CLUB NOTES

Washingboro' M.C.—Meetings have been held recently in the Leader's house, owing to the Village Hall not being available, but very soon a suitable club-room will be obtained where Mr. R. Hamblett will fix up his wireless set. Lectures on Motor Cycling and tuning for speed have been arranged. Club roll: 16. *Secretary*: T. Smith, 3, Stamford Villas, Washingboro', Lincoln.

South Park (Ilford) M.C.—Members are very enthusiastic model builders and some good models have been built, including the Loom on which the builder has woven several neck-ties. Other points of interest are Lantern Lectures and an Exhibition. Club roll: 45. *Secretary*: Norman Tweddell, 103, Breantore Road, Seven Kings, Ilford.

Chalmers Church (Alloa) M.C.—Has now become affiliated with the Guild and members are very enthusiastic. An interesting syllabus has been arranged, including Model Construction, Lantern Lectures, and Musical Evenings with Tea and Exhibition of models. Club roll: 24. *Secretary*: Wm. Henderson, c/o Mr. Meins, 1, Hawkhill Cottages, Clackmannan Road, Alloa, Scotland.

Holy Trinity (Blackburn) M.C.—Very successful meetings have been held and the membership is steadily increasing. Great keenness is shown in the club's football team, and some excellent games have been played. The Leader, Mr. Hulme, gave a lecture on the "*Steam Engine*," which he illustrated by a model constructed by himself. Club roll: 28, average attendance, 20. *Secretary*: H. Jepson, 11, Pine Street, Blackburn.

St. Mary (Bourne) M.C.—An interesting lecture was recently given by Capt. Purvis, R.N., on "*The History of our Ships*," and there was a good attendance. Model building is one of the chief features in the club's activities. Club roll: 16. *Secretary*: Douglas L. White, "Rosedale," Stoke, Andover, Hants.

Combe St. Nicholas (Chard) M.C.—The session has been the most successful ever experienced, and the members' subscriptions for last year left a surplus to carry over to this year for club improvements. Another model competition is being arranged. Club roll: 15. *Secretary*: L. Bailey, Combe St. Nicholas, Chard, Somerset.

Buckfastleigh (Devon) M.C.—Is unfortunately without a club room owing to the building where the room was situated being partially demolished. Members are anxiously looking out for another room, and if anyone knows of a suitable room will he please communicate with the Secretary. Club roll: 26. *Secretary*: H. J. Parsons, Bell House, Fore Street, Buckfastleigh, S. Devon.

Rosyth M.C.—Model building continues to be a popular feature. It has been decided to arrange a Members' Party, the expenditure upon this to be met mainly from Club funds. Club roll: 9. *Secretary*: Edward Hunter, 79, Admiralty Road, Rosyth, Fife.

Glevum (Gloucester) M.C.—Members, who are all Boy Scouts, recently assisted in an Operetta in aid of the Missionary Societies, and have been kept very busy preparing for a Christmas Pantomime. A Gymnasium Class is held each Saturday evening, and other events are Wireless Evenings, a Jumble Sale, and visits to different works, etc. Club roll: 20. *Secretary*: C. L. Wilks, 89, Regent Street, Gloucester.

Rolleston M.C.—Has been reorganised into Senior and Junior sections. The two sections meet once a fortnight in the Senior Room for lectures, but should the smaller boys not wish to listen they can play games, build models, etc. A wireless valve set has been purchased from funds raised at the last Exhibition and Concert. Mr. Taylor, a local gentleman, recently gave an interesting lecture on "*Astronomy*," which was greatly appreciated. Club roll: 23. *Secretary*: E. P. Toon, Sherbourne House, Tutbury Road, Rolleston, Burton-on-Trent.

Great Baddow (Chelmsford M.C.)—Keen interest is shown in constructing models, and the most recent efforts include a Crane, Pit Head Gear, and Fire Escape. The club became affiliated with the Guild in December, and promises to be very successful. Club roll: 10. *Secretary*: G. T. Kemp, 5, King Edward St., Beehive Lane, Baddow Road, Chelmsford, Essex.

Loanhead M.C.—Recent activities included a Magic Lantern Entertainment and a Lecture by the Leader on the "*Motor Car*," explaining the working of the engine. Club roll: 18. *Secretary*: B. Warnock, R.P. Manse, Loanhead, Midlothian.

Peebles M.C.—The Leader, Mr. Flint, has done admirable work for this club, and recently obtained a new club-room from the local Y.M.C.A. free of charge. One night each month is set aside as a "Talk Night," when the Leader reviews the articles appearing in the "*M.M.*" Meetings are held every Tuesday. Club roll: 7. *Secretary*: A. Ker, 1, Ker Place, Peebles, Scotland.

Liscard High School M.C.—Many new members have recently joined, and the club has again been divided into three sections, Photographic, Wireless and Meccano, owing to the popularity of this system last session. Each subject is illustrated by models built by members, and special demonstration evenings are held. A Social Evening and Dance is also included in the club's winter activities. Club roll: 65. *Secretary*: A. B. Warburton, 11, Brisbane Avenue, New Brighton.

Meccano Club Leaders

No. 18. Mr. R. Patrick

In addition to being the leader of the Glenelg (South Australia) Meccano Club, Mr. Patrick is also the local Meccano dealer. He can claim a long and intimate acquaintance with the hobby, and his knowledge is of considerable assistance to the Club members.

Glenelg is the chief watering-place of South Australia, being 6¾ miles from Adelaide, and it has many historic associations. The Meccano Club was first started in July 1923, with a membership of sixteen. Mr. Patrick then took over the Leadership, and affiliation with the Guild was granted early last year. Since then the number of members has increased to 63, and the Club has been divided into two divisions, junior and senior, under sub-leaders.

Mr. Patrick is an able lecturer and his talks on Club nights are eagerly looked forward to, while his great popularity with boys is evident from the steadily increasing number of Club members.

Boroughmuir School M.C.—Members propose to pay monthly visits to such places as the Leith Docks, printing works of the "*Scotsman*," Rosyth Dockyard, the Rubber Mills, and various other interesting places. After each visit it is proposed that a club member shall read a paper on the various features seen. An interesting lecture was given by Mr. Fraser on "*A Visit to the Canary Islands*," illustrated by lantern slides. The membership increases steadily. Club roll: 42. *Secretary*: James D. Watson, 1, Alvanley Terrace, Edinburgh.

Luton M.C.—Great interest is shown in Wireless Telegraphy, and recently members brought their wireless sets to the club-room and demonstrated them. Other activities include lectures on Telegraphy, Magnetism and Electricity, and the First Cable. Lectures have become so attractive that it is proposed to hold them more frequently. Club roll: 26. *Secretary*: L. Goldsmith, 69, Tennyson Road, Luton, Beds.

Ellesmere Port M.C.—A Wireless Set constructed by members has been tested and has given good results. Model Building and further Experiments in Wireless figure in the interesting syllabus. Club roll: 22. *Secretary*: W. H. Hope, 41, Princes Road, Ellesmere Port, near Birkenhead.

Chard M.C.—An Exhibition was held in December, at which some very interesting models were displayed, including a Dredger, Motor Bus, and Roundabout. A local gentleman judged the models and distributed the prizes. Other activities include a Model Building Competition. Club roll: 16. *Secretary*: Wm. Sanders, Stamford House, Upper Combe St., Chard.

King Edward's School (Birmingham) M.C.—Last session a few meetings had to be postponed owing to the production of a school play, but next term it is hoped to make good headway. A new Secretary will shortly be appointed, as Master Robertson has resigned to become Secretary of a new club, called the Handsworth M.C. Club roll: 16.

Victoria (Glasgow) M.C.—Was recently divided into Senior and Junior sections, and this arrangement has proved quite satisfactory. An interesting lecture was given by A. Boggs on "*Wireless Telegraphy*," on which occasion the committee of the newly-formed Govan Meccano Club were present. Club roll: 39. *Secretary*: T. Calderwood, 63, George Street, Whiteinch, Glasgow.

Bromley County School M.C.—Members are now busy fitting the lifts in their model of the Eiffel Tower, which are intended to work automatically. E. Taylor gave a very interesting lecture on "*Lighthouses*," and it has been proposed to have more lectures in future. Club roll: 10. *Secretary*: H. Seale, 14, Broadway, Bromley.

Boston (Lincs.) M.C.—Recently had a "prize-giving" night, when prizes were presented by a local gentleman, Mr. French, for the best Meccano and Fretwork models. G. Harvey's Motor Chassis was considered the best model, and A. Read won a prize for a Fretwork bracket. Club roll: 30. *Secretary*: R. Robinson, 30, Woodville Road, Boston, Lincs.

Accrington M.C.—An interesting lecture on "*Cotton*" was given by Mr. Airey, who explained the different processes through which cotton passes from the time it leaves the plantation until it is made up into material. Other activities during last month included Wood and Cardboard Model Making, and an Essay on "*My Favourite Hobby*." Club roll: 22. *Secretary*: V. Waterhouse, 45, Ramsbottom Street, Accrington.

India

Delhi Children's M.C.—Became affiliated with the Guild in November to the delight of all members. Steady progress continues to be made, and the club's prospects are bright. *Secretary*: Mr. R. Raman, Children's M.C., Charkhe Walan, Delhi, India.

South Africa

Malvern M.C.—Members have held a "Pound Day" in aid of the Children's Home, and a Garden Fete in aid of the Home and the Club Building Fund, and it was hoped to make at least £100. Further activities include Model Building, Games, Lectures and Concerts. Club roll: 31. *Secretary*: C. Gunnell, 177, St. Frusquin St., Malvern, Johannesburg, South Africa.

Clubs not yet Affiliated

Caulfield (Melbourne) M.C.—Has been established only about four months, but has already become a strong club. A very successful Exhibition was held in connection with a Church Fete. Club roll: 14. *Secretary*: Neil Brown, 89, Eskdale Road, Caulfield, Melbourne, Australia.

Norbury M.C.—Members have recently concentrated on recruiting, and the numbers are increasing week by week. Meetings are held in St. Philip's Hall, kindly lent by the Church authorities. Efforts are being made to form a library, and to persuade local gentlemen to give lectures. Club roll: 23. *Secretary*: W. R. Leader, 70, Norbury Crescent, Norbury, London, S.W.16.

Handsworth (Birmingham) M.C.—Will shortly become affiliated with the Guild. The Leader, Mr. Allan, is very enthusiastic and hopeful of a successful year. *Secretary*: N. J. Robertson, 30, Hinstock Road, Handsworth Wood, Birmingham.

Walthamstow M.C.—A club has recently been formed at Marsh Street Congregational Church, and all boys wishing to join should communicate with the Secretary: C. Redfern, 34, Church Hill Road, Walthamstow, London, E.17.

Proposed Clubs

Watford M.C.—Arthur Paskell, 1, Platts Avenue, Watford, is anxious to form a club and would like to hear from Meccano boys wishing to join. An adult Leader and a club-room are urgently needed.

Dublin M.C.—It is hoped shortly to establish a club in Dublin if a club-room can be found. Any information regarding a suitable room will be gladly received by the Leader, Mr. Kidney, 73, North Circular Road, Dublin, or D. J. Scannell, 25, Star of the Sea Terrace, Sandymount, Dublin.

Keighley (Yorks.) M.C.—Efforts are being made to form a club in Keighley, and an adult Leader is required. All Meccano boys interested are asked to write to H. Haygarth, 7, Raven Street, Keighley, Yorks.

Aylestone Park (Leicester) M.C.—All boys interested in Meccano and wishing to form a club in the district are requested to get into touch with S. Buxton, 36, Lothair Road, Alyestone Park, Leicester.

Newcastle Model Engineers, M.C.—Strenuous efforts are being made to start a club in Newcastle, and Mr. B. Gilbey, 205, Back Welbeck Road, Byker, Newcastle-on-Tyne, who is willing to become Leader, appeals to all boys interested to communicate with him. A club-room is urgently needed.

Siena (Italy) M.C.—It is proposed to establish a club in Siena. Mr. Bruchi has kindly consented to be the Leader, while his son, Valentino Bruchi, 39 Via Ticasoli 39, Siena, Italy, will carry out the Secretary's duties.

Wireless Helps Navigation

Position-Finding by Radio

DURING recent years great advances have been made in finding the position of a ship by means of radio. The method is used when, owing to cloudy weather, the ship has been unable to obtain her position from the stars for several days, or when the ship is near a coast in a fog and it is essential to know the exact position. The method is also much in use for finding the position of aeroplanes engaged in the cross-Channel flight to France. The principles of position-finding both at sea and in the air are similar, and as they are of general interest and of growing service we propose to describe them briefly.

If a rotating frame aerial is used for receiving wireless messages it is found that the messages are loudest when the aerial is pointing " end-on " to the sending station. When the aerial is at right angles to the direction of the signals they disappear almost entirely. In modern practice it is not necessary to revolve the actual aerial, however, for the necessary adjustment may be made in the apparatus of the receiving set by moving only a small part.

The bearings of two known stations are obtained by a ship in this manner and the results plotted on a map. The position of the ship may then be found quite easily. In the accompanying diagram A and B are the known positions of two shore stations and C is a ship requiring to find her position. Supposing that from the ship C, station A is found to be due south and station B is E.S.E. If the line AC is drawn on the map due north from A, and BC W.N.W. from B, the place where the two lines cross is the position of the ship. In practice it is advisable to choose the stations A and B so that the lines AC and BC cut the coast at as sharp an angle as possible, since if the angle is very acute considerable deflection is probable.

Compass Stations

Another method is for the stations A and B to be fitted with direction-finding apparatus and for them to find the bearings of the ship C. The result obtained by station B is telephoned by land-line to station A, where the results are plotted on a map. Station A then transmits by wireless the result to the ship in terms of longitude and latitude. This method is used every day in connection with aeroplanes on the cross-Channel route, the two stations employed being Croydon and Paulhan. The result of the plotting is wirelessed to the aeroplane, the aviator being told that he is now over such-and-such a village, or so many miles from some well-known landmark.

In this method it is necessary for the shore stations, known as " compass stations," to be informed by the ship or aeroplane that the position is required, and all other radio activities of the station must be stopped while the bearings are being obtained.

The Chief Compass Stations

In the case of ships this " shore-station " method has one drawback. If the area over which the compass stations work is a large one, there may be a number of ships requiring bearings at the same time. In this case the various ships have to wait their turn, which often causes considerable delay. On the other hand, a ship fitted with a direction-finder can obtain her position from any two stations, whether compass stations or otherwise, without troubling them, provided they are transmitting at the time. This method permits any number of ships to obtain their respective positions at the same time, while the two land stations transmit their usual messages unhindered.

The more important ship compass stations in the United Kingdom are Amlwch (call sign BXV), Berwick (BVG), Carnsore (BVZ), Flamborough (BVN), Larne (BXJ), Lizard (BVY), Malin Head (GHM), Peterhead (BVL), Rhyl (BZW), and Seaview (BXK).

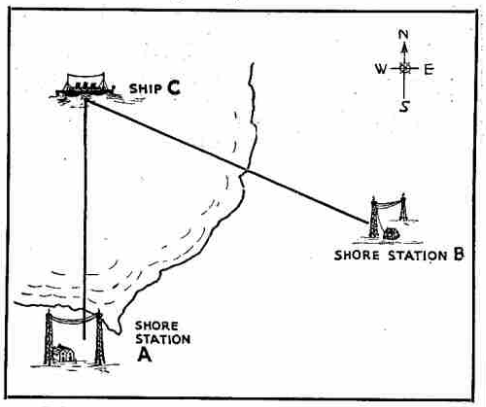


Diagram illustrating the method of finding position of a ship with the assistance of two shore stations.

All these stations are controlled by the Admiralty, with the exception of Malin Head, which is under the Post Office. All transmit on a wave length of 450 metres (except Malin Head, which is usually 600 metres, but sometimes 300 metres) and most of the stations work in pairs.

Under-Water Radio

Recently a third method of finding a ship's position in fog has been introduced at the Maas light-ship, which sends signals through the ether and the sea simultaneously. The signals travel through the ether at the speed of light, but through the water their speed is only 4,700 ft. per second. By measuring the difference between the times of arrival of the same signal sent by these two routes the distance of the lightship can be found with a fair degree of accuracy. For instance, if the under-water messages arrive one second later than the ether messages, the lightship is 4,700 ft. distant; if two seconds later, 9,400 ft. distant, and so on. The bearing is obtained in the usual way, by means of direction-finding apparatus, and from the two factors of direction and distance the position is plotted on a map.

Aeroplane Finds Ship at Sea

The remarkable accuracy that may be attained in wireless direction finding is well demonstrated by an experiment recently described by Dr. J. Robinson :—

" A test of the method was made some time ago by having a ship transmitting at sea out of sight of land. An aeroplane started from Biggin Hill, in Kent, without any information, except that it had to find the ship, which would transmit a particular signal every few minutes. The ship might have been in the English Channel or in the North Sea, but the observer, immediately on getting into the air at Biggin Hill, gave the pilot the correct course, and the aeroplane was flown straight to the ship, which was some 10 to 15 miles south of Brighton. The course followed from Biggin Hill to the ship was not deviated from in any degree. It should be noted that in this particular case visibility was very bad, and the pilot was within two miles of the ship before he observed it."

Submerged Electric Cables Guide Ships

A few years ago a cable was laid on the sea-bed of New York harbour and through the harbour entrance. An electric current passes through this submerged cable and causes a note to sound in a telephone on all ships fitted with suitable receiving apparatus coming within two miles of the cable. The nearer the ship is to the cable the louder are the signals, and when these are at their maximum the ship is directly over the cable. In this manner ships are able to follow the course of the cable and enter the harbour in safety, even in the densest fog.

The French port of Brest has installed a similar cable and it is hoped to have the device at all French ports within a short time. It is proposed also to lay such a cable across the English Channel, so that the cross-Channel services will not be hindered by fog. The system is equally practicable for aircraft, and will prove useful for them if it is installed on land as well as on sea.

Guiding Aeroplanes to Earth in Fog

Cables will be used in a somewhat similar manner at the Croydon Aerodrome in connection with a series of experiments to be carried out with the object of finding a satisfactory solution of the difficult problem of guiding aeroplanes safely down when, owing to the landing ground being hidden by mist or fog, the pilot is unable to see to land in the ordinary manner. From electric cables laid across the aerodrome will be radiated upward a very powerful electric field by which apparatus in the aeroplanes flying above will be influenced.

The Story of Metals

1. COPPER.

IN the first instalment of our articles "*The Story of Iron and Steel*" we saw that the history of mankind may be divided into three great epochs, according to the nature of the tools and weapons used in each. First there was the Stone Age in which the use of metals was unknown, at any rate until the later stages of this epoch, the implements and weapons being made chiefly from bones, stone, and flint. Then followed the Bronze Age in which bronze, a metal composed of copper and tin, began to be employed and gradually came into general use. Last came the discovery of the art of smelting and working iron, and so the Bronze Age passed and the Iron Age came.

Copper Known Long Before Iron

From this it will be seen that copper was known and used at a far earlier period than iron, and the reason for this is not difficult to understand. Iron, although one of the most widely diffused metals, is never found in a pure state—except in meteorites—and the ore is not easy to recognise or to work after it is once found. On the other hand, copper usually occurs in a fairly pure state, and as with gold and silver, would attract the attention of pre-historic man on account of its brilliant colour. In addition to this, copper is very easily worked, far more so than iron.

It is, of course, impossible to say how or when the art of smelting copper was discovered, but Lord Avebury suggested that it came about in the later stages of the Stone Age through the accidental use of copper ore stones in the fire-pits built for cooking purposes.

Copper Used 10,000 Years Ago?

Bronze, as we have seen, is a mixture of copper and tin, and it appears likely that the real Bronze Age was preceded by a period in which pure copper was the only metal known and used. Possibly bronze was first produced by accident during the smelting of copper ores along with which were ores containing tin. Assuming that this was the case, it is natural to suppose that prehistoric workers would soon notice that the resulting metal was a great improvement as regards hardness, and further experiments would no doubt make it clear that this improvement was due to the presence of tin. It may be mentioned here that brass appears to have been unknown to early man, the first definite reference to this metal indeed dating only from Roman times, and therefore the early written references to brass probably really apply to bronze.

From various kinds of evidence available it appears probable that copper and bronze were in use to some extent as far back as ten thousand years ago—that is long before the commencement of written history. Certain Egyptian relics of copper and bronze are believed to date back 7,000 years, and there is evidence that copper tools were made in Ireland about 2,500 years B.C. The ancient Greek and Trojan warriors used copper for their swords and spearheads.

Origin of the Name

According to the historian Pliny, the Romans obtained their supplies of copper from the island of Cyprus. The metal was known to them as "*aes cyprium*," which was afterwards corrupted into "*cuprum*," from which our word copper is derived.

Little is known about the production and working of copper until the year 1556, when Agricola published a book entitled "*De Re Metallica*," giving details regarding the metallurgical processes of the period. It is recorded that Edward III. granted to a company of adventurers the right of working "the copper mines of Skildane in Northumberland, and the copper mine of Alston Moor in Cumberland, and the copper mine near Richmond in Yorkshire, during a term of 15 years, and on payment of a royalty to himself of one-eighth and one-ninth to the Lord of the Soil." In Queen Elizabeth's time there was a rich copper mine at Keswick in Cumberland, of which the Queen deprived the Earl of Northumberland on the ground that it was a mine-royal. It is recorded that 4,000 men were employed at this mine, but this number is probably exaggerated.

Smelting in South Wales

The first copper ores to be smelted in South Wales came from Cornwall, from the mines of the Mines Royal Company established by Queen Elizabeth. At Neath, copper smelting was in operation at least as early as 1585. During the 17th century the industry prospered greatly in the Neath district, and at the end of that century several copper works were in operation. The conditions in the district were particularly favourable for smelting operations, for there existed close together the richest copper mine in the kingdom, an ample supply of suitable coal, and the necessary refractory materials, including the famous Dinas rock, for the construction of the smelting furnaces. In addition to all this, the neighbouring coast was well supplied with safe harbours.

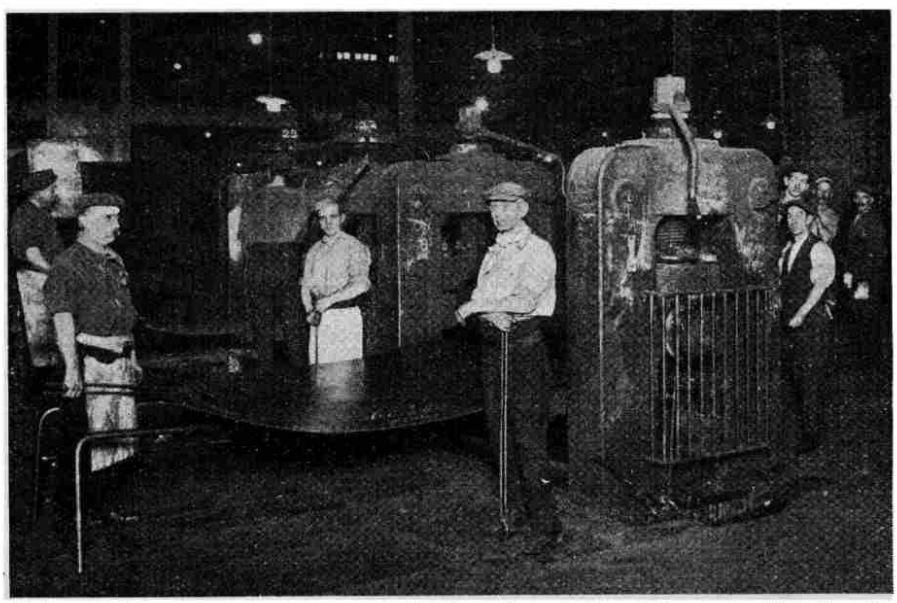


Photo courtesy [*Williams, Foster & Co. and Pa coe, Grenfell & Sons Ltd.*

Rolling Copper Sheet

Neath had become a well-known smelting centre before the erection of furnaces at Swansea was sanctioned. A document, dated the 26th September, 1720, contains the following extract :—" Wee, the Portreeve, Aldermen and Burgesses of the Burrough of Swansey in the County of Glamorgan, doe hereby certifye all whom it may concern that wee doe approve of the erecting of a Copper Worke. . ."

During the 18th century copper ores were smelted in various other parts of Britain, but at the close of that century and in the early years of the 19th century no other centre was able to challenge the dominating position of Swansea.

Distribution of Copper Ore

In the early part of the last century about 7,000 tons of copper were produced annually in England from English ores, this amount being approximately 75 per cent. of the world's production.

England retained her leading position up to about the middle of the century, when the opening up of large ore deposits accompanied by great development of metallurgical operations abroad, brought about the production of large quantities of copper outside this country. The copper resources of Chile were developed about 1830; twelve years later the Australian mines were opened up, and in another two years the Lake Superior deposits were discovered. In 1860 the Spanish and Portuguese ores came into a position of great importance on account of the discovery of suitable methods of treatment.

Recent developments in copper smelting commenced about 1880, when the rich deposits at Butte, Montana, U.S.A., were discovered, followed shortly afterwards by the discovery of copper in the Yukon district and elsewhere. About the same time deposits were discovered in Queensland, Siberia, and the Katanga regions of the Congo.

Characteristics of Copper

Next to iron, copper is the most important of all metals. It is distinguished by its peculiar red colour. It has exceptionally high conductivity for both heat and electricity, being surpassed in these respects only by silver. It can be rolled into the thinnest sheets or drawn into the finest wire with comparative ease, and forging operations can be carried out on either the hot or the cold metal. The tenacity of cast copper ranges from 10 to 13 tons per square inch—as compared with aluminium 5 tons and pure iron 18 tons—but cold-working, such as rolling, hammering or drawing, may more than double the normal tenacity.

At ordinary temperatures copper is not attacked either by dry or moist air, but moist air containing carbonic acid gas causes the production of a green film known as verdigris. This film appears to act as a protective coating, quite unlike the film of rust on iron, which rapidly corrodes through the metal. Ancient specimens of copper and bronze that have been excavated show a coating of this green film.

An Old Legend

We have all heard how the alchemists of olden times sought to bring about the transmutation of metals—that is to change one metal into another, and in particular to transform the commoner metals into gold. They resorted to all kinds of schemes to justify their theories, and made use of the water of a certain river in Hungary, which was found to convert iron immersed in it into copper. There was really nothing at all mysterious about this, however. The river and its tributaries passed through districts containing deposits of copper, and a small amount of the metal was taken into solution. Upon the insertion of iron in the water, metallic copper was precipitated from the solution and the iron dissolved.

This same principle is used to-day on a large scale in the treatment of certain low-grade copper ores, and in this connection it is interesting to know that considerable quantities of copper have been recovered by guiding drainage waters from the old copper slag heaps in Swansea through channels in which scrap iron was deposited.

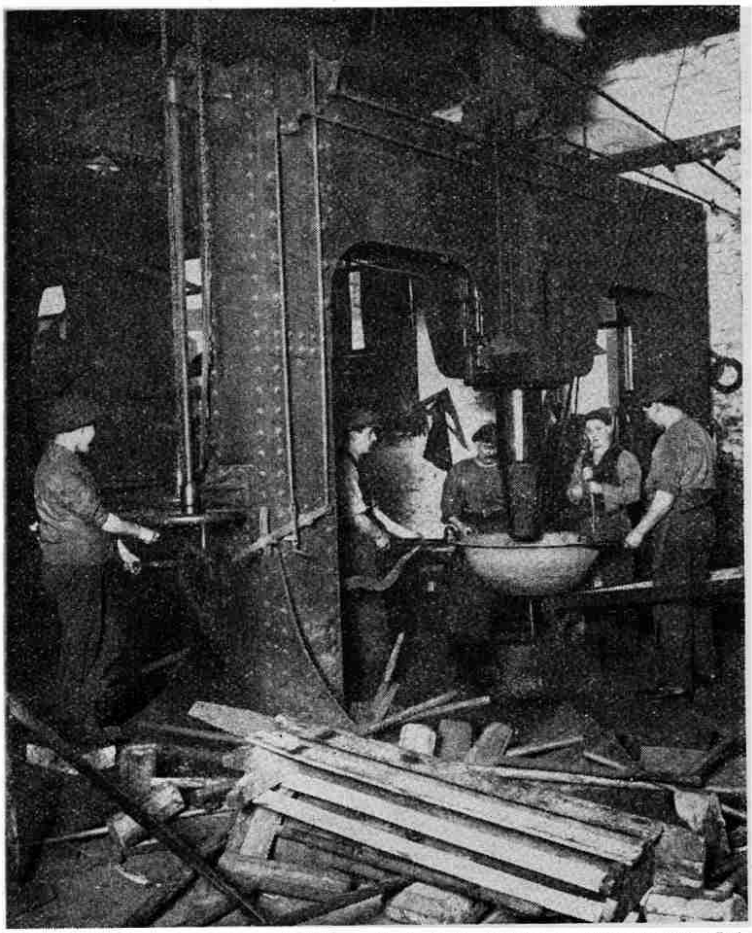


Photo courtesy [*Williams, Foster & Co. and Pascoe, Grenfell & Sons Ltd.*

Steam-hammer Beating Copper Bowl from the solid

The Most Important Ores

Copper is obtained from minerals that are widely distributed throughout the world. Native copper is comparatively rare, the chief sources of commercial importance being the deposits of the Lake Superior region in northern Michigan. Huge masses of the metal weighing many tons have been discovered in this region lying on the surface of the ground. In Minnesota in 1854 forty men were engaged for a whole year in cutting up a single mass of copper weighing about 500 tons.

The most important oxide ores of copper contain the metal in the form of bright green "malachite," or the azure blue " azurite." Malachite, besides being a source of copper, is of interest on account of its extensive use for the manufacture of ornaments. The cathedral of Leningrad (better known as Petrograd, formerly St. Petersburg) contains immense green columns of pure malachite obtained from Siberia. Large quantities of this mineral are also found in the copper fields of Katanga in the Congo, and also in Australia.

The most important copper minerals are the sulphides. Pure copper sulphide, or copper glance, is an important constituent of the ores of Spain and of Butte, Montana. More common are the complex sulphides, notably copper pyrites, a mixture of copper and iron sulphides possessing a brass-like colour and containing nearly 35 per cent. copper. This mineral occurs widely and provides the bulk of the copper produced in the world.

Industrial Uses

The industrial uses of copper are more varied and more extensive than is generally recognised. Everybody knows that enormous quantities of copper are used in the form of wire—from the thinnest " flex " to the stoutest cable — for conducting electric currents, but the extent to which the metal is used in other directions is by no means fully appreciated.

Take, for instance, the locomotive. Throughout the British Empire and most parts of the world copper is used almost exclusively for the plates of which the firebox is constructed. Steel is more commonly used in the United States and in Canada, but copper, in spite of its greater cost, has many points of superiority over steel. Its high conductivity for heat results in greater efficiency for a given fuel consumption, it scales much less quickly than steel and it is less liable to failure during use. The strength and hardness of copper used for firebox plates is increased by the addition to it of a very small quantity of arsenic.

Locomotive boiler tubes may be made of copper, brass, or steel. New copper tubes give a service equal to approximately 110,000 miles as compared with a service of 70,000 to 80,000 miles for mild steel. Vast quantities of copper and its alloys are used also for similar purposes in the engines of ships of all types.

In many industries such as brewing, distilling and jam-making, the metal vessels employed must be able to withstand the action of various acids. On account of its high resistance to corrosion, copper is very extensively used for making the

(*Continued on page* 95)

The "Flying Scotsman"

New Rolling Stock for East Coast Trains

TWO entirely new restaurant car trains have recently been completed for the famous "*Flying Scotsman*," a train that has been leaving King's Cross, London, and Waverley Station, Edinburgh, at 10 o'clock every week-day morning, since 1862. Indeed, this train holds a unique record for unaltered time of departure, for on no other railway has any single train left at any particular time of the day for such a long period as 62 years.

The new trains embody many novel features, of which perhaps the principal innovation is the exclusive use throughout the train of electricity instead of gas for cooking and lighting.

Cooking with Oil Lamps

It is interesting to compare the restaurant cars of olden days with those now running on the East Coast route to Scotland. The first restaurant car saloon to run on any railway in Great Britain was instituted between King's Cross and the North in September, 1879. This car, which did excellent service and was at that time considered to be the last word in luxury, had no heating apparatus, and was only available for first-class passengers.

Railway carriages in those days had no corridors, and travellers had to remain in the restaurant car throughout the whole journey. Accommodation was limited—only 19 passengers could be seated at any one time—and the cooking was done with coal, supplemented by oil lamps. The innovation of a restaurant car for a long journey was, however, very welcome, and seats in the car were in great demand.

Articulated Restaurant Cars

The new restaurant cars for the "*Flying Scotsman*" enable luncheon or dinner to be served to 78 persons at each sitting or approximately one quarter of the maximum number of passengers that the whole train will accommodate. Two or three sittings, therefore, will suffice to meet the requirements of almost all passengers.

A separate kitchen car is placed between the first-class and third-class restaurant carriages. These, of course, are easily reached by passengers even when the train is travelling at high speeds. Thus we have a triplet restaurant car "set" which has been built on a special principle. The three carriages are carried on four bogies only, a principle known to the engineering world as "articulated." By this arrangement the riding is improved, oscillation reduced to a minimum, the weight of the train considerably lightened, and the cost of haulage thereby lessened. The whole length of the triplet set is 151 ft., and its total weight 83 tons.

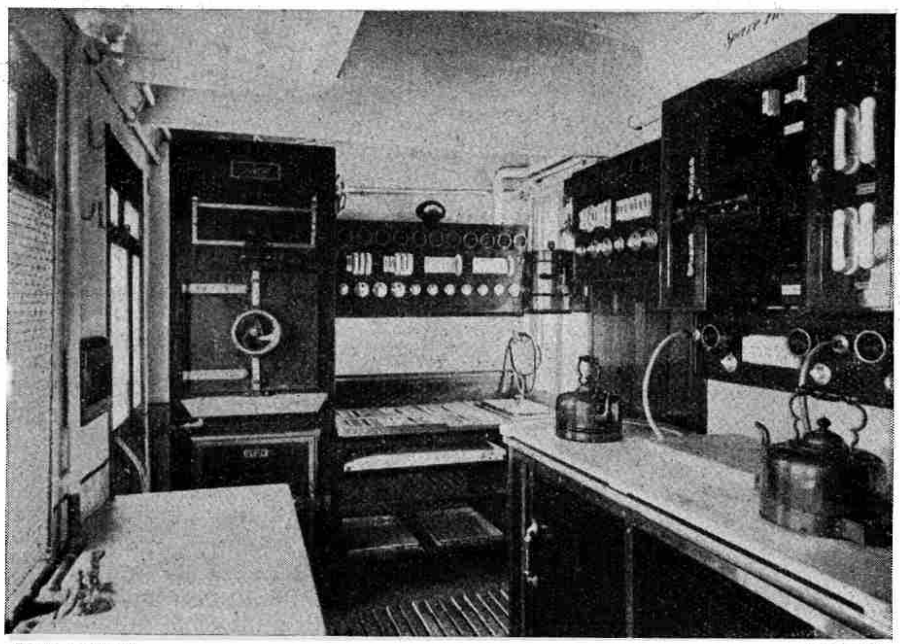


Photo courtesy [*L.N.E.R.*

The "All-Electric" Kitchen, showing Electric Oven, Switches and Serving Hatch

The Electrical Equipment

A brief description of the cooking apparatus in the electric kitchen will no doubt be of interest in view of the novelty of the application. The credit for the introduction of the articulated train and the application of electricity throughout, is entirely due to the enterprise of Mr. H. N. Gresley, the Chief Mechanical Engineer of the L.N.E.R., under whose personal supervision the work has been carried out.

The electric current is supplied by accumulators (which are mainly used when the train is standing) and by two dynamos, carried on the under-frame of the kitchen car. The dynamos are each of 7.2 kilowatt capacity, with self-contained automatic pole changes, and are driven by means of belts from the axles of the carriage—in other words, the forward movement of the train generates the electricity which cooks the food.

The main cooking range is fitted across one end of the kitchen, and on the left is the roasting oven, with a steaming oven, grill, and hot-water tank superimposed. On the right is the boiling range, with six hot plates for frying, boiling or heating sauces, etc., and one boiling pan of 7 gallons capacity for cooking vegetables, etc. Between the serving hatches is fitted a heated cupboard which will take the whole of the plates required for the service, and the top forms a convenient table.

Two urns and two six-pint kettles are available for boiling water for teas, and for supplementing the supply from the boiler on top of the oven range. There are also two 45-gallon tanks for warm water fitted in the roof of the corridor just outside the kitchen. Electrically-heated elements are fastened on the underside of these tanks which are connected with the boiler on top of the oven range. A continuous supply of boiling water for washing-up and other purposes is thus assured, as the water is partially heated in the roof before it is brought to boiling point in the boiler.

The control of the cooking equipment in the kitchen is arranged as conveniently as possible for the chef. Pilot lamps are set over the switches, illuminating red glasses inscribed with the name of the particular pieces of apparatus in use, so that at a glance an indication is obtained of the different operations that are going on.

Simplicity of Decorations

The advantages of cooking by electricity in a railway train will be apparent to everyone, but a special point is the cooler and purer atmosphere under which the chef is able to do his work, and the fact that food cooked by electricity is better cooked and more palatable and nutritious than when cooked by any other process.

Special attention has been paid to the ventilation of the restaurant cars, by providing louvre ventilators of an improved pattern above large plate-glass windows, 4 ft. in width. Electric fans are also provided in the roof of the car for extracting the impure air from the carriage.

The tendency in recent years in the decoration of restaurant cars and other railway carriages has been to make them more and more ornate, a fact that is particularly noticeable on the railways abroad. In dealing with the scheme of decoration for the new train this tendency has been entirely reversed, however, and the prevailing note of the whole scheme

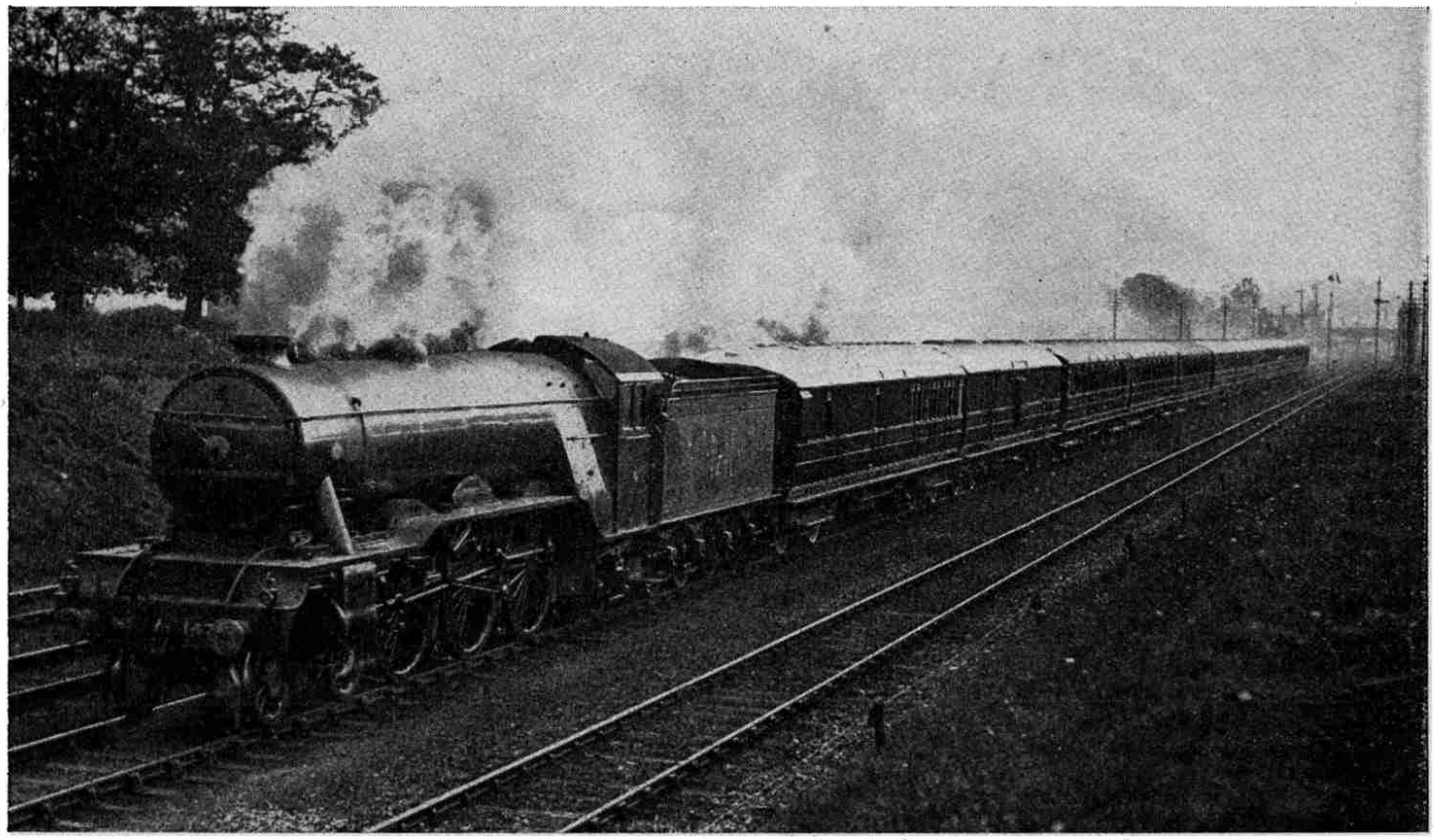


Photo courtesy] [*L.N.E.R.*

The New "*Flying Scotsman*" Travelling at Full Speed on its First Trip

of decoration throughout the train is simplicity.

The walls of the First-Class Restaurant Car are lined with large natural-coloured mahogany panels. The usual net racks and hat bags are all of the plainest possible design. The seats in the first-class compartments are of the arm-chair type, comfortably upholstered in green morocco leather and fitted with specially-constructed cushions. The floor is covered with green india-rubber over felt, which deadens sound, is very soft to walk on, and can be very easily cleaned. The lobbies are covered with cocoa-fibre mats.

The seats in the third-class compartments are very comfortably upholstered in crimson and black plush.

Throughout the compartments of the train the electric lighting is under the control of the passengers.

Automatic Coupling

Special attention has been paid to the lavatory accommodation. Hot and cold water is provided, and the floors are covered with red rubber. All the lavatories can be quickly swabbed out, the waste water running out by a special arrangement in the floor.

A special item of interest in connection with the new trains is the automatic coupling of the buck-eye type and the Pullman vestibule. The buck-eye coupling, which was first adopted by the L.N.E.R., holds the carriages rigid, and has proved its efficacy on the Sleeping Car and other trains by the East Coast route.

This is the first complete dining car train for an important service that has been constructed by the L. & N.E. Railway, and it embodies all the latest features of the best practice of each of the Companies forming the Group. The new trains are claimed to be the most comfortable and luxurious in the world for passengers paying ordinary fares, and we feel sure that every reader of the "*M.M.*" wishes he could make a long journey in one of them!

Four of the new trains have been commissioned and all have been built at Doncaster. Each complete train includes 12 vehicles, only some of which are articulated, the others corresponding with the rolling stock of ordinary standard design but incorporating all the latest improvements.

A typical train consists of three brake vans, four composite and two third-class coaches and a "Triplet" restaurant car. The total length overall of this train was 682 ft. and the weight 370 tons.

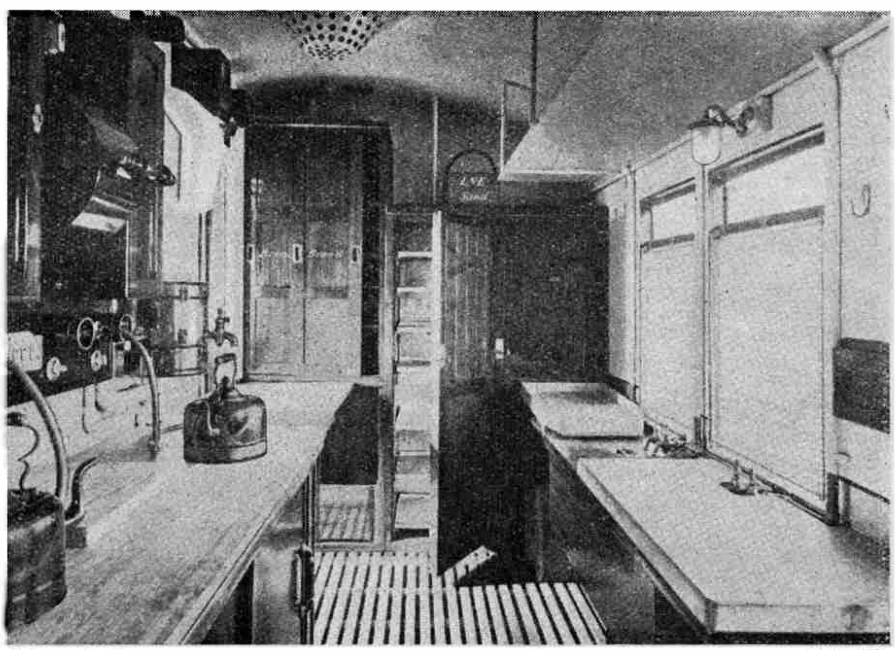


Photo courtesy] [*L.N.E.R.*

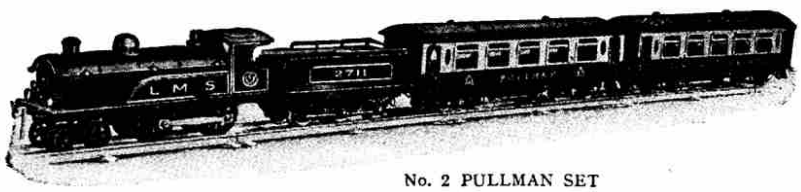
The "All-Electric" Kitchen, showing Washing-up Sink and Electric Kettles

HORNBY CLOCK WORK TRAINS

THE TRAINS WITH THE GUARANTEE

YOU can have any amount of fun playing with a Hornby Train. Shunting, coupling-up the rolling stock and making up trains will give you hours of pleasure. Hornby Trains are beautifully finished, strongly made, and will last for ever. One of their most valuable features is that all the parts are standardised, and any lost or damaged part may be replaced with a new one.

Every train is guaranteed, and you are therefore sure of satisfaction if you buy a Hornby.



No. 2 PULLMAN SET

No. 2 Pullman Set

The No. 2 Loco with Tender measures 17 in. in length. The Loco is fitted with superior mechanism and the accurately-cut gears ensure smooth running. Loco, Tender and Coaches are superb in appearance and finish, enamelled in colours and stoved at a high temperature to ensure durability. The Loco is fitted with reversing gear, brake and governor.

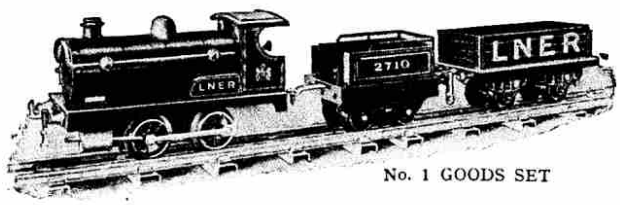
Gauge 0 in colours to represent the L.M.S. or L.N.E.R. Companies' rolling-stock. Each set contains Loco, Tender and two Coaches, with set of rails to form a circle of 4 ft. diameter. Price 60/-.

No. 1 Passenger Set

The Loco is fitted with reversing gear, brake and governor. Loco, Tender and Coaches are superb in appearance and finish, enamelled in colour and stoved at a high temperature to ensure durability. The doors of the Coaches open.

Gauge 0 in colours to represent the L.M.S. or L.N.E.R. Companies' rolling-stock. Each set contains Loco, Tender, two passenger coaches and set of rails consisting of two straights and curves to form a circle of 2 ft. diameter. Price 30/-

No. 1 PASSENGER SET



No. 1 GOODS SET

No. 1 Goods Set

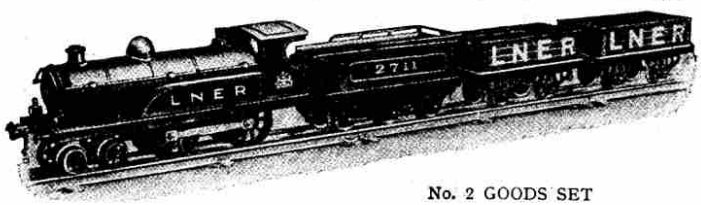
Gauge 0 in colours to represent the L.M.S. or L.N.E.R. Companies' rolling-stock. Each Loco is fitted with reversing gear, brake and governor. Each set comprises Loco, Tender, one Wagon, and set of rails as in the No. 1 Passenger Set. Price 22/6

No. 1 Hornby Loco Price 15/-
" " Tender " 2/6
Hornby Passenger Coach Price 5/-
No. 1 Hornby Wagon " 2/6

No. 2 Goods Set

Gauge 0 in colours to represent the L.M.S. or L.N.E.R. Companies' rolling stock. This set contains Loco, Tender and Rails as in the No. 2 Pullman Set, and two Wagons. Loco fitted with reversing gear, brake and governor. Price 37/6

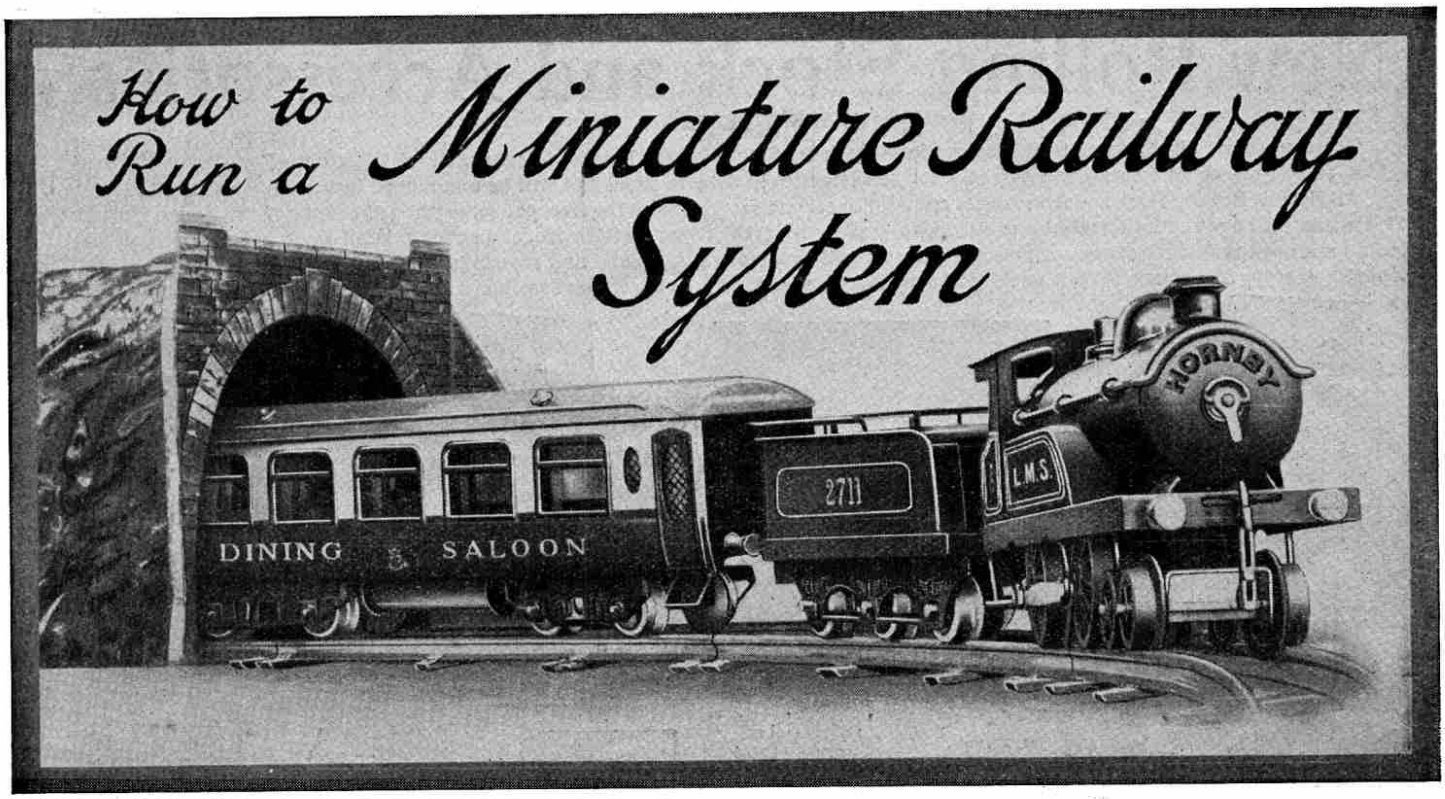
No. 2 Hornby Loco ... Price 22/6
" " Tender " 3/6
Hornby Pullman or Dining Car ... Price 15/-
No. 2 Hornby Wagon " 2/6



No. 2 GOODS SET

Ask to see Sample Sets at your Toy Store

MECCANO LTD., BINNS ROAD, LIVERPOOL



V. MORE LAYOUTS AND LOCO CLASSIFICATION

IN giving advice in regard to planning a miniature railway one is always up against the great difficulty that domestic conditions and circumstances vary so much. In the absence of detailed information as to individual requirements it is impossible to give a really satisfactory answer to the question : " How shall I plan my Hornby Railway ? " All that can be done is to make practical suggestions for miniature railway planning in general, and leave it to the unfailing ingenuity of Meccano boys to adapt these to their own needs, making whatever modifications may be necessary.

Care in Handling Rails

The comparatively few cases in which a spare room can be devoted to a permanent layout will be passed over, for the time being, consideration being given only to the Hornby Railway owners who are not so fortunate.

It is not often that an ordinary table is large enough for an interesting layout, even using the small (one foot) radius rails. Thus, in most cases the track has to be laid on the floor and taken up each time after use. In laying and re-laying the track on the floor it is necessary to use a reasonable amount of care in handling the rails, and particularly the points and crossings, so that they shall not become bent out of shape, thus causing derailments and accidents of all kinds. Incidentally, it may be remarked that the rails will remain in good condition much longer if they are packed away neatly each time according to some plan, and not simply crammed into a box in a confused mass.

Long Oval Layout

After geometrical layouts (such as those described in the November " *M.M.*") have been tried, most railway enthusiasts begin to wish to experiment on something rather more realistic. Here almost everything depends upon the size and shape of the room, but generally speaking a long oval is the best plan from which to commence operations. In order to economise space the oval should be made as large as possible, and the various sidings, etc., planned to come inside it. Fig. 1 shows the kind of simple layout that may be developed in this way. Here we have a station with a loop line and, leading off from the main line, sidings for passenger coaches and goods wagons. One of the sidings terminates in a turntable. If sufficient space is available to allow the sidings to branch off from the main line close to the station, so much the better, but it will be found that this necessitates more room.

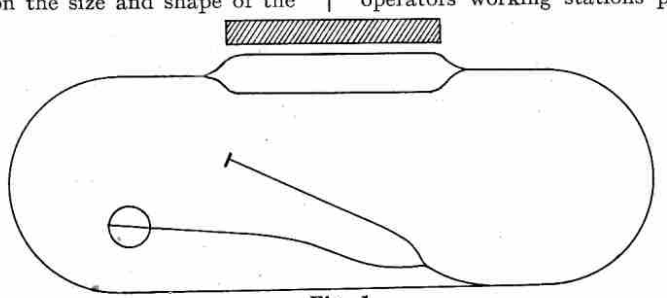


Fig. 1

With two locos hauling respectively a passenger train and a goods train a great deal of fun may be had with this layout. Two brake rails should be fitted in such a position that a train may be stopped in the station or on the loop line, and two other brake rails are required for the sidings. The exact position of these brake rails must be found by experiment.

According to the space available the plan may be developed almost indefinitely. Branch lines and more sidings may be added, but it will be found that a too elaborate system of sidings is very troublesome to work, and unless planned with the greatest care, is impracticable.

Non-Continuous Layouts

Continuous layouts are best suited to steam locos, but for clockwork locos non-continuous plans such as that in Fig. 2 are better. The greatest fun with these layouts is obtained by working out a time-table and running a number of trains in strict accordance with it. The distance between the two terminal stations will, of course, be determined very largely by the size and shape of the room, but in any case it should be adjusted according to the length of run of the locos on one winding. Nothing is more aggravating than to see a loco slow up and come to a standstill with its train half way round the track. The only way to avoid this is to make the distance between the terminals such that the locos will traverse it once, twice, or more times on one winding, with a margin to spare sufficient to allow trains to be shunted out of the way on to the loop line if required.

If the two stations are placed close together they may be attended to quite well by one operator, but more fun is obtained with two operators working stations placed as far apart as possible. If each operator has a copy of the pre-arranged time-table and follows it closely, many hours of real fun may be had, not to mention a good deal of excitement when one operator or the other makes a mistake in despatching a train. The layout shown in Fig. 2 may, of course, be developed by the addition of sidings and one or more branch lines.

(*Continued on page* 81)

New Rolling Stock and Accessories

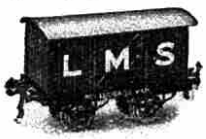
(HORNBY SERIES)

There are now 50 different train accessories—Stations, Signal-boxes, Lamps, Wagons, Level-Crossings, Foot-Bridges, Turntables, etc. Further accessories will be added to the system from time to time, and will be announced in the pages of the "*M.M.*"

All Hornby Rolling Stock and Accessories are built in correct proportion to the size, gauge, method of coupling, etc., of the Hornby Trains and all have the uniformly beautiful finish that is the great feature of the Hornby series. With these accessories you can build up a most realistic railway system, and the splendid range of rails, points, and crossings make possible endless variety in rail layout. Hornby Trains are British made, and your dealer will be able to show you specimens of the new products.

SIDE TIPPING WAGON
Excellent design and finish.
Price **3/6**

No. 2 LUMBER WAGON
Fitted with bolsters and stanchions for log transport. Suitable for 2 ft. radius rails only. Price **5/-**

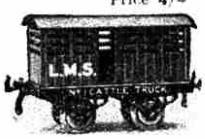


No. 1 LUGGAGE VAN
Representative colours.
Price **4/-**

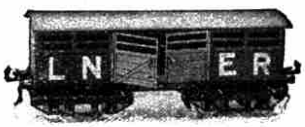
No. 2 LUGGAGE VAN
Finished in colour. Fitted with double doors. Suitable for 2 ft. radius rails only. Price **6/6**

SECCOTINE VAN
Price **4/-**

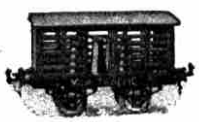
No. 2 TIMBER WAGON
Beautifully enamelled in colour and stoved. Suitable for 2 ft. radius rails only. Price **4/6**



No. 1 CATTLE TRUCK
Fitted with sliding door. Very realistic design.
Price **4/-**



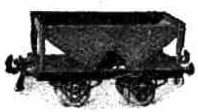
No. 2 CATTLE TRUCK
Splendid model fitted with double doors. Suitable for 2 ft. radius rails only. Price **6/6**



MILK TRAFFIC VAN
Fitted with sliding door, complete with milk cans. Price **4/6**

ROTARY TIPPING WAGON
Finished in colour.
Price **4/**

No. 1 LUMBER WAGON
Fitted with bolsters and stanchions for log transport. Price **2/-**



HOPPER WAGON
Mechanically unloaded. Finished in colour. Price **4/-**

CEMENT WAGON
Finished in colour.
Price **4/-**

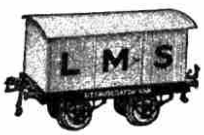
GUNPOWDER VAN
Finished in red.
Price **4/-**

BISCUIT VAN
Price **4/-**

No. 1 TIMBER WAGON
Beautifully enamelled in colour and stoved. Price **2/-**

GAS CYLINDER WAGON
Finished in red, lettered gold.
Price **3/-**

PETROL TANK WAGON
Finished in colour.
Price **3/-**

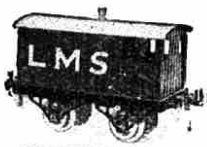


REFRIGERATOR VAN
Enamelled in white, lettered black. Price **4/-**

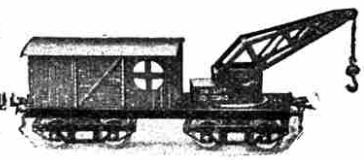
SNOW PLOUGH
Finished in grey, with revolving cutter driven from front axle.
Price **5/6**

CRANE TRUCK
Working model. Finished in colours.
Price **4/6**

TROLLEY WAGON. Finished in colour. Suitable for 2 ft. radius rails only. Price **6/-**



BRAKE VAN
Finished in colour.
Price **4/-**



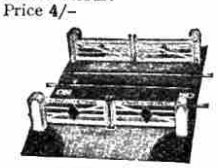
BREAKDOWN VAN AND CRANE
Excellent finish. Beautifully coloured. Suitable for 2 ft. radius rails only. Price **7/-**

GUARD'S VAN
Price **5/-**

JUNCTION SIGNAL
Signal arms operated by levers at base. Very realistic model standing 14 in. in height. Price **5/6**

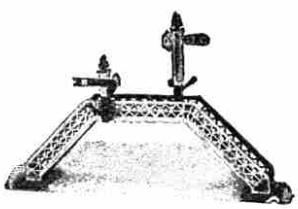
SIGNAL CABIN
Dimensions: height 6½ in., width 3½ in., length 6½ in. Finished in colour and lettered "Windsor." Roof and back open to allow signal-levers to be fitted inside cabin if desired. Price **6/6**

SIGNAL
Price **2/6**

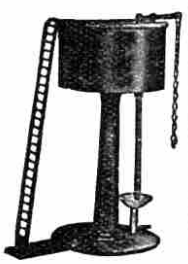


LEVEL CROSSING
Beautifully designed in colour. Measures 11½ in. × 7½ in., with Gauge 0 Rails in position.
Price **6/6**

TUNNEL
Price **7/6**

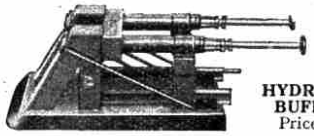


FOOT-BRIDGE
No. 1. With detachable signals. Price **6/-**
No. 2. Without signals. Price **3/6**
Signals, per pair **2/9**



WATER TANK
Brightly coloured in red, yellow and black. 8½ in. in height, with flexible tube and pump lever.
Price **6/6**

SPRING BUFFER STOP
Price **1/6**



HYDRAULIC BUFFERS
Price **5/-**

VIADUCT, complete with approaches. Price **7/6**

ASK YOUR DEALER TO SHOW YOU SAMPLES

Miniature Railways

(*Continued from page 79*)

Layouts on Landings

In a very small room, the terminal stations often cannot be placed far enough apart to give a satisfactory length of run between them, and in such cases the layout in Fig. 3 is useful. Here the terminal stations are both outside the oval, and a train starting from either of them may be sent round the continuous line as many times as desired, and then run into the other terminus. This layout, developed to the limits of space available, is one of th best for a small room. In order to obtain the best results two operators are needed, but if necessary one operator can manage fairly well. In this and the previous layout brake rails must be inserted in the track to bring the trains to a standstill at the correct points.

In many quite small houses there is often a fairly long hall or landing that can be pressed into service, thus making possible a much longer run than could be obtained in one of the rooms. Sometimes the layout can be extended so as to pass into and round a bedroom, and it is quite exciting to watch the trains disappear into the room and come into view again in business-like fashion shortly afterwards. The use of a room in this way makes the return of the trains to their starting point quite a simple matter.

Outdoor Railways

In dry summer weather (when shall we get any !) the railway may be taken out of doors if a small level piece of close-cropped grass is available, or failing that a level stretch of path. Unless the conditions are particularly favourable, however, it will be found necessary to provide a foundation of planks of some kind in order that the track may be sufficiently firm to allow of safe running.

In countries where they really do get a long spell of summer an outdoor railway may be made a great success. An Australian Meccano boy, for instance, has laid out a most interesting out-door line. This passes partly along gravel walks and partly over a lawn. The track is laid down on thin planks supported on a light wooden trestle framework about 3 ft. high. The line winds its way round various shrubs and bushes and passes through two tunnels—one of them 6 ft. in length—and over a miniature lake by means of a realistic trestle bridge. This boy finds that he can safely leave his track down for quite a long period in the dry hot weather, but in this country, unfortunately, this appears to be impossible without the rails becoming very rusty.

If a room with French windows opening on to a lawn is available a combined indoor and outdoor line may be arranged, the terminal stations being inside the room and the track passing through the open windows on to the lawn, sweeping round a circle and finally returning to the room again. A big layout of this kind worked by two or three operators is quite an exciting affair.

The Classification of Locos

The letters I receive day by day from boys all over the world regarding their Hornby railways contain a great variety of questions on various railway matters. Beginners appear to have some difficulty in regard to the classification of locomotives according to the number and arrangement of their wheels. The modern method of representing the classification by a system of numbers is really very easy to understand. For this method the normal arrangement of wheels in every loco is assumed to be :— first, leading wheels ; second, driving wheels; and third, trailing wheels. The wheels of the tender are left out of consideration.

For example, take a loco having four leading wheels, four coupled driving wheels and two trailing wheels. Such a loco would be described as being of 4–4–2 type, and it will be seen that the figures indicate quite clearly the wheel arrangement. If a loco has either no leading wheels or no trailing wheels, a cipher, " 0," is used instead of a figure. The Hornby No. 2 Loco is an example of the 4–4–0 type, that is to say it has four leading wheels and four driving wheels, but no trailing wheels. Stephenson's " Rocket," the winner of the famous Rainhill competition, was a 0–2–2 loco, being without leading wheels and having only two driving wheels and two trailing wheels.

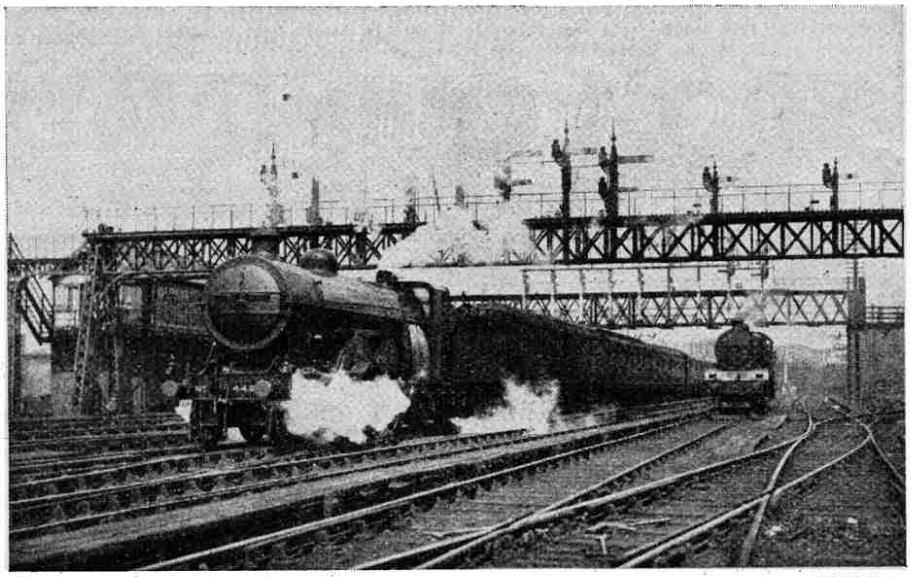


Photo courtesy [*L.N.E.R.*

Aberdeen-London Express

Some Named Types

Certain types of locos are known by special names, most of which originated in America. Among these are " Atlantic," 4–4–2 ; " Pacific," 4–6–2 ; " Consolidation," 2–8–0 ; " Prairie," 2–6–0, and so on. Tank locos are distinguished from locos having tenders by placing the letter " T " under the figures, as for example $\frac{4\text{–}4\text{–}0}{T}$, or $\frac{2\text{–}4\text{–}2}{T}$ The Hornby No. 2 Tank Loco is of $\frac{4\text{–}4\text{–}4}{T}$ type.

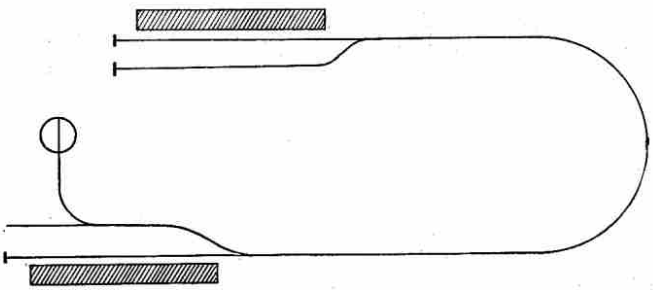


Fig. 2

Why Wheels are Coupled

Locos are also classified as passenger, goods, or shunting engines according to the work they are intended to perform. Roughly speaking, passenger locos are designed for speed and goods locos for power. One of the simplest types of loco is the " single-driver," now looked upon as out of date. In this type there are no coupled wheels, but instead there is one very large driving wheel, not connected with the other wheels, which are a good deal smaller.

The reason for the passing of the " single-driver " is that modern loco designers have established the principle that as many wheels as possible must be coupled together in order to achieve the best results. The effect of coupling wheels together is to distribute the driving force among the wheels, which increases the adhesion to the rails and gives greater stability. For this reason locos with a great number of wheels coupled together are used for hauling heavy goods trains. Tank locos, intended primarily for short-distance runs, are suitable for all kinds of work, passenger traffic, goods traffic or shunting.

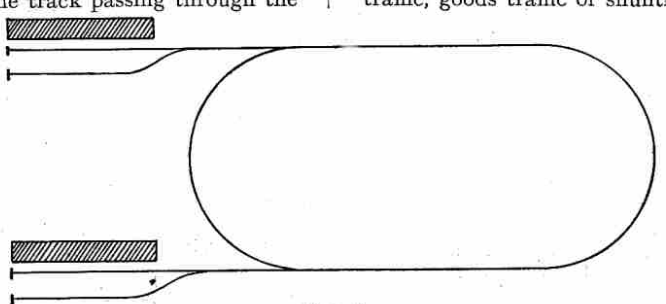


Fig. 3

American and Canadian Locos

Some young railway enthusiasts are a little worried about the American and Canadian locos on account of their strange appearance, and imagine that these locos must be constructed on very different princples from ours. As a matter of fact, however, these locos are similar in all essentials to British locos. Their peculiar appearance to British eyes lies mainly in the fact that

(*Continued on page 92*)

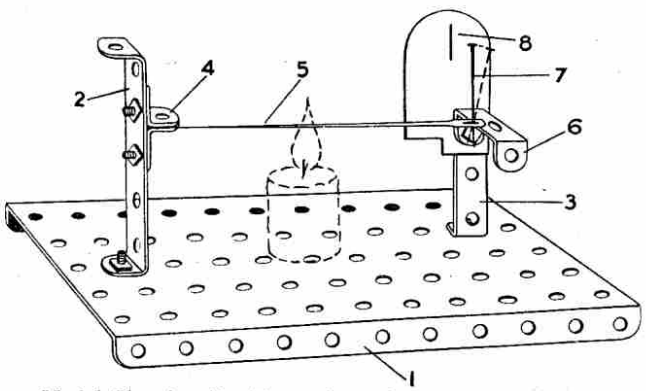
FROM OUR READERS

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

To Show how Metals Expand when Heated

Everybody knows that metals expand with heat and contract with cold, and that that is the reason why railway rails are laid with a small space between each so that they can " stretch," as it were, without forcing one another out of position. The little model shown in the accompanying photograph illustrates in a simple and interesting way this expansion and contraction.

The base of the model consists of a Flanged Plate (1) carrying two upright $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips (2 and 3). Two Angle Brackets (4) hold a large needle (5)—such as an ordinary darning needle—firmly by its point, and so placed that its eye rests lightly on the Double Bracket (6) as shown. A pin (7) is now fixed with its point in the eye of the needle, not firmly but just so that it will stand upright, with its point resting against the edge of the Double Bracket (6). A small piece of lighted candle is then placed beneath the needle and left until the latter becomes quite hot. If the head of the pin is closely watched it will be seen to move gradually as the needle expands. A piece of cardboard (8) may be cut in the shape illustrated and bolted to the Double Angle Strip (3) so that the movement of the pin can be more clearly followed.



Model Showing the Expansion of Metals when Heated

J. H. CONSTABLE (Brighton).

Photography and Meccano

Those fortunate Meccano boys who possess a camera will find it of very great value in connection with their hobby. A camera is particularly useful in regard to competitions, for it eliminates the tedious process of sketching models and it reproduces faithfully minor details which are very difficult to draw effectively. Photography is also of great use in connection with Meccano Clubs, in regard to producing permanent records of outstanding events. What, for instance, could be more interesting than a sort of photographic diary of the many happy incidents which occur during club days—picnics, football and cricket matches or model exhibitions ?

T. J. ROBERTS, Liverpool.

The Wonders of Liquid Air

Most readers of the " *M.M.*" have heard of liquid air, but probably very few of them have ever seen it. At our school one day we had a lesson on this remarkable substance, and shortly afterwards our Science Master took us to a mine rescue station, not far away, where liquid air is prepared for use by rescuers after an explosion in a mine. The value of liquid air for this purpose lies in the fact that it contains about sixty per cent. of oxygen.

On arriving at the station we were taken to the room where the air is liquefied, and there we found the machine already started for use. After it had been working for a short time the demonstrator disconnected a piece of tubing, whereupon the air could be seen before it had reached the point of liquefaction. It appeared just like steam issuing from the safety valve of a locomotive. When this " steam " came in contact with my hand it felt something like being stroked with icy-cold velvet. We were all watching this " steam " with keen interest when, without any warning, the demonstrator took off my hat and held it under the jet. When he returned it to me it looked and felt as though it were wet through. Then it turned white and at the same time became as stiff as a board. Afterwards another change took place, and what appeared to be dense white smoke rose from all parts of it, as though the hat were on fire.

Various experiments were then performed with the liquefied air. A small quantity was poured into a beaker, and a piece of rubber tubing was held in it for a few moments. The demonstrator then took out the tubing and struck it sharply, when it broke into splinters. The intense cold of the liquid air had completely frozen the rubber. This experiment was then repeated with a piece of paper. Finally a test-tube was half filled with mercury and placed in the liquid air for five minutes, at the end of which period the mercury was frozen into a solid mass. The test-tube was then broken to remove the mercury, and for the first time in our lives we saw a man pick up a piece of mercury without any trouble and then use it as a hammer to drive a nail into a piece of wood !

We were next taken to see the fire engine, a 55-60 h.p. Leyland. We were also shown a gas mask specially designed at that station and approved by the Government. In full working order it weighs 38 lbs. but it is so well balanced that anyone who tried it on would be surprised at that statement.

We concluded an interesting visit by calling upon the canaries used by rescuers in mine disasters for detecting the presence of gas.

B. HUTCHINSON (Chesterfield).

Useful Copying Apparatus for Meccano Clubs

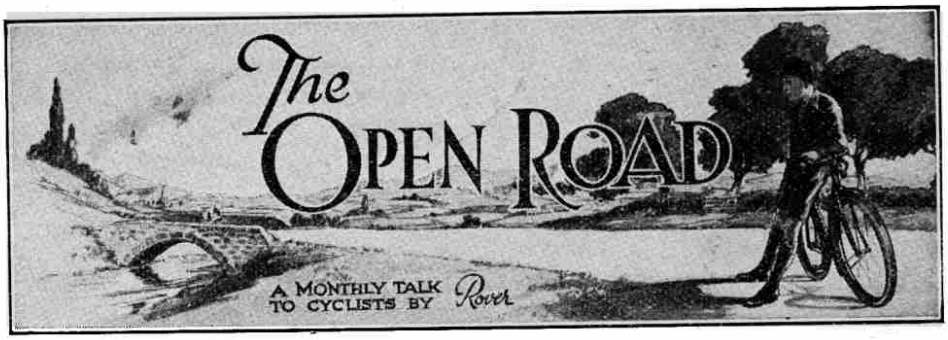
One of the most useful possessions that a Meccano Club can have is a copying apparatus, by means of which announcements and notices of various kinds may be quickly duplicated.

A simple yet effective form of duplicator may be made with very little difficulty. The materials required are a shallow tray of suitable size, such as the lid of a square biscuit tin ; two ounces of good glue ; eight ounces of glycerine ; and a few drops of oil of cloves. Melt the glue in a small quantity of hot water, the best method of doing this being to place the glue and water in a tin standing in a pan of hot water. When the glue is melted, add the glycerine and oil of cloves and mix the whole together very thoroughly. Then pour the hot mixture into the tray and allow it to set.

To use the apparatus, the original copy of the notes to be duplicated must be written with hectograph or other special aniline ink. It is possible to make such ink but it is very much better to buy it, and it is not expensive or difficult to obtain. When the ink is dry, press the paper on the surface of the mixture in the tray and rub it gently into contact. Leave it for three or four minutes and then peel it off. An impression of the ink will now remain on the jelly, on to which blank sheets of paper are gently pressed and peeled off at once, when each one will be found to be a good copy of the original.

On the average from 20 to 50 impressions may be obtained from one copy. When the required copies have all been taken off, the jelly surface must be washed with a sponge and it is then ready for duplicating fresh material. Occasionally the jelly should be allowed to stand overnight in a warm oven, so as to eliminate from the surface all traces of the impressions that it has carried.

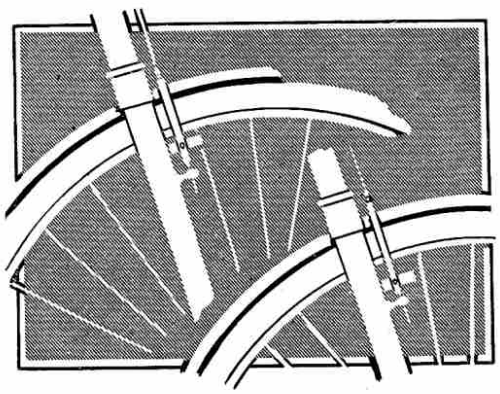
H. BEDFORD (Barnsley).



XII. USEFUL ACCESSORIES

ONE of the greatest temptations to the new cyclist is that of overloading his machine with a variety of accessories. Every new cycling article on the market is eagerly purchased, from an outsize in " Felix " mascots to a wicker-work trailer, until his machine eventually resembles a perambulating shop counter. The result of this accessory - collecting habit is that the cyclist labels himself a very obvious beginner, and also makes his riding considerably more tiring. The carrying of even the most necessary accessories such as lamp, bell, and pump makes a surprising difference in long-distance touring, as every experienced rider has found. " Travel light " is advice that is particularly applicable to cyclists, and it should be remembered on every occasion when the purchase of a fascinating but obviously superfluous accessory is being contemplated.

BRAKE ADJUSTMENT



To be efficient, brake blocks must be fitted so as to be close to the rim, but of course not actually touching it. The two sketches show correct (upper) and incorrect (lower) positions when the brake is not in use.

Lamps and Bells

The two most important items in the equipment of a cycle are, of course, the lamp and the bell. In legal terms, they provide " audible and visible warning of approach," and consequently are necessary to the safety of all road-users. The subject of lamps—electric, acetylene and oil—was fully discussed in the November number of the "*M.M.*," and it is sufficient to repeat that all three have their various advantages and drawbacks, and one should be chosen to suit the rider's particular requirements.

The bell question, too, requires little comment, apart from the fact that a good one will be found to be cheapest in the long run. The tinny and ineffectual sound of a cheap model is all too familiar nowadays, and is unworthy of a good machine. A reliable bell by a well-known maker is a good investment, and with the exception of an occasional drop of oil it will require no attention. The bell itself should not be too large or ostentatious, and should be fitted to the handlebars in preference to the top tube.

Luggage Carriers

Almost all cycles on the road nowadays are fitted with a luggage carrier of one kind or other. Perhaps the most popular is the one that is fitted to the seat stays over the rear wheel. Other types are made to fit the head of the machine or for carrying on the handlebars, while special clips to hold tennis-racquets, rifles, golf-clubs, and cycling capes may be obtained from the majority of sports or cycle dealers.

A rear-carrier has several decided advantages over other types. Any weight upon it, such as parcels or luggage, does not affect the steering as would be the case if the weight were at the front. Also, as the back wheel is the steadier of the two, there is far less jolting or vibration —often an important consideration when out shopping ! Several different types of rear-carriers are obtainable, ranging from a clip-on carrier, attached by a single nut, to the light and rustless but more expensive aluminium type, and the final choice must be left to the rider's requirements and purse.

Cyclometers

Although not an essential part of a cycle, there is probably no more popular accessory than the cyclometer, and its first expense is amply repaid by the added interest and information that it affords. The instrument is fitted to the front wheel and it not only automatically records every mile covered, but it also affords useful information regarding the mileage obtained from tyres or other fittings. In purchasing a cyclometer care should be taken to see that the instrument is not of continental make, as these quickly prove unreliable and inaccurate.

One or two extra tools such as an adjustable wrench and a screwdriver must also be included in this list of useful accessories, and a couple of cleaning brushes, a stiff one for the chain and a softer one for the enamelled parts, will

(*Continued on page* 95)

Railway Progress in 1924.

At the beginning of a new year it is always instructive to look back over the previous year and note the progress made in the various branches of engineering. This is particularly the case with railway engineering, which covers such a wide field of operations. In the issue of the 9th January, "*The Engineer*" reviewed in its customary efficient and comprehensive manner the principal railway works carried out during 1924, and from this review we extract a few particulars that are likely to interest our readers.

London Midland and Scottish

On the London Midland and Scottish Railway, station improvements and extensions were commenced at Bangor and St. Annes. The two lines of railway between Chevet Junction and Snydale Junction, south of Normanton, are to be increased to four at an estimated cost of over £200,000. The first stage in this work is the opening up of Chevet Tunnel, 702 yards in length, and this is now nearing completion. Good progress was also made in the work of duplicating the two lines of way on the Lancashire and Yorkshire section between Horbury and Wakefield, which work has now been proceeding for some two years. Good progress has been made with the extensive additions to the siding accommodation at Ellesmere Port.

London and North Eastern

During the year several bridges were renewed on the Great Eastern section of the London and North Eastern Railway, chief among these being the underline bridge that carries the Cambridge main line over the River Lee between Broxbourne and Roydon. The old bridge had a central span of 60 ft. and two side spans each of 31 ft. On account of unequal settlement in one of the piers, and other defects, it was decided to renew the bridge in one span. The trusses of the reconstructed bridge have a span of 136 ft. from centre to centre of end pins, and are 20 ft. in depth between the axes of the top and bottom booms. They are of the riveted-through truss type and are sub-divided into eight 17 ft. bays. The ends of the trusses rest on steel rocker bearings, and at the Broxbourne end of the bridge provision has been made for expansion and contraction. The bridge is designed to carry a static axle load of 25 tons.

Up and down goods lines between the Ouse box and Huntingdon, including a new bridge over the River Ouse, were completed, and the Cuffley and Stevenage line was opened for passenger traffic. The latter line provides an alternative route between King's Cross and Stevenage and renders unnecessary, for the time being, the widening of the tunnels and viaduct at Welwyn. A new engine yard at King's Cross was opened, with a turntable 70 ft. in diameter. This turntable obviates the necessity for the 4–6–2 tender locos having to go to Hornsey to be turned.

A contract was let for the provision of a new steel viaduct to replace the existing timber viaduct on the Blyth and Tyne, between Bedlington and North Seaton. The new viaduct will consist of eleven spans of 75 ft. each, two of 68 ft. each, and one of 80 ft. 9 in. The timber viaduct has 43 spans of 25 ft. each. At the entrance to Tyne Dock new gates, sluices and machinery are being provided. New electrically-driven pumps are being installed at the Alexandra Dock Dry Docks, Hull, together with new dock gates for the Alexandra Dock entrance. At the electric and hydraulic power station at Immingham, the Lancashire boilers are being replaced by water-tube boilers, and additional electric generators are being installed. A beginning has been made with the reconstruction of Berwick Station, a work that will cost about £43,000.

Great Western

On the Great Western Railway the High Street Station at Swansea is being reconstructed. This is a terminal station, and its present three platform lines are to be increased to five, each to be 800 ft. in length. New carriage sidings, with a turntable of 65 ft. diameter, are being provided between Swansea and Landore. The heading of the second single line, Colwall Tunnel, was driven for 980 yards out of the total of 1,600 yards and was lined for 330 yards. The Newton Abbott junction station is to be rebuilt, and it is hoped to have a good deal of the additional platform accommodation ready for this year's summer traffic. The new station buildings at Aberystwyth are well in hand.

One of the two remaining timber viaducts built by I. K. Brunel is being replaced by a solid embankment. This is situated on the Falmouth line near the point where that branch leaves the main line at Penwithers Junction. About a quarter of a million cubic yards of filling will be required. The other Brunel viaduct is at Perran nearer Falmouth, and this is being replaced by a masonry arch structure erected alongside it.

The new ventilating plant for the Severn tunnel was brought into use during the year.

Southern

The Totton, Hythe and Fawley light railway on the Southern Railway is approaching completion. Each of the three stations will have platforms 350 ft. in length. Reinforced concrete has been mainly used for these and for the nine under and over bridges and the numerous culverts. Reconstruction of the station buildings at Southampton Town was begun, and considerable progress made with the enlarged station at Exmouth, which is to have two platforms 600 ft. in length and 25 ft. in width.

The locomotive depot at Exmouth Junction, the principal depot of the Southern Railway in the West of England, is being re-modelled. It is to have a ferro-concrete engine shed 270 ft. in length and 235 ft. in width, with thirteen roads, a mechanically-driven coaling plant, and an electrically-operated engine turntable 65 ft. in diameter. The scheme includes also a carriage and wagon shop 310 ft. by 100 ft. and shops 500 ft. by 30 ft. for the engineer's department. The machinery will all be electrically operated. A group of ten sidings to accommodate 400 wagons is being laid down.

For the electrification of the South-Eastern section, 180 miles, single track, of conductor rails were laid, and about 200 miles of the running rails bonded for the return current.

Metropolitan and Great Central Joint

On the Metropolitan and Great Central Joint Railway the alterations at Harrow, preparatory to carrying the Uxbridge branch line under the main lines, were made in October. New automatic signalling was brought into use, and this system was carried on to Rickmansworth in November. The electrified line between Harrow and Rickmansworth was opened last month. A junction is being put in under Euston Road, London, and a length of railway laid to couple up the Metropolitan main line with the Widened Lines, which start at King's Cross and run to Moorgate.

Underground

The Charing Cross line on the Underground Railway is being extended under the river to Kennington. The circular loop at Charing Cross will be done away with and one will be provided at Kennington. Many other important improvements are well on the way towards completion.

More Underground Stations

Four new stations on the Clapham-Tooting section of the Underground are to be constructed. Two will be entirely below the surface and the two others will have booking halls on the ground level.

New L.N.E.R. Rolling Stock

The L.N.E.R. is shortly to introduce new rolling stock on its suburban lines. The new trains will consist of ten coaches with a carrying capacity of 872 passengers. There will be two units, each made up of five coaches, built on the articulated system similar to that successfully adopted on the L.N.E.R. trains running between King's Cross and Edinburgh. Further details will be given in one of our future issues.

Experimental "Sentinel" Locos

The well-known makers of the "Sentinel" wagon have recently developed an entirely new type of power unit for use on railways. The new unit consists of a steam loco with vertical engine, the length over-all being 16 ft. 10 in., width 8 ft., and wheel-base 7 ft. The total weight is 17 tons. It is anticipated that these locos will be particularly useful in shunting operations. It is claimed for these locos that the adhesive factor is so much greater than that of locos of the ordinary type, that weight for weight, they are able to haul approximately a 35 per cent. greater load for about one-third of the working and maintainence costs.

Only Three Fatal Accidents

During 1924 there were only three train accidents in which passengers lost their lives. On 26th April, two passenger trains were standing at the Euston No. 4 box—a night Scotch express on the up fast line and an excursion on the up slow. The express went forward first, but the signalman sent the "train out of section" signal on the slow line instrument instead of on the one for the fast line. A second train on the up slow line was then accepted and it ran into the excursion train with the result that five passengers were killed. The second fatal accident was at Haymarket, Edinburgh, on 28th July, when a passenger train standing in the station was run into by another train and five passengers were killed. The third accident was at Warton signal box, Lytham. On 3rd November, the tire of the left-hand leading wheel of the bogie of an engine fractured, causing the derailment of the train and the loss of thirteen lives.

One Thousand Million Passengers

Railway statistics issued by the Ministry of Transport recently show that there have been substantial increases in both passengers and receipts on the railways of Great Britain during last year. During the first ten months 1,036,623,323 passenger journeys were made, this figure showing an increase of 6,735,000 over the similar period in 1923. Excursion and week-end fares also increased by 41,770,681, the total being 152,212,739. There was a slight reduction in the number of workmen's fares with a total of 258,219,638, and a falling-off of 6,765,300 in "other descriptions," which numbered 73,770,292.

An Increase of £1,400,000

The passenger receipts for the ten months were £59,348,863, an increase of £2,074,392 on the similar period of 1923. Excursion and week-end fares stood at £11,991,007, an increase of £2,936,571. Workmen's fares at £3,421,286 showed a decrease of £9,200, while the "other descriptions," totalling £7,355,425, gave an increase of £250,488. Including season ticket-holders, parcels and miscellaneous traffic, the total receipts from passenger train traffic reached £80,669,070 for the ten months—an advance of £1,477,799 on the corresponding period last year.

Falling Off in Freights

Freight train traffic showed a falling off during the ten months of 5,983,088 tons, the total being 284,517,046 tons. General merchandise at 52,424,481 tons, and minerals at 55,682,681 tons, show respective increases of 2,193,687 tons and 2,916,376 tons, but coal, coke and patent fuel, which aggregated 174,292,345 tons, is down by 10,110,839 tons. The total receipts from these sources were £89,159,473, a decrease of £3,579,703.

Ancient Castle Wall Discovered

While excavating in connection with the re-building of Berwick Station, the engineers of the L.N.E.R. recently discovered part of the East wall of the old Castle, upon the site of which Berwick Station stands. Particular care is being taken in reconstructing the Station to preserve the historic foundations, and it is hoped to discover further remains of the old Castle.

New Railways in Turkey

New railways are shortly to be constructed in Turkey and in Persia. In the former country three lines are contemplated, 30, 60 and 120 miles in length respectively. The longest of the three will join the railway from Baghdad to Ardassa. In Persia an American Company has obtained a concession from the Government to build a railway from Teheran to Tabriz.

Popularity of Restaurant Cars

The L.M.S. reports that during the past year 1,811,164 meals were served on its restaurant cars. The figure shows an increase of 219,384 on the total for the previous year.

Successful Articulated System

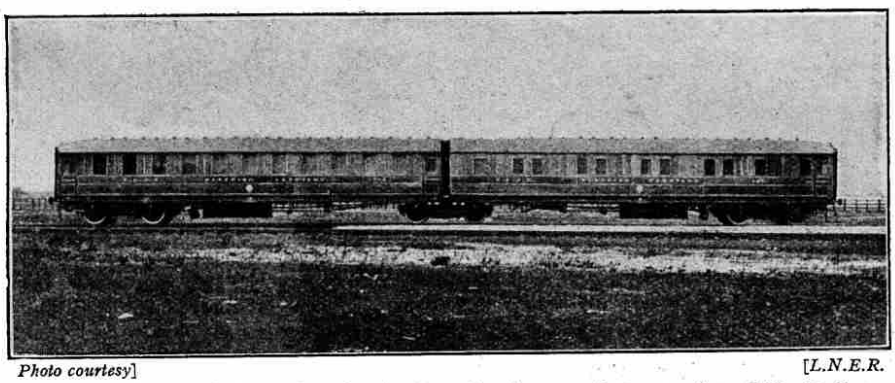


Photo courtesy [*L.N.E.R.*

The above photograph, showing a sleeping carriage on the G.N. Railway, illustrates one of the first units to be built on the articulated system evolved by Mr. H. N. Gresley, the Chief Mechanical Engineer of the L.N.E.R.

The articulated principle was adopted in the quintuple, or five-coach, dining-car trains between King's Cross and Leeds. More recently the principle has been successfully applied to the express trains on the L.N.E.R. service between London (King's Cross) and Edinburgh (Waverley). Our illustration is of particular and topical interest because of the announcement made on this page regarding the new L.N.E.R. suburban rolling stock that is now being built on the articulated principle.

Sleeping Saloons for L.M.S.

Ten new first-class sleeping saloons have recently been built at the Wolverton works of the L.M.S. for service on the London-Scotland route. Similar in arrangement to the standard sleeping cars, the new cars have an overall length of 71 ft. 8 in., a width of 9 ft., and weigh 41 tons. Each saloon contains twelve single berths, attendant's compartment, and lavatory. Special attention has been given to the springing of the cars to ensure smooth running, and each saloon is mounted on two 6-wheeled bogies and supported on an all-steel underframe. The cars are equipped with Westinghouse steam heating, and the electric lighting switches to each berth are under the control of the attendant.

Travelling Hothouses

One hundred special vans have been completed at the L.N.E.R. works at Stratford for carrying bananas from the port to the consumer. These vehicles are insulated and so arranged that the whole of the inside is air-tight. Steam heating-pipes keep the fruit at a suitable temperature.

L.N.E.R. Water Troughs

The water level in the troughs on the G.N. section of the L.N.E.R. has been raised by 1 in. to bring it to the same level as the water in the troughs on the other sections. This makes it possible for locomotives on different sections to pick up water throughout the whole system.

Photograph courtesy of] [Messrs. Gent & Co., Ltd.

Hoisting into Position the Hands of the East Dial

Electric Clocks—(*Continued from page* 57)

pendulum. The length of the pendulum is so regulated that it takes half a minute for it to complete the fifteen swings, so that an impulse occurs once every half minute. By means of an electro-magnet it is a simple matter to make these impulses turn a ratchet wheel with 120 teeth once in an hour and to attach a minute hand to this. The hour hand is driven from this by the usual gearing.

There is no limit to the number of dials that can be worked from the one master clock, the only connection between them being two wires to carry the currents. In the Royal Liver Building at Liverpool over 600 dials are controlled by a master clock in the main hall. Controlled dials may be placed anywhere in any room in a large building, in offices, or in the factory; throughout a ship or in all parts of an exhibition, as at Wembley, or even in different parts of a town.

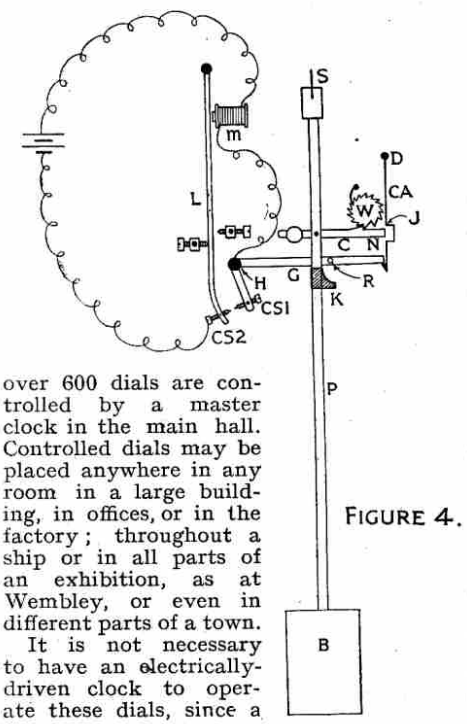


FIGURE 4.

It is not necessary to have an electrically-driven clock to operate these dials, since a control attachment can be put on any clock that will switch a current on and off for a moment at stated intervals. In fact, the writer of this article has made an extension of the ordinary weight-driven Meccano Clock model that enables it to control any number of dials in different rooms of his house. The clock itself may stand in the hall and be made to control dials in dining and drawing rooms and in as many bedrooms as may be desired. This model will be described in a forthcoming issue, and is sure to arouse considerable interest among our readers.

A Wonderful Building

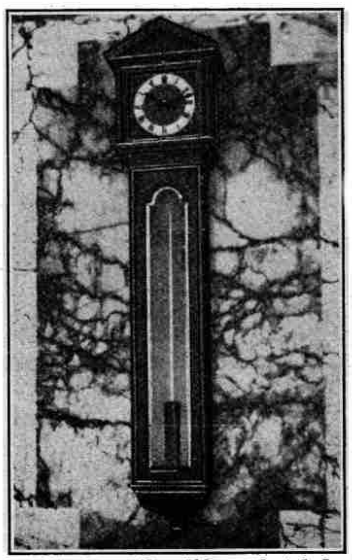
No article on electric clocks would be complete without some mention of "Great George," the wonderful clock on the Royal Liver Friendly Society Building overlooking the River Mersey at Liverpool. This clock, which was designed, manufactured and erected by Messrs. Gent & Co. Ltd., of Leicester, is not only the largest turret clock in England, but is also the largest electrically-driven clock in the world.

The Liver Building was opened on Coronation Day, 20th July, 1911. It is a gigantic structure of ferro-concrete, seventeen storeys in height, and is the dominating feature of the river front. In going round this wonderful building one receives an impression of tremendous strength, and it is easy to realise the enormous value of this modern method of building construction.

A visit to the top of this building is a very interesting experience. Stepping into one of the many electric lifts we are carried swiftly and smoothly upward for many storeys until the limit of the lifts is reached. Passing through the room where the electric lift machinery is working away with wonderful ease and precision, we step out into the open air on to the flat roof of the main building. From here we can admire the wonderful view over the busy city, with the river and docks spread out below us like a map. We then ascend a spiral staircase inside one of the towers and again step out into the open to see the same view as before, but with its proportions noticeably altered by the extra height. Looking down we see tiny trams crawling about the city and miniature figures that it is difficult to realise are people as tall as ourselves. If there is a strong wind blowing it is very necessary at this height to hold on to hats and caps very carefully the whole time. Any Meccano boy who visits Liverpool should, if possible, try to obtain permission to visit this wonderful building, which will probably interest him even more than the clock itself.

The Largest Electric Clock in the World

The clock is situated at a height of 220 ft. above the ground level. It has four dials, each 20 ft. in diameter, which, it is interesting to learn, are 2 ft. 6 in. larger than those of "Big Ben" at Westminster. The figures on the dials are 3 ft. in length, and the spaces between the minute divisions are each 14 inches. The minute hands are 14 ft. in length and 3 ft. in width at the centre, and they are built up of sheet copper on a gun metal frame. The ironwork of the dials weighs nearly fifteen tons, and nearly a ton of opal glass was used in the faces. The four pairs of hands with bearing spindles weigh two tons.



Photograph courtesy of] [Messrs. Gent & Co., Ltd.

The Master Clock, or Transmitter, in the Vestibule of Royal Liver Buildings

The total weight of the clock mechanism is four tons, and yet it is automatically driven by a small battery without any winding or attention. The control is so perfect that the clock keeps accurate time to one second per week. The controlling transmitter is synchronised by electric current direct from Greenwich Observatory every day, so that the clock always indicates Greenwich Mean Time.

Each of the four dials of the clock is lit up at night by four powerful electric lamps. An even lighting of the dials is obtained by causing the light from these lamps to be reflected on to a white wall, from which a beautifully diffused light is reflected on to the dial. Special electric mechanism is fitted for switching on these lights at a certain time at night and switching them off again at a certain hour in the morning. This mechanism is automatic and performs its work of switching on and off, day by day, without any attention.

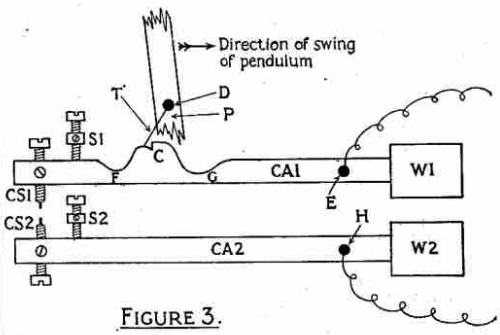


FIGURE 3.

Some idea of the enormous size of "Great George" may be gained from the illustration on page 56, which shows a party of thirty-nine guests lunching round one of the dials on 18th November, 1910, shortly before its erection on the Liver Building.

NEXT MONTH:—

THE ELECTRIC TELEGRAPH

Engineering News of the Month

New Bridge for Zambesi

The necessity for another railway bridge across the Zambesi River has been felt for some time. It has recently been proposed to erect a new bridge further down the river than the wonderful bridge, by which the Rhodesian railway crosses the Zambesi Gorge, below the Victoria Falls. The bridging of the Zambesi at this point by means of a great steel arch was a very wonderful engineering feat. The main arch of the bridge is 500 ft. in length between the centres of the end parts, which are 105 ft. in height. There are also two short end spans 62½ ft. and 87½ ft. in length respectively. The erection of this bridge in a position so far removed from sources of supplies presented difficulties that were overcome only by the dogged perseverance of the engineers.

Commenting on the proposed new bridge "*Modern Transport*" says: "Just over a hundred miles from the mouth of the Zambesi, in Portuguese East Africa and on the northern bank, stands the town of Chindio, the southern terminal of the Central Africa Railway. Opposite, on the southern bank of the river, is the northern terminal of the Trans-Zambesia Railway, opened two years ago. At this point the projected bridge would be built, and would replace the existing ferry service, which can hardly cope with existing traffic, let alone the big expansion which would follow the opening up of the Tete coalfields by a branch railway—another scheme which is linked with the bridge project, and which would materially improve the operating outlook for the railways in this zone.

"The bridge is the key to the development of the British protectorate of Nyasaland, and of a large adjoining portion of Portuguese East Africa. Although owned by various companies, the railway from the port of Beira to Blantyre, Nyasaland, is continuous except for the break at the Zambesi. It is in contemplation to extend the northern extremity of this line as far as the great inland sea of Lake Nyasa, opening up a large tract of some of the richest land in the southern half of Africa."

A Mountain on the Move

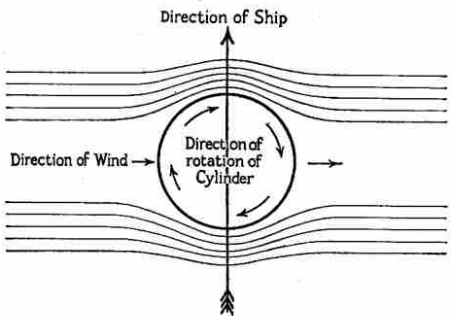
The movement of the mountain in the Rhymney Valley, in Wales, has destroyed part of the main trunk sewer, only just completed, at a cost of nearly a quarter of a million. The trouble is developing and huge fissures are appearing in the main road at the mountain foot. A disturbance on a large scale is feared and a very close inspection is being maintained. Another mountain across the valley is also on the move and is causing the G.W.R. considerable apprehension.

Rotor Principle for Aeroplanes

In last month's "*M.M.*" we gave a short description of the Flettner Rotor ship, in which sails are replaced by rotating cylinders. Important experiments are now being carried out in no less than five countries—England, France, Holland, America and Germany—in the application of the rotor principle to aviation.

In the Flettner rotor ship the propelling force is derived from the wind as in the case of an ordinary sailing vessel, but in a different manner. When both the vertical cylinders or rotors are rotating in the same direction they tend to propel the ship in a direction at right angles to that of the wind.

A little study of the accompanying diagram will make this clear. If the directions of the various arrows are



examined it will be seen that, on reaching the cylinder, the air current divides itself into two streams in order to pass round the obstruction. The cylinder is rotating in the direction shown, and therefore the air stream on one side meets a surface moving in the same direction as itself. This has the effect of accelerating the flow of air, thus producing suction tending to draw the ship forward in the direction of the large arrow. The air stream on the other side encounters a surface moving in an opposite direction to itself and its flow is retarded, thus causing pressure tending to push the ship forward.

The "Googlie" Bowler

It is interesting to know that the rotor ship is really an application of the forces that are at work when a tennis ball, to which spin has been imparted, deviates from the straight path. The same principle explains the "drift" of projectiles fired from rifled guns and the remarkable effects produced by a "googlie" bowler.

The experimental work already carried out in the application of the rotor principle to aeroplanes appears to have established that rotating cylinders in place of wings should support an aeroplane in flight, and that the lift per horse power with rotors should be greater than that attainable with wings. It has been found that even a small cylinder built into the wing of an aeroplane produces a perceptible increase in lifting power.

A Problem Solved?

In the Flettner ship the cylinders are vertical, but in an aeroplane they are placed horizontally across the machine in the same position as an ordinary wing. The cylinder is rotated by the aeroplane engine and its effect is exactly the same as in the rotor ship. The accelerated stream of air flowing over the cylinder produces an upward pull, and the stream flowing under the cylinder produces an upward push, the combined effect being a very strong lift.

The powerful lift obtainable by rotors suggests the possibility that this principle may go far towards solving the problem of the helicopter—that is an aeroplane capable of rising directly from the ground without a preliminary run to attain the necessary lift, and news of future developments in this connection will be eagerly awaited.

New British Battleships

Details of the "*Nelson*" and the "*Rodney*," the two battleships that Great Britain was authorised to build under the terms of the Washington Treaty, have become available through a statement made by Captain H. H. Hough, Director of Naval Intelligence in the United States Navy, to a sub-committee of the United States Congress. The particular interest aroused by these vessels, which were laid down two years ago, lies in the fact that they are the first British capital ships that may be regarded as embodying to the full the lessons of the war in general, and the battle of Jutland in particular, as viewed by British Naval experts.

Armoured Decks

The new vessels are 702 ft. in length on the water line. Their greatest breadth is 106 ft.—greater than that of any other ships in the world—and they have a mean draught of 30 ft. at their standard displacement of 35,000 tons. Their speed will be about 21 knots, that is the same as that of the pre-war "Iron Dukes." The thickness of their belt armour will be 14 in.—an inch more than that of previous ships, and the decks will be specially armoured to resist bomb attacks from the air or high-angle fire.

It is very probable that the "*Nelson*" and "*Rodney*" will have no funnels visible, and that the products of the furnaces will be carried off by pipes running along the

side of the ship and discharging the fumes through an escape valve in the stern. There should be little difficulty about this, as all modern battleships use oil fuel, which gives out very little smoke except when the speed is being changed.

The armament of the ships as described by Captain Hough is particularly interesting. It will consist of nine 16 in. guns mounted in triple turrets all placed in the forward part of the ship. Previously no more than eight 16 in. guns have been carried by one vessel. In addition there are to be twelve or sixteen 6 in. guns mounted in pairs in light closed turrets.

The grouping of three guns in one turret permits a more numerous armament to be carried for a given weight than would be possible with two-gun turrets. The effect of placing all three turrets forward will simplify the layout of boilers and machinery. The magazines will be grouped forward also, and a long armour belt extending three parts of the length of the ship will no longer be necessary for their protection. Possibly there may be more than one armoured deck in the ships so as to give a series of protective shields against attacks from the air.

It has been objected that the placing of all three gun turrets forward would have the drawback of depriving the ships of stern fire. There appears to be little force in this objection, however, because the turrets can be turned so that the guns completely cover all but about 20 degrees from the centre line of the ship.

It is stated that the 16 in. guns are to be 50 calibres in length, and if so they will be the most powerful guns afloat.

When these two new battleships are completed Great Britain, under the Washington Treaty, must discard the four "*King George V.*" ships, and the Treaty also precludes us from laying down another capital ship before the year 1931.

Motor 'Bus that runs on Rail or Road

The interesting experiment is being tried in the Transvaal of using a combined road and rail motor omnibus. According to "*The Times*," a vehicle of this type, built at Johannesburg, is now being tested on the Naboomspruit-Springbok Flats. On the road-rail the omnibus has its front axle supported on a bogie running on the rail, while the driving wheels run on wheelways. The motor is of 36 h.p., water cooled, and capable of running on motor spirit or producer gas from a Parker gas producer, using charcoal as fuel. The front wheels of the bus are solid, while the rear wheels have twin giant pneumatic tyres. It is stated that a speed of 20 miles an hour is attained, and that a load can be hauled up a gradient of one in twenty.

The value of the vehicle lies in its ability to leave the track at any point and discharge its passengers and goods where required, whether at a station, post-office, or hotel.

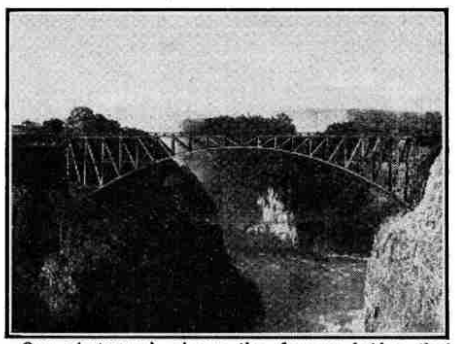
London Automatic Telephones

The hand-operated telephone system of London is being converted into an automatic switching system. The work was commenced some little time ago, but it is estimated that 15 years will be required to complete it.

Not only does the automatic system give greater efficiency, but it also eliminates the monotonous daily routine of the switchboard attendants. Another great advantage of the automatic system is that the service at night is as good as during the day.

The automatic telephone exchange is a most intricate piece of mechanism and is operated by the subscriber. He works a dial on his instrument in a somewhat similar manner to that in which the embossing machines at railway stations emboss one's name on a strip of aluminium, after a penny has been placed in the slot.

A Famous Bridge



Our photograph shows the famous bridge that spans the gorge of the Zambesi, below Victoria Falls. The Bridge made possible the construction of the Cape to Cairo Railway, and it is one of the loftiest bridges in the world. At the Victoria Falls the river is a mile in width, and the Falls 400 ft. in height. The Bridge is so close to the Falls that the trains are often delayed by spray! As is mentioned on the previous page, it is now proposed to construct another bridge across the Zambesi.

Incidentally, a wonderful development of the telephone is now the subject of experiment in the United States. With this system a typist will be able to type at a speed of at least 30 words a minute messages given to her from as great a distance as 5,000 miles. The system is already in use by our own Post Office on several long trunk lines, and the Americans are now planning to extend the system for the use of private individuals.

The Meccano Idea

Steel Houses Made Easy

We reprint the article below from the "Westminster Gazette," by permission of the Editor. We feel sure that our readers will find it interesting.—EDITOR.

HOUSES put together like a Meccano set enabling father and son to bring their happy experience of playtime to the making of a permanent home are the very latest invention.

Perhaps the new demand for steel houses was bound to bring this development about in time, but an eminent engineer, Mr. J. C. Telford, O.B.E., has been the first to apply the Meccano idea to the solution of the housing problem. He has been so successful in the attempt that Birmingham, which had refused to have anything to do with steel houses, has placed an order for three pairs of experimental villas, and other corporations have followed this lead.

Much is being written about steel houses, but as a fact few of the structures under discussion are really steel bungalows. They are steel and cardboard, or steel and wood, or steel and concrete, and nearly all require a certain amount of expert labour in construction.

A Few Hours' Work

This astonishing Telford patent provides for an all-steel house which a youth, who has played with a good set of Meccano, can construct. In the course of a few hours father and son working together, and getting great fun out of the job, can put together a complete and commodious villa to house permanently the entire family. It is actually the first real revolution in home-making since the housing problem became acute.

There is no skilled labour required from beginning to end, and another of the advantages is that there are no wet materials employed that have to be dried out before the new home can be occupied. When pater and Johnny have done their job of work and play, the house that Johnny built is immediately available for residence.

Mr. Telford explained his momentous invention to a correspondent in an interview, and particularly stressed the fact that the whole fabric is made on the fascinating Meccano principle.

Pipes Fixed In

"Each house consists of a living-room, kitchen, bathroom, scullery, and coal cupboard on the ground floor," he said, "with three good bedrooms above. Everything possible is made of steel, even to the staircase, and every component part is made on the mass-production principle and has only to be fixed in place by bolts exactly as the boy makes his wonderful bridges and crane in the playroom. Even pipes for water, gas, or electricity are already fixed on the steel plates and have only to be joined by a screw union.

"The houses are made with a six-inch cavity wall, which is in contact with the roof and also the exterior of the chimney flues. The latter are made of cast-iron pipes, and any heat transmitted by the chimney is re-transmitted round the house by virtue of the contact of these flue pipes."

The whole structure is made of pressed steel plates, and no stanchions are required, as the plates are pressed in the form of a box and bolted together by the turned-in flanges. It is the simple Meccano idea all through.

An Artistic Lining

This being so, it is possible for each amateur or professional assembler to add bay windows or turrets or any other fanciful features his taste may direct. He may also exercise personal judgment in treating the interiors, and the happy use of such durable and adaptable material as "SX" board will give a strong, non-conducting, and artistic alternative lining. The commonly heard objection to steel houses that they must have a monotonous uniformity is therefore removed.

A confidential report from the Ministry of Health indicates that these Meccano villas are likely to be regarded with warm approval. Municipalities desiring to erect sample houses for demonstration purposes will be granted a subsidy by the Ministry so that these novel Meccano houses may be accepted as one of the approved solutions of the housing problem.

Handling Goods on the Docks

Labour-Saving Machines in Warehouses

EVERYBODY knows that goods from foreign countries are brought to this country by sea, landed at one of the great ports and then distributed to their various destinations. Probably, however, very few people know the vast amount of organisation necessary to carry on the work of the docks.

Handling Explosives

Let us start at the moment when a steamer has been safely berthed and when the great dockside cranes—electric, steam, or hydraulic—are at work discharging her cargo. A certain quantity of the goods landed is taken away at once in special vehicles waiting for that purpose, but by far the greater proportion of the cargo has to remain on the quay. Goods are not allowed to be kept on the quay for an indefinite time, however, otherwise the congestion would become very serious, and usually, if merchandise is not removed within about 48 hours, a special charge called "penalty rent" or some similar name, comes into force.

Certain kinds of traffic, however, are never allowed to touch the quay at all. These include explosive goods, which either have a vehicle waiting to receive them and take them away or they are carried off by the dock authorities to a place of safety, at the expense of the owners of the traffic. The same thing applies to any kind of goods that would be likely to contaminate other goods lying near.

All docks have ample railway sidings giving direct connection with the main railway lines, and also with the large warehouses standing near by. Traffic that is ready for immediate despatch is carefully stowed into trucks, and if these trucks are open and the traffic is of a perishable or fragile nature it must be properly sheeted to protect it from the weather. Some traffic, of course, is not sent by rail, but by horse vans or motor lorries.

Bonded Warehouses

For various reasons, however, it is not always convenient for goods to be sent forward direct. For instance, the goods may not have been consigned to any particular buyer, and the shippers may be relying on the consignees to find a buyer after the goods reach this country. Again, it may be that the buyers are not ready to receive the goods. In all such cases storage in a warehouse is necessary.

Warehouses may be of one or more storeys, but a single-storey warehouse is better, not only because it costs less to build but also because the goods it contains can be handled more easily, and it can be better lighted by means of a glazed roof.

In all warehouses special attention is given to the prevention of fire. Most warehouses have a sprinkler or other system installed, so that if at any time the temperature rises above a certain point water is automatically turned on.

A certain number of warehouses at all docks are "Bonded," that is, they are buildings approved by the Customs Authorities for the storage of dutiable goods. Whereas in the ordinary way duty must be paid on goods immediately on arrival at the docks, goods stored in Bonded warehouses are not liable for duty until they leave the warehouse for final delivery.

Making Gravity Help

At the warehouses, goods are unloaded from trucks by cranes of all types. Some of these cranes travel about and do their work so cleverly that they appear almost human when in action. Whenever possible, goods are stacked by means of "stackers," which usually consist of square-shaped rollers fixed in a frame and turned by electric or other power. The traffic to be stacked is fed to the end of a series of these rollers, and these carry the packages to the top of the stack and place them in the desired position. Bale lifters, on the same principle as the Meccano model No. 443, are used for handling the larger bales of wool, cotton, etc.

Delivery of traffic from the warehouse is often effected by means of "gravity runways," which consist of a number of rollers fixed in a frame down which gradually run the goods to be delivered. Delivery can also be effected by the same cranes that were used to receive the goods into the warehouse, but the special advantage of gravity runways is that they require no power to work them. Generally speaking, in all warehouses man-handling is reduced to its lowest possible limit in order to keep down costs and to speed-up the work.

So far we have spoken of traffic handling in general, and it will be interesting now to say a few words on the treatment of various individual traffics.

Handling Cotton and Wool

Cotton, for instance, is packed in huge bales, and contrary to what might be expected, the worst-packed bales are the American. They are, therefore, extremely difficult to handle, as when they arrive they have often burst in various places and the raw cotton is protruding. On the other hand Egyptian cotton is carefully press-packed, enabling a larger quantity to be packed into one bale and rendering the handling of the bales very much easier.

Wool also arrives in large bales, and in this traffic what are known as "extra services" are often required. These services include mending bales and setting out for show, the latter involving the removal of one corner from each bale in order that prospective buyers may examine the contents.

Precautions against fire must be redoubled in the case of inflammable merchandise like cotton and wool. Warehouses intended for the storage of this class of traffic are generally divided into fire-tight sections, so that in the event of one part of the warehouse catching fire the other portions may be saved. Also an ample supply of water must be kept at hand, and this may be provided for by means of a large tank on the roof.

Tobacco, Canned Goods and Grain

Tobacco is usually packed in great barrels called "tierces," weighing about 7,800 lb. each. The Customs Authorities require that this traffic should be weighed, and large scales are therefore provided. The hoops are slipped off the barrels by means of machinery, leaving the tobacco standing up in its own bulk, and the barrels are re-fixed after weighing. Tobacco is often kept for years in store in order that it may mature.

Wines and spirits also often remain in store for a long period. This traffic is usually stored by means of barrel racks which make the removal of casks an easy matter.

Canned goods are imported from America and other countries in huge quantities, and a large amount of this traffic usually goes into warehouses. The "extra services" commonly

Photo courtesy [*Messrs. Henry Simon Ltd.*

Portable Combined Piler Stacking Sacks