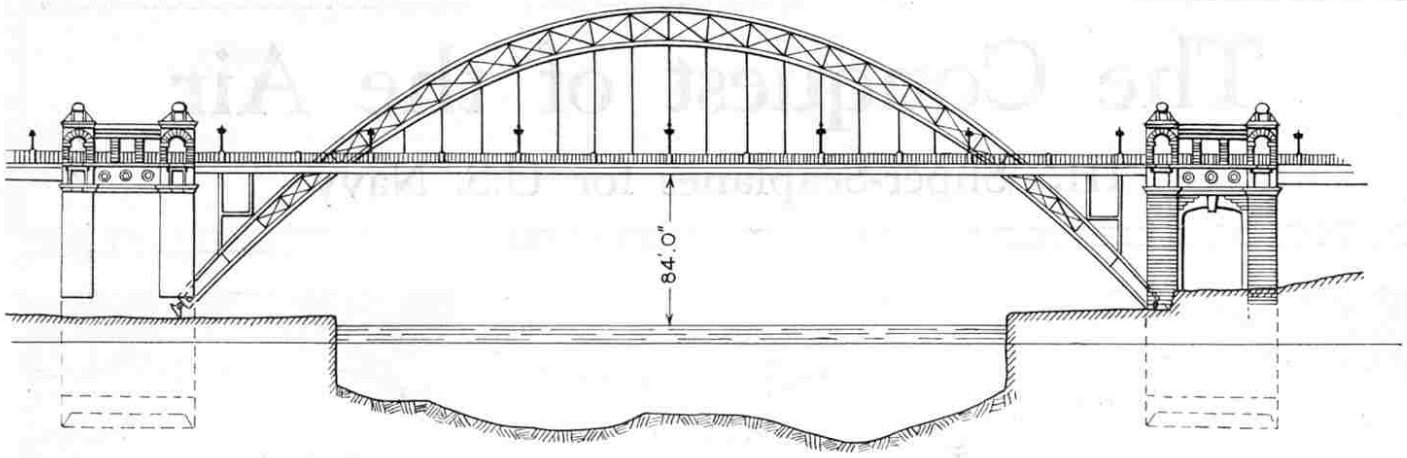
Extensions at the Coventry Gas Works costing over a quarter of a million sterling, are to be put in hand immediately. The work includes the extension of the gas-making plant by installing new vertical retorts with a total capacity of two and a quarter million cubic feet of gas daily and five million cubic feet gas-holder and tank. The scheme includes the extension of the railway siding and other improvements.

* * * *

Repairing Durham Castle

Engineers have often been called in to strengthen buildings and perhaps the most notable instance of recent times is that of St. Paul's Cathedral, where the operations will require several years to complete.

Work has been in progress for some months underpinning Durham Castle by concrete buttresses and walls. In this instance, as in the case of the repairs to the tower of Lincoln Cathedral, cement grouting is being used. This consists of forcing liquid cement through cracks in the walls, where it hardens and solidifies with the original masonry, the whole becoming a solid mass. In the case of Durham Castle over 10,000 gallons of liquid cement have already been used, and the work is still in progress.



A New High Level Bridge Across the Tyne

A new high-level bridge is to be built over the Tyne between Pilgrim Street, Newcastle, and High Street, Gateshead. The bridge will have a span of 540 ft. and will thus have the largest arch of all bridges in this country. The clearance of the bridge will be 84 ft. above the river, which incidentally is the same as that of the existing high-level bridge and of the King Edward VII. Railway Bridge. The bridge will carry a roadway 38 ft. in width and a 9 ft. footpath at each side. A double tram track will be laid in the middle of the roadway and the whole cost, including the approaches, will be about £1,000,000.

The existing high-level bridge was built by Robert Stephenson and opened for traffic on 15th August, 1849. One of the many fine bridges erected as the result of the development of railways, the bridge crosses the deep ravine that lies between Newcastle and Gateshead, with the river Tyne flowing below. For some 30 years the Newcastle Corporation had discussed various methods of improving the very inadequate communication between the towns. They consulted Telford and other eminent engineers, but negotiations drifted on year after year without anything definite being decided, and it was not until the northward march of the railway made a new bridge absolutely necessary that any progress was made.

The existing bridge may be said to combine the two principles of the arch and of suspension. It is composed of six spans of 125 ft. each. The four ribs of each span are of cast iron, while the suspension rods are of wrought iron encased in hollow iron castings. The local authorities insisted that the bridge should carry foot passengers and ordinary vehicles, as well as the railway, and therefore the bridge is provided with two decks. The upper deck, above the arched ribs, carries the railway, and the lower one, which is suspended from the arched ribs, carries the roadway, consisting of a carriage-way 20 ft. 4 in. wide and two footways. The length of the bridge and viaduct from Gateshead station to the Newcastle terminus is about 4,000 ft. and the bridge passes over the roofs of houses on both sides of the ravine.

The piles used to obtain the necessary foundation for this bridge were driven by means of a Nasmyth steam hammer, and this was probably the first occasion on which the steam hammer was employed for bridge pile-driving.

The King Edward VII. Bridge, crossing the Tyne to the west of the present High Level Bridge, is for railway traffic only, and it is expected that the new bridge will do much to relieve the congestion in road traffic.

More New Bridges

Another new bridge that it is proposed to construct is a swing bridge over the River Ouse at Booth Ferry, north of Goole. At Yarmouth a new bridge over the Yare is to replace the Southtown bridge. A new bridge is to be built over the Trent at Gunthorpe near the present Gunthorpe Toll Bridge, and the widening of six bridges over the Avon at Bath is also contemplated.

* * * *

Smaller Ships

The restriction of emigrant traffic to the United States has so reduced the volume of traffic that, coupled with high building and operating costs, the building of further steamships of the monster type in the near future is rendered problematical.

Steamship companies announce that they will watch closely developments in the methods of propulsion, so that the best and most economical means may be employed to restrict their building programme to vessels of moderate size and with a less elaborate decoration and furnishing of the public rooms. While maintaining the present standard of comfort for first-class passengers, the companies will institute improvements for the comfort of second and third class passengers.

Lifting 72,000 Tons

The world's heaviest ship, the White Star liner "*Majestic*," was last month lifted 40 ft. by the great floating dock at Southampton. This is the first occasion on which a weight of more than 50,000 tons has been lifted by any dock in the world. It is also the first time that it has been possible to dry-dock the "*Majestic*" in British waters, her half-yearly docking having hitherto been done in America as there is no graving dock large enough to take her in this country.

The weight of the "*Majestic*" is 64,000 tons fully laden, but when in dock she was without fuel or stores, which enabled her weight to be cut down to 55,000 tons, a weight well within the calculated lifting capacity of the dock. Five hours were required to lift the ship. The fourteen pumps pumped 88,000 tons of water out of the tanks in the sides and hold of the dock, and she floated with the ship poised in the cradle on the bottom platform.

The dock itself, which was opened by the Prince of Wales last summer, weighs about 17,000 tons, so that the total weight raised on this occasion was something like 72,000 tons.

Bridge across the Zambesi

The construction of the proposed bridge across the Zambesi is going forward. The bridge is estimated to cost £800,000 and it will connect the Trans-Zambesi and Central African Railways, and complete a through-line from Beira to Nyassaland. The bridge will help largely in the development of the coal mines of the district.

* * * *

Forth Road Bridge

A proposal has recently been made to build a road bridge across the Forth at Queensferry. The cost of the proposed bridge, including the acquisition of land, is estimated at £4,000,000. It is suggested that the bridge be of the suspension type, with two spans of 2,400 ft. each. Should the bridge be constructed it would allow the continuation of the Great North Road through Scotland to Inverness and Aberdeen.

* * * *

New Montrose Bridge

Montrose Town Council has decided to replace the suspension bridge over the River South Esk by a modern structure costing £90,000.

The Conquest of the Air

III. Super-Seaplanes for U.S. Navy

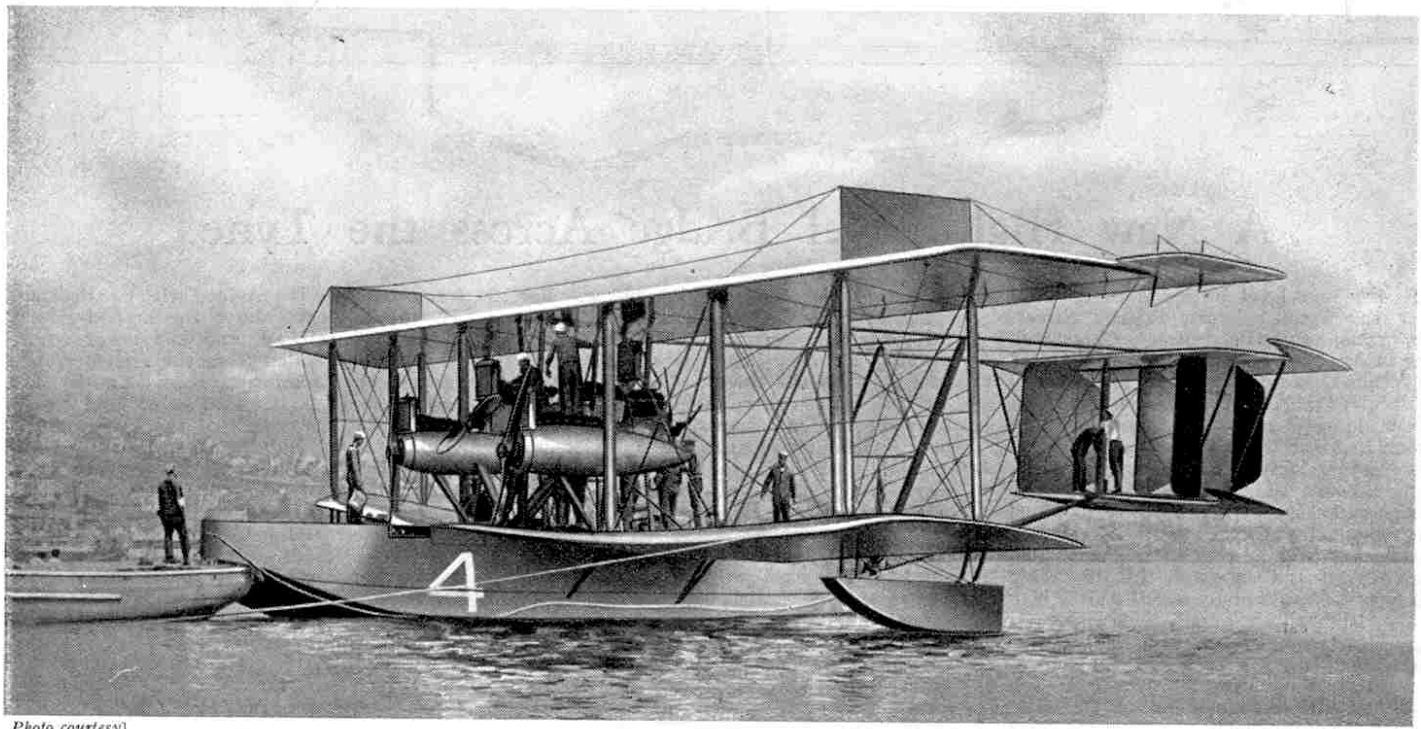


Photo courtesy] [*U.S. Navy Department*

The first U.S. Navy Seaplane (N.C.-4) which flew across the Atlantic between 8th and 31st May, 1920.

THE importance of large seaplanes, having a great range of flight and capable of working well in advance of the fleet to which they are attached, is becoming increasingly apparent. As a result, super-aeroplanes and super-seaplanes are being planned and constructed in almost every country that has either a commercial or strategical interest in aviation.

In America in particular, the advantages of these super-aeroplanes are fully realised. Experts have recently pointed out to the Secretary of the Navy that seaplanes of a type capable of working independently of support from any surface vessels would be particularly useful in the Pacific.

The United States has a considerable coastline to guard, both in the Atlantic and the Pacific, and although the cutting of the Panama Canal has simplified its defence very considerably, there yet remains the very grave problem of giving adequate naval protection to both east and west coasts. In the event of the United States being at war with any nation possessing fighting ships, this problem would become acute.

More certainly would this be the case in the Pacific, where the United States has island possessions (Hawaii) that are of great strategic importance. It is more particularly in regard to this and other similar outlying territories that seaplanes and aeroplanes would be of the greatest value to the United States. Not only would they by bomb attacks be able to considerably hinder and disorganise an invading force, but they would be able to fly to, and defend any point on the coast long before the Pacific Fleet itself could reach the scene of action.

A Giant Seaplane

For these reasons alone, this type of aircraft is the centre of attention in America at the present time, and orders have recently been placed by the American Navy for a super-seaplane which, if successful, will probably lead to orders for a large number of a similar type. The new seaplane, when fully loaded, will weigh 24,000 lbs. Its wings will have a span of 87 ft. 6 in., a width of 14 ft. and a total area of 2,400 sq. ft.

The fuselage, 60 ft. in length, will be built entirely of duralumin. The advantage of constructing the body of duralumin is that it will not become waterlogged—as might be the case with a wooden hull—and on this account it is claimed that the new seaplane will be sufficiently seaworthy to keep afloat, even in the roughest sea. Further the use of duralumin reduces the weight to a minimum, more particularly so as the same metal is used in the construction of the wings. The decreased weight allows greater fuel-carrying capacity and gives greater speed, the latter advantage also being assisted by the decreased air resistance of the wing truss, to details of which further reference will be made later.

Geared-down Engines Used

The new giant will be driven by two 800 h.p. Packard motors—the largest aero engines ever built in America. They are designed for the high working speed of 2,200 revs. per minute, at which speed they give their maximum power for a given weight.

It must be noted, however, that this high speed is not the propeller speed, for the engines will not drive the propellers directly. Instead, they are geared down to give co-ordination between engine and propeller, to ensure that the speed at the tip of the propeller blades is in ratio with the forward speed of the aeroplane—an important matter.

The plan to gear down the engines is in accordance with the best modern practice. Experts are agreed that in the future, in all "slow" aeroplanes, geared-down engines will be adopted universally. The term "slow" is here used in a comparative sense, judged by some of the high flying speeds attained by other—and often specially-designed craft. For instance, although the new American giant falls within the "slow" classification, it will nevertheless be capable of a speed of at least 100 miles per hour!

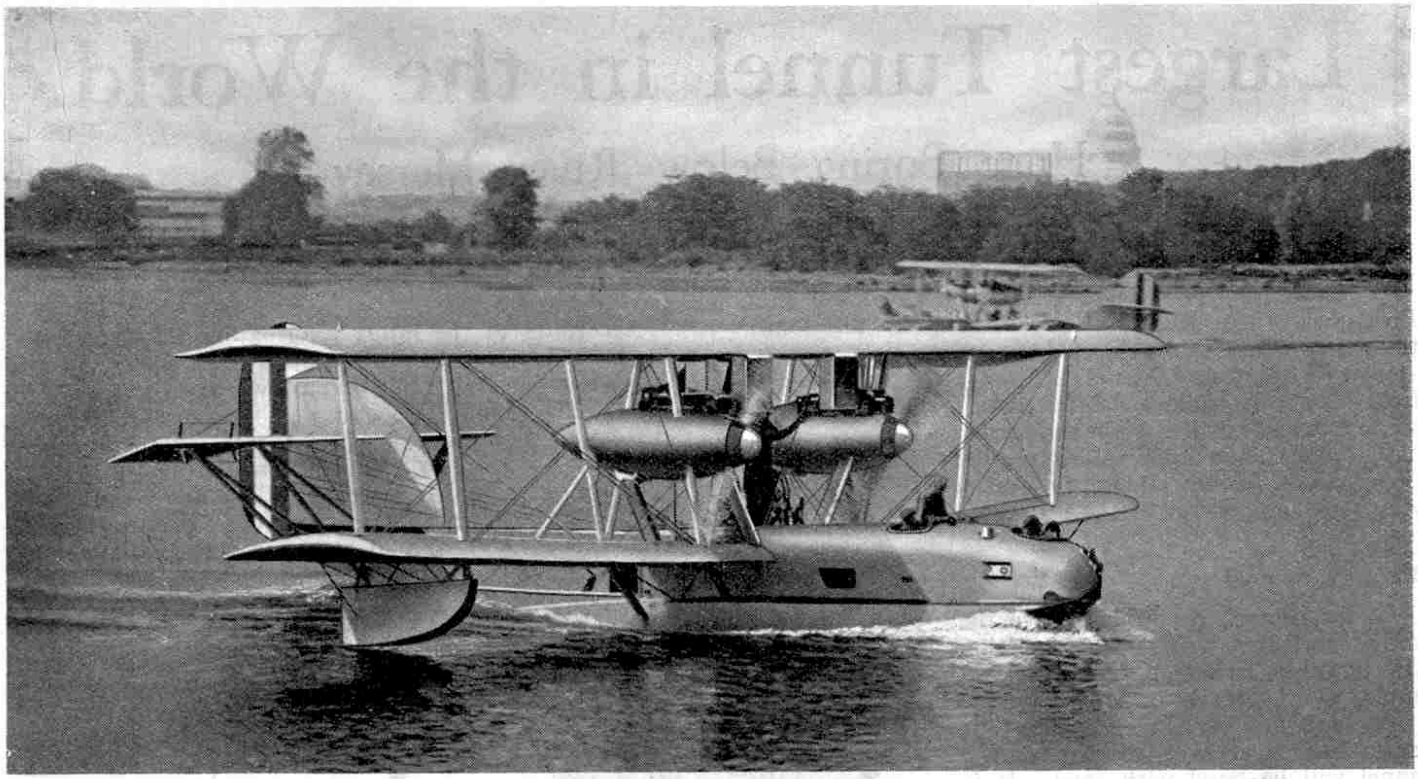


Photo courtesy [*U.S. Navy Department*

Long Distance Scouting Seaplane (PN–7) of the U.S. Navy

Tandem v. Parallel-Mounting

It is interesting to learn that the two engines of the new giant will be mounted in tandem, one propeller being at the front of the engine and the other at the rear.

Although mounting the engines on either wing is generally regarded as being more efficient than mounting in tandem, tandem mounting has the advantage that, should one of the engines fail, the plane will be able to continue in flight on one motor only. Although this is theoretically possible with two engines not arranged in tandem but on either wing, it has been found in practice that should one of the engines fail, when the pair are mounted on either wing, the unbalanced thrust of the remaining propeller becomes a definite source of danger. This is because of the fact that it is thrusting "off centre" and this renders control of the aeroplane very difficult. The advantage of being able to sustain flight indefinitely on one motor far outweighs the slight loss in efficiency.

Illustrations and further details of the new giant seaplane are not yet available. It is believed, however, that the design will follow very closely the lines of the successful P.N.–7 type of long-distance scouting seaplane now in use by the American Navy Department, which we are able to illustrate on this page.

Five Years' Progress

It is very interesting to contrast the P.N.–7 with the N.C.–4, the first giant seaplane to be built for the American Navy. Although only five years have elapsed since the N.C.–4 was constructed, a comparison of the two photographs accompanying this article shows how great has been the progress in design in the meantime. It will be noticed that the P.N.–7 has a clean wing truss, whereas the N.C.–4 is more cumbersome in this respect. The design of the P.N.–7 does not, however, show any radical alterations or extraordinary changes from previous designs. Greatly improved in general details, it shows a steady advance in many minor points.

The main advantages are found in the wing trussing. The N.C.–4 necessarily had innumerable struts and wires in its wing structure, because it had a comparatively "low-lift" wing and a correspondingly large wing area. It had a shallow wing camber giving a correspondingly low resistance to bending stresses. The P.N.–7 on the other hand, has a "high-lift" wing, which enables a reduction to be made in both the area and the span. In it, too, the considerable depth of camber allows the use of long unsupported spans and reduces the external wing-bracing to a minimum.

London to "Mespot." Non-Stop

The N.C.–4 had four Liberty motors each of 400 h.p. Although the horse-power was practically the same as that of the giant seaplane now building, the maximum speed of which the older machine was capable of was only 75 m.p.h. whereas, as has already been mentioned, the new giant will have a speed of at least 100 m.p.h.

The N.C.–4 weighed 28,000 lbs. and its range was 1,600 miles at the outside. The new giant seaplane is 4,000 lbs. lighter and has a range of at least 2,600 miles. If flown from a base in this country it would be able to make a non-stop flight from, say, Croydon to the Ural Mountains; to the Caspain Sea; to Egypt; or almost to Basra and the Persian Gulf. It would also be able to fly across the Atlantic with ease. Indeed, it would have the greatest range yet attained by any aeroplane or seaplane of its size and weight.

It should be mentioned that the maximum range is not calculated on a stripped machine but is based on the weight of the plane carrying enough petrol for its maximum range, a crew of five—two pilots, two mechanics and a wireless operator—together with full fighting and bombing equipment.

Giant Block-Setting Cranes—

(*Continued from page* 223)

sea-walls, and in the combating of the elements during their construction, that this branch of engineering is seen at its best. In his difficult task the harbour engineer has no more powerful assistant than the giant block-setting cranes that we have described in these articles during the past few months.

These giant cranes thus play an important, although indirect part, in developing British trade and in advancing the interests of the Empire. The cranes build a harbour, the harbour enables ships to load and unload, and the town that owns it becomes a leading port and the centre of trade for a wide and prosperous area. Ships come and go, carrying the produce of the country to distant ports, where in turn other harbours shelter them from the fury of the seas whilst they unload their cargoes. All this has been made possible by giant block-setting cranes, without which the engineer could never have carried out the great works that stand to his credit to-day. It will be no matter for wonder, therefore, if cranes of this type will be the most popular type of crane models of the future among Meccano boys.

(THE END).

Largest Tunnel in the World

Huge Boring Below River Mersey

A GREAT engineering scheme for a new tunnel under the River Mersey between Liverpool and Birkenhead has been under consideration for some time and negotiations have been proceeding with a view to obtaining financial assistance for the project from the Government. After long conferences and seemingly endless discussion the matter has at last taken practical shape, the Government having offered to bear a very large proportion of the estimated cost.

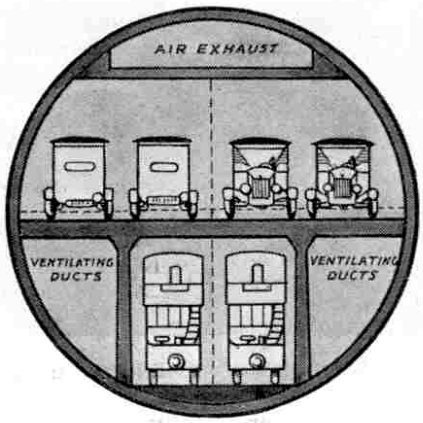
Bridge v. Tunnel

The tunnel will be the largest in the world, and the works in connection with it will be on such a scale as to find employment, directly or indirectly, for a very large number of men. Important orders for steel will result, as the tunnel will be lined with steel. It is estimated that the work will require at least 125,000 tons of cast iron, the cost of which would be about £1,000,000, and the engineering trade as a whole would benefit in this and in other ways.

The decision to construct the tunnel was arrived at after consultation with leading engineers, a tunnel being generally preferred to the alternative suggestion for a huge bridge to span the river. There is already a tunnel under the Mersey, of course, but it is solely for the use of the electric trains of the Mersey Railway between Liverpool and Birkenhead. The new tunnel, on the other hand, is essentially intended for road traffic, its value lying in the fact that at present the only direct communication between Liverpool and Birkenhead is by ferry-boat across the river, the alternative being a long journey via Runcorn and over the famous transporter bridge.

As first planned the new Mersey tunnel was to take roughly the course indicated in the illustration at the foot of this page, but the branch leading to Seacombe has now been abandoned. It was also planned originally to construct the tunnel for four lines of traffic for ordinary vehicles with a section below for trams, as shown by the circular diagram. It has now been decided, however, to dispense with the tramway part of the scheme.

According to the latest information the tunnel will be 44 ft. in diameter and will have an upper road to carry four lines of traffic and a lower road to carry two lines. The tunnel is estimated to cost £5,000,000, towards which the Government are to pay £2,500,000. In addition the Government have agreed to allow tolls to be levied for a period of 20 years and to bear half the charge of upkeep of the tunnel for all time.

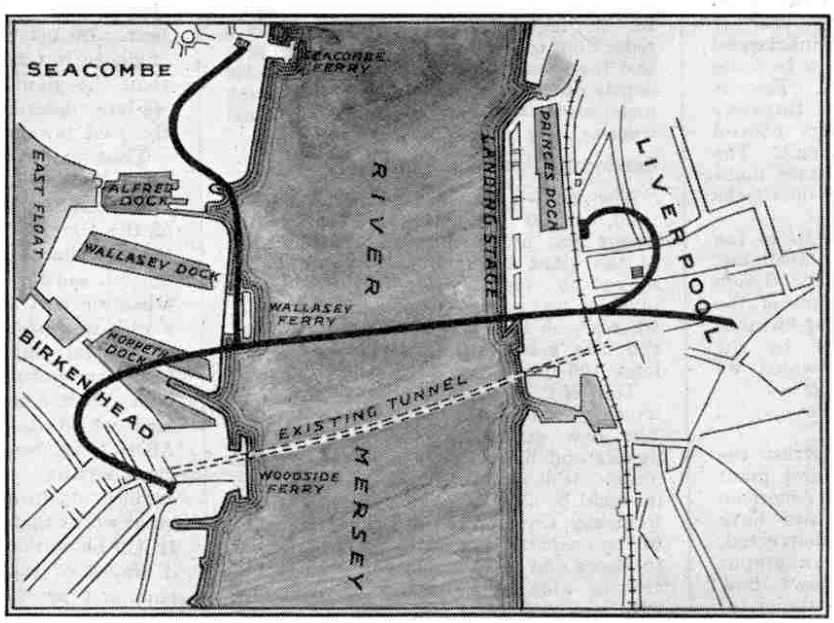


A :—Section of Tunnel as originally planned, with double track for road vehicles above and tramway track below

Liverpool's Huge Exports

The supporters of the new tunnel scheme believe that its construction will result in considerable further development of Liverpool and Birkenhead. Whether this proves to be the case or not, it is certain that the tunnel will relieve the existing traffic congestion between the two places. It will also give easier access to the whole of the Wirral, to Chester and to North Wales, for traffic from West Lancashire.

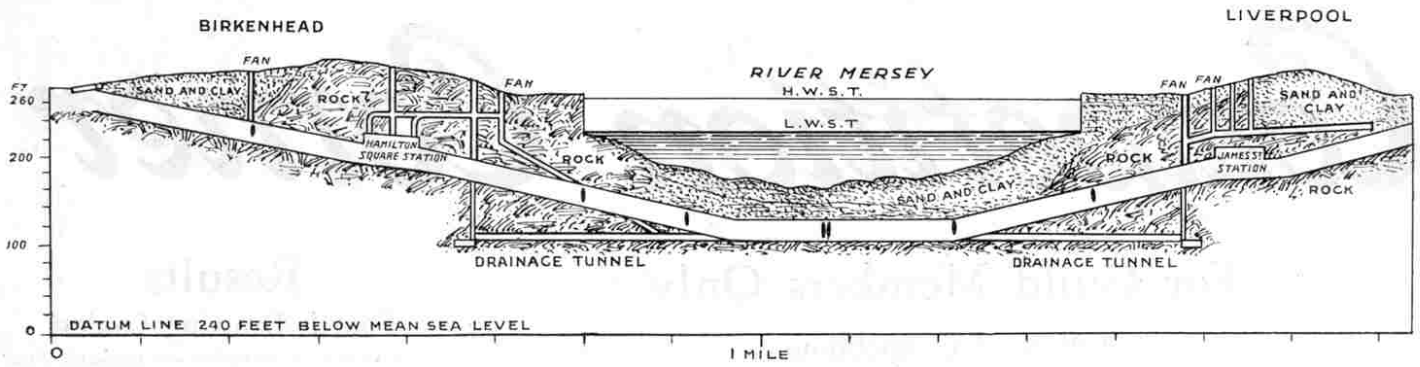
The growth of Liverpool as a port has been very remarkable. In 1858 the water area of the Liverpool and Birkenhead Docks was just under 200 acres, as compared with 600 acres to-day. In the same period the quayage has increased from 15½ miles to nearly 37 miles, and the tonnage of vessels using the port has grown from about four millions to nearly fourteen-and-a-half millions. To-day Liverpool is the first export port of the United Kingdom, exporting twice as much as London, and more than London, Manchester, Hull, Middlesbrough, Bristol and Southampton combined. As regards imports Liverpool is the second port of the Kingdom, London being the first.



B:—Approximate course of tunnel as first proposed

The Existing Tunnel

The course of the existing Mersey Tunnel is well shown in our sketch on the next page. The construction of this tunnel was authorised by Parliament in 1856 but work was not commenced until December 1879, when a small experimental tunnel was driven to test the



C:—Plan of existing Mersey Railway Tunnel

continuity of the sandstone across the river. This preliminary work was completed in 1881 and the main tunnel itself was begun. Shafts were sunk on each shore to a depth of 170 ft., sufficient to draw off water from the drainage tunnel, which had to be formed below the main tunnel, with a fall from the centre towards each shaft as shown in the illustration. The distance between the shafts was one mile and ten yards. Pumps were placed in both shafts to keep the works dry during their construction and also to drain the tunnel after its completion.

The Liverpool drainage tunnel was driven by hand at an average rate of about 11½ yards per week, while the Birkenhead drainage tunnel was driven by a Beaumont boring machine at an average rate of 14½ yards per week. The two portions of the drainage tunnel were joined at a distance of 1,115 yards from the Birkenhead shaft, the divergence between the two lines being only 2½ inches. The main tunnel was 26 ft. in width and 23 ft. in height.

For the traffic between Liverpool and Birkenhead it was necessary to have stations nearer the river than the points where the inclines from the tunnel come out into the open. Accordingly a station was constructed on each side, in the rock, slightly inland from the pumping shafts, the railway level on the Liverpool side being 92 ft. below the surface and that on the Birkenhead side 103 ft. below. Hydraulic lifts are provided to convey passengers to and from the street above. The ventilation of the tunnel is provided by two fans on each shore, which maintain a continuous current of air through the tunnel.

This Mersey Tunnel is of interest as being the first important submarine tunnel specially designed for railway traffic, although a railway was actually run earlier through the Thames Tunnel.

OUR MAIL BAG

In these columns the Editor replies to letters from his readers, from whom he is always pleased to hear. He receives hundreds of letters each day, but only those that deal with matters of general interest can be dealt with here.

Correspondents will help the Editor if they will write neatly in ink and on one side of the paper only.

W. L. Holcroft (East London, S.A.)—"I told my older brother that there is much more sense in writing to you and playing with Meccano than eloping with girls till twelve o'clock at night." We should think so indeed, W.L.! We have sent you some interesting literature by separate post. We are always pleased to hear from you.

L. Millery (Ramsey).—Your suggestion for a competition in connection with the "*M.M.*" covers is good, and we shall probably adopt it. We are surprised to hear that you have an epidemic of measles, for we have always found Ramsey a remarkably healthy place.

B. Spooner (Orehunga, N.Z.)—We have posted the back numbers of the "*M.M.*" to you. We are sorry that you have had such a tough time for the last year or two, Bruce, and we wish you better luck in the future. It isn't everyone, though, who has such a good mother.

C. Westrope (Surbiton).—We receive many hundreds of letters from boys each day and all the specially interesting ones like your own we read and deal with personally. We are sorry you do not like the Meccano boy's short trousers—we must take this matter up with his tailor!

V. Halpe (Colombo, Ceylon).—"We never enjoy a fine winter here in Ceylon, for there is no snow. I envy you your better luck." Don't envy us Vernon. We would risk exchanging one of our winters for one of yours. Copies of the "*M.M.*," to replace those lost in transit, have been posted to you.

S. Marsh (Thornton-le-Fylde).—We are constantly warning our readers not to send presents to native boys in the West Coast of Africa, or even to reply to their letters, and we are glad you ignored the one that you received recently. Thanks for your suggestion for a new competition, which we will consider.

E. Watson (Poulton-le-Fylde).—Your suggestion for a "Poet's Corner" for the "*M.M.*" rather startled us. No doubt it would be very interesting to describe the life and work of one poet each month, but of course Meccano boys are really more interested in engineers, inventors and scientists than in poets. I am sure that if we were to substitute "*Famous Poets*" for "*Famous Engineers*," our readers would descend upon us like a whirlwind. Your four lines of poetry describing the disastrous journey of Owen Moore are pathetic but we seem to have heard them before:—

Owen Moore went out one day,
Owin' more than he could pay.
Owen Moore came back that day,
Owin' more.

J. Hudson (Haworth).—No engineering structure in the world is more wonderful than a huge liner and you will be glad to know that we are preparing an interesting article on this subject. We are delighted to hear that you think the "*M.M.*" is "simply spiffing." If your Dad has to drag you away from the Magazine late at night we expect it is so that he can settle down to read it himself!

L. A. J. Edwards (Streatham).—"When I tried the King of Papers, the '*M.M.*' I gnashed my teeth with rage at being such a fool as not to have tried it before." Perhaps your action was rather strong, Leslie, but it shows the right spirit! We are glad that you have registered a vow never to miss another number. It was very encouraging to hear the opinion of your engineering friend who thinks the "*M.M.*" "ripping" and wishes it had been published when he was a boy. Your idea for a "Hobbies Page" is being considered.

B. Stewart (Newtownards).—"Going down two steps my puppy got his fore-paws on the bottom step while the cart was on the top step. The strap under his body held his hind legs hanging in the air and in trying to get down, his hind legs went so fast I could not see them!" This is a really trying experience for any puppy, B.S., and when the hind legs did ultimately get down, we hope you were duly sympathetic with their small owner. We were startled to hear that on a previous occasion your puppy "sat down and sang a foxtrot," but we conclude that we have under-estimated the musical abilities of terriers although we have three of our own!

Jas. Mason (Lickley).—

"The Meccanograph and Weaving Loom,
And Meccano sets are quite a boon.
The children now, they want a model
As soon as they begin to toddle."

Your other verses are not quite so good, James, although they contain golden truths.

D. C. Todd (Staverton).—Many thanks for your article. You say that it is your first effort in this line and that you submit it in fear and trembling "for we all know how complimentary Editors are to would-be journalists!" Editors are not half so terrible as they are reported to be—in fact most of them are just ordinary human beings with full sympathy for beginners. Never hesitate to send articles to us, for they will always be read with interest and considered carefully with a view to publication.

W. S. Mitchell (Edinburgh).—Your suggestion that we should publish at the close of each year an index for the previous twelve issues is excellent and we think it should be quite possible for us to carry out the idea next December. We already issue a spring-back binder, as no doubt you know. You say you look forward to the time when there will be 100 pages in each issue. We, too, should like that time to arrive, as then we should have plenty of room for the things that even yet are so often "crowded out." We are glad to hear of your success in shorthand and we hope that you will attain the speed at which you are aiming.

C. J. Miller (Southampton).—"When I entered the Competition I felt I had about as much chance of winning a prize as a mouse caught in a trap. You may imagine my surprise when I saw my name as a prize-winner." We are afraid that many readers are too apt to regard their chance of winning a prize as hopeless. The way to win a prize is to tackle competitions in a spirit of confidence. We shall be glad to see a photograph of your wayside station when it is finished. Your cardboard station certainly met with ill-fortune, but after all no one expects people to fall over railway stations!

Miss W. Fornachon (Cambridge).—We are certainly not among those who are shocked when you say that you wish you were a boy. Your enthusiasm for Meccano is very refreshing, and we were particularly interested to hear that "even Mother approves of Meccano now!" although no doubt she was a little startled when you declined the needlework basket and demanded a Meccano set! You appear to have succeeded in getting your own way, no doubt because—as you put it—"I stuck to it like a pot of glue." We have written you separately in regard to the gramophone you propose to make, but although possible in Meccano we fear it is a complicated model to make successfully.

Competition Corner

For Guild Members Only

"Motto" Competition

Nearly five years ago we invited members of the Meccano Guild to submit suggestions for a motto for the Guild. Many mottoes were sent in, but we did not consider any of these quite good enough to be adopted and we determined to ask for further suggestions at a later date. Enthusiasm for the Meccano Guild is now greater than ever before, and therefore we have decided that this is a suitable time to introduce this matter again.

This competition is confined entirely to members of the Guild. Entries must consist of one or more mottoes applicable to the Guild as a whole and expressing its spirit and objects. It is clear that a motto of this kind must be short, and provided that they fulfil the above conditions the mottoes consisting of the fewest words will have the best chance of success.

A prize of 10/6 will be awarded for the winning motto. There are no age limits in this contest and competitors may send in as many mottoes as they like. Envelopes containing entries should be marked "Motto" in the top left-hand corner and should be addressed to the *Guild Secretary*.

Closing date 30th May (Overseas: 30th September).

Essay Competition

"How I spent my Easter Holiday"

By the time this issue of the Magazine is in the hands of our readers the Easter holiday will be over. It is always interesting to look back upon a holiday and recall the many pleasant hours spent and the jolly times we had with our friends, whether indoors or out in the open. Meccano boys are particularly fortunate in regard to independence of the weather during holidays, for if outdoor amusement is impossible there is always the old Meccano or Hornby Railway to fall back upon, with the certainty of hours of keen enjoyment.

We at Headquarters are always interested to hear of our readers' doings at holiday times, and therefore this month we announce an Essay Competition on the subject, "How I Spent My Easter Holiday." Possibly some readers may think that they have no chance in such a competition because their holiday was spent quietly at home without any particularly noteworthy incidents occurring, but this is not the case. The winning essays will be those that give the best account of a holiday, without reference to how or where the time was spent.

The competition will be divided into two sections, (A) for those of 16 years and over and (B) for those under 16. Four prizes will be awarded—Meccano goods to the value of £1/1/– and 10/6 for the first and second in each section respectively.

Essays must not exceed 1,000 words in length and must be written legibly on one side of the paper only, with the competitor's name, address and age on the back of each sheet.

Closing date 30th May (Overseas: 30th September).

Painting Competition

In response to many requests from our readers we are announcing this month a Painting Competition, the subject being "My Hornby Train." This subject was put forward by one of the successful entrants in our recent "Suggestions" competition and we hope to have a large number of entries. A Hornby Train lends itself well to a contest of this kind and we confidently expect some very realistic results. Although we announce this as a "painting" contest, entries coloured in crayon or otherwise will be accepted. The main thing is to produce a realistic reproduction in colour.

The competition will be divided into class (A) for those of 16 and over and (B) for those under 16. We are offering four prizes—Drawing or Painting Materials, or Meccano products if preferred, to be selected by the winners, to the value of 10/6 and 5/– respectively for the first and second in each section.

Closing date 30th May (Overseas: 30th September).

Competition Closing Dates:

HOME.	
Essay (April)	30th May.
Fourteenth Photo	30th May.
Fifth Drawing	30th May.
Guild Motto	30th June.
Easter Holiday Essay ...	30th June.
Painting (Hornby Train) ...	30th June.
Fifteenth Photo	30th June.
OVERSEAS.	
Twelfth Photo	30th June.
Fourth Drawing	30th June.
Essay (March)	31st July.
Thirteenth Photo	31st July.
Essay (Inventors)	31st July.
Essay (April)	31st August.
Fourteenth Photo	31st August.
Fifth Drawing	31st August.
Guild Motto	30th September.
Easter Holiday Essay ...	30th September.
Painting (Hornby Train) ...	30th September.
Fifteenth Photo	30th September.

Results

Fourth Drawing Contest

A great many of our readers took advantage of this drawing contest, the subject of which was a "A Petrol Motor Bus or Motor Lorry." Competitors still further showed their artistic abilities with pen and pencil and quite a number of the drawings received were remarkably good, the details being well brought out. Under the circumstances it was a most difficult problem to adjudge the winners, but after very careful examination it was decided to award the prizes as follows:—

Class (A), 16 and over, First Prize (Drawing or Painting materials or Meccano Products value 10/6), S. Sharvell (Wembley); Second Prize (Drawing or Painting materials or Meccano Products value 5/–), S. Howson (Cumberland). In Class B, under 16, similar prizes were awarded to L. Lee (Surrey) and F. Weeks (Middlesex) respectively.

Twelfth Photographic Contest

Many excellent photographs were received in this competition, the subject of which was a "Bridge, Viaduct or Aqueduct." Bridges of all kinds were "snapped," ranging from the Forth Bridge to a small rustic bridge crossing a stream, and the detail in the photographs in most cases was excellent. In passing we may mention that we should like to see more competitors doing their own developing and printing.

In section A, under 14, B. Sandham (Preston) has been awarded the first prize, Meccano Goods value 10/6. for his fine snapshot and enlargement of the Forth Bridge. The second prize, Meccano Goods value 5/–, was won by L. E. Ashforth (Birmingham) for a snap of the Cuthadam Bridge. In section B, 14 and over, similar prizes were won by D. J. Kendrew (Southport) and F. G. Clements (Luton).

Third Cross Word Puzzle Contest

We endeavoured to make this puzzle a little more difficult than the previous "Cross Word," and it certainly proved a "teaser," for the number of entries was much smaller than in the previous contest. Many readers made a valiant effort to solve the puzzle and a considerable number submitted very creditable efforts. We were glad to notice a considerable improvement in the original puzzles submitted. These on the average were not only much more carefully prepared but also they showed a very considerable amount of ingenuity.

All entries were treated on their own merits and it was finally decided to award the three prizes offered as follows: First Prize (Meccano Goods value £1/1/–), Alan G. Pirie (Glasgow); Second Prize (Meccano Goods value 10/6), Ian Lamb (Broughty Ferry, Forfarshire); Third Prize (Meccano Goods value 5/–), Helen Holtby (Worthing).

We heartily congratulate the prize winners, especially Helen Holtby, on their really excellent entries.

Overseas Result

Christmas Puzzle Contest

Boys of every age from all over the World entered this popular puzzle contest, and although the entries were not quite so numerous as those in the Home Section there were quite enough to keep us extremely busy.

Every individual entry was examined very carefully and we found that several competitors had sent in the correct solutions to all the puzzles they selected. After the fullest consideration, and in accordance with the rules governing this contest, in which neatness played an important part, the prizes were awarded as follows:—First Prize (Hornby No. 2 Goods Set), T. G. Young (Auckland, New Zealand); Second Prize (Hornby No. 2 Tank Loco), J. S. Anderson (Tasmania, Australia). Three other prizes consisting of Meccano Radio Receivers or Headphones were awarded to E. H. Craft (New South Wales, Australia), N. Montgomery (Melbourne, Australia), and D. Moore (Tasmania).

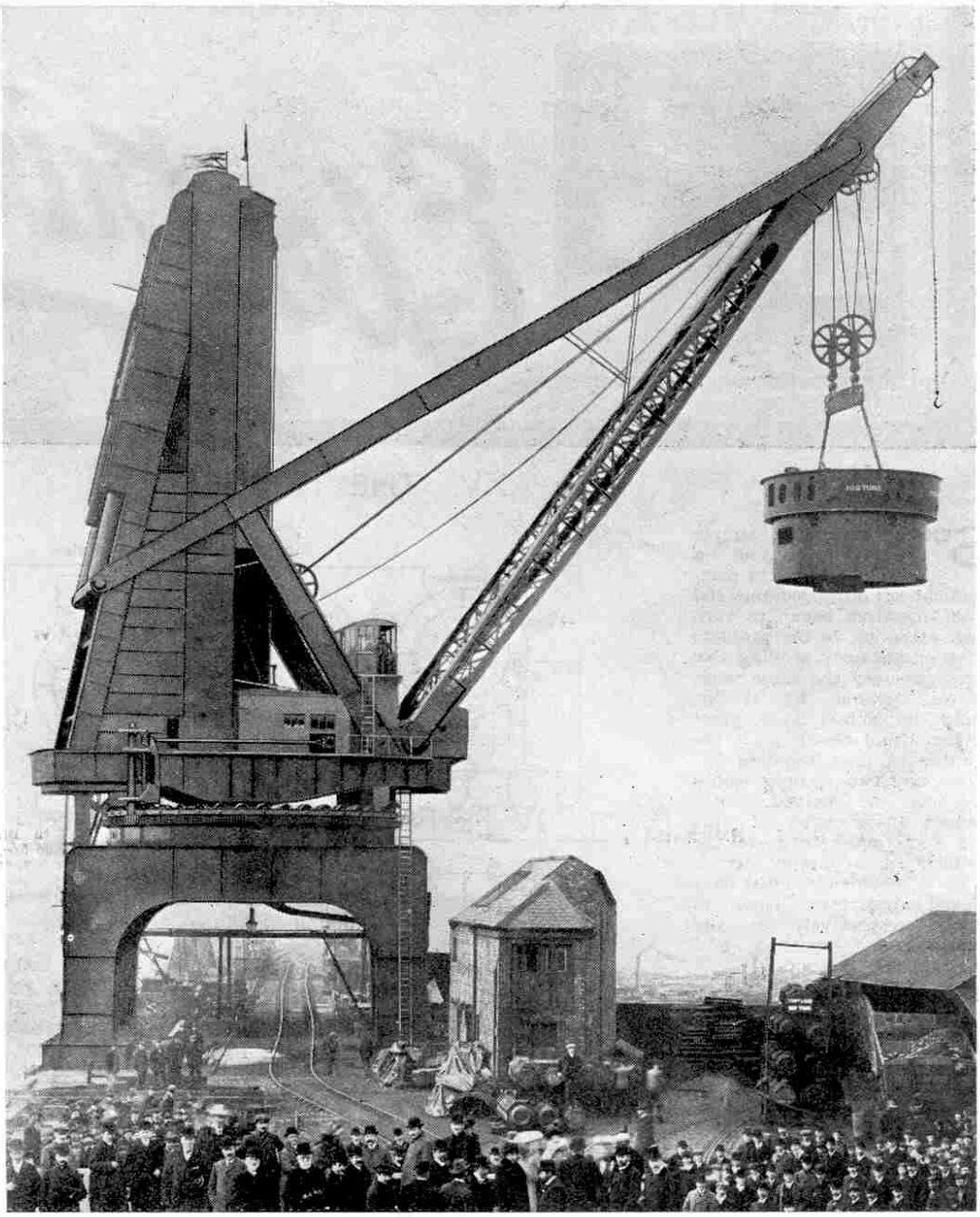
(*Continued foot of next column*).

A Fine Crane

By the courtesy of Messrs. Sir W. G. Armstrong Whitworth Ltd. we are able to illustrate on this page a special hydraulic crane, which is also shown on our cover this month. This fine crane is of 200 tons capacity and was used in the shipment of the 2–8–0 locos. built for the Belgian State Railways by the same firm, and described elsewhere in this ussue. The crane should form an excellent model for reproduction in Meccano.

As will be seen from the illustration the jib and operating mechanism is mounted on a massive base. This pivots on a central pillar and rotates on a roller race, which is fitted with rack gearing on its outside edge. Meshing with this racking gear is a pinion wheel, which is driven through a vertical rod by bevel gearing to a horizontal rod that, through bevel gearing again, transmits power from the engine.

The movement of the jib is controlled by pistons that are directly connected to the guide arms, and as full play is given to the movement of these pistons it follows that the jib can be raised or lowered through a very wide arc.



"Lynx-Eyed" Contest Solution of Third Series

Owing to the Overseas Section of this contest not closing until the 30th April we have not been able to publish the solutions before this date. Hundreds of entries were received in this contest and we made it a point of giving a prize to each competitor who sent in a correct solution. In accordance with the rules laid down in the event of a tie, the first three prizes were awarded to those whose entries were the neatest.

We now give the correct solutions to the three sets of Puzzle Pictures appearing in the October, November and December issues of the "*M.M.*" respectively:—First Set:—Picture No. 1, Model No. 335. (2) 20, (3) 314, (4) 105, (5) 215, (6) 42, (7) 339, (8) 203, (9) 330, (10) 223, (11) 305, (12) 130. Second Set:—(13) 343, (14) 33 (15) 241, (16) 115, (17) 224, (18) 228, (19) 244, (20) 64, (21) 253, (22) 47, (23) 217, (24) 131. Third Set:—(25) 317, (26) 3, (27) 220, (28) 41, (29) 309, (30) 220, (31) 116, (32) 50, (33) 107, (34) 204, (35) 17, (36) 128.

Shipping Locos. Overseas—

(*Continued from page* 215)

as Liverpool varied and interesting shipments of a similar nature are constantly being made. Only a few weeks ago, for instance, the King of Egypt's State Railway Coach was lifted by the "*Hercules*" and deposited on board the deck of the S.S. "*Amarapoora*" to be shipped to Port Said.

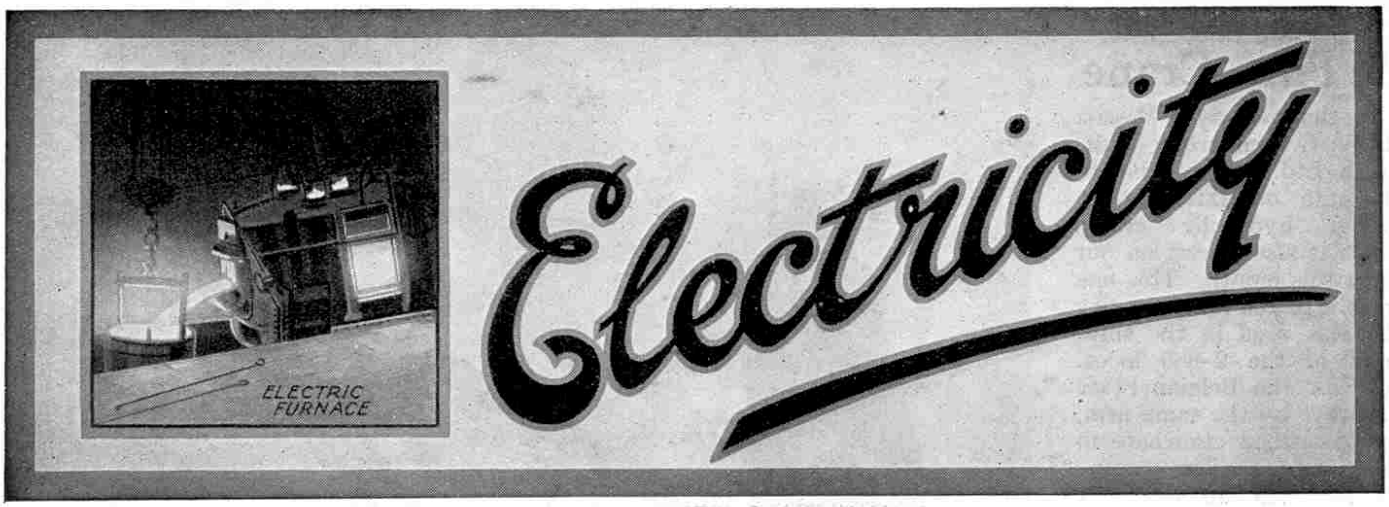
No doubt many of our readers saw this luxurious coach when it was on view at the Wembley Exhibition last year. In this connection it is estimated that nearly two million people inspected it, inside and out, at Wembley.

The Coach is 70 ft. in length and weighs 60 tons. There are six compartments, comprising vestibule, lounge, bureau, bedroom, bathroom, and a room for the King's valet. The lounge is decorated after the Louis Quatorze period, the bureau in the Adams style and the bedroom in the Louis Sieze style, with white and old gold predominating.

A Vision of Cream and Gold

It is fitted with electric heating to supply hot water for the bath and wash basins. The exterior is painted in cream colour, picked out with gold lining, and each centre panel has a hand-painted reproduction of the Royal Coat-of-Arms. The coach is, indeed, regarded as one of the most luxuriously appointed state vehicles on any railway.

Owing to the great width of the coach special arrangements had to be made for its conveyance to Birkenhead. It was placed on special bogies on the L.M.S. Rly., at Birmingham (where it has been stored since the exhibition) and all traffic was stopped during its journey to Birkenhead. Special care had to be taken in lifting it so as not to strain the under-carriage unduly, and the precautions in this connection, and also in the shipping of the coach, were of an elaborate nature.



XV. THE TELEGRAPH

SOON after the simple telegraph became a practical means of communication on a commercial scale inventors began to turn their attention to the problem of simultaneously sending two messages over the same wire. It was obvious that if this could be achieved a great saving would result, since the number of lines required between any two stations would at once be halved. After various unsuccessful attempts had been made to solve the problem, two methods were evolved which ultimately proved satisfactory. These are known respectively as the "differential" method and the "bridge method."

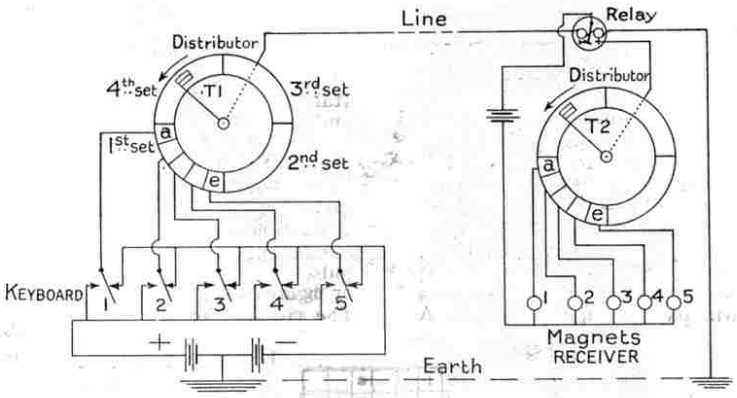


Fig. 1

The Differential Method

The differential method is so called because it makes use of double or differential windings on the relay. The circuit is shown in Fig. 4. When the key K is depressed so that pivot "p" is electrically connected to the stud "b," a current will flow from the battery BB through the key to the link BC on the relay. Here the current divides into two equal parts, one of which passes through each winding of the relay. One part of the current then flows by way of terminal A to line, and the other part through D, resistance R and condenser X to earth.

The values of the resistance and the condenser are so adjusted that they exactly balance the resistance and capacity-to-earth of the line, and the technical name for these two units is "artificial line."

Since the real and artificial lines are identical so far as the current arriving at BC is concerned, this current splits up into two exactly equal portions, and these, passing in opposite directions round the magnets of the relay, neutralise each other's magnetising effect and so do not act on the armature of the relay.

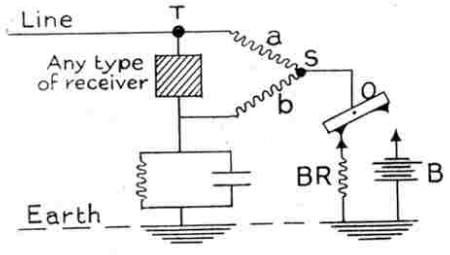


Fig. 3

Path of Received Current

A received current passing along the line enters the relay at A, flows through one of the coils of the magnet to C, and thence passes to the key K. If the key is in the position shown in the diagram the current flows through the back stop "a" and the resistance BR—adjusted to equal the resistance of the battery BB—to earth. If the key is depressed when the current arrives at "p" the current flows through the battery BB to earth. Since the current flows only through one coil of the magnets, these act on the armature and complete the circuit consisting of this armature, the sounder S and the sounder battery SB.

If the key happens to be in the midway position, however, so that it is not making contact with either "a" or "b," the received current, having passed through the first coil of the relay, will pass through the second coil from B to D, going round the magnets in the same direction and thence through the artificial line to earth. The added resistance of the line, of course, halves the current, but this now passes round the magnets of the relay twice as many times as formerly, and therefore acts upon the armature of the relay with as much force and certainty as before. Thus both stations are able to transmit and receive messages to and from each other at the same time without the slightest interference taking place.

The early difficulties encountered in duplex telegraphy were due mainly not to faulty method but to the fact that no allowance was made for the capacity of the line to earth. Until this factor was taken into consideration the artificial line could not be electrically identical with the actual line.

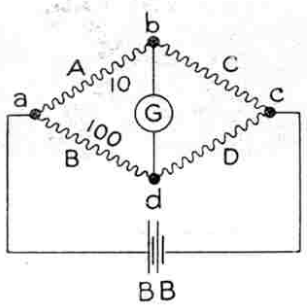


Fig. 2

The Wheatstone Bridge

Another system of duplex telegraphy much used is shown in Fig. 3. This is known as the bridge method, owing to its similarity to the well-known method of measuring

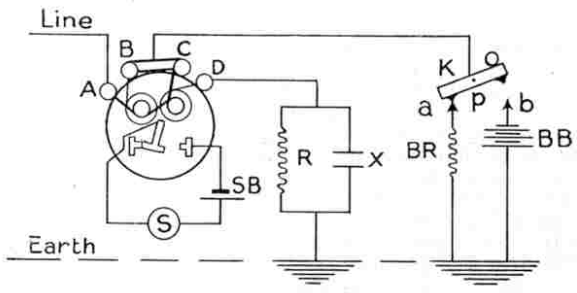
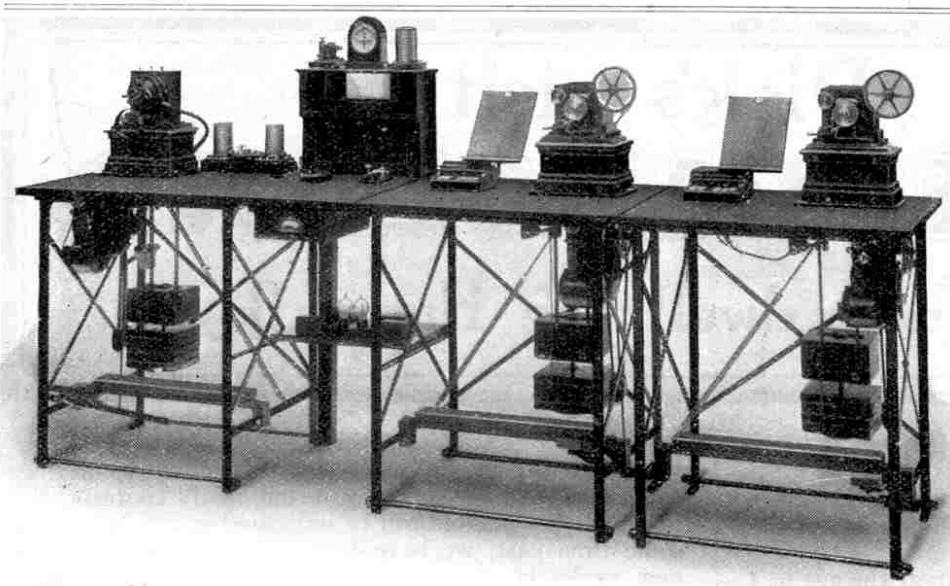


Fig. 4



Courtesy [*Messrs. Siemens Bros. & Co. Ltd.*

Fig. 5. Baudot simplex double station set

the value of an unknown resistance by means of a Wheatstone bridge.

The diagram of the circuit of the Wheatstone bridge is shown in Fig. 2, in which A and B are two known resistances of, say, 10 and 100 ohms respectively, C is a variable resistance and D is the unknown resistance to be measured. At G is an ordinary galvanometer and the more sensitive this is the more accurate will be the final results. There is a small battery at BB.

It is clear from the diagram that the current from the battery, upon arriving at "a," will divide in the proportion of 10 to 1, since this is the ratio of the two resistances A and B. This means that ten times as much current will pass through resistance A as through resistance B.

Now, if the resistances C and D are also in the same proportion, no current will flow through the galvanometer and the needle will not be deflected. Hence, if we adjust the variable resistance C until the needle is not deflected at all, we know that D is then ten times the resistance of C. We know the value of C, and therefore it is quite easy to calculate from this the resistance of D. This is the usual method of measuring electrical resistance and the Wheatstone bridge is one of the most useful pieces of apparatus in the possession of the electrician.

The bridge method of telegraphy (Fig. 3) operates as follows. When the key is depressed, current flows

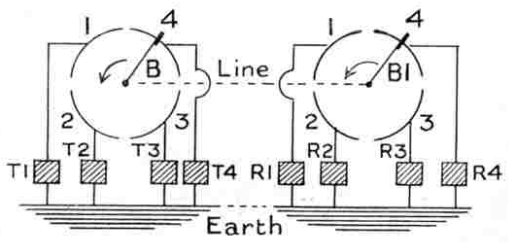


Fig. 6

from battery B and splits at S, part going through the resistance "a" to line and part through "b" to the artificial line and to earth. If the resistance "a" bears the same proportion to the resistance "b" as the resistance and capacity of the line bear to the resistance and capacity of the artificial line, no current will flow through the receiving instrument. This method possesses the advantage that any type of receiver may be employed, thus making the system suitable for cable telegraphy.

Multiplex Telegraphy

Multiplex telegraphy is a system whereby a large number of messages may be sent over one wire at the same time. The method consists of having, say, four transmitters at one end and the same number of receivers at the other end. Each of the transmitters is connected in turn to the line by means of the rotating brush B, Fig. 6, where T1, T2, T3 and T4 are four transmitters. At the receiving end is a corresponding rotating brush B1 that connects the four receivers R1, R2, R3 and R4 to line. The two brushes rotate at the same speed, and thus R1 receives only from T1, R2 receives only from T2, and so on.

This method may be employed for more than four transmitters and receivers if desired. Our diagram merely shows the principle of the apparatus, and in actual practice various modifications have to be made. The greatest difficulty lies in the motors driving the brushes, for the two independent motors at the two stations must both revolve at exactly the same speed in order that the two brushes may keep pace with one another. The transmitters and receivers may be of almost any type.

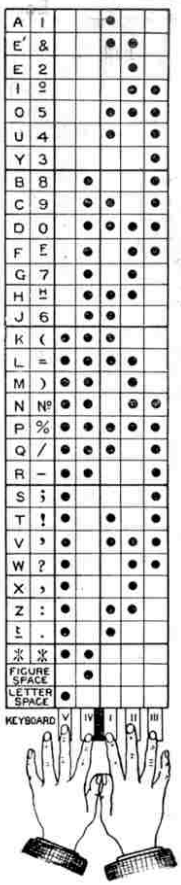
The Baudot System

The foregoing method of transmission is no longer used in Great Britain, but the Baudot system of multiplex type-printing telegraphy utilises a very similar method. This system is used extensively in the British Post Office, in the French telegraph services, in Italy, Russia and other countries in Europe, as well as in India and Ceylon.

The Baudot system was first used commercially in France about 1877, and in recent years its use has increased very greatly owing largely to its adaptability to many different types of telegraph service.

In this system the Morse alphabet is not used, but instead five pulses of current are used to denote each letter. These pulses may be either positive or negative currents, and letters or figures are indicated by altering the arrangement of the pulses. The code is shown in the accompanying table (Fig. 7).

The pulses are controlled by a keyboard with five letters. A simplified wiring diagram of the circuit of one sending and one receiving station is shown in Fig. 1, from which its similarity to the multiplex system already described will be seen.

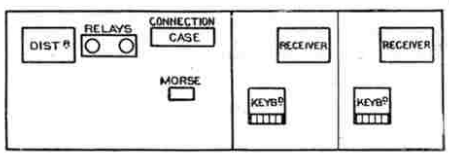


Courtesy [*Messrs. Siemens Bros. & Co. Ltd.*

Fig. 7. The Baudot Alphabet

360 Words a Minute

The two trailers T1 and T2 rotate in unison. Thus segment "a" at the sender is connected to line at the same time as the "a" segment at the receiver, and so on. Each of the five keys at the sender is an independent reversing switch and if the correct keys to indicate a particular letter are pressed while the trailers are passing over segment "a" to "b," the reversed currents will act on the polarized relay and these particular magnets in the receiver will receive an impulse of current. Thus if keys 1 and 4 are pressed, magnets 1 and 4 will be energised.



Courtesy [*Messrs. Siemens Bros. & Co. Ltd.*

Fig. 8. Plan of set illustrated in Fig. 5

These magnets produce certain mechanical movements in the receiver, causing the letter corresponding to the pressing of keys 1 and 4 to be printed on a strip of paper tape.

Each of the four sets of segments on the distributors is connected to separate transmitters and receivers and thus four messages can be sent along the line at once, each sender transmitting one letter per revolution of the trailers. This occurs 180 times a minute, and in consequence a quadruple set sends out 720 letters or about 120 words per minute.

A sextuple duplex—the first of which was installed in England in December 1913—sends 360 words a minute. In order that the operator shall know when to press the keys, a cadence note sounds

(*Continued on page* 247)

Dick's visit to MECCANOLAND

Where dwell the Happy Boys

(Continued)

"ABOUT what age do boys usually take up Meccano, and when do they leave off building with it?" I asked.

"Tens of thousands of boys take it up at the age of 4 or 5, practically as soon as they can use a screw-driver," replied Mr. Hornby. "As far as I can see, they give up building with Meccano only when they die!"

"The most suitable age is anywhere between 5 and 70. Young boys play with it for the fun of building machines and seeing them operate. Boys from 14 to 20, who have reached the thinking age, find in Meccano something more than a hobby for their leisure hours. Through Meccano many of them have discovered that they have a natural gift and inclination for engineering work. They are making engineering their profession in life and solving the great question of their future career in the best way of all, that is by their own free choice and inclination. They take up real work, still encouraged and instructed by the hobby that they began as children.

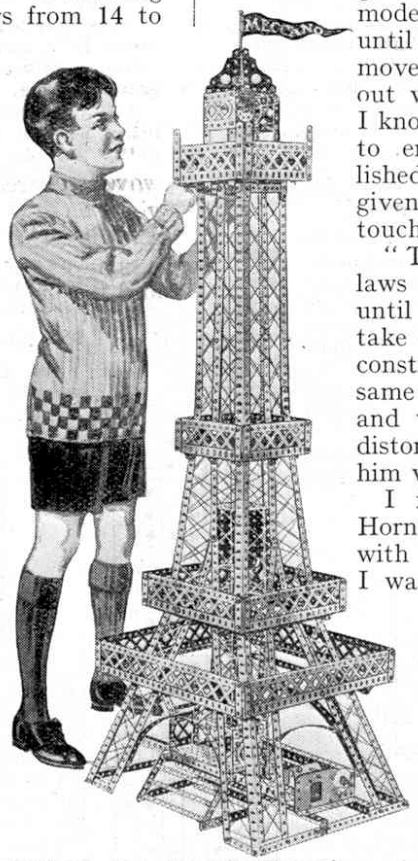
"Then grown men — professors, draughtsmen and engineers—use Meccano for building scientific instruments, models of inventions, new devices and for trying out ideas. Here is a file of letters from men all over the world who have written to tell us that they are using Meccano every day of their lives for one thing or another, and by doing so are saving thousands of pounds that they would otherwise have to pay for models and patterns with which to try out their ideas."

A Hundred Thousand Models

"All this is very interesting indeed," I said, "and I am beginning to wonder why boys ever buy any toy other than Meccano. How many models do you think your biggest Outfit will make altogether?"

"That is a question," replied Mr. Hornby, "which I hope never to be able to answer. We show over 400 in our Manuals, and we have hundreds and hundreds of new ones, as yet unpublished, and each of them is as good as any we have ever had.

"New ideas for models reach us every day. Over a hundred thousand have been sent in for the Meccano Prize Contests by competitors—and I can tell you that as long as our staff of expert model-makers produce at their present rate, and as long as Meccano boys continue to show the same ingenuity in our many contests, the new models available will be unlimited in number. For some time past, we have been describing at least one new model in every issue of the *Meccano Magazine*."



Dick examines the Eiffel Tower in Meccano

Don't Buy an Imitation

"When Meccano was first invented it was possible to build only simple models with it, but as new engineering parts were added to the system, models of a much better type became possible, until now we claim that there is no mechanical movement known that cannot be worked out with Meccano. This is a strong claim, I know, but it is the fidelity of Meccano parts to engineering principles that has established the supremacy of the hobby, and given it a standing that competition cannot touch.

"The Meccano system is based on the laws of engineering and mechanics, and until these laws are superseded nothing can take its place. Take it from me, any other constructional toy that attempts to do the same thing in any other way is unscientific, and will do a boy more harm than good, distorting his mind instead of furnishing him with useful knowledge."

I felt that I wanted to interrupt Mr. Hornby to tell him how cordially I agreed with all he said, and how full of admiration I was for the great work that he and his Company were doing among boys like my own. His enthusiasm and earnestness were wonderful things to me, and I found myself beginning to share them.

A Loom that Weaves

As he finished speaking he crossed over to a small table and brought back with him a model, the mechanism of which was about as complicated as anything I had ever seen.

"Look carefully at this model," he said. "It is the Meccano Loom. It was designed by a man who has made textile engineering his life-study and business. Every part used in it is a Meccano part, which may be purchased from any Meccano dealer.

"It is at present set to weave a length of coloured material suitable for a tie or hat-band, and I want you to notice how regular and perfect the material is—in fact it is just as good as the best you could buy in a first-class store. Now watch! I am going to

weave a little of the material for you."

He commenced to turn the handle, and instantly the whole machine came to life. The healds worked up and down in regular rhythm; the reed swung backward and forward, closing up the material, and the shuttle darted from side to side, leaving a trail of bright blue thread behind it, called the "weft," I believe.

The above illustration shows some of the beautiful material that may be made with the Meccano Loom. Unfortunately, it is not possible to reproduce the finished product in colours, so that the illustration gives but a poor idea of the attractive appearance of the finished fabric, the patterns of which are worked in blue, orange, gold, red, etc.

Before our astonished eyes a piece of most beautiful fabric was being woven, and anything more fascinating it would be impossible to conceive. This was a triumph of mechanism that I had never expected to see, and I was quite willing to believe Mr. Hornby's statement that no mechanical or engineering movement was impossible to Meccano. I was so fascinated with the model that I believe I should have stolen it if Mr. Hornby had not been in the room—I wanted it for myself and Dick!

I Become a Weaver

As I fingered the beautiful fabric over and over again, I could scarcely realise that I had actually seen it being woven. I took hold of the handle myself, and as I did so I wondered if the machine would be as obedient to me as it had been to Mr. Hornby. I commenced to turn, and felt a thrill of eager expectancy such as I had not experienced for many a long year.

Again the machine sprang into life, every little part of it seeming to know exactly what to do and just when to do it. I was fascinated by the "zip-zip" of the shuttle as it shot backward and forward between the threads of the warp, leaving in its track a little blue line of weft, which the reed instantly pressed firmly into the finished fabric.

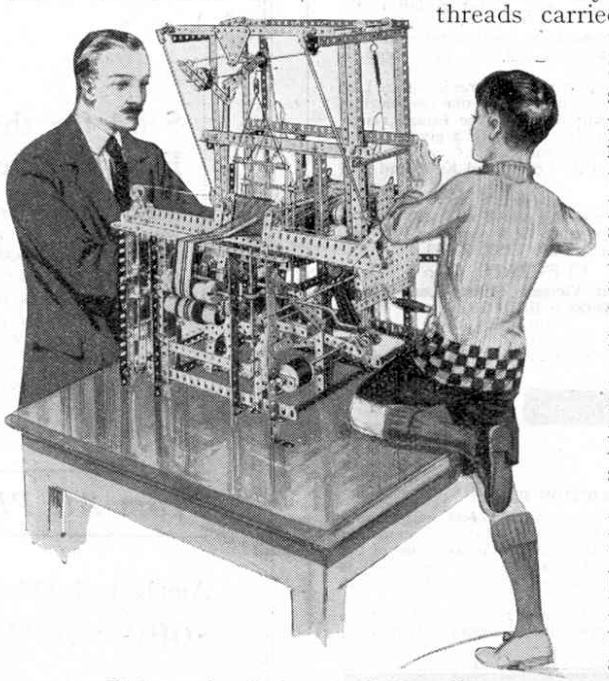
"Now you see for yourself," said Mr. Hornby, "that weaving with the Meccano Loom is delightfully simple. All that is necessary is to turn a crank handle—the model does the rest. I should mention, perhaps, that there is a certain knack in turning the handle, but this is soon acquired. Perhaps the only difficulty is to get the edges of the material even, but this comes easily after a little practice.

"Fabric woven with the Meccano Loom makes beautiful hat-bands or neck-ties. Tastefully woven, these will make excellent gifts for your friends, Dick. Imagine their surprise when you tell them the fabric is made to your own design on a model loom of your own construction."

Here Mr. Hornby took out a dozen beautiful fabrics from a drawer.

"Look at these," he said. "All these fabrics were woven entirely on a Meccano Loom from silks such as you buy in the hank or in bobbins. They represent only a few of the infinite number of patterns obtainable, the designs of which depend entirely upon the mechanical skill and the artistic ability of the person working the Loom.

"If it is desired, fabrics that are entirely plain may be woven, or a simple or intricate pattern introduced at will, in any chosen colour. The width of the material depends upon how you construct your Loom. On all Meccano Looms the fabric may be woven to any desired length, however, for when the threads of the warp are exhausted they may be joined to more threads carried on a second beam, and the process continued indefinitely. Similarly, when the weft in the shuttle has all been used, a new shuttle may be slipped into position in an instant and the weaving continued. The process need not be completed at one operation, as weaving may be stopped at any time and re-started when required, without the continuity of the material being broken."



. . . Dick was frantic to get at it himself . . . .

"Could we buy one of these Looms to-day?" I asked Mr. Hornby. "I am sure we should like to take one back with us, shouldn't we, Dick?"

"You cannot buy the Meccano Loom," Mr. Hornby replied. "You see we do not sell models but Meccano Outfits, and the Loom is built with the same parts that make the Clock, the Chassis, and hundreds of other models."

(To be concluded)

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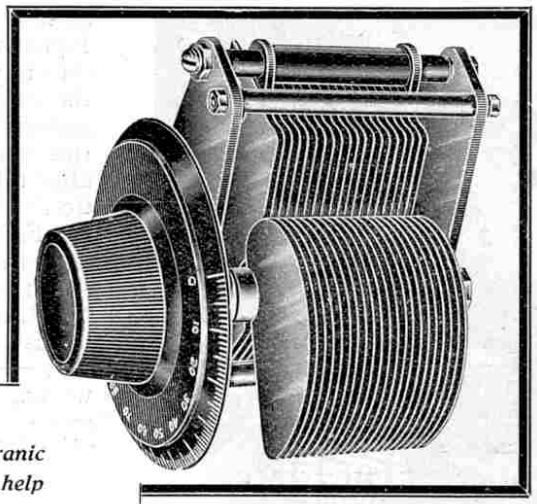

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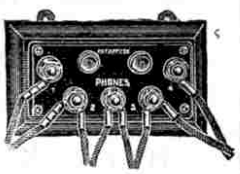

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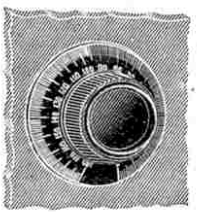

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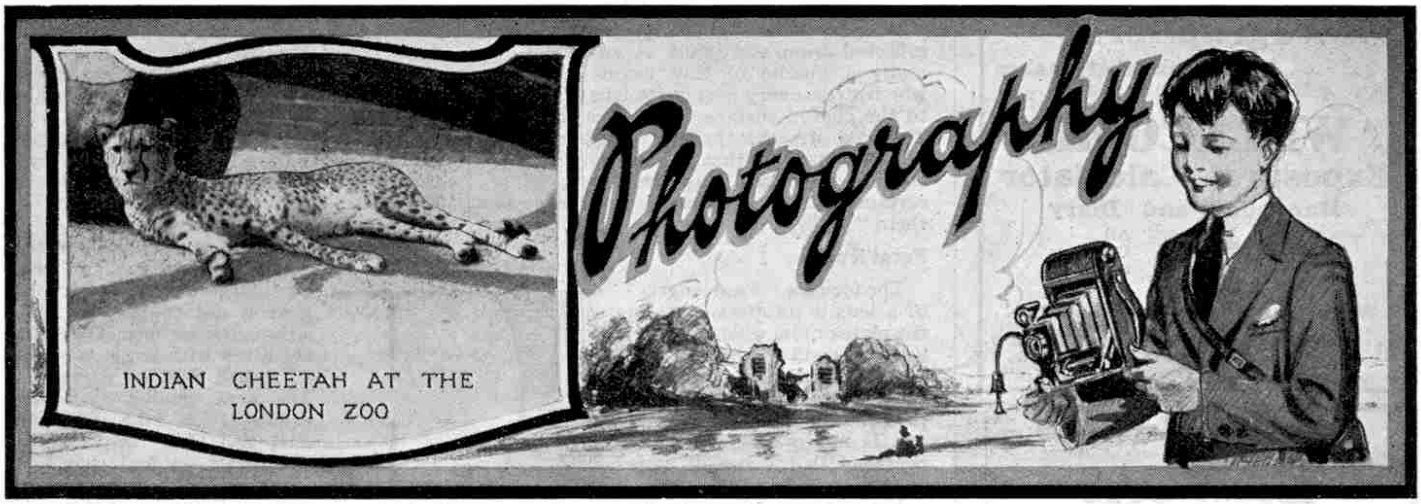

II. CAMERA LENSES

LAST month we dealt with the various types of cameras and the question of the choice of plates or films. Now we come to an equally important consideration, that of the lens and shutter. Usually standard lenses and shutters are fitted in the cheaper cameras, but as a rule the purchaser of a better camera has the choice of one or more makes or types of lenses, and, perhaps, of shutters also. Different lenses serve different purposes and this article will give you some idea of the principles involved, so that you will more easily be able to choose a lens to serve the particular purpose for which it is required.

It is a common experience for an "old hand" at photography to be told, on showing a particularly fine specimen of his work, "You must have a wonderfully good lens." This remark is made time after time by people who have no knowledge of photography, and it shows that they attribute the excellence of a photograph almost entirely to the quality of the lens.

No greater mistake can be made, for although a good lens must obviously be better than an inferior one, yet without knowing the condition under which a particular photograph was taken it is impossible to say whether the photographer used a lens of the highest quality or one that would be classed as inferior.

Pinhole Cameras

No doubt at some time or another most Meccano boys have possessed what is known as a "pinhole" camera. This is a camera without a lens and in which the photograph is taken by means of a tiny hole pierced through the front of the camera. Such a camera is of little practical use for a reason that we shall see in a moment, but it serves to illustrate the principle of the lens.

Every object that we are able to see reflects rays of light from every point, and as light always travels in straight lines, each of these rays travels in a straight line from the point on the object from which it is reflected.

If we place a sensitive plate in some kind of frame and hold it up in front of a building, such as a church, with the idea of taking a photograph, we shall fail utterly because when we come to develop the plate it instantly turns black all over and is useless.

The reason of this is that every part of the plate receives rays of light from every part of the church and the result is hopeless confusion. In order to photograph the church we must arrange matters so that the rays from the nave fall only on one part of the plate, the rays from the tower only on another part, and so on. In the case of a pinhole camera this is done by enclosing the plate in a box that is light-tight except for a tiny hole in the end of the box opposite to the plate. The effect of this is to allow only one set of rays from each part of the building to reach the plate, other rays that are not wanted being excluded.

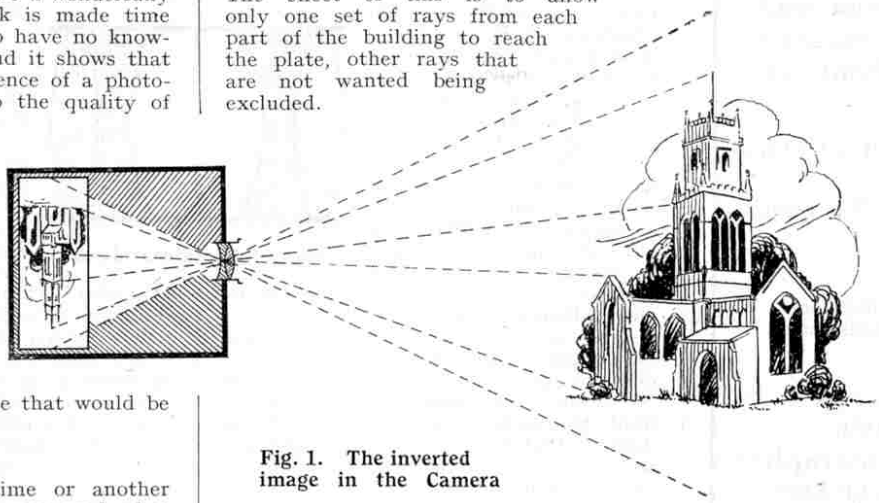

Fig. 1. The inverted image in the Camera

Because all rays of light travel in straight lines, the course of rays reflected from any object is that shown in Fig. 1. Each bundle of rays that passes through the pinhole into the camera continues its straight course to one particular part of the plate.

Why the Image is Upside Down

If we fit a piece of ground glass in the position occupied by the plate we shall be able to see exactly the same picture as will appear on the plate after development, and we shall notice at once that the picture is upside down. A little study of Fig. 1 will show why this is the case. Notice that the rays from the base of the church are travelling upward in a straight line when they pass through the pinhole, and that they continue their upward course until they reach the top of the plate. Similarly the rays from the top of the tower travel downward and so reach the bottom of the plate. The same thing holds good with all the rays in proportion and the result is that the image of the church on the plate is upside down.

Quite successful photographs can be taken with a pinhole camera but, owing to the very tiny dimensions of the pinhole, the amount of light illuminating the plate is so small that an extremely long exposure is needed to effect the chemical change in the emulsion of the sensitive plate necessary to produce a photograph. This means that a pinhole camera must always be used on a stand or placed on a table or wall. Of course, it is quite impossible with such a camera to photograph any object that is moving, no matter how slowly. It might be thought that this difficulty could be overcome easily by enlarging the size of the pinhole, but directly we do this we get back to our original trouble, that of rays from all parts of the object reaching all parts of the plate.

Superiority of the Lens

Fortunately, however, the difficulty disappears if we substitute a lens for a pinhole. The lens allows us to use a very much larger aperture than a pinhole because it bends or "deflects" all the rays of light that reach it, with the result that bundles of rays from each part of the object are concentrated on one particular part of the plate instead of being allowed to reach all portions of it.

(Continued on next page)

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What appears to be a single ray of light reflected from one point of an object is really a bundle of tiny beams of light which strike every part of the lens. Owing to the curved surface of the lens they do not pass straight through, however, but are deflected so that on emerging from the inside of the lens they meet at a certain point. This point is known as their "focus."

Focal length

The focus or "focal length" of a lens is its distance from the plate or film when focussed upon a distant object. The size of the image produced by any lens is exactly proportionate to its focal length, and is not in any way connected with the size of plate used.

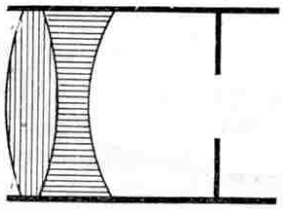

Fig. 2. Single Lens

For instance, supposing we have two lenses each of 6 in. focal length, one made for use with a quarter-plate and the other with a half-plate, the images produced by these two lenses will be exactly the same in size, but because the half-plate is larger it will include more of the view.

Stops or Diaphragms

With every photographic lens some form of "stops" or "diaphragms" are used. In their simplest form these stops may consist merely of a series of holes in a strip of metal that can be moved so as to bring any particular hole into position in the lens. Practically all modern cameras are fitted with what is known as an "iris diaphragm" however, consisting of a number of extremely thin metal or vulcanite leaves that may be moved so as to produce a series of circular apertures of various sizes. A similar arrangement is used in the human eye, where it works automatically, according to the light that strikes the eye. To test this beautiful piece of apparatus, go into a darkened room where there is a looking glass. After remaining a few seconds in the dark, light a candle and approach the mirror. Watch the pupil of your eye in the mirror, bringing the candle near to your eye. You will see the pupil large at first, but as the rays from the candle fall upon it it commences to contract, closing automatically according to the proximity and brilliance of the light.

The exact position in which the iris diaphragm is placed in a lens varies with different types. Whatever its position its action is the same in every case—it limits the diameter of the aperture to be used, so that by adjusting the diaphragm we may use either the full lens or only a small central portion of it.

The size of the aperture as thus regulated by the iris diaphragm has a very marked effect on the photography of objects near and far from the camera and this point will be dealt with when we come to the actual exposure.

F. Numbers

The stops or diaphragms are described by the relationship between the focus of the lens and the diameter of the stop. There are two systems in use, the "F" system, which is mostly used, and the "U.S." system.

The "F" number is obtained by dividing the focal length of the lens by the diameter of the stop. For example, the value of a $\frac{1}{2}$ in. stop in a 4 in. lens would be F8, while a $\frac{1}{4}$ in. stop used with the same lens would give F16.

The "U.S." or "Universal System," which is used on all Kodaks, starts from the basis of the value F4 and calls this 1. The next smaller stop is 2, the next 4, and so on.

All good lenses are marked with either F or U.S. numbers. Probably the largest F number in general use to-day is F4.5, although some special cameras are fitted with lenses working at much larger apertures. The next smaller stops are usually F5.6, F6.5, F8, F11, F16, and F32.

In order to find the U.S. number for any stop marked with an F number it is simply necessary to divide the F number by 4 and square the result. For instance, F8 equals U.S.4, while F16 equals U.S.16, the latter being the only case in which the figure is the same in both systems.

Types of Lenses

The speed of all lenses working at the same stop is the same, and therefore the photographer knows that if he has half a dozen different lenses, and uses each one with the same stop, an exposure that is correct for the first lens will be correct also for all the others.

Having seen something of the principle of the photographic lens we must now turn to the types of lenses in everyday use. These are three in number, the single lens, the double lens or rapid rectilinear and the anastigmat.

Single Lenses

The single lens, which is variously described as "achromatic," "meniscus," or "landscape," is not really a single lens at all, but is made up of two lenses cemented together so as to appear one, as shown in Fig. 2.

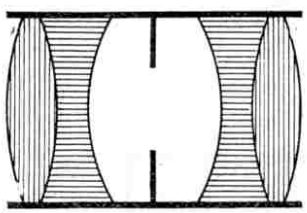

Fig. 3. Rectilinear Lens

A true single lens such as an ordinary magnifying glass cannot be used conveniently for photographic purposes because it is not achromatic. Those of our readers who have studied physics know that white light is made up of rays of seven different colours, namely, red, orange, yellow, green, blue, indigo, and violet. When light passes through an ordinary magnifying glass the different coloured rays are not all deflected to the same extent. For instance, the violet and blue rays, which have the strongest effect upon the sensitive emulsion of the plate, come to a focus appreciably nearer the lens than the other rays. The result is that it is impossible to obtain a sharply focussed photograph with such a lens without special adjustment.

In the photographic single lens the effect of combining two lenses is to produce an achromatic lens that deflects the rays of every colour to the same extent. The single lens is excellent for landscape work and it will take portraits, but it has the disadvantage that it cannot be used with a larger stop than F11, and consequently it is comparatively slow. It also has certain disadvantages in regard to distortion, this being particularly noticeable