VOL XII. No. 10 OCTOBER 1927

MECCANO MAGAZINE

Building Sydney Harbour Bridge.
(see page 841)

MECCANO MAGAZINE

Editorial Office
Binns Road
Liverpool

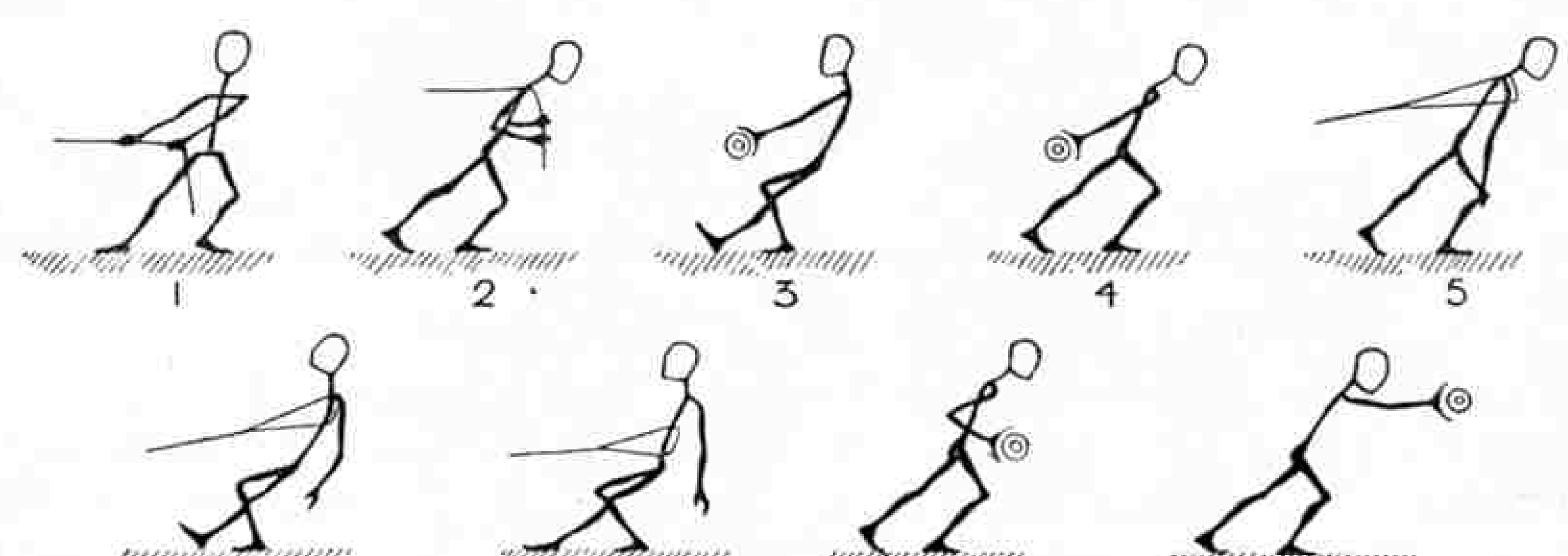
Vol. XII. No. 10
October, 1927

With the Editor

Moving Heavy Loads

The accompanying diagram (reproduced from the Journal of the National Institute of Industrial Psychology) will, I feel sure, interest readers of the "*M.M.*" Before referring to the diagram let me first mention that the Institute was founded in 1921 for the application of psychology and physiology to industry and commerce. Briefly, the idea is to discover by experiment the easiest and most efficient methods of carrying out routine tasks.

The present example deals with some experiments that have been made with a view to discovering the best means of pushing and pulling heavy weights. Twenty athletic students took part in the experiments and were invited to exert their maximum strength, in different positions, in pulling at a rope attached to a counterweight with a dynamometer fixed between the two. The dynamometer readings in the case of the nine positions shown in the figure were found to be :—



(1), 70.7 ; (2), 56.6 ; (3), 74.2 ; (4), 71.6 ; (5), 68.7 ; (6), 82.7 ; (7), 77.1 ; (8), 62.0 ; (9), 68.4 kilogrammes.

The conclusion arrived at is that position 6 is the best, being 17 per cent. above the mean strength of all positions, and position 2 the worst, being 18 per cent. below the mean strength. My readers may care to remember this, should they ever have to do any work to which the results could usefully be applied.

German Locomotives for South Africa !

Engineers are particularly interested in a report from South Africa of the failure of foreign-made steels. It appears that some little time ago the South African Railways purchased a quantity of rails from steel manufacturers on the Continent and that these rails have now become so defective that large quantities of them have had to be condemned as useless, to a total value of over £200,000.

One would have thought that the South African Railway Board would have remembered the loud out-cry, only a few years since, at the failure of a large number of foreign-made locomotives. Despite this, however, the South African Railway Board have once again given a locomotive contract, amounting to over half a million pounds, to German firms. It is a remarkable fact that although Great Britain takes nearly 75 per cent. of the goods exported from South Africa, the Union Government never shows any eagerness to place orders in this country. Indeed the contrary is the case and there has been a marked readiness to place contracts on the Continent and in the United States.

This is a dangerous policy, especially so in the matter of railway steel and equipment, for British steel manufacturers are able to point to the magnificent record of British steel rails in direct contrast to the countless failures of foreign-made articles. This is partly accounted for, perhaps, by the fact that in this country nearly all the steel used for rails is made by the open-hearth process. Although this is more costly, it is a process greatly superior to the Bessemer process used in America and on the Continent, by which rails are made cheaper but of inferior steel. Another point is the fact that in British rolling mills steel ingots are "cropped" until every sign of "pipe" is eliminated and nothing remains but solid metal to be rolled down into rails. This practice of carrying the rolling to the last degree is not always followed in many foreign works.

Buy British !

The award of contracts to non-British firms has naturally met with strong disapproval from commercial sources in the Dominion itself and in this connection the official journal of the Association of Chambers of Commerce of South Africa says :—"An astute business man considers many factors besides price before placing an order. In this particular instance locomotive experts are agreed that the British tender was for locomotives that are vastly superior to the best German locomotives, and that South Africa will make a great and costly mistake if it buys the German locomotives. If the Union is sincere in its desire to co-operate in the development of Empire trade, it must be prepared to take the longer view, to sacrifice a little here and there temporarily, as every business man has to do if he wishes to retain his best customers. Great Britain takes annually £44,000,000 worth of Union products, against less than £4,000,000 bought by Germany."

We can but hope that public feeling in the Dominion will result in a change of policy in the future, for after all is said and done, South Africa's locomotives and rails should be like Hornby Trains—"British and Guaranteed."

"The Wooden Walls of England"

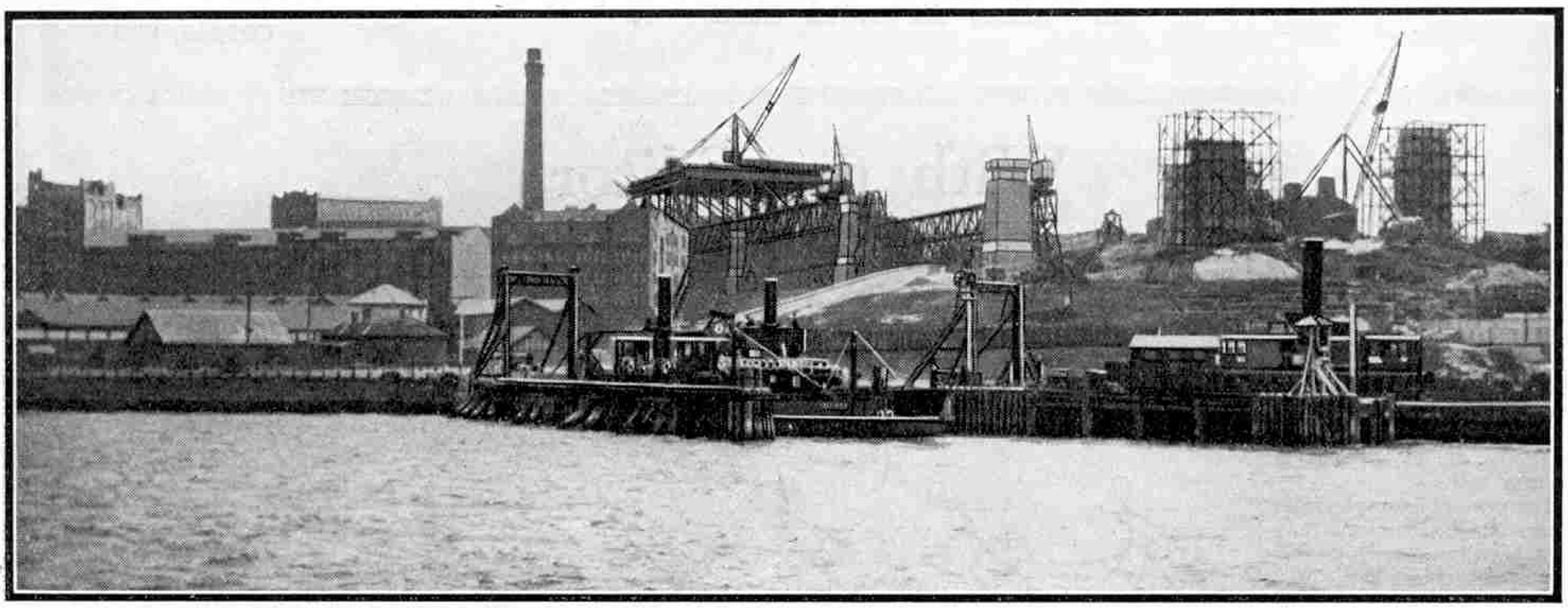
A centenary that probably will pass with little comment, but which nevertheless is of great interest, occurs this month. On 20th October, 1827, was fought the naval battle of Navarino, in which a combined fleet of English, French and Russian warships destroyed the fleet of the Turks and their Egyptian allies. The battle was not in itself of great importance, but it is of particular interest as being the last battle of any magnitude in which wooden battleships took part. Probably also it was the last big battle in which the tactics of Drake and Nelson were employed.

The great victories of these famous admirals were won by similar methods. The sides of their wooden ships were pierced with holes to accommodate the guns, and while solid cannon balls were fired from these at close quarters, sections of their crews armed to the teeth attempted to board the ships of the enemy and capture them by hand-to-hand fighting. A fight at sea in those days was undoubtedly a stirring affair, and there must be few boys who have not been thrilled by reading the story of the great fight between Amyas Leigh's ship "*The Rose*" and the three Spanish vessels, described so graphically in Kingsley's "*Westward Ho !*"

Next month I hope to publish an illustrated article describing the development of the British battleship up to the latest mighty fighting units the "*Nelson*" and the "*Rodney*."

Spanning Sydney Harbour

Progress Made in Building of Great Bridge



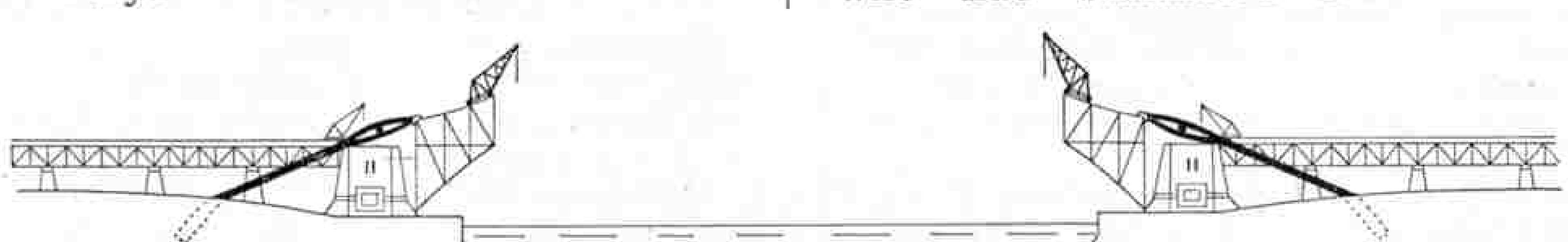
Progress of Sydney Harbour Bridge at Dawes Point

In the *"M.M."* of December 1926 and January last we related how the proposal for a bridge across Sydney Harbour, New South Wales, led to the designing of the magnificent structure now being built.

The possibility of such a bridge had been discussed on many occasions since 1815, when Francis H. Greenway, then Government Architect, brought a scheme before the notice of Governor Macquarie. Some years later, in a letter to the press, Greenway wrote :— ". . . in the event of the bridge being thrown across from Dawes Battery to the North Shore, a town would be built on that shore, and would have formed with these buildings a grand whole that would have indeed surprised anyone on entering the harbour, and have given an idea of strength and magnificence that would have reflected credit and glory on the Colony and the Mother Country."

The problem of connecting the two shores was considered seriously in 1912 by a committee specially formed for the purpose and the main question to be decided was whether a bridge or a tunnel would be the more suitable. The committee decided that a bridge was preferable and, after examining carefully various schemes submitted, advised the construction of a cantilever bridge.

The necessity for a bridge increased rapidly during the early years of the present century. By 1921 the traffic across the harbour had increased to 42 million passengers and it was admitted on all sides that something must be done at once. The bridge question was then re-opened in earnest, the recommendations of the 1912 committee were accepted and in the following year the Government of New South Wales passed an Act authorising the construction of a bridge to cross the harbour in one span at a height sufficient to allow the passage of the largest ocean liners.



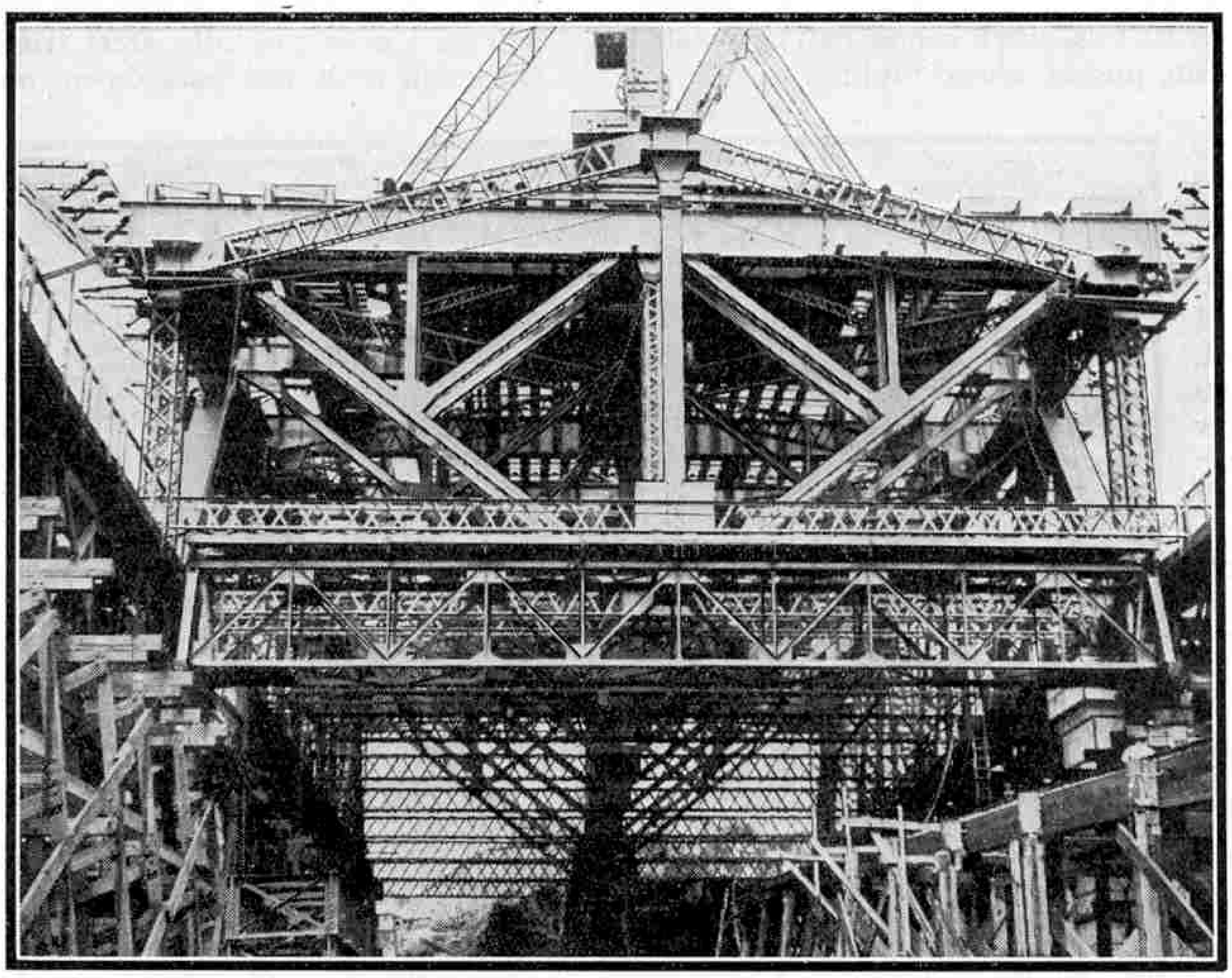
This diagram shows the erection of the second panel of the arch, the final anchorage being made from top of end post. The cable is sunk in the ground in a 120 ft. tunnel

The general design and exact position of the bridge, together with the dimensions, etc., were defined by a specification drawn up by Dr. Bradfield, and competitive tenders were invited from a number of engineering firms in all parts of the world, and competition was very keen. After careful examination of the tenders and designs, and after repeated Cabinet meetings, the Government came to a decision and in February 1924, it was announced that the contract had been awarded to Dorman, Long & Co. Ltd., of Middlesbrough, who had submitted seven alternative tenders for arch and cantilever bridges.

The successful tender was for an arch bridge with a central suspended span to extend across the harbour from Dawes Point to Milson's Point. As has already been mentioned, the Government had leaned very much towards the idea of a cantilever bridge—in fact, the original specifications called for a cantilever solely. The suggestion for an arch bridge was advanced partly on the ground that the cost would be appreciably less, and also because it was believed that the arch type would present a more pleasing appearance.

As the highest point of the arch will be 450 ft. above high-water level, the bridge will dominate the harbour completely. In selecting the arch type the authorities have ensured that the traveller entering Sydney Harbour from the sea will be met by the sight of a giant bridge well worthy to rank with the finest of any other country in the world.

The contract stipulates that constructional operations are to be carried on simultaneously on both sides of the harbour, and the time limit for the work is fixed at six years from the date of notification of acceptance of the tender, unless, of course, a special extension of time is granted by the Australian Government.



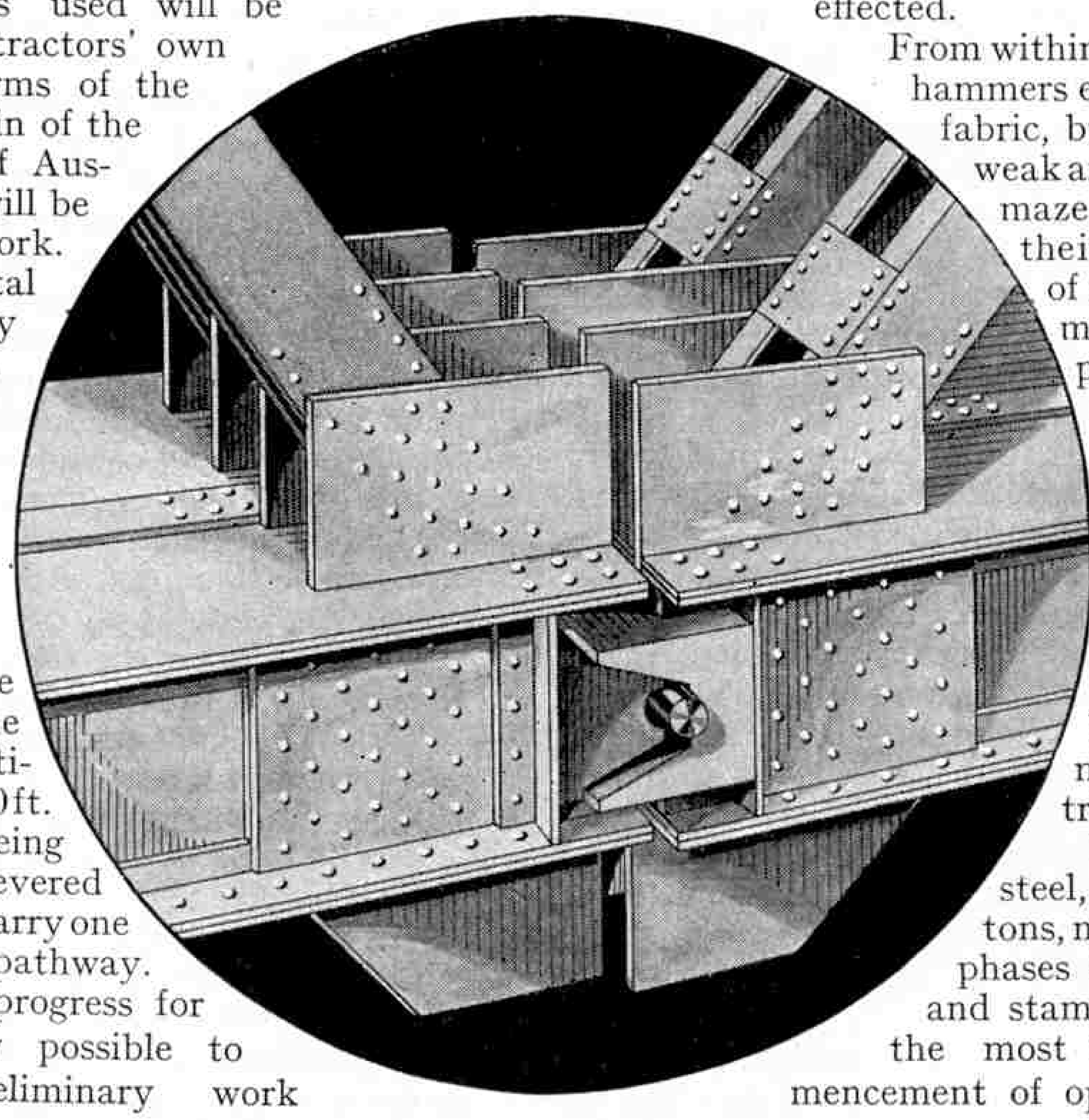
Cross section of the first span

The question of a steady and assured supply of materials is invariably of first importance in the carrying out of so vast an undertaking. In this respect Dorman, Long & Co. Ltd. are particularly fortunate, for some years ago they established constructional works at Sydney and Melbourne. Although the greater part of the heavy steel plates used will be manufactured at the contractors' own works in England, the terms of the contract require that certain of the lighter materials shall be of Australian origin. In all there will be over 50,300 tons of steelwork.

The bridge will have a total width of 150 ft. and will carry four lines of railway of 4 ft. 8½ in. gauge, a road 57 ft. in width, and two footpaths each 10 ft. in width. It wi.l consist of two hinged spandrel braced main trusses, set in vertical plane and spaced 98 ft. 6 in. apart from centre to centre, the clear span, centre to centre, being 1,650 ft. The web system will consist of verticals and diagonals forming 50 ft. panels, the cross girders being pitched 50 ft. apart and cantilevered beyond the main trusses to carry one railway track and a 10 ft. pathway.

The work has been in progress for two years and it is now possible to realise how much preliminary work has been done in that time, especially on the south. Approaching Circular Quay by water, one perceives on the southern shore a jumble of concrete walls, a maze of brown and silver-grey steelwork with imposing granite piers thrusting up through the mass, and higher still, pointing dizzily upward, the long slanting arms of cranes perched aloft—slim pencils of iron, hard against the blue of the sky. Across the harbour a conglomeration of buildings, walls and steelwork testifies to similar construction being in progress on the northern shore.

On going ashore at Circular Quay one is better able to appreciate the huge scale upon which operations are being conducted. At the southern end of the bridge one walks immediately under the first great steel approach span now in position astride George Street, and looking up at it arouses a sense of awe as one begins to appreciate the tremendous and intricate interlacing of heavy metal that has been effected.

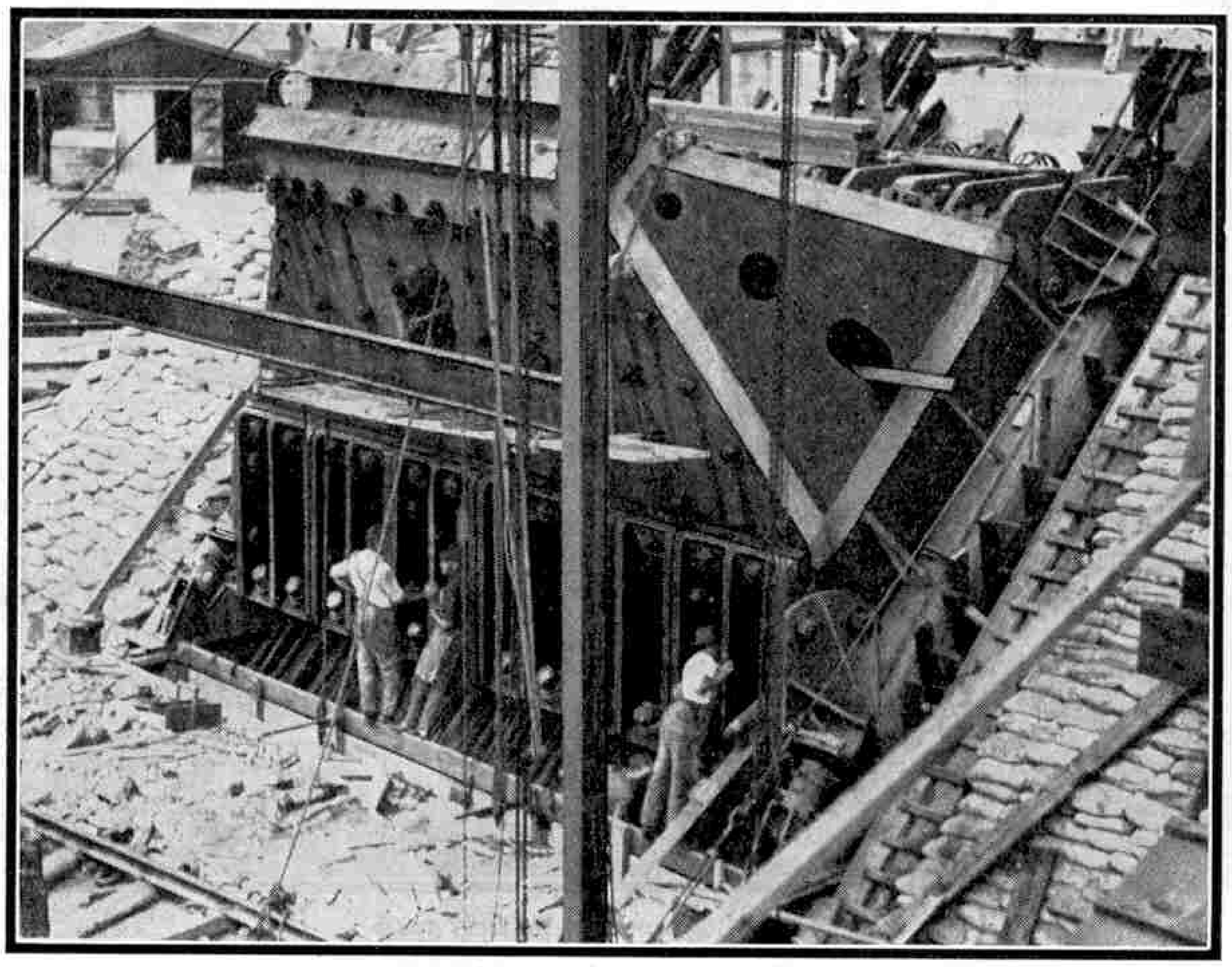


Our illustration shows how the two sides of the arch will be joined in mid-air. The sides will be constructed to within eleven inches of each other and horizontal and lateral variations will be adjusted by an ingenious system of interlocking saddles

From within this labyrinth the strokes of hammers echo and re-echo through the fabric, but the sound seems pitifully weak and is lost to the senses in the maze of steel. One somehow gets the impression as of the impotence of a tiny pick against a rocky mountain side. Yet these repeated hammer blows and the driving and burring of rivets are a proclamation of progress. Beneath the span and over the full width of the street is stretched close-meshed steel wire netting, for the smallest rivet falling from the great height of the bridge would mean injury to any pedestrian it might strike.

The fixing of this first span of steel, which weighs over 1,600 tons, marks one of the most forward phases in the construction to date and stamps the past six months as the most important since the commencement of operations. It may now be said that the work has emerged from the preliminary steps and that the bridge proper has come into being. With the colossal task of erecting and riveting the span completed, the " false work " on which it has been placed in position is now being removed, preparatory to being placed in position to enable work on No. 3 span to be commenced. The No. 2 span over its false work is now half completed and the work is being pushed ahead rapidly.

Another important factor at this scene of operations during the past six months has been the erection of the two main bearings of forged steel, each of which weighs 400 tons. Both are now in position. Two similar bearings will be placed on the opposite shore. Upon these four bearings will depend in large measure the stability of the main arch, for they will take the whole weight of the enormous span across the harbour and will have to withstand a thrust of 20,000 tons each. These figures convey some impression of the gigantic nature of this bridge-building feat.



One of the Bearings or Giant Hinges on the Southern end of the Bridge

All the granite piers on the south side of the harbour have been completed and only two remain to be finished on the northern shore.

Towering above the granite piers, the main pylons, two at each end of the bridge, will rise to a height of 285 ft. A beginning has been made on these pylons and many of the stones now in position at their bases weigh as much as seven tons each. The work on these stones is very beautiful and to protect them from injury and weather the stones have been surrounded by closely-packed sandbags.

It is worthy of remark that the builders praise very highly the quality of the granite which is being used. As stated in the "*M.M.*" of December last, the stone is being obtained from Moruya in New South Wales. The quarry is situated about three miles from the town and the bridge builders have constructed three ships, capable of carrying 400 tons of granite each, for transporting the stone to the bridge site. At the quarry itself 300 men are employed and a special town known as Granite Town has sprung up in the vicinity. There are at present about 75 houses in the town and special accommodation is provided for married men and their families. There is an improvised co-operative store, while a concert hall is in course of erection and a swimming pool being made.

Apart from actual work on the bridge structure, an enormous amount of excavation work has had to be carried out. Up to a few months ago 33,277 cubic yards of earth had been removed, 98,420 cubic yards of rock wrenched out, and the total quantity of cement deposited exceeded 40,000 cubic yards.

In addition to all this work, special tunnels have been constructed to accommodate the 128 cables that will sustain the weight of the main arch when it commences to reach out across the harbour. These cables will lead over the lofty steel trusses at the termini of the main arch and pass down, on the approach sides, to massive anchorages where they will be looped underground in the form of a horse-shoe.

The activities of the builders are at present concentrated on the north and south foreshores, and it will be some time before the structure begins to take shape over the water. The work has now advanced so far that an idea of its immensity and value may be obtained, and only a few short years will now elapse before this, the largest arch bridge in the world, will be completed. It will then stand a colossal thing of beauty, linking the great Australian city from which the harbour takes its name with the densely populated suburbs on the opposite shore. Unbroken railway communication with the rich and ever-growing coastal towns will then be established and dependence upon the inadequate existing ferry services will be removed.

Meanwhile the people of Sydney are watching the progress of the bridge with keen interest. There are a few pessimists who prophesy that it will collapse before both sides meet in the centre. The design of the bridge was not finally settled, however, until every conceivable point had been carefully thought out, and the reports of the engineers were considered by the members of the New South Wales Government in repeated meetings. The change from a cantilever to an arch bridge was not decided upon, therefore, without due consideration and most people are content to rely upon the calculations of the engineers and on the reputation possessed by Dorman, Long & Co. Ltd. for sound workmanship.

This well-known firm has built special shops in which to carry on the necessary work of assembling and testing the component parts of the bridge.

The building of these shops alone was a big undertaking, since it involved the levelling of thousands of tons of solid rock. The work that the contractors put into this, however, has been amply repaid by the efficiency and convenience of the workshops. They have been erected alongside a deep-water frontage that enables vessels from overseas or from other parts of the Australian coast to bring in material for the bridge and discharge it at the bridge itself. A customs branch has been established at the shops for the special convenience of the contractors in this respect.

LIVES OF FAMOUS INVENTORS

VIII.—SIR GOLDSWORTHY GURNEY—STEAM CARRIAGE PIONEER

GOLDSWORTHY GURNEY was born on 14th February, 1793, at Treator, Nr. Padstow in Cornwall. Little is known of his youth except that he received his education at Truro Grammar School. In order to appreciate the value of Gurney's work it must be remembered that at the time of his boyhood railways were unknown, while in Cornwall even stage coaches were seldom seen for there were few roads in the county fit to carry them. Watt's steam pumping engines were by then well established in the tin mines, and at Redruth in 1794 a sensation had been created when William Murdock successfully lighted his lodgings with coal gas, as described in the June "*M.M.*"

At the age of 10 Gurney was sent on holiday to Camborne, where he had the good fortune to see Richard Trevithick experimenting with his newly-invented passenger carrying locomotive. Trevithick had been greatly interested in a model locomotive made by Murdock and he was convinced that great possibilities awaited the invention of a satisfactory steam road carriage. At Camborne, with the aid of a relative named Andrew Vivian, he quietly set about constructing such a vehicle, and it was the result of their efforts that Gurney saw being tried out.

Sir Goldsworthy Gurney

On the completion of his schooldays Gurney was placed with Dr. Avery of Wadebridge as a medical pupil, and in due course he became a qualified surgeon and commenced practice in the neighbourhood. He soon built up a successful practice and was exceedingly popular with his patients, but scientific research appealed to him more than the life of a family doctor.

About the year 1820 Gurney removed to London and delivered a series of lectures at the Surrey Institution. These addresses were remarkable for their great diversity of subject, some dealing with researches in electricity and others with gases and heat. Although there is little information available on the subject it is evident that Gurney must have had a good deal of ability as a lecturer. It is at any rate certain that he made considerable impression upon the prominent scientists of the day and it is interesting to note that in later years Michael Faraday spoke very highly of Gurney's ability, and acknowledged freely that his lectures had been of great assistance to him in his own researches.

In the course of one of his lectures upon electricity Gurney referred to his discovery that a magnetic needle responded instantly to the influence of a galvanic battery when the poles of this were united over the needle. Although he made no efforts to develop this discovery it is evident that his keen brain saw that it held great possibilities, for on one occasion he remarked "here is an item which may, and I foresee will, be made a means of intelligible communication."

One of the most important of his early inventions was that of the oxy-hydrogen blowpipe. He carried out an elaborate series of experiments upon the effect of his blowpipe upon various substances, in one of which he found that when a cylinder of lime was heated to a certain degree it evolved a dazzlingly brilliant light. Gurney realised immediately that he had discovered a new and available source of illumination, but characteristically he did nothing to make use of the discovery.

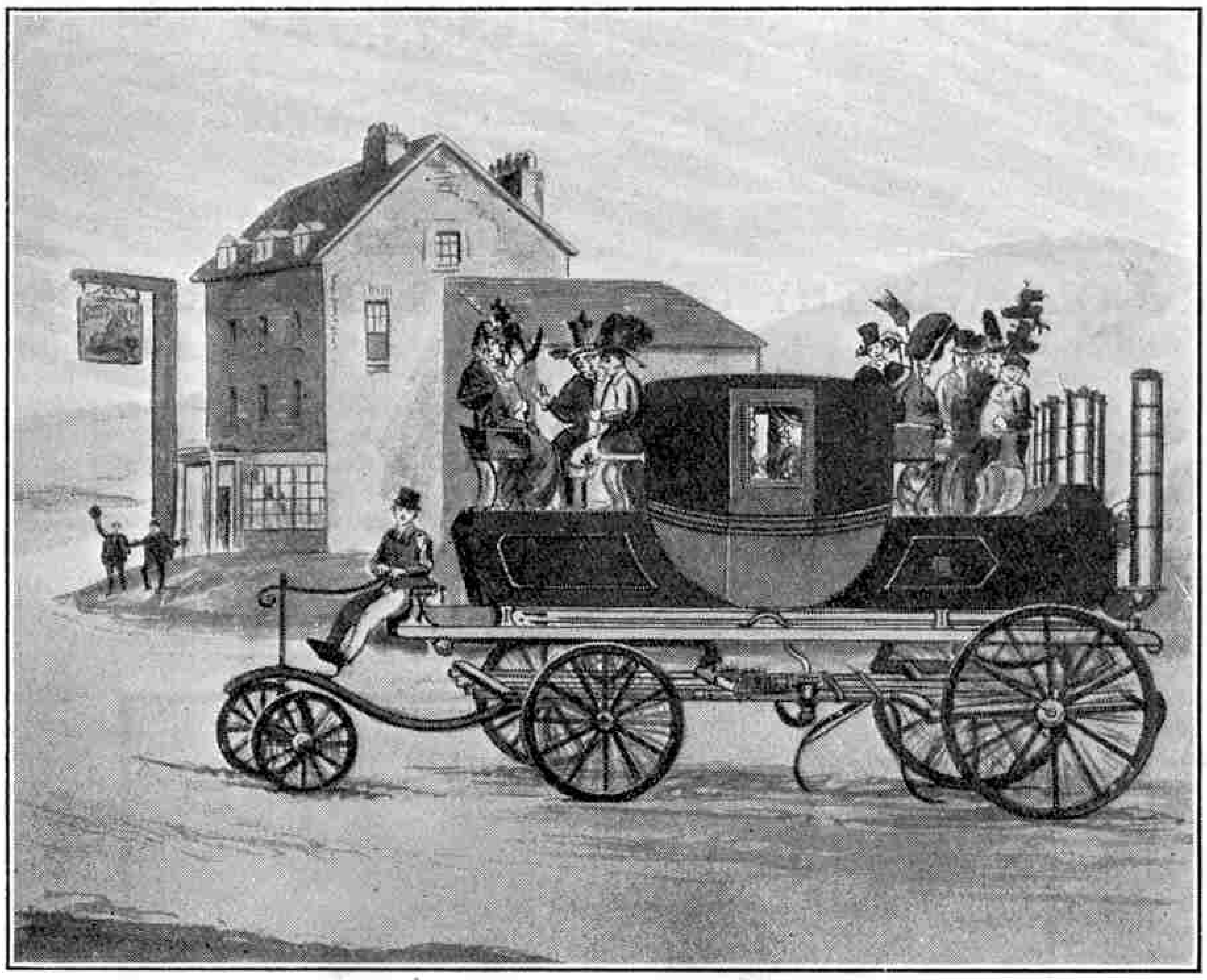
Lime-light, as it was called, was first put to practical use by a man named Thomas Drummond in 1826, and the effectiveness of the light attracted general attention. The result was that Gurney's invention became known as the "Drummond Light" and this name has stuck to it ever since. Drummond was not at all to blame in this matter. On the other hand, he went to very great trouble to explain that the invention was entirely the work of Gurney. In a letter to the chairman of a House of Commons Committee on Lighthouses, he stated clearly and frankly that he made no claim to the invention, but that he "had it from Mr. Gurney in 1826." In spite of these efforts, however, Drummond's name continued to be associated with the light, and all Gurney got out of it was a gold medal awarded by the Society of Arts in recognition of his discovery of the blow-pipe which formed the vital principle of the light.

In 1823 Gurney commenced experimenting seriously in the possibilities of steam locomotion. It is evident that he had not forgotten the impression made upon him 20 years before when he witnessed the trials of Trevithick's locomotive, for his efforts were devoted towards producing a steam-propelled road vehicle. In a lecture given about this time he asserted his belief that "elementary power is capable of being applied to propel carriages along common roads with great political advantages and the floating knowledge of the day places the object within reach."

For a time Gurney endeavoured to carry on both his experimental work and his medical practice by taking in a partner to relieve him of some of the work connected with the latter. Presently, however, he realised that in order to achieve the results at which he was aiming he must devote himself entirely to experiment and research, and he therefore transferred his medical practice to his partner. His patients apparently considered that he was leaving them in the lurch and they protested vigorously, but to no avail!

In 1825 Gurney took out a patent for a steam carriage having a peculiar arrangement of pushing struts or legs as a secondary means of propulsion, and during 1825-6 he constructed his first carriage. The propelling legs, to quote Gurney's own words, " as the carriage ascends the hill are set in motion and move like the hind legs of a horse, catching the ground and thus forcing the machine forward, increasing the rapidity of the motion and assisting the steam power." At this time Gurney apparently shared the prevalent belief that, at starting, the wheels of a carriage would spin round without biting, and there is little doubt that the legs were intended to be of assistance at this stage of operations.

In 1827 Gurney completed a steam carriage capable of carrying 21 passengers. This carriage embodied many interesting features in addition to propelling legs. Superheated steam was supplied by a water-tube boiler to two cylinders, which were fixed below the coach body and drove the rear wheels. In this coach the necessary draught was produced by means of a fan driven by a separate engine.


Gurney's steam carriage of 1827, with propelling legs

Gurney was not the inventor of the tubular principle for boilers. More than 20 years earlier a tubular boiler that proved very successful in the Cornish mines was patented by a Mr. Woolf, and Trevithick, in a patent of 1815, appears to have considered the employment of a boiler of this nature, although apparently no locomotive was ever constructed according to this patent. Great credit is due to Gurney for the application of the tubular principle in his road-carriage boiler, the steam being generated inside the tubes.

In later vehicles the propelling legs were abandoned and a steam jet was employed to force the draught. On account of this, Gurney has been credited with the invention of what is now known as the steam blast, but it does not appear that this claim can be upheld. The credit for this valuable invention has been claimed for Robert Stephenson, William Hedley, Timothy Hackworth and others, in addition to Gurney, but there seems to be little doubt that the honour rightly belongs to Trevithick.

Trevithick was the first to build a steam locomotive to run on rails and in this locomotive the exhaust steam was discharged into the funnel to force the draught. It has been argued that Trevithick merely turned the steam up the chimney as the most obvious means of getting rid of it, and that he did not realise the effect of doing so. This argument appears to be settled definitely by a letter written by Trevithick himself on 20th February, 1804, in which he says :—" The steam that is discharged from the engine is turned up the chimney about 3 ft. above the fire. The fire burns much better when the steam goes up the chimney than when the engine is idle." In another letter Trevithick wrote :—" The steam is delivered into the chimney above the damper; when the damper is shut the steam makes its appearance at the top of the chimney but when opened none can be seen. It makes the draught much stronger by going up the chimney, no flame appears." From this evidence it is surely clear that, whether Trevithick first turned his steam up the chimney by accident or not, he quickly noticed the effect of doing so and realised its value. It was entirely characteristic of Trevithick that he made no practical use of his discovery and it was left for George Stephenson, some 25 years later, to apply the steam blast in such a manner as to lay the foundation of the modern locomotive.

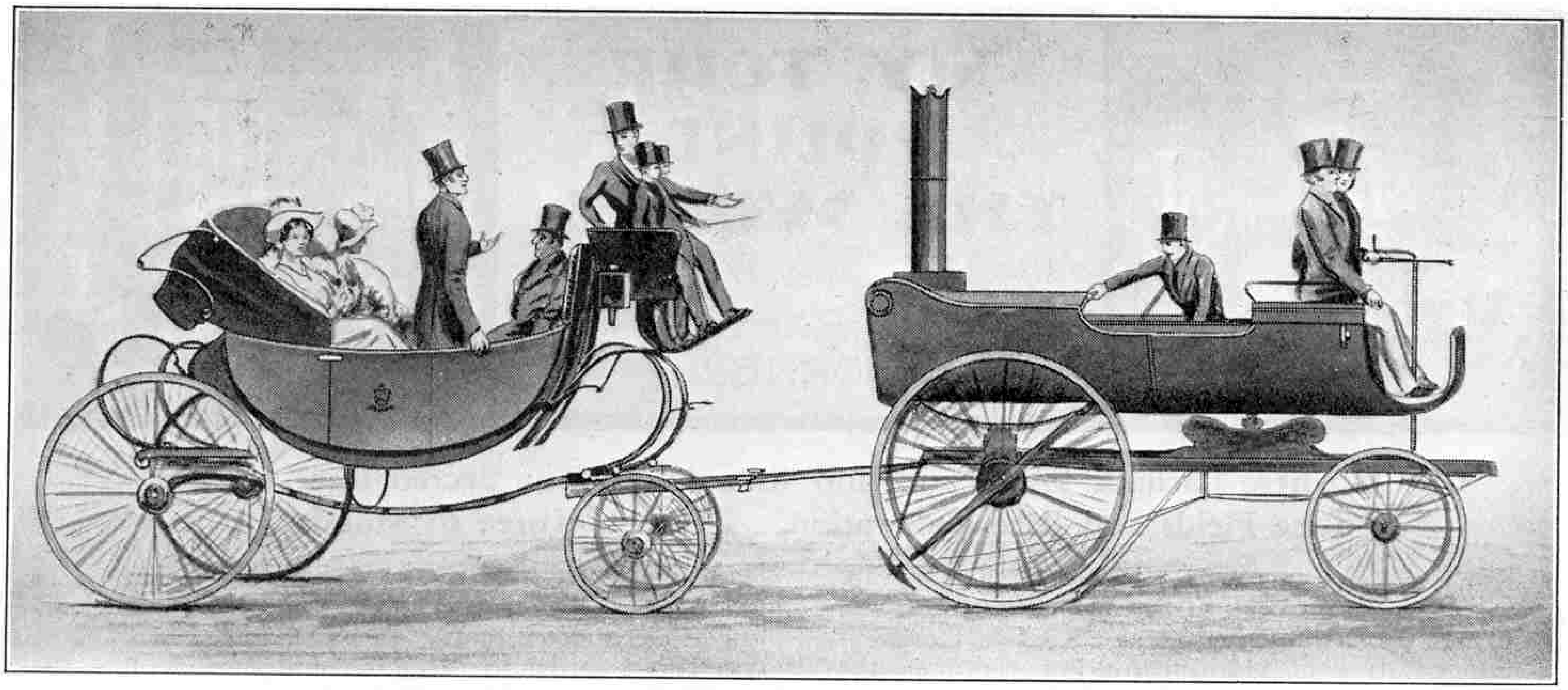
Up to a certain point Gurney's road carriage was successful and it was often to be seen steaming along the highways about London. On one occasion Gurney undertook a journey from London to Bath and back and succeeded in accomplishing the feat at an average speed of 15 miles per hour. This trip was the first long journey ever made at sustained speed by a locomotive on the highroad, and it proved beyond doubt the possibilities of the invention. On another occasion a journey from Melksham to Cranford Bridge, a distance of 85 miles, was accomplished in 10 hours, including several stops on the way.

At this time there was a remarkable outburst of prejudice among the uneducated workers against machinery of any kind. Their argument was that the introduction of machinery meant less work for them and therefore they took every opportunity of smashing such machinery as they could lay their hands upon. For some extraordinary reason Gurney's steam carriage aroused the bitter hatred of the agricultural community. It is difficult to understand what damage they thought it was going to do to them, but apparently the mere fact that it was " machinery " was sufficient. On one occasion, when Gurney was driving his carriage through Melksham on the occasion of a fair, a massed attack was made upon the vehicle and its occupants were stoned and beaten. Gurney himself was so badly knocked about that he lost consciousness and did not regain it until he had been safely conveyed to Bath. Opposition of this kind had no effect upon the inventor, however, and he continued to develop and improve his carriage.

In 1831 several of Gurney's steam carriages were taken over by Sir George Dance who, for some months, used them to run a regular coach service four times a day between Gloucester and Cheltenham, a distance of about nine miles. The average speed of these journeys, including stoppages, was about 10 or 11 miles per hour. About 400 profitable journeys were run before the service ceased to pay owing to the passing of an Act imposing utterly prohibitive tolls, equal in some cases to half the working expenses. This crushing legislation against all road vehicles was apparently instigated by influential people who were interested in the future of rail locomotion and who saw in the growing road traffic a serious rival.

In 1831 a Government Committee was formed to enquire into the whole matter of road carriages. After due consideration this committee pronounced strongly in favour of every encouragement being given to Gurney and other inventors, and declared the steam carriage to be " one of the most important improvements in the means of internal communication ever introduced." The opposing interests in Parliament rallied their forces, however, and proved strong enough to prevent the committee's recommendation being acted upon.

Even after this setback Gurney was still determined that the steam carriage should not be driven off the road. He submitted to Parliament a personal petition for a further consideration of the situation and succeeded in securing the appointment of another Committee. This Committee came to the same conclusion as its predecessor and recommended that the ruinous clauses of the unpopular Act should be withdrawn and that reasonable compensation should be paid to Gurney for the loss he had sustained through the operation of the Act. Nothing resulted from these suggestions, however, and Gurney in deep disgust put



Later type of carriage, hauling a nobleman's barouche

on one side the subject of steam carriages and devoted himself to matters less financially disastrous.

From time to time Gurney reverted to his experiments in illumination. His discovery of the blowpipe already referred to paved the way for the subsequent tremendous development of incandescent gas lighting, and although he did not live to witness its development his researches in this direction attracted a great deal of attention. In 1852 the Government appointed him to arrange and carry out a complete system of lighting and ventilation in both Houses of Parliament. His scheme was successful and two years later he was appointed to superintend and extend the system he had installed. In this capacity he served the Government up to 1863, when he resigned. In that year also he received the honour of knighthood in recognition of his discoveries and inventions.

Gurney was too industrious a man ever to be wholly idle and during the first year of his retirement he busied himself in writing a treatise to which he gave the lengthy title: "Observations pointing out a means by which a Seaman can identify Light-houses, and know their Distance from his Ship, in any position or bearing of the Compass." As a suitable means of signalling he suggested a systematic flashing of lights.

While deep in the task of correcting his copy one day, Gurney had a seizure, the effects of which compelled him to relinquish even his literary labours. He retired to his house at Reeds, near Bude, where his wants were lovingly attended to by his daughter Anna. Although he felt the effects of his seizure until the end of his life, he recovered sufficiently to spend a portion of each year in farming at Hornacott Manor, Launceston, Cornwall. He was genuinely interested in agriculture, and became president of clubs devoted to improving the industry, at Launceston and Stratton.

His death occurred at Reeds on the 28th February, 1875, at the ripe old age of 82. Some years later his daughter installed a memorial clock in the tower of Poughill Church, Stratton, Cornwall, while a tablet to his memory was placed within the church.

During the period in which Gurney was experimenting with steam road carriages, several other inventors were busily engaged in attempts to produce vehicles of this type. The majority of these inventions were failures but a few had a considerable measure of success.

A road carriage constructed about 1824 by a London man named W. H. James, had many interesting features. The rear axle of the vehicle was in two halves to each of which was attached a pair of cylinders arranged to drive cranks set at right angles to each other. The carriage, which weighed about three tons, was tried out over a rough gravelled road through Epping Forest and, carrying a load of 15 passengers, it succeeded in attaining a speed of from 12 to 15 miles per hour. Owing to the excessive steam pressure several tubes fractured in the welds, but the carriage accomplished the return journey at the rate of seven miles per hour and with the load increased to 24 passengers. Subsequently the carriage was equipped with a new boiler, but it encountered a succession of mishaps of various kinds and ultimately was abandoned.

Some of the most successful steam carriages in the early 19th century were those invented by Walter Hancock, whose first vehicle made its appearance in 1827. It was noteworthy for its original type of boiler, which comprised a series of flat chambers side by side, built up of boiler plate and connected by tubes and stays. Short vertical tubes connected each chamber to a horizontal overhead pipe that did duty as a separator or steam drum. The carriage had three wheels, the front wheel being driven by two oscillating cylinders connected with the wheel axle, which was cranked.

In February 1831, Hancock placed in service a second steam carriage named the "*Infant*," and in 1832 this was to be seen plying between Paddington and London "City." During October of that year the "*Infant*" accomplished a four-day trip from London to Brighton and back at an average speed of 10 miles per hour. On the first day the carriage steamed 38 miles, a halt for the night being made at Hazledean; the remainder of the journey to Brighton was accomplished the following day. Eleven passengers were carried on the outward journey and 15 on the two-day return trip.

Hancock built several steam carriages for private companies, but none of the vehicles enjoyed long periods of service owing to the failure of the companies. In 1833 the industrious inventor built an improved road carriage which he named the "*Autopsy*." A feature of the chassis was the turning of the rear axle by an endless chain working from the engine shaft.

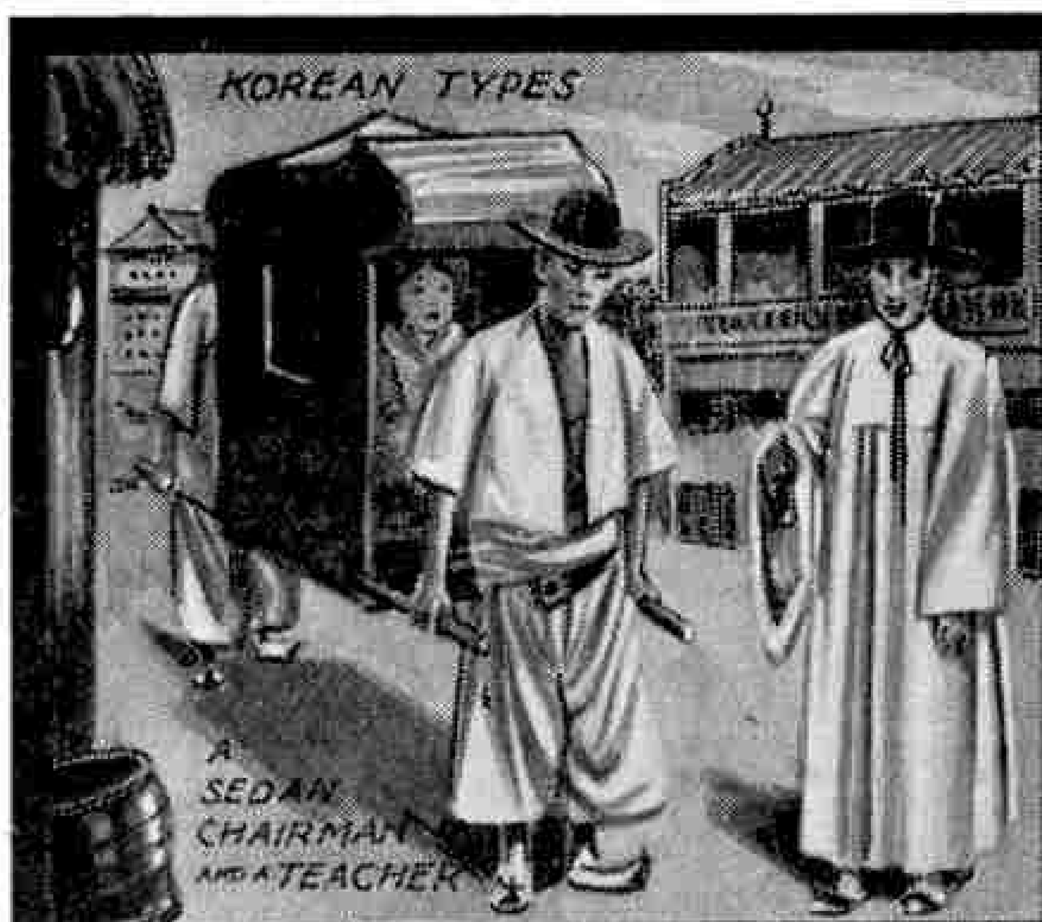
By the end of 1833 more than a dozen steam road vehicles were operating in the vicinity of London, but the heavy taxation that drove Gurney out of the business gradually suppressed other venturesome spirits.

In 1834 Hancock made his first "drag" steam coach which, in addition to accommodating 10 passengers, was sufficiently powerful to tow a second passenger carriage. This contrivance accomplished a speed of 14 miles per hour over level road. In the following year he made a more ambitious effort and brought into service the "*Erin*," a passenger-carrying and "drag" coach capable of accommodating 20 persons. The "*Erin*" achieved wonders and must have caused the enemies of road carriages some apprehension. On one occasion it attained a speed of 10 miles per hour while towing three omnibuses, in addition to a stage coach laden with 50 passengers!

Hancock finally withdrew his steam carriages from the road in 1836, after having achieved a considerable amount of success in running regular trips in the neighbourhood of London.

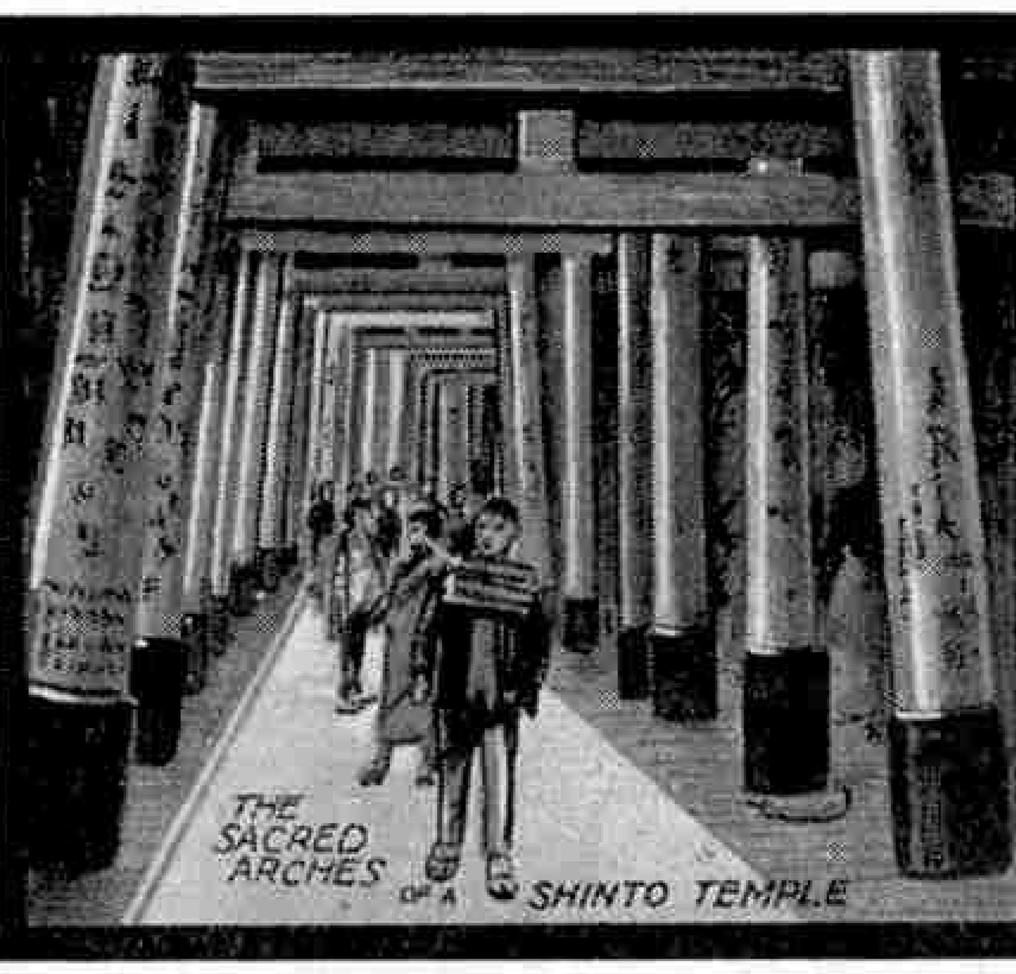
To New Readers

Previous articles in this series of "*Lives of Famous Inventors*" have dealt with James Watt, the Inventor of the Steam Engine (March, May-August 1927), and George Westinghouse, Inventor of the Air Brake (September 1927)



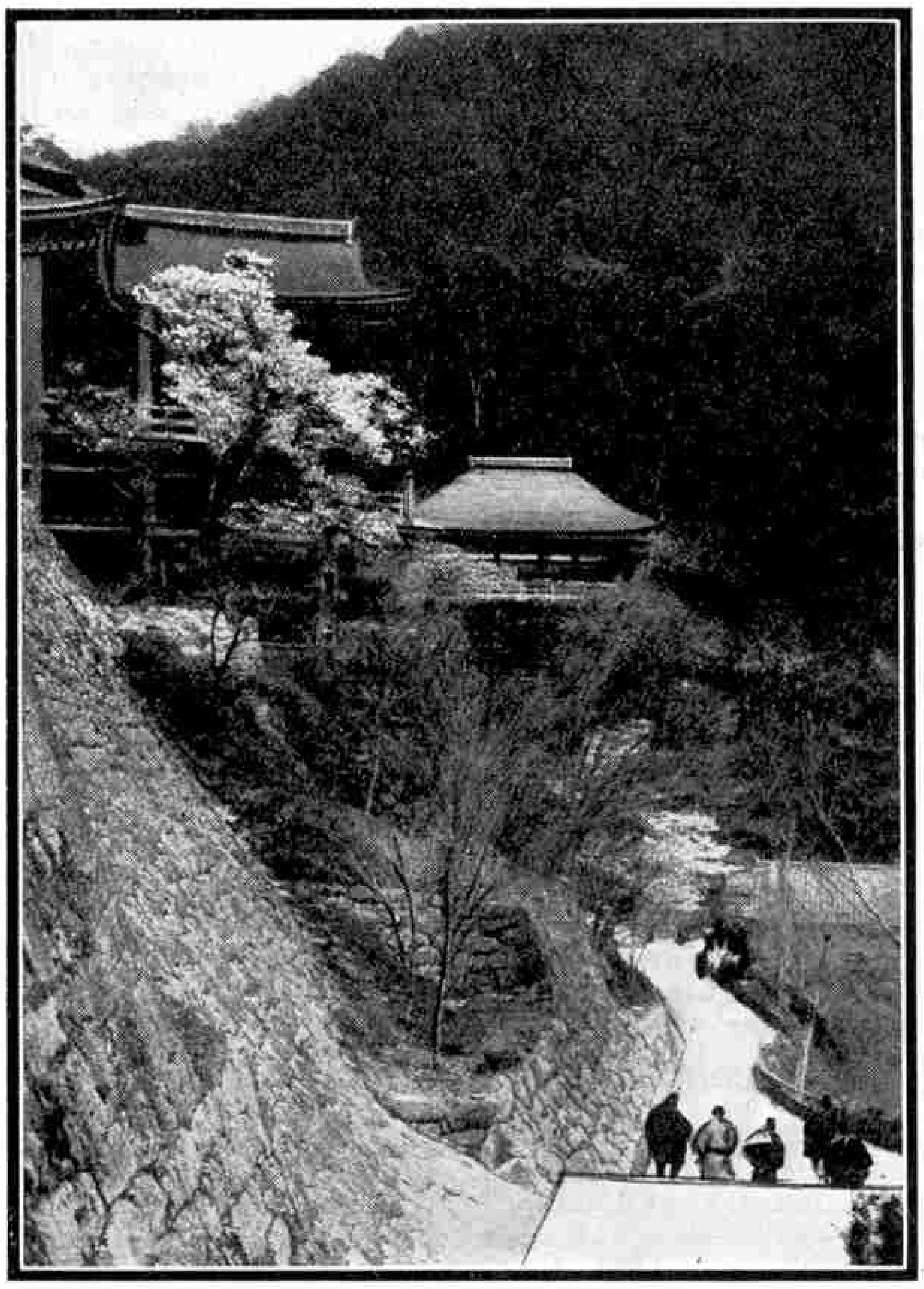
MY TOUR ROUND THE WORLD

by
FRANK HORNBY



III. Japanese Lacquer Work and how it is done. The Sacred Deer at Nara. Rice Fields and Rice Cultivation. Through Korea to Mukden.

AFTER a short stay at Kobe I went on to Kyoto, an ancient city full of temples, monasteries and mysterious things in general. Kyoto is thoroughly representative of old Japan. For centuries the Palace of the Mikado has stood within it and its streets have seen the passing of thousands of royal and religious processions. It has obstinately refused to become Westernised and its population has gradually decreased.



Garden and Kiyomizu Temple at Kyoto, Japan

I found Kyoto very interesting. Its streets are straight and unpaved, no carriages are to be seen and the only vehicles are the rickshaw and a sort of two-wheeled trolley which is normally drawn by oxen, but also on occasion by men or even women. The houses are very quaint to Western eyes. They are of the frailest possible construction, the roof of drab tiles seeming to be the only portion of them that is in any way substantial. There are no windows, and the necessary light comes through the paper screens that form the outer walls. Many of the houses have little courtyards of their own surrounded by bamboo fences and containing the miniature gardens for which Japan is so famous.

The Japanese gardens are wonderful productions and they fascinated me intensely. My first impression at a casual glance was that they were toy gardens only fit for children's playthings, and containing very little beyond stunted trees, a few stones and a tiny lake or possibly a waterfall. I soon realised, however, that there was organised method in their layout, and I made up my mind that I would try, if possible, to penetrate to the idea in the minds of their makers. I found that the aim of the Japanese gardener was to reproduce in miniature a favourite country scene, with perhaps a few additions of his own design to enhance the artistic effect according to Japanese ideas. His ambition is satisfied if his garden recalls a hillside bordering on a lake, or a valley hidden away among the mountains of old Japan. The result is very beautiful, with a strange quaintness about it that is impossible to describe. Most decidedly a garden in Japan is not a place in which the gardener displays his skill in rearing fine plants or gorgeously coloured flowers and in arranging them for effect.

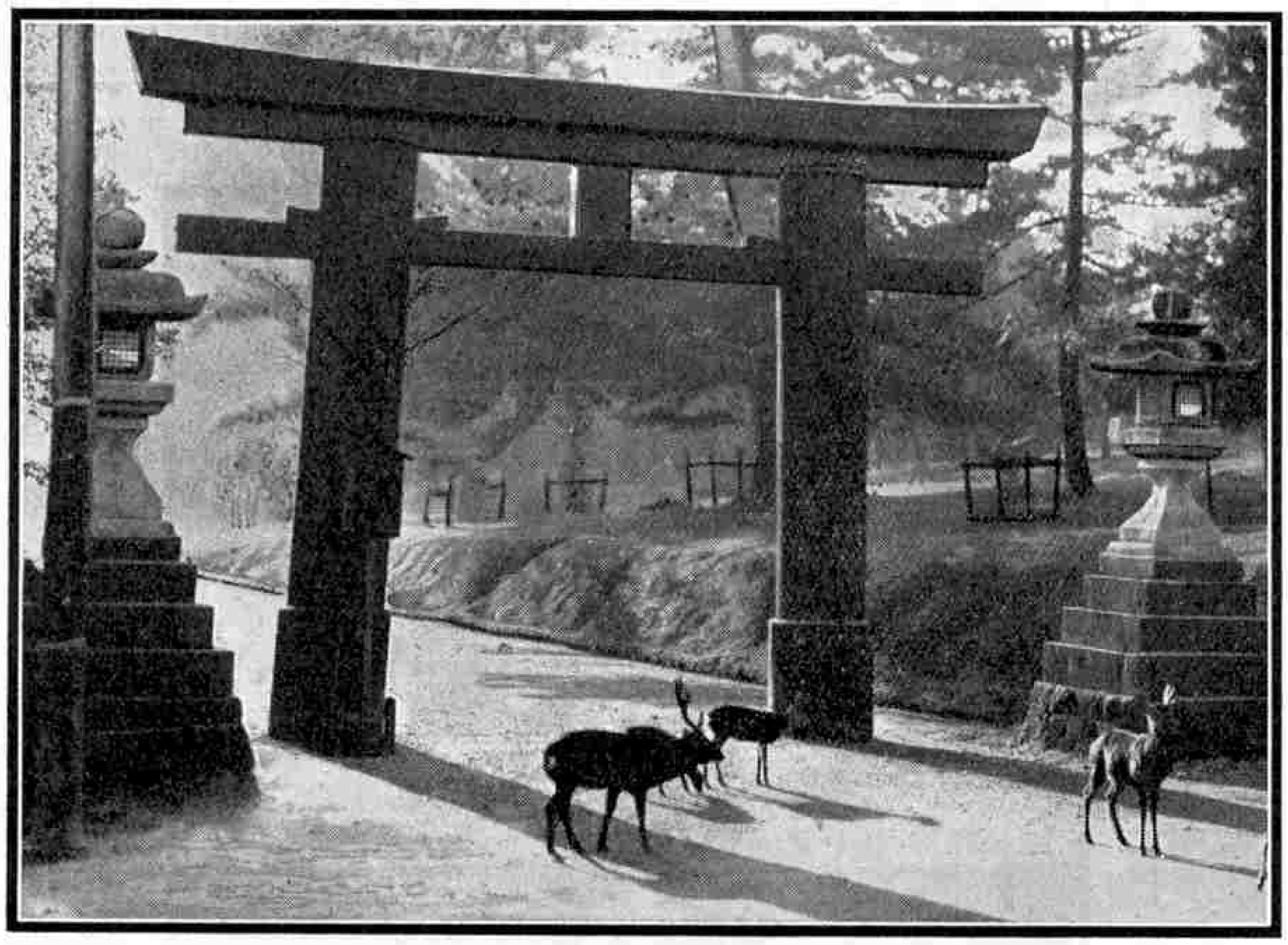
Kyoto is regarded as the art centre of Japan. In particular it specialises in high-class lacquer work, in which I am greatly interested, and I was delighted to have the opportunity of visiting one of the establishments where the best work is produced.

The use of lacquer for ornaments seems to have originated in China more than 6,000 years ago, but it has reached its highest development in Japan. The lacquer is made from the sap of a tree that grows freely in Japan and in China, the name given to the Japanese tree being "*Urushi-no-Ki.*" It is obtained from the tree by a method somewhat similar to that employed for extracting rubber. Several horizontal incisions about half an inch in depth are made in the trunks and main branches of the tree. These incisions are then deepened with a knife of special shape and in the course of three or four days a clear resinous juice mixed with milky matter begins to exude.

This juice in a fresh state is yellow to greyish-white in colour, and is thick and sticky. On exposure to the air it soon turns brown and subsequently black, and becomes very hard. The lacquer obtained from the branches of the trees is regarded as more valuable than that from the trunks, because it sets considerably harder. A black lacquer is prepared in the open air by stirring the fresh juice for two or three days and adding water containing iron.

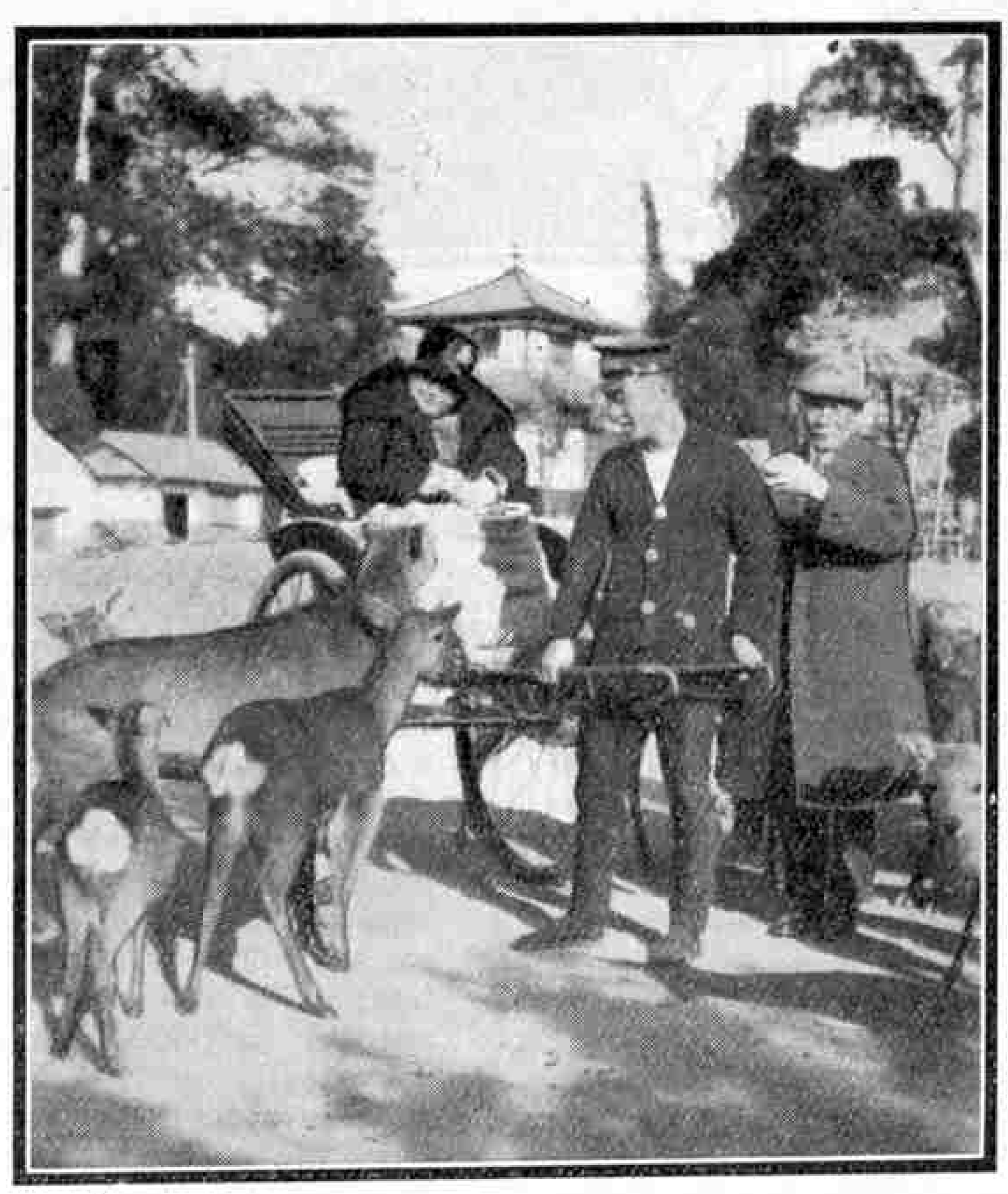
The only treatment that this valuable product requires before use is pressing through thin but strong paper in order to free it from small solid impurities. If by any chance it becomes too thick before it is used, it is reduced by the addition of a small proportion of a special vegetable oil. The articles to be lacquered are usually pasted over with paper or linen cloth to avoid cracking or breaking. The joints are then plastered over with a mixture of burnt earth and lacquer. This painting is repeated several times at intervals of at least one day, and between these applications the surface is carefully polished with pumice stone. When the result is regarded as satisfactory, powder is laid on the article with a flat brush having stiff short bristles.

After each coat of lacquer has been applied the articles are dried in closed boxes to prevent dust settling upon them. It is a very curious thing that the lacquer dries best in a damp atmosphere, and this suggests that the process is not one of ordinary drying, but that certain chemical changes take place. Many attempts have been made to introduce lacquer working into Europe and the lack of success is probably due to the climate. In England, for example, lacquer requires 14 days or even more to dry, and even the most skilled and patient worker finds it almost impossible to keep dust away during such a long period.



Gate to Shrine at Nara, Japan

Perhaps the most interesting operation in lacquer working is the working with gold. First of all the artist draws the pattern in white chalk. Then a coating of fine gold-dust is laid on with a piece of cotton-wool when the lacquer is half dried, and the excess of gold is dusted off with a very soft brush made from the long winter coat of a white horse! For work of the highest and most durable quality other layers of lacquer and gold are laid over these ground layers. Another interesting process is that which produces raised gold lacquer instead of the ordinary flat effect. In this case finely powdered camellia wood charcoal is shaken over the portions of the lacquered surface that are to be gilded in order to raise these above the general level.



The Sacred Deer at Nara are inquisitive

I was very much impressed with the extraordinarily beautiful work done in the establishment I visited. Among the several examples shown to me was an ordinary box, made of well-seasoned cypress wood, with a drop lid, 14 in. in length, 12 in. in width, and 6 in. in depth, having a design on the outside and one on the inside of the lid, with the rest of the box suitably finished. On inquiring the price I was told it was 4,500 yen, equal to about £450, and that it had taken the artist three years to complete! I have no doubt, however, that if I had wished to buy the box I could have obtained it at a very considerable reduction on this price, as it is the custom in the East to substantially raise the price at first and to accept finally about half the amount originally asked!

The quality of the lacquer work I saw was very different from that to which we are accustomed in the English shops, in which the material is merely varnished, with the design stamped upon it. The Japanese put their best workmanship into lacquer work for sale to their own countrymen, that designed for tourists and for export being specially made of much lower quality.

Much superstition remains in Japan in spite of the great influence of western civilisation. An example of this came to my notice in Kyoto. On a wide platform in front of a temple on a hill that I visited there squats the wooden form of the god Binzuru. He is credited with the power of healing the sick and the method by which he does this is very peculiar. Anyone suffering from headache, for instance, first rubs Binzuru's head and then his own with a piece of wood. A cure may result, but in the meantime Binzuru's head is getting worn away by the constant rubbing to which it is subjected! Other parts of his body that are by no means as large as they were originally are his stomach and his great toe, while his nose has been rubbed so often that it has practically disappeared!

From Kyoto I visited a place called Nara, about forty miles away, where there is a beautiful park containing many ancient shrines revered by the Japanese.

Leading up to these shrines are avenues of lanterns, some of which are made of stone mounted on pedestals, and others of bronze. There are something like 2,000 lanterns in all and they have been placed there by the people as memorials to their ancestors. These avenues are a thousand years old and many of the lanterns are tanned to bronze green by a growth of moss. They are all lighted on the night of Setsubon, which is the commencement of the Spring season, and present a fairy-like spectacle. The largest shrine contains an enormous bronze image of Buddha in a sitting position; it is 53 ft. 6 in. in height and weighs 440 tons, and dates back to the 7th century.

In the same park there are about 800 deer, which are tame and wander freely over the grounds. They are regarded as sacred, and legend says that the feeding of them is favoured by God and is equivalent to an offering to the shrine. Biscuits can be bought in the park to feed the deer, which will flock around you—as long as you have anything to give!

My next visit was to Tokyo, the capital of Japan. It is a large city that went by the name of Yedo until 1868, the year in which Western civilisation first came to Japan. The streets of Tokyo are wide and modern, with two lines of tramways and broad pavements, and in the main street the little houses of wood and paper screens have been replaced by two-storeyed brick buildings in European style. Many factories also have been established.

The people, too, are changing in character. The women seem to cling to their native costume, but some of the men wear strange mixtures indeed, in the attempt to compromise between Eastern and Western costume. I often saw men wearing bowler hats along with kimonos, and the occasional addition of such incongruous items as "plus-fours" and elastic-sided boots does not improve the general appearance of the Japanese dandy!

I drove about the city and visited several temples, but was most struck with the evidence of the havoc wrought by the terrible earthquake of 1923. Japan is unfortunately placed, for it lies in an area in which earthquakes are very common, and the effects of some of these have been disastrous in the thickly populated cities. A tremor of some kind happens more than 1,000 times a year, while serious earthquakes occur about once in three years. In 1923 the casualties numbered more than 200,000, and a similar figure was reached in a previous earthquake in 1703.

The irrigation of rice plantations is one of the greatest agricultural enterprises in Japan, but strange to say it is carried out in a most primitive method. The picture shows two weather-beaten country folk treading the wheel which scoops water over to the next field, while a Japanese umbrella very much the worse for wear is supposed to be keeping a certain amount of rain off

The violence of earth movements in Japan is attributed to the fact that the sea to the west is shallow, while that on the Pacific side is very deep indeed, the ground plunging down into the famous Tuscarora Deep, which is about 28,000 ft. in depth on the average. It is in this famous depression that a sounding of 34,120 ft., the greatest depth yet found in the ocean, was obtained. Earth movements are always most violent and produce the greatest effect on steep slopes such as this.

The constant recurrence of earthquakes is mainly responsible for the flimsy nature of Japanese buildings. The light houses of wood, bamboo, and paper are easily rebuilt after an earthquake has destroyed them but, unfortunately, there is always the danger of fire. This danger is even greater to-day, when numerous gas pipes run under the streets of the larger cities, for an earthquake inevitably breaks these up and the resulting escape of gas is exceedingly dangerous. Recently, large buildings of reinforced concrete, on the American plan, have been erected in some cities, and buildings of this type seemed to withstand the shock of the earthquake of 1923 very well indeed.

I returned to Kyoto by rail and on the way could not help noticing the enormous extent to which rice is cultivated, practically the whole country being converted into rice "paddies," as the fields are called. There is a variety of rice that can be grown in a field like wheat, but ordinary rice must grow in water, or in ground saturated with water, for at least half its life. A paddy field is made by temporarily removing the top layer of soil and beating the rice down to make it watertight. An earth wall is then built round the field so that it can be transformed into a pond. The necessity for growing more and more rice as the population of Japan has increased has led to the use of every conceivable scrap of level land, with the result that some of the paddy fields on the hillsides are no larger than a counterpane!

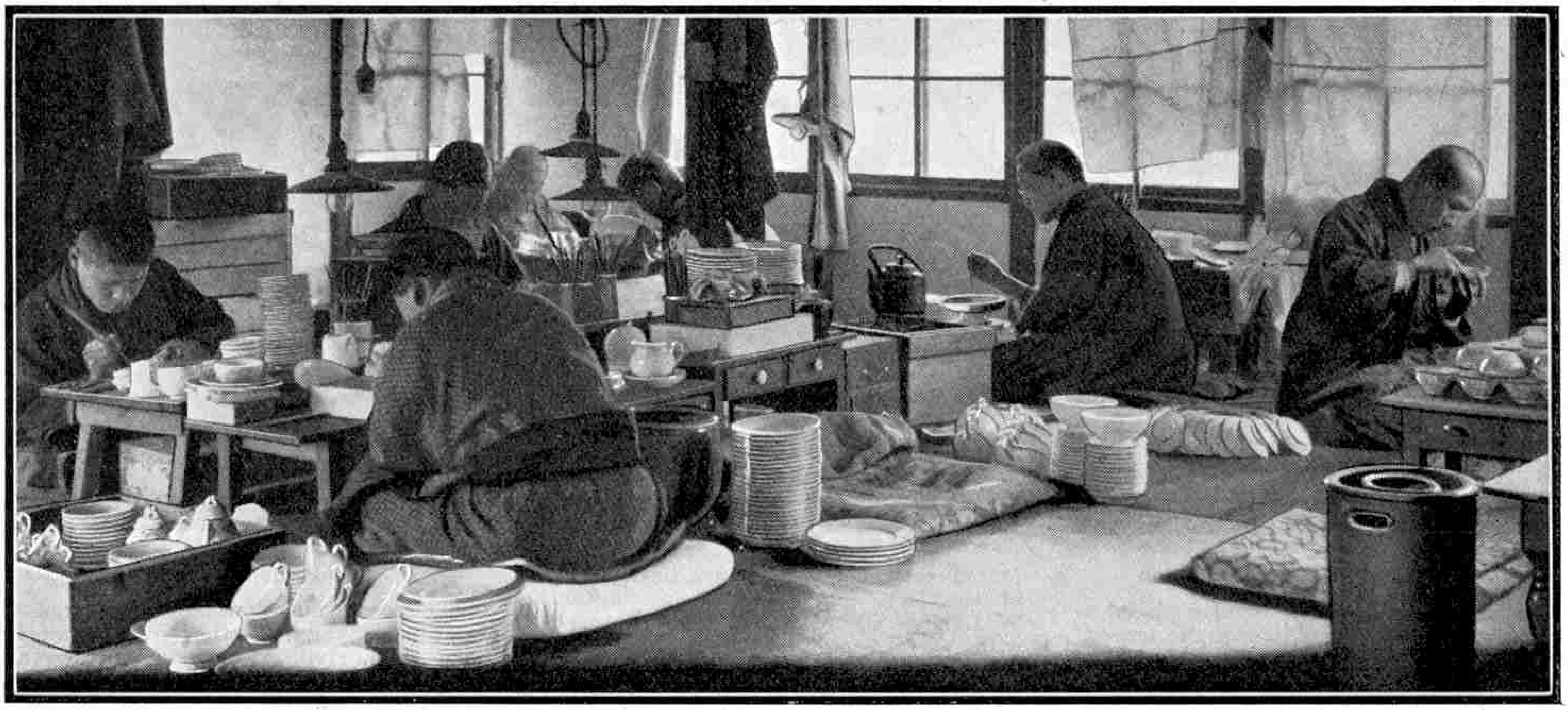
Then comes the irrigation process. The water comes to the paddy fields in countless ways. Sometimes it is diverted by means of aqueducts or canals from a stream near by, but in most cases it must be pumped. The pumps are usually weird contrivances worked by man-power, and a very good idea of the quaint nature of many of the pumps in use may be obtained from a photograph that I secured and which is reproduced on this page.

The cultivation of rice is a most unpleasant business to look at, although I suppose the Japanese are too much accustomed to it to feel uncomfortable. The rice is planted in seed beds and transplanted into the paddies at a later stage, this operation being carried out with much ceremony, for no respect is too great for the staple food of the country. Women and girls do most of the work, which consists in pushing the clumps from the seed beds down into mud. Weeding and raking are carried out with the field under water, the workers wading about in thick sludge. It is possible to run off most of the water as the crop ripens, but in quite two-thirds of the rice paddies the water covers the ground throughout the year. When the time comes for harvest, the farmer, his wife and all his family wade into the sludge to cut the rice with short sickles.

The life of a Japanese rice farmer is full of hardship, for the labour of growing rice is enormous. A much heavier crop is obtained from a given plot of land than would be the case with wheat or oats, and the labour is thus well repaid. The Japanese eat rice at every meal and three or four bowls to each person is an ordinary supply. While one may be excused for leaving most of the various dishes that constitute a Japanese meal, it is almost impiety not to consume all the rice provided!

Before leaving Kyoto for Shimonoseki, to take steamer for Korea, I visited a native restaurant to "enjoy," with some friends, a real Japanese dinner. The restaurant was divided up by screens into something like fifteen private compartments, and in order to accommodate larger companies the screens were all made to slide back. The floor was covered with matting, and before entering we removed our boots. Cushions were placed on the floor, on which we sat. The attitude was very pleasant for a few minutes, but none of us was very comfortable throughout the meal, "pins and needles" attacking us in a very painful manner! The night was very chilly, and a charcoal brazier was placed in front of each of us in order to keep us warm.

In the centre of the compartment was a low table, no more than eight inches in height, and upon this the food was served. There was no cloth and no table appointments whatever. The only articles with which we were supplied were a skewer about as large as a toothpick, and a pair of chop-sticks, in the use of which I, for one, was by no means expert! The courses were many, but to me all were very unpalatable. Fish formed the greater part of the menu and was served dry, pickled and raw, with a plentiful supply of rice and some fruit.



Decorating Pottery in a Japanese Workshop

Japanese cooking is best described, I think, as exquisite in the sense that the food is neither greasy nor messy, nor in crude lumps. The circumstance that what is being eaten was once a live fish or a live bird is concealed as far as possible, and an attempt is made to make each dish pretty to look at. By comparison the methods that we use are barbaric. After all, the business of eating in Western countries has advanced very little since the days when the hunter killed his deer, skinned it, roasted it and ate it before the fire. Now, the head of the family hacks pieces off a bird or a joint and hands the fragments round, practically the only real refinement being that the cooking is done in a separate room, and that we keep our fingers out of our food!

For drinks at my Japanese dinner, tea and "sake" were provided, very small drinking utensils, similar to those found at home in dolls' houses, being used. The Japanese waitress was dressed in the usual picturesque fashion, and in the intervals sat on the floor awaiting further commands. I found the experience very novel and interesting, in spite of the discomfort.

My stay in Japan had been very pleasant and I regretted leaving it, particularly when passing through Korea, where there is very little to be seen except barren mountains and stony plains. I arrived by steamer at Fusan, on the south coast of this backward country, and travelled by rail from one end of it to the other on my way to Mukden. The railroad through the country was constructed by the Japanese, who have built up a very efficient system of transport in their own country and in Korea and Manchuria in spite of the comparatively late date of their adoption of Western means of transport. The first railway in Japan was opened for traffic very little more than 50 years ago, but the Japanese have proved themselves apt pupils and to-day there are over 8,000 miles of railway, mostly Government owned. Excellent long-distance expresses are run, particularly on the 700-mile route from Tokyo to Shimonoseki, and, as Meccano boys will know, one type of locomotive now largely used throughout the world originated in Japan. This is the "*Mikado*" type, which owes its existence to the necessity for a large fire-box in order to burn the poor quality of coal available in the country.

Japanese Girls at Tea. (Note the electric fan)

The Korean villages are very primitive, the houses being built of stones collected in the vicinity and plastered over with mud. Some have rough wooden doors and window frames, and the roofs of all of them are roughly thatched with rice straw. The most singular part of the Korean house is its heating system. The floor is made of flag stones plastered over with clay and covered with thick oiled paper. Underneath this, and forming as it were the joists, run a series of horizontal flues. A fire is made outside the room, and the hot, smoke-laden air circulates through the flues and escapes at the opposite end. In this manner the floor of the room is thoroughly heated, making it comfortable to squat or lie down upon.

The Koreans are an interesting people, and their apparel is very grotesque, particularly their hats. The dress of both the men and women is composed of white material. The reason for this, I was told, is that white is their mourning colour and, as somebody or other connected with them is always dying, they adopt this particular type of apparel as a matter of convenience. So they are prepared for a funeral at the shortest notice! There are two kinds of hats worn by the men, one a straw hat of pyramidical shape and the other, resembling a small top hat in white, perched on the top of the head and secured there by white tapes attached to the rim of the hat and tied under the chin.

On leaving Korea I found myself on very interesting ground. Japanese influence is supreme in Korea and in the Chinese province of Manchuria to-day as a result of war with Russia rather more than 20 years ago. The huge battle fronts and combats lasting for many days, that were such a striking feature of the Great War, were first seen in this war which the Japanese won decisively. The line of the Japanese advance against the Russians is now followed by the railway on which I travelled to Mukden, the capital of Manchuria, and the most important city in the north of China.

New Airship Shed at Cardington

The Air Ministry has recently placed a contract for the demolition of the largest of the three airship sheds at Pulham, Norfolk, and its subsequent rebuilding at Cardington, Bedfordshire. The shed is 756 ft. in length, 180 ft. in width and its maximum interior height is 110 ft. It is large enough to accommodate two airships of the R33 type. When rebuilt at Cardington the shed is to be extended so that it will be 812 ft. in length and 156 ft. in height. It will also be widened to give a clear inside width of 180 ft. The shed will then be large enough to accommodate the new Empire airships R100 and 101.

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Chamberlin Non-Stop Record in Danger

There are good grounds for believing that owing to non-compliance with a technicality, the non-stop record set up by the American airmen, Chamberlin and Levine, on their flight from the United States to Europe, will not be officially recognised. According to the rules of the Federation Aeronautique Internationale, all machines must carry a parachute for each member of the crew and each passenger. In the absence of such parachutes the machine's performance cannot be recognised. It is believed that Chamberlin did not comply with this regulation and the position is that the F.A.I. will have to refuse to acknowledge the record or else ignore its own rule.

The same comment applies to the flight made by Colonel Lindbergh from America to Paris. In this case there seems to be even clearer evidence that the parachute was not carried, for the simple reason that Lindbergh could hardly have made use of a parachute from his enclosed cockpit.

While we recognise that rules are made to be kept, these seem to be instances where "honour in the breach" might gracefully be conceded.

* * * *

The 1927 King's Cup Race

For the second year in succession the race for the King's Cup was won by the de Havilland Company. Nottingham was the venue this year and there were 16 competitors, of whom six completed the full course of 552 miles. The length of the course, by the way, was announced officially as 540 miles but the distance of the second lap actually measured 12 miles more than the computed 180½ miles.

Four machines retired in the first lap, four in the second lap, and a further two in the last. The winner was Captain W. L. Hope piloting a D.H. Moth equipped with a Cirrus I engine. His time for the full course was 5 hrs. 50 mins. 14 secs. The second machine was a Widgeon-Cirrus II, piloted by Captain J. Macdonough. His time was 5 hrs. 15 mins. 49 secs. The third machine, a Vicker's Vixen-Lion, was piloted by Mr. F. R. Schofield, and this completed the course in 3 hrs. 49 mins. 23 secs. The race is, of course, a handicap affair. The fastest lap was that of the Vixen-Lion which did the second at an average speed of 137.7 m.p.h.

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Safety Stopping Device

A solution of the problem of safely stopping aircraft within a distance of twice their own length is stated to have been discovered by Mr. Francis Jenkins, an American inventor. Patents have been taken out for his device, which consists of a reversing propeller that rapidly brings the machine to a standstill. A propeller-reversing lever is incorporated in the machine but cannot be operated while the machine is in the air. When the aircraft lands a spring is released by the wheels striking the ground and the safety-guard on the reversing gear is disconnected and the pilot can bring the machine to rest in a confined space. With this invention, it will be possible to establish landing places on the tops of buildings.

* * * *

From Ship to Land by 'Plane

What is claimed to be the first aeroplane flight from a passenger liner at sea was recently successfully accomplished by Mr. Chamberlin, the aviator who made the flight from New York to Berlin. The liner chosen for this experimental flight was the "*Leviathan*," on the deck of which a special runway, from which the machine took off, had been constructed. The liner was outward bound from New York, and the aeroplane left the ship to fly back to New Jersey.

This flight is of considerable technical interest, as several of the new French and Italian trans-Atlantic liners are being equipped to carry one or more aeroplanes. It is possible, although no definite announcement has yet been made, that these aeroplanes will be used to expedite the delivery of mails from mail steamers. Provided that the technical difficulties can be overcome, there is no reason why at least two days in transit could not be saved by this method.

Civil Aviation in America

The recent trans-Continental and trans-Atlantic flights from the United States have given civil aviation in America a decided fillip. More than 50 new airports have been established during the last few months, and over 100 different cities have allocated funds for the creation of local aerodromes. Throughout the country trade organisations and civic authorities are co-operating in an effort to inaugurate a complete network of airways and airport systems, and by the end of this year it is estimated that approximately 1,000 airports and intermediate landing grounds will be established in the U.S.A.

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Japanese Air Service

An air service for mails and passengers between Osaka in Japan and Shanghai in China, is about to be established. It will be operated by a Japanese company and, at the outset at least, Japanese aeroplanes only will be employed. Possibly, however, orders for machines will be placed in other countries when the service is in full operation.

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New Light 'Plane Altitude Record

Captain H. S. Broad flying a D.H. Tiger-Moth Monoplane established a new world's altitude record for machines of the light aeroplane class on 29th August last. He reached an altitude of over 20,000 ft. but although the machine was still climbing, he was forced to descend owing to the rarity of the atmosphere which made breathing very difficult. Captain Broad, on alighting, stated that with an oxygen apparatus he believed he would have reached nearly 30,000 ft. The machine made the climb in just under 17 minutes.

The effort was officially observed by the Royal Aero Club and the record will be submitted, in due course, to the Federation Aeronautique Internationale for confirmation.

* * * *

The World's Youngest Air Pilot

The distinction of being the youngest pilot in the world is held at present by Lilian Dawson, a 14-year old schoolgirl of Pittsburgh, U.S.A. At the age of only four she had her first experience of flying and she obtained her pilot's certificate a year ago. Under American regulations she is debarred from securing a passenger-carrying licence until she is 18 years of age.

European Air Tour

An interesting aerial tour of Europe was recently made by the Comte de la Vaulx, the President of the Federation Aeronautique Internationale, who, in the course of an 8,500 mile trip, used 26 different machines and was driven by pilots of 17 different nations. Starting from Toulouse in a passenger machine belonging to the Latecoère Company, he dined at Tangier the same evening. Three days later the same machine took him to Lisbon, from whence he travelled to Madrid by train. There is no civil aviation service in Portugal and the Portuguese authorities declined to permit the use of one of their military machines for the trip. From Madrid the Comte flew to Rome in a Spanish machine, via Barcelona and Marseilles. From Rome the flight was continued to Belgrade in an Italian military machine and thence to Bucharest in a Serbian army 'plane. A Rumanian army machine took him on to Budapest, and from there to Vienna a Hungarian civil machine continued the flight. The journey from Vienna to Munich, Zurich, Geneva, Basel and back to Prague was made in German machines. At Prague, by the way, considerable aero developments are in hand; a special arterial road, six miles in length, is being constructed from the city to the civil aerodrome, and is solely for the use of air passengers. The next stopping point was Berlin, and another German machine carried on to Stettin and Stockholm. Finnish and Norwegian 'planes continued the trip to Helsingfors, Oslo and Copenhagen, and eventually Paris was reached via London and Brussels.

The flight was carried out to a timetable and was spread over 75 days. The flying time was a mere matter of slightly over 100 hours, the average speed throughout being 83 m.p.h. No delays of any description at all were encountered in the air.

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The Cairo-Basra Air Service

As a result of an outbreak of cholera in the area through which the Imperial Airways' machines on the Cairo-Basra service pass, five days' quarantine is being imposed on all travellers passing through Basra. Incidentally, this provided an opportunity to reveal an unexpected advantage of aircraft. A certain Arab official on the return journey from a pilgrimage, found that travelling by ordinary methods would land him in the quarantine camp at Basra for a five days' compulsory stay. Accordingly, he hired a machine at Gaza and, avoiding Basra, was landed at a convenient islet in the Persian Gulf. Here he was picked up by a passenger boat and continued his journey without further delay.

Longest Sea Flight

A flight across the Eastern Pacific was completed recently by Lieuts. Maitland and Hegenberger of the U.S. Air Corps. Their route lay between San Francisco and Honolulu and the flight was undertaken in a Fokker machine with three 200 h.p. Wright-Whirlwind engines. The total distance was 2,400 miles and was covered in 25 hrs. 43 mins. This flight is the longest made entirely over the sea.

The New "King's Highway"

Courtesy] ["De Havilland Gazette"

The monotonous nature of the desert country over which Imperial Airways Middle East Service lies is well illustrated in this picture. The "waves" are sand dunes, each about 200 ft. in height

Aeroplane Landing for Ships

One of the difficulties preventing the use of the decks of ordinary ships for launching and receiving aeroplanes is the lack of space. The "take-off" problem appears to have been solved by the introduction of catapults, and a new device invented by a Swiss seems to offer a practical solution of the landing difficulty.

A machine when landing must fly into the wind, and this requirement provides the principle on which the idea is based. Enormous propellers in the device produce a strong breeze blowing out of a vertical bank of large openings. An airman, wishing to alight, swoops straight down into the artificial wind and its effect is to reduce his speed relative to the ship, while at the same time his air speed need only be reduced to that necessary to counterbalance the velocity of the wind. When the speed of the aeroplane has been reduced to that of the ship, the 'plane can settle on the deck, after which the air blast is stopped. A large number of wind vents ensures a uniform blast of air from the apparatus. It is claimed that when this is in operation landing will be so gentle an operation that a seaplane could alight on the deck of a ship without injuring its floats. Used in conjunction with a launching catapult, this apparatus will make it possible for an aeroplane to alight on almost any vessel of the liner type.

It would seem that the day is not far distant when floating re-filling stations will be available for trans-oceanic airmen. The present necessity for carrying fuel enough for thousands of miles will cease to exist and passengers and cargo will make the trip in place of fuel tanks.

Schneider Cup Race

The greatest seaplane race of the year was fixed to be decided at Venice on the 25th of last month. Unfortunately, we were compelled to go to press long before the results were available, but a full report of this great international race will appear in our next issue. British, French and American machines were entered, and principal interest in this country is fixed on the Super-Marine-Napier S.5 Monoplanes and the Gloster-Napier 4 Biplanes. Actually, the British challenging team consisted of three machines, but seven were built to various designs by Air Ministry order and six of these were chosen to go to Venice, after final tests had been made in England. Later tests at Venice determined the actual machines to represent this country.

The British machines consisted of three Super-Marine-Napiers, two Gloster-Napiers and one Short-Bristol-Crusader. The machines were transported by aircraft carrier to Venice, where they were afforded the opportunity to make several practice flights over the course before the race.

At the time of writing, there are no details available of the actual speeds of the machines, but each represents a considerable advance upon the machines that were representing Britain in last year's race. Then, it will be remembered, the British team throughout was dogged by ill-luck, but even so there was very little doubt that the Italian Macchi machine that won the Trophy for Italy, was superior in some respects. Against that may be placed the fact that each machine of the British team was entered privately, no attempt being made by the Air Ministry to organise the British challenge or to supplement the efforts of the manufacturers concerned.

* * * *

Queenstown-Germany Mail Service

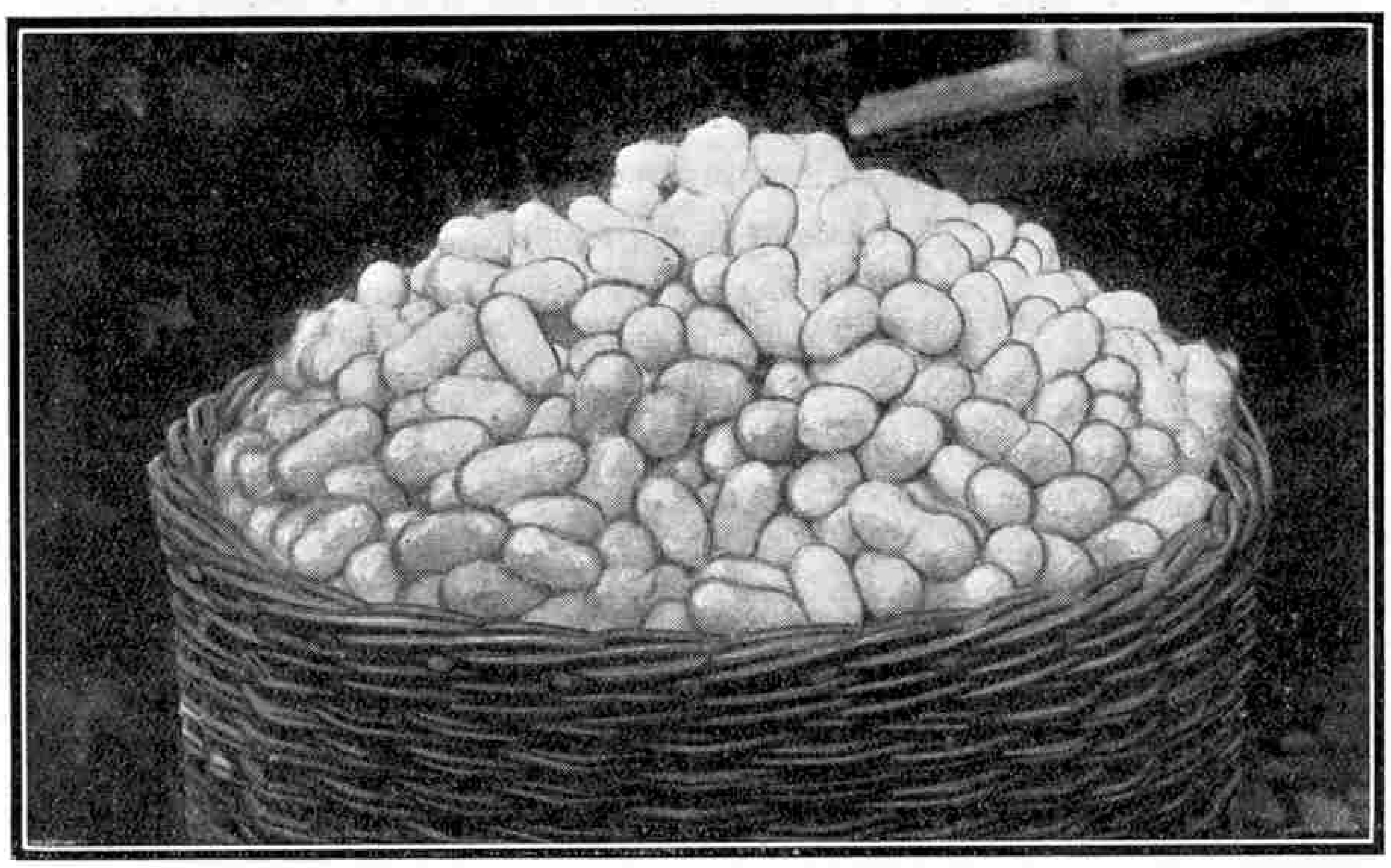
A proposal is being seriously considered in German aviation circles for the inauguration of an air mail service between Queenstown (Ireland) and Germany. The proposal is to pick up trans-Atlantic mails and passengers from incoming liners at Queenstown and take them by air to Germany. Probably a stop would be made at Liverpool to pick up English mails and passengers. In this way it should be possible to save nearly six days in transit. At present the mails travel the full distance by liner, this portion of the journey involving a further week in transit.

A similar service to Queenstown would also be instituted, but mail and passengers from Germany to England would be dropped at Hull instead of continuing across to Liverpool.

THE STORY OF SILK

I.—HOW THE INDUSTRY GREW UP

THE silk industry has existed from very ancient times and has passed through many vicissitudes and extraordinary changes and developments. The industry originated in China where it probably flourished at a very remote period. We are told that the Empress Se-ling-she, wife of the Emperor Hwang-te, 2640 B.C. encouraged the cultivation of the mulberry tree and devoted herself to the rearing of silk worms. She is credited also with the invention of the silk loom. For many centuries the Chinese guarded the secrets of silk culture with the utmost vigilance, but gradually the knowledge spread to Japan and subsequently to India. The first notice of the silk worm in Western literature is due to Aristotle, who speaks of "A certain great worm which has, as it were, horns, and differs from all others."



An ex-soldier near Berlin occupies his leisure time breeding silk worms. Our illustration shows a portion of the cocoons ready for spinning

The Romans obtained their silk textures from India at enormous cost. A pound of silk then was worth a pound of gold, and the Emperor Aurelian is reported to have replied to his Empress when she asked him for a gown of silk :—" May the gods forbid that I give so much gold for so little thread ! " The use of silk garments by man was considered effeminate luxury. Heliogabalus was the first Emperor who had the extravagance to clothe himself with this costly material. He appeared one morning clad in silk from head to foot and caused more scandal by this act than by any other of his many follies.

The Emperor Justinian (483-565) set up looms for the weaving of silk in his palace at Constantinople and endeavoured to encourage the establishment of the industry in the city. For a time his efforts met with little success, but about the year 550 there arrived at Constantinople two Persian monks who had lived in China for a long period and there learned the secrets of the art of silk rearing. Justinian had these monks brought before him, and after he had heard their story he urged them to return to China and endeavour to bring away a quantity of silk worms' eggs. The monks agreed to undertake this somewhat perilous task and ultimately succeeded in smuggling out of China a considerable quantity of eggs, successfully hidden in a hollowed out portion of the pilgrim's staff that each carried. In due course these eggs were safely delivered at Constantinople and their development marked the commencement of silk worm rearing in Europe. From this modest beginning the industry has developed far and wide among Western nations.

Towards the middle of the 13th century the cultivation of the mulberry tree was introduced into Sicily and little by little the art of rearing silk worms spread throughout Italy, Spain and lastly through France. " Silk then became so common," says Mézerin in his chronicles, " that in the year 1437 as many as a thousand citizens of Genoa appeared clothed in silk in a public procession."

The art of silk weaving was naturalised in France by Louis XI. He invited workmen over from Italy, and by their aid one Guillaume Brissonnet established at Lyons a small manufactory for textures of silk mixed with gold and silver. By letters patent dated from Orleans 23rd December, 1466, the King formally recognised this institution and in order to give it fitting encouragement and support decreed that a rate of 2,000 silver pounds should be levied yearly upon the inhabitants of Lyons " to pay for the aforesaid looms, the masterworkmen who will be employed, and the things indispensable to the dyers." Moreover the King exempted for 12 years from all rates, duties and taxes all the workmen who were in any way connected with the silk trade. Four years later, in 1470, a colony of Italian weavers settled at Tours, and founded a silk manufactory, but it was not until the end of the century that the first mulberry trees were planted in France. As late as 1802 there could still be seen at Allan, near Montélimar, in the Department of the Drome, the first of these mulberry trees to be grown on French soil.

In spite of this apparent progress, and notwithstanding the immense demand for silks, the French factories did not thrive. The most enthusiastic Frenchmen had to admit that the textures woven in their country could not be compared with the gold and silver cloths and the silks and velvets of Genoa. The result was that the price of French silks fell, the weavers came near to starvation, and the Lyons trade seemed well on the way to extinction.

Photo courtesy] [*Director, Victoria & Albert Museum*

An interesting old print, showing cocoon reeling on a Chinese Silk Farm

Then Francis I came to the throne and brought about a great change for the better. He strongly resented the idea that the French silk trade was unable to hold its own with that of Italy, and he realised that the privileges and immunities conferred upon the weavers by Louis XI had not been sufficient to give the required stimulus to the Lyons trade. Francis therefore determined to increase these privileges and to hold out to foreign silk weavers more tempting benefits. By an Edict of 2nd December, 1536, he conferred upon this fortunate class a list of exemptions such as to-day would cause any country to be overwhelmed with a flood of immigrants. The silk weavers were to pay no taxes and were to be lodged free; they were not to be liable to imprisonment for debt and they were to be licensed to carry swords, a privilege that in those days belonged exclusively to the aristocracy.

Two Genoese, Stephen Turqueti and Barthelemy Nariz, allured by these attractive offers, set the example to their fellow-countrymen and came to Lyons. They speedily realised large fortunes, and a steady stream of Italians began to flow across the frontier. The talent and industry of the newcomers, sustained by the patronage of successive kings, caused the prosperity of the French trade to increase rapidly, and before long the productions of France attained a high degree of excellence.

The manufactories of Genoa were still formidable rivals, however, and the continued excellence of the Italian silks was disquieting to the weavers of Lyons. The word "protection" began to be murmured, and in 1560 a petition was addressed to the King praying him to prohibit the importation of foreign silks, or at least to impose upon them such a heavy duty as would make them cease to be dangerous to the French trade. Francis II, who was then King, would have none of this, however, and answered resolutely that the only way to stimulate the French weavers to honest exertions was by admitting foreign competition; and that if the ports of France were closed to imports of silk from Italy, the French public would be at the mercy of the Lyons workers, who would then grow careless. "Besides," added the King, "it must not be said that the French, who are superior to the Italians in the arts of war, are afraid to cope with them in the arts of peace."

In 1600 the Duke of Sully caused new plantations of mulberry trees to be planted at Tours, Paris, Orleans and in the Province of Poitou. At the same time large quantities of the seeds of this valuable tree were distributed throughout the country, together with little books giving instructions in regard to planting and rearing. Not content with this the Duke ordered a considerable number of French boys to be sent each year to Italy and apprenticed to the silk makers of that country at the expense of the Government. In due course these boys returned home as skilled workmen, and they well repaid the money that had been expended upon them by improving the products of their country, thus giving a new impetus to the trade.

A further step remained to be taken before France could stand on a footing of equality with its silk weaving neighbours. Neither Lyons nor Tours had yet learned to manufacture the rich and gorgeous tissues in which gold and silver are blended with silk to form marvellous figures and splendid designs. Italy and the East still held the monopoly of these master works of textures that were used to adorn cathedrals, royal palaces and the gala robes of kings. Sully imported Milanese workmen who were specially famous in this branch of the art, but this experiment did not meet with success.

It remained for an inhabitant of Lyons, a man named Claude Dangon, to solve the problem by devising a loom capable of producing the best quality "fashioned" silks—that is figured tissues. Dangon's first efforts proved a failure but he was not disheartened and by indomitable perseverance and unceasing labour he succeeded in attaining his object. In 1611 he presented to the municipality of Lyons a few samples of his new textures and received the sum of 200 silver pounds as a reward. Twelve months later, on the occasion of new successes on his part, the town of Lyons voted him a pension of 6,000 silver pounds a year and a five-year monopoly for the manufacture and sale of "fashioned" tissues.

The loom inaugurated by Claude Dangon was the "*Metier a la tire*" or "Throwing Loom." It caused a complete revolution in the Lyons silk trade and continued to be used until the beginning of the 19th century when the improved loom of Jacquard superseded it.

The method of giving an artificial gloss to woven pieces of silk was discovered in 1663 in a most curious manner. Octavio Mey, a merchant of Lyons, was one day greatly worried over a certain matter. As he sat in his chair deep in thought he absentmindedly played with a small bunch of silk threads and presently, without thinking what he was doing, he put the threads into his mouth and began to chew them. On taking the threads from his mouth he noticed that they had acquired a peculiar lustre. He expected that this lustre would soon disappear but to his astonishment he found that it remained on the threads even after they had dried. Mey was a man of keen intellect and he realised at once that behind this apparently insignificant occurrence there lay a secret worth unravelling and he set himself to study the problem. The result of his efforts was the discovery of the "*procede de lustrage*" or "glossing method."

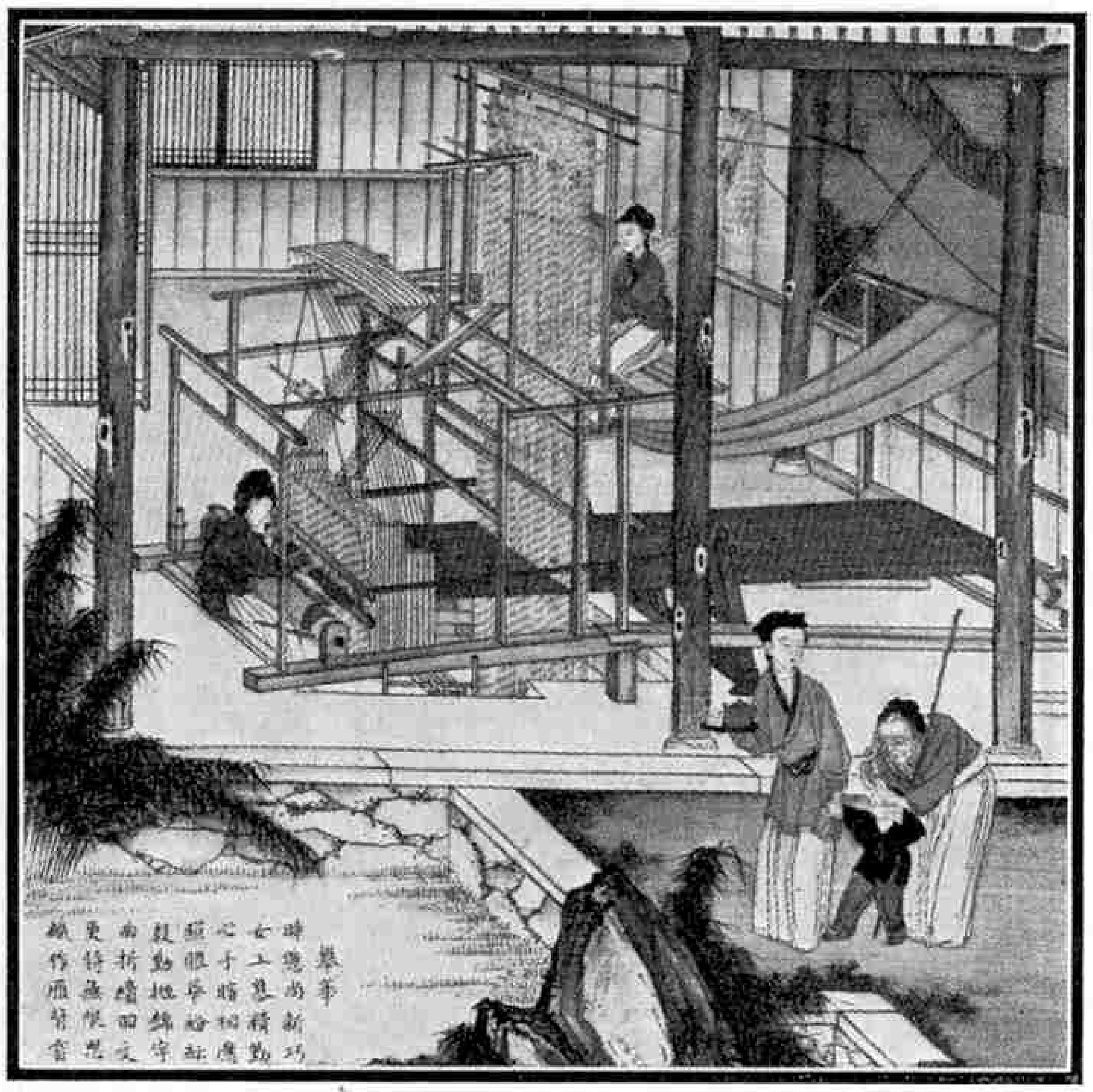


Photo courtesy] [*Director, Victoria & Albert Museum*

An ancient Chinese Draw-Loom or pattern-weaving machine. From an old print

The method of imparting artificial gloss to silk has undergone considerable change in the course of years, but formerly it was done as follows. Two rollers revolving on their axes were set up at a few feet from the ground and at about 10 yards in a straight line from each other. Round the first of these rollers was wound a piece of silk 20, 40 or 100 metres in length as the case might be. A length of 10 yards of the silk was then unwound and fixed by means of a brass rod in a groove on the second roller, care being taken to stretch the silk between the two cylinders as tightly as possible. A workman, using a thin blade of metal, daintily covered the upper side of the silk—that which formed the inside of the piece—with a coating of gum.

On the floor beneath the outstretched silk was a small tramway upon which ran a kind of tender filled with glowing coals. As fast as one man covered the silk with gum another moved the tender up and down so as to dry the gum before it had time to permeate the texture. This was a very delicate operation, for if the gum were allowed to run through the silk, or if on the other hand the coals were kept too long under one place, the piece was spoiled. In the first case the silk would be stained beyond remedy and in the second it would be burned. None but trusty workmen were allowed to undertake this task and even with the most skilled men damage sometimes occurred. When a length of 10 yards of the piece had been gummed and dried it was wound round the second cylinder, another length of 10 yards was unwound, and so on to the end of the piece.

The silk, with its coating of dry gum, was stiff to the touch and when folded crackled like strong note-paper. In order to make it soft and pliable again it was rolled some six or seven times beneath two cylinders, one of which had been warmed by the introduction of hot coal inside it. The piece then acquired that bright new look, so greatly admired in fresh silk.

During the first half of the reign of Louis XIV the Lyons trade rose to the acme of its prosperity. The unbounded luxury of the Court, the continued recurrence of state pageants, masquerades and festivities of all kinds, and above all the determined encouragement given to the silk manufacturers by the able statesman, Colbert, contributed to place the French silk weavers in a position superior to those of other nations. The Italians had neither wealthy monarchs to patronise the silk trade nor open-handed princes to stimulate it. One after another the Genoese looms were closed, until only a few continued working. At the same time the Lyons textures improved in quality year by year and by 1670 the exports of Lyons merchandise to England, Germany, Sweden and Spain, had already reached a vast development.

This prosperity was destined, however, to receive a terrible blow as the result of the religious persecutions of the period, which resulted in some 50,000 French Protestant families emigrating to England, Holland and North Germany in 1685. The number of looms at Lyons that previously had been 10,000 was suddenly reduced to 2,500, while the looms for making ribbons and braiding decreased from 8,000 to 3,000. The persecuted weavers carried their trade with them to Geneva, Zurich, Creveld, Berlin, Elberfeld and London, in the last named city establishing themselves in the district of Spitalfields. It is to these refugees that we really owe our English silk trade.

In 1774 Cardinal Fleury, then Prime Minister of France, sent the famous mechanician Vaucanson to Lyons to inspect the looms and report upon them. Vaucanson carefully studied the working of the looms and came to the conclusion that they were capable of considerable improvement. He not only suggested the changes that were needed but also invented a new loom capable of weaving two pieces of silk at a time instead of one. As soon as the silk workers heard of this invention they set up a great outcry. They got it into their heads that the inventor's aim was to do away with handwork entirely and they worked themselves into such a state of rage that one day they stoned him in the public streets.

Vaucanson's revenge was ingenious and amusing. He devised a machine by which a donkey could weave a whole piece of silk all by himself without the aid of man! A detailed description of this machine and of its advantages was published in a well-known newspaper and as might be imagined it did not by any means soothe the feelings of the enraged silk workers.

During the second half of the 18th century the manufacture of silk made great progress, largely due to Philippe Lassalle, who was as renowned for his skill as a painter and a draughtsman as for his ability as a master weaver. Lassalle devised a new machine by means of which the designing of figures upon silk was carried to such perfection that portraits of Louis XV and Catherine II of Russia were executed to the admiration and amazement of experts. These two portraits were shown at the London Exhibition of 1851 and were universally declared to be matchless as works of art.

After the Revolution, Napoleon ordered that none but French silks and velvets should be used in the adornment of imperial palaces and in the official costumes of State dignitaries. During the Napoleonic Empire the trade of Lyons and Tours, which the Revolution had almost ruined, was restored to its former state of prosperity. The continental blockade had closed almost all the European ports to English goods so that there was no competition with Spitalfields' textures to be feared in the markets of Germany, Italy or Russia. During this period in which Lyons enjoyed a complete monopoly for its merchandise in Europe, French silks, on account of being exported in such quantity, acquired great celebrity. Jacquard then appeared and introduced improved machinery that brought about a complete revolution in the method of weaving.

The ex-soldier, who occupies his leisure time near Berlin in breeding silk worms, is here shown searching out those silk worms that have been attacked by sleepy sickness

Joseph Marie Jacquard was neither a mechanician nor an artist nor yet a superior workman, but he had a shrewd mind and possessed the valuable faculty of knowing what was useful and good in the works of others. A machine of Vaucanson's that had been laid aside and forgotten struck him as being particularly ingenious and he soon recognised that with a few modifications it might be made to render the greatest service. Before this time the weaving of silk was a very complicated process. Each loom required two workmen and there was a very great deal of mounting and dismounting, and screwing and unscrewing to be done whenever it was necessary to fix or unfix the silk on the frames. Jacquard's loom required only one workman and in addition it simplified the various operations to such an extent that the one weaver had much less to do than formerly when he had a fellow-workman.

The new loom was first displayed at the Paris Exhibition of National Industry in 1801, but the judges paid scant attention to it and merely awarded it a bronze medal. Jacquard was not discouraged, however, but set up a few of his looms at Lyons in an empty wing of a hospital that he hired for the purpose and quickly obtained very satisfactory results. Then, as in the case of Vaucanson, there arose a great uproar among the silk workers. The weavers in the big factories heard that a machine had been invented to diminish the number of operators required, and they burst into Jacquard's workshop, smashed his looms and compelled him to fly for his life.

Sick at heart, Jacquard was on the point of carrying his invention to England and would have done so but for an unexpected circumstance. His broken looms were put up for sale by auction as old iron and wood and it so happened that a Government inspector was present at the sale. The inspector examined the remains of the looms at first rather casually but afterwards with keen interest as he realised their value. He drew up a report upon them and forwarded it to the Government and on the strength of this report the Government immediately offered Jacquard a premium of 50 Frs. for each loom he set up. In 1806 the Municipal Council of Lyons purchased from Jacquard for a pension of 3,000 Frs. exclusive rights of working the looms. This was a beggarly indemnity but Jacquard was poor and was only too glad to accept it. Some 13 years later his services were at length acknowledged by the award of the decoration of the Legion of Honour, and in 1839 his fellow-citizens, awaking up to the fact that he was a great man and had poured millions of francs into their pockets, decided to erect to him a statue of bronze. The statue was duly completed, but by that time Jacquard was dead.

The earliest record of silk weaving in England is an Act of Parliament passed early in the 14th century, prohibiting the importation of "silk threads and ribands" by the "Lombards and the Italians" whose commercial invasion was ruining the trade of the English silk weavers. No restriction was placed upon the purchase of raw silk from the East, for an ample supply of this was vital to the home trade. The work of the British silk weavers of that period was of a high standard, and such tapestries and embroideries as still remain are among the finest work of their kind.

One of the most famous embroideries of the period is the "*Syon Cope*," a wonderful piece of richly-coloured cloth upon which are woven various biblical scenes and numerous heraldic devices. It is said to have been made by the nuns of a convent near Coventry, during the 13th century, and to have passed later into the care of a convent at Isleworth. This convent was (*Continued on page* 891)

ON THE SHORES OF THE SUEZ CANAL

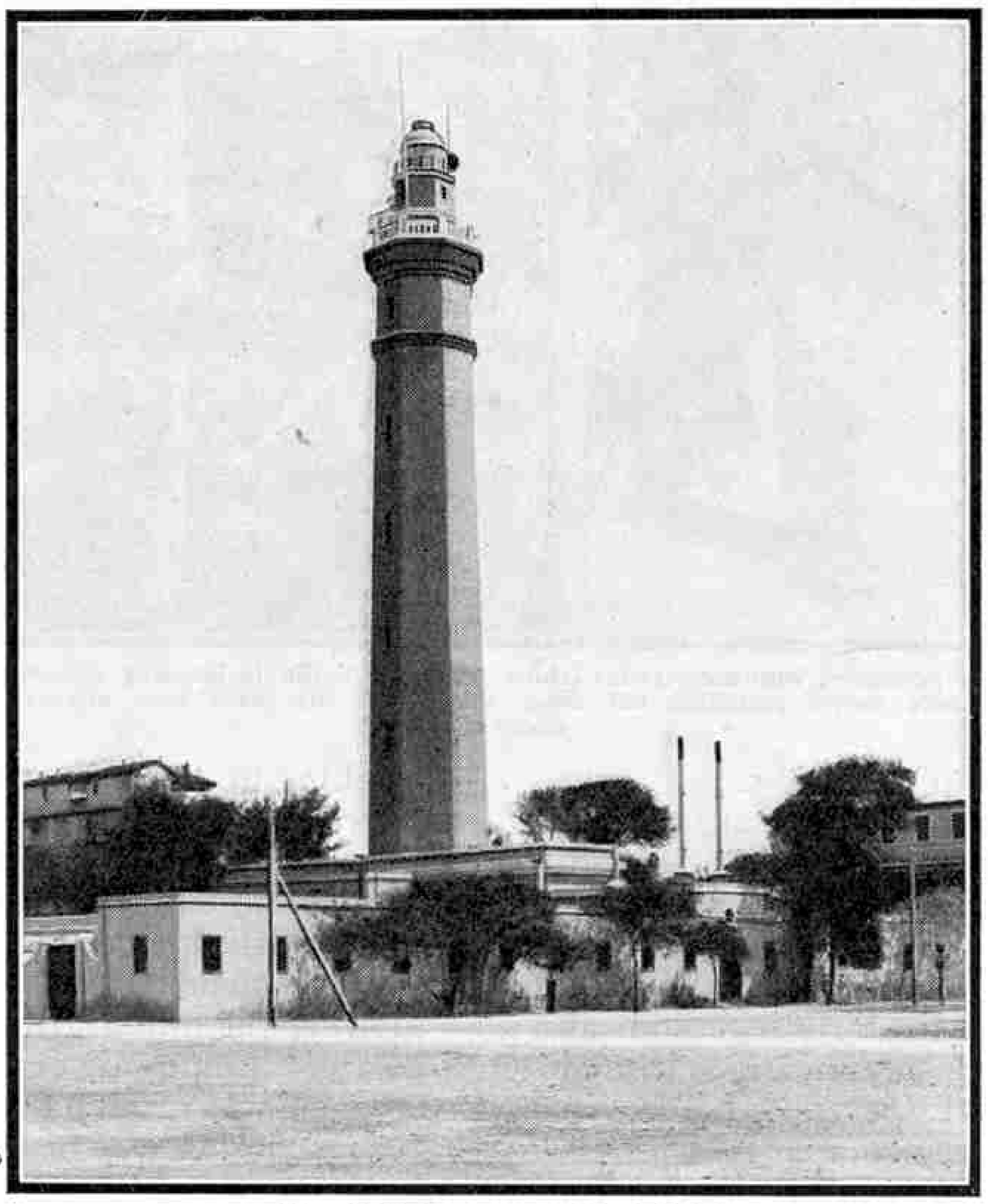
FAMOUS CANALS OF THE WORLD.

IV.—THE SUEZ CANAL

LAST month we described the attempts made in early times to establish communication by canal between the Mediterranean and the Red Seas, and we related how the great Suez Canal undertaking, formulated by the French engineer, Ferdinand de Lesseps, was commenced in 1859.

The first two years of operations did not see a great deal of progress made with the actual cutting of the canal, the time being largely taken up with completing a detailed survey of the route decided upon, erecting saw-mills and workshops, building accommodation for many thousands of labourers and commencing the making of the subsidiary Freshwater Canal to which we referred last month.

As the task of excavating the channel that was to be the main canal at length got well under way, the amount of forced labour employed steadily increased until ultimately between 25,000 and 30,000 natives were engaged. This army of workers was moreover, changed monthly. All these thousands of men employed in digging a huge channel out of the sandy wastes must have presented a remarkable spectacle, while the huge scale of the operations probably caused a good deal of wonderment among the natives themselves.



The Lighthouse at Port Said

From Port Said, the place selected for the Mediterranean entrance to the Canal, the route lay in a southern direction and traversed the eastern extremity of the marshy expanse of Nile delta called Lake Manzala. This extensive lake is roughly 28 miles by 23 miles and is dotted with numerous islets. It varies in depth from a few inches to several feet, and on the north is separated from the waters of the Mediterranean only by a narrow sandy strip of land. At a small place known as El Kantara El Khazneh, the canal route left the lake behind and, intercepting the ancient caravan route leading from northern Egypt to Palestine and Syria, continued southward to the Balah Lakes, which are miniatures of Lake Manzala.

From the Balah Lakes the country crossed by the canal became more undulating and, wherever practicable, advantage was taken of sandy depressions in order to minimise the amount of excavation work. These shallow valleys were in many cases found to be coated with a deep deposit of salt, giving them the appearance of being snow-covered and indicating that at some time they had been covered by the sea.

Where the ridges of higher land could not be avoided, increased excavation was necessary in order to maintain the canal bed at the uniform depth of 26 ft. below sea level decided upon. The deepest cutting occurred at El Gisr, a locality midway between the Balah Lakes and the salt-encrusted depression that later became Lake Tisma. At El Gisr the excavation when ultimately completed was 85 ft. in depth. A cutting 55 ft. in depth had to be made through the sand dunes at Serapeum, six miles north of Tisma. At such places the banks of the canal were cut at a slope having a ratio of 2 to 1.

For some five years work proceeded without any serious interruptions, but then occurred an event that threatened to wreck the whole scheme. During a visit to England in 1862, the Viceroy of Egypt invited Sir John Hawkshaw, an eminent engineer—who is best remembered, perhaps, by his appointment in 1887 as engineer-in-chief of the Severn Tunnel project—to visit the Isthmus of Suez and compile an independent report of the work being carried out by the French engineers, and to express his views as to the future prospects of the waterway. Hawkshaw accepted the invitation and journeyed to Egypt.

Unfortunately, however, the Viceroy died in 1863, before the British engineer's report was received, and when this arrived it passed into the hands of Ismail Pasha, brother of the late Viceroy and his successor in office.

Ismail regarded with acute disfavour the construction of the great canal across his country by "foreigners" and was greatly alarmed at the generous privileges bestowed upon the Suez Canal Company by his late brother, especially at the right they now had to appropriate land successfully irrigated by the "sweet water" (fresh-water) canal. Where possible and practicable the route of this secondary waterway embodied remains of a primitive canal which, as Ismail knew, had rendered very fertile the land it had served. He deeply resented also the obligation placed upon him by the concession to provide the necessary forced labour for carrying out the Suez Canal scheme. In addition, many stories of the hardships borne by the natives employed on the canal works and of the tyranny of their overseers had reached him, increasing his prejudice against the foreigners and their scheme. Thus it came about that when the important matter arose of ratifying the document of concessions to the Company, the new Viceroy flatly refused to give his signature to it, and forthwith stopped the supply of forced labour. This, of course, brought operations on the canal works to a standstill.

Statue of de Lesseps on the Jetty at Port Said

When the company had recovered from the first shock of this sudden crisis, they placed the whole matter before the King of France, Napoleon III, and awaited his judgment. After due consideration the King gave a verdict in favour of the canal company, and in July 1864, Ismail Pasha was ordered to pay them £3,360,000 as compensation for the loss of the valuable privileges he had withdrawn. By 1869 this considerable sum had all been paid, the money, as received, being used to defray the cost of the canal.

The fining of the Viceroy did not solve the serious problems of labour and equipment created by his act. Deprived of the compulsory service of the natives, the company now had to pay a reasonable wage to induce labourers to work for them, and the funds available for this purpose were only sufficient to maintain about half the previous number of employees. The company sought to engage much of the necessary labour in Europe, but white men were not attracted by the prospect of working for several years in the hot Egyptian desert, and the company found the recruiting task very difficult.

In order to make up for the inevitable serious shortage of labour, Europe was searched for mechanical plant, and every suitable dredger and excavator obtainable was acquired and shipped as speedily as possible by canals and seas to Egypt.

At the isthmus suitable accommodation had to be provided for the European labour engaged, and some widening of the "sweet water" canal carried out to enable certain dredging plant to be conveyed along it to the scene of inland operations on the main canal. Before the end of 1864 the various delays were mostly overcome, however, and with close upon 8,000 European labourers and 10,800 paid natives at work the construction of the canal once more showed signs of progress.

In the northern area of the canal zone small dredgers were set to work excavating two parallel narrow channels through Lake Manzala, a protecting bank being built up on the tidal side with the excavated earth. Larger dredgers equipped with chutes were then employed to clear out the central portion and deepen the wide channel now formed to the required depth. The material raised by these dredgers was used to consolidate the side banks. The same plan was followed in defining the course of the canal through the Balah Lakes.

The making of the canal cutting through El Gisr Ridge had been effected to a depth of almost 7 ft. below sea level before work was interrupted by the concession crisis, and operations were now resumed, the work of excavation being done without mechanical aid.

South of El Gisr the course adopted for the canal lay through the salt-encrusted valley of Lake Tisma, five miles in length, and thence out through the Serapeum Ridge. From Serapeum the route diverted eastward in order that full advantage might be taken of the two long valleys later known as the Great Bitter and Little Bitter Lakes respectively.

The 23-mile channel of the canal through these lakes was excavated to a certain extent by manual labour and then completed by bucket dredgers conveyed to the site by way of the Freshwater Canal, from which sufficient water was admitted to the incomplete Suez channel to enable the dredgers to be used. In places the valleys lay so low that little excavation was necessary to reach the 26 ft. deep channel required. After being mechanically lifted from the channel bed by the buckets, the silt was automatically tipped into long semi-elliptical chutes about 5 ft. in width, hinged at a considerable height to the dredger and extending at a downward slope toward the shore. The chutes were supported midway between shore and vessel by a floating pontoon. Some of these chutes were 230 ft. in length and their great reach enabled the dredgers to work in mid-channel.

By 1866 twenty of these dredgers were at work along the canal route, as well as 18 smaller dredgers and about 40 dredgers without chutes. The latter vessels were accompanied by elevators and were used on sections of the canal where it was not convenient to deposit dredged material ashore by means of the long chutes. In contrast to the latter, the elevators were virtually iron arms inclined upward, as their name implied.

The material raised by a dredger having no chute was put into boxes, of roughly four cubic yards capacity, upon an attendant pontoon. The boxes as filled, were lifted to the adjacent elevator and chains attached which, manipulated by a small steam engine aboard, hauled the boxes to the top of the runway. At this, the shore end, the runway was as high as 45 ft. above water level and extended inland over the canal bank for more than 70 ft. The contents of the boxes were then tipped to the bank below.

From the Little Bitter Lake the course of the canal turned eastward again and passed through the Shaluf Ridge. When the Shaluf cutting was almost finished an underlying bed of rock was located, and special rock-breaking apparatus had to be used to complete the excavation of the channel. The apparatus employed consisted of simple pile-driving frames erected over the bottomless well of bucket dredgers. Iron rock-breaking rams, square and having a wedge-shaped steel-pointed end, were hoisted up within the staging by hydraulic power and dropped from a height of from five to 20 ft. upon the submerged rock. The massive spears, weighing about four tons each, gradually shattered the rock as the blows were aimed at definite places.

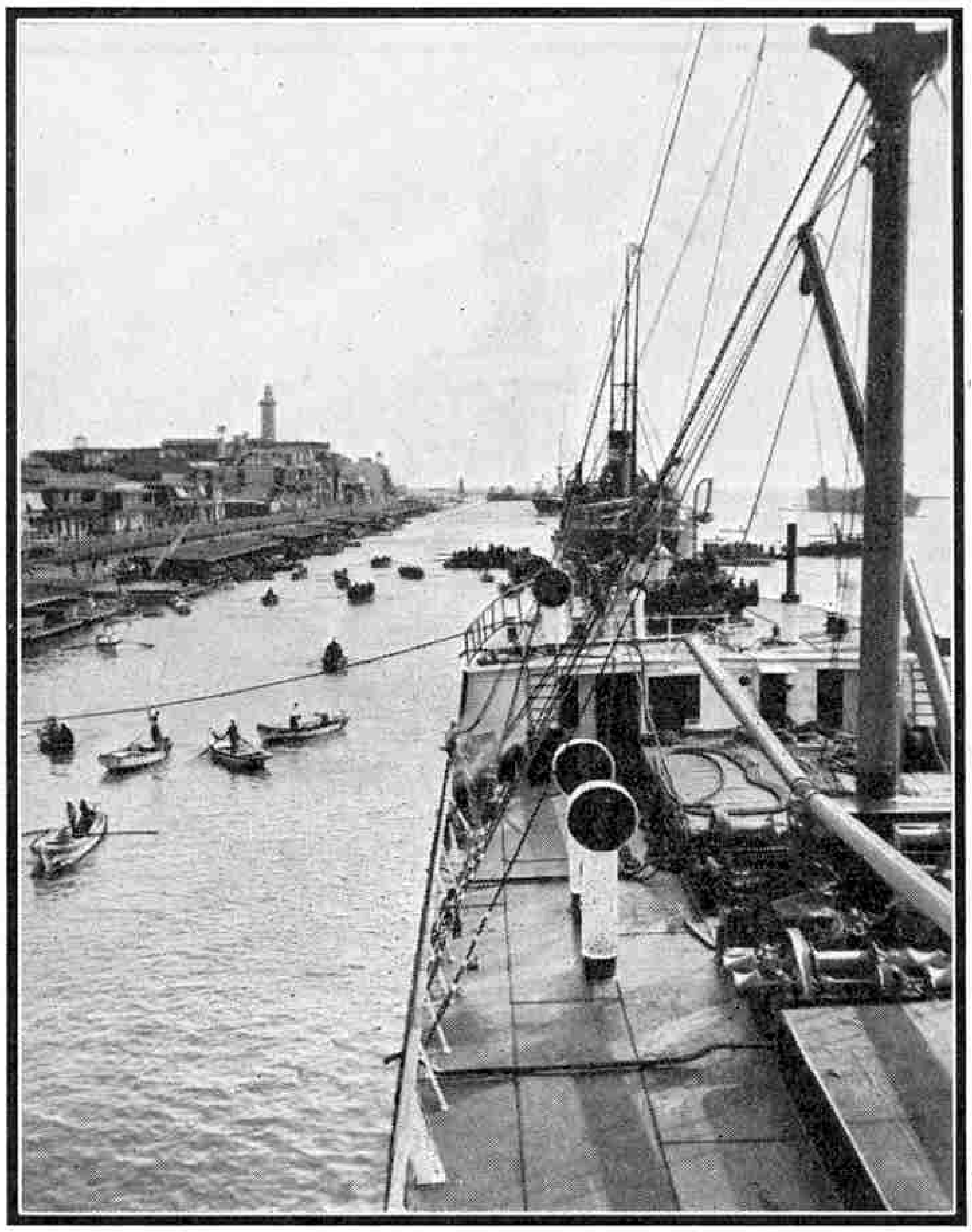
Ten of these rams used in one set were equivalent to 500 blows per hour. Generally, however, the stagings erected could only accommodate five rock-breaking rams. The rock having been thus broken away, the loose fragments were collected and brought up by the bucket dredgers. At Shaluf as much as 10,000 cubic yards of solid rock was broken up and raised within 16 hours. This method of removing the rock proved on this occasion quicker and more economical than the ordinary operation of blasting under water would have done.

The remainder of the canal excavation to Suez was through low-lying country and did not present any difficulties. Every five or six miles along the route the canal was widened slightly for a short distance to facilitate vessels passing each other. At these points iron mooring posts, the bases of which were firmly socketed in concrete beds, were erected at the canal side. Tall iron beacons, spaced about 250 ft. apart, were erected along both banks of the canal where this traversed the lakes.

The canal was restricted to a bottom width of 72 ft., except in places where the channel was widened out to allow vessels to pass each other. The width of the canal at water level also varied, being 328 ft. through Lakes Manzala and Balah, 190 ft. through the steep cuttings of El Gisr and Serapeum, and 225 ft. from the Bitter Lakes to Suez.

While the construction of the canal across the isthmus was in progress, the building of breakwaters to form harbours at each end of the waterway was simultaneously carried out. At the Mediterranean end the strong silt-bearing current flowing in an easterly direction from the Nile delta had to be taken into consideration, and in order to prevent this current, heavy with sand washed from the Nile, from causing the canal entrance to silt up, the western breakwater at Port Said was built farther out to sea than the eastern one. At the shore end the two breakwaters were 4,600 ft. apart and converged to 2,300 ft. at the seaward end. The western breakwater was constructed for a distance seaward of 9,800 ft., while the eastern breakwater was only made 6,233 ft. in length.

It was originally intended to use stone for the building of these massive piers, but this idea was abandoned when it was found that the material could not be obtained from nearer than Alexandria, necessitating a voyage of 150 miles by sea, which then would have been both tedious and costly. Huge concrete blocks, each of about 350 cubic feet and weighing as much as 20 tons, were therefore made on the sites, as many as 250,000 being required to build the breakwaters, which were completed by March 1869. Within the harbour of about 450 acres dredging was instituted to keep the bed clear of such deposit as succeeded in entering round the western pier or was washed in by heavy seas. Docking facilities were also constructed at the entrance to the canal.



Steamers entering the Suez Canal at Port Said

At the Red Sea end of the canal the building of the harbour at Suez was greatly simplified by the existence there of a natural gulf. As at Port Said, two piers were built, one being an earthen embankment throughout and the other, 2,900 ft. in length, of concrete.

The project was now taking on a finished appearance and in February 1869 the removal of the temporary dam at the Port Said end of the canal was begun. Thus, after being held back for many centuries, the waters of the Mediterranean once more began to flow towards the Red Sea. In July of the same year the removal of the temporary dam at the Suez end of the canal was also commenced, and by October the entire channel was filled.

Preparations were now put in hand for the official opening of the Suez Canal. This was fixed for 17th November, 1869, and as the time drew near various royal and other distinguished people began to arrive at Port Said for the ceremony. On the morning of 15th November the arrival of a vessel named the "*Graf*," with the Emperor of Austria on board, was announced by a salute of guns.

On the following day an Egyptian sailing vessel called the "*Latif*," of about 15 ft. draught, was sent down the canal on a test voyage to ensure that everything was in order for the official trip on the morrow. When the vessel was some 30 miles from Port Said it stuck fast, however, and assistance was hurriedly sent to re-float it and to improve the canal bed at that point. News of this slight mishap was received with apprehension at Port Said, where there was a prevalent belief, especially among the Egyptians, that the canal would already be too shallow, owing to loose sand from the banks slipping down, for even light sailing craft to navigate safely.

On the morning of Wednesday, 17th November, the harbour of Port Said presented a picturesque spectacle. Vessels varying from palatial foreign yachts to the English gun-boat "*Rapid*," and bearing flags representative of every European nation, crowded the harbour. Shortly after 8 a.m. the French Imperial yacht "*L'Aigle*," with the Empress Eugenie on board, moved majestically to the canal entrance and the official voyage through the Suez Canal began. As the yacht entered the canal, the "*Graf*," with the Emperor of Austria on board, moved out of the crowd of waiting ships and followed at a distance the French vessel. In due course the others assumed their places in the rear, the seventh being a yacht carrying Prince Henry of Holland, the eighth, "*Psyche*" with the British Ambassador on board, and the ninth a Swedish vessel conveying Prince Oscar. In all, 36 ships, their draught varying from eight to 16 ft. formed the single-file procession.

Sailing regulations limited speed along the canal to six miles per hour and it was not until three o'clock in the afternoon that the increasing line of ships had advanced sufficiently ahead to enable the 36th vessel, the "*Fayoom*," a paddle steamer drawing 14 ft. aft, to enter the canal. It was noted by many on board the larger vessels that their ships created considerable wash, and it was obvious that constant dredging and restoration would be necessary to maintain the depth of the channel.

For many miles inland from Port Said the canal follows an absolutely straight course and the varied procession of ships made an impressive spectacle.

As the journey through the canal was made only during the hours of daylight it was impossible to negotiate the entire canal in one day, and three nights were spent en route. The first night was spent at El Gisr, the voyage being resumed before noon the following day. On reaching Lake Tisma on the second day the procession anchored in front of the picturesque little town of Ismailia. The various guests on board went ashore and the rest of the day was spent in festivity, the town being "en fete" for the occasion. The procession did not leave Lake Tisma until the Friday morning and reached the Great Bitter Lake before nightfall. Here another halt for the night was called.

Coaling Ship at Port Said. All the coal has to be carried aboard on backs of labourers

The journey from Lake Tisma to the Bitter Lakes was not without incident. The steering of the Egyptian crews was very erratic and one of the vessels, about half way along the procession, got too near the side of the canal and grounded. The vessel immediately behind was the paddle steamer "*Fayoom*," and on seeing the mishap ahead the crew became greatly excited and hastily brought their own vessel to a standstill. In common with most of the other ships taking part in the official ceremony, the "*Fayoom*" had been considerably lightened at Port Said, and a severe breeze that had been encountered after leaving Lake Tisma now took charge of the situation. The "*Fayoom*" was suddenly swung round by the wind and a moment later became fast on a submerged sandbank.

Other vessels in the rear had by now also been brought to a standstill. On the "*Fayoom*" and the vessel ahead confusion reigned supreme; the crews rushed about the decks gesticulating and shouting wildly to each other, while the captains tore up and down the decks, cursing the canal and its originator with vigour! It is related of the captain of the "*Fayoom*" that in his frenzy he commenced throwing the ship's coal into the canal in order to further lighten his vessel! After a considerable time something like order was restored on board the grounded vessels and systematic efforts were made to refloat them. When this had been accomplished the voyage was resumed.

On the Saturday morning the fleet moved forward from the Bitter Lakes and before noon had passed out of the Suez Canal and anchored safely in the Red Sea, off Suez.

Up to the date of opening the Suez Canal the undertaking had cost £16,633,000, more than double the original estimate of de Lesseps. The work of dredging the channel and improving the harbours went on uninterruptedly, however, and at Suez two large dock basins were later constructed, and also a dry dock for repairs to shipping.

The Suez Canal provides a short cut from the Mediterranean to the Red Sea, of roughly 132 miles, and reduces the voyage between Europe and India by about 3,700 miles. This tremendous advantage was quickly appreciated by shipping, and the canal became a great success. During the first year of its existence the Suez Canal was traversed by 486 vessels, and two years later (in 1872) 1,082 ships made use of the new inland route.

As traffic on the canal developed, however, certain disadvantages and limitations became evident. The drawback most quickly felt was the narrowness of the waterway, for this necessitated a vessel drawing close to the side and tying up to one of the mooring posts before a ship approaching from the opposite direction could pass.

Although vessels were restricted to a speed of six miles per hour the heavy wash set up as they drew to the side of the canal caused frequent and sometimes very considerable erosion of the sandy banks, the loosened material sliding to the canal bottom and thereby greatly lessening the depth of the channel. A complete hold-up of traffic occurred whenever a ship grounded on one of these sandy shoals, rendering it necessary to constantly dredge the channel in order to maintain the depth throughout of 26 ft. During the first twelve years in which the canal was in use the dredging to alleviate this trouble amounted annually to roughly 800,000 cubic yards. Another disadvantage and one that greatly hindered the saving of time claimed by traversing the canal route, was the absence of any means of illuminating the canal for navigation at night.

The success of the canal and the steady development of British interests in the East, brought about a reversal of the Government's policy of aloofness to the Suez undertaking. In 1875 an opportunity presented itself to acquire the viceroy's share in the Suez Canal Company, and this was purchased by the British Government, under Disraeli, for £4,080,000. By this important move Britain became practically half owner of the Suez Canal Company.

Ten years later a plan to widen and deepen the canal for the whole length was put into operation. The width was increased to 213 ft. in the straight lengths and 246 ft. to 262 ft. at the curves, while the depth was increased to 29½ ft., thereby making the channel navigable to vessels of greater draught. The widening of the channel practically doubled the accommodation of the great waterway, but this decided advantage has in later years been somewhat annulled by the construction of much larger vessels, so that the problem of preventing erosion of the banks has not greatly diminished.

Another improvement carried out in 1885 and which was greatly welcomed, was the introduction of an extensive system of shore lighting, electric lights being placed on lofty posts at all mooring places. Luminous buoys were also placed at the entrances to the canal.

In 1886 mail steamers and vessels of war were for the first time permitted to use the canal, and in March of the following year the whole of the canal route was declared open for night traffic.

There was a considerable falling-off in traffic along the Suez Canal during the four or five years immediately following the Great War, but a remarkable recovery has been made. In 1925 all records for the Canal were broken by the passage of 5,337 vessels, totalling the huge figure of 26,762,000 net tons. The present-day use of larger vessels is very clearly shown by a comparison of the traffic figures of 1913 and 1926. During the former year 5,085 vessels, representing 20,034,000 net tons, passed along the Canal, while in 1926 the famous waterway was used by only 4,980 vessels, but these totalled 26,060,000 tons—an increased tonnage of roughly 30 per cent. More than one half of the traffic along the Suez Canal is British, the remainder being contributed chiefly by French, Dutch and German shipping.

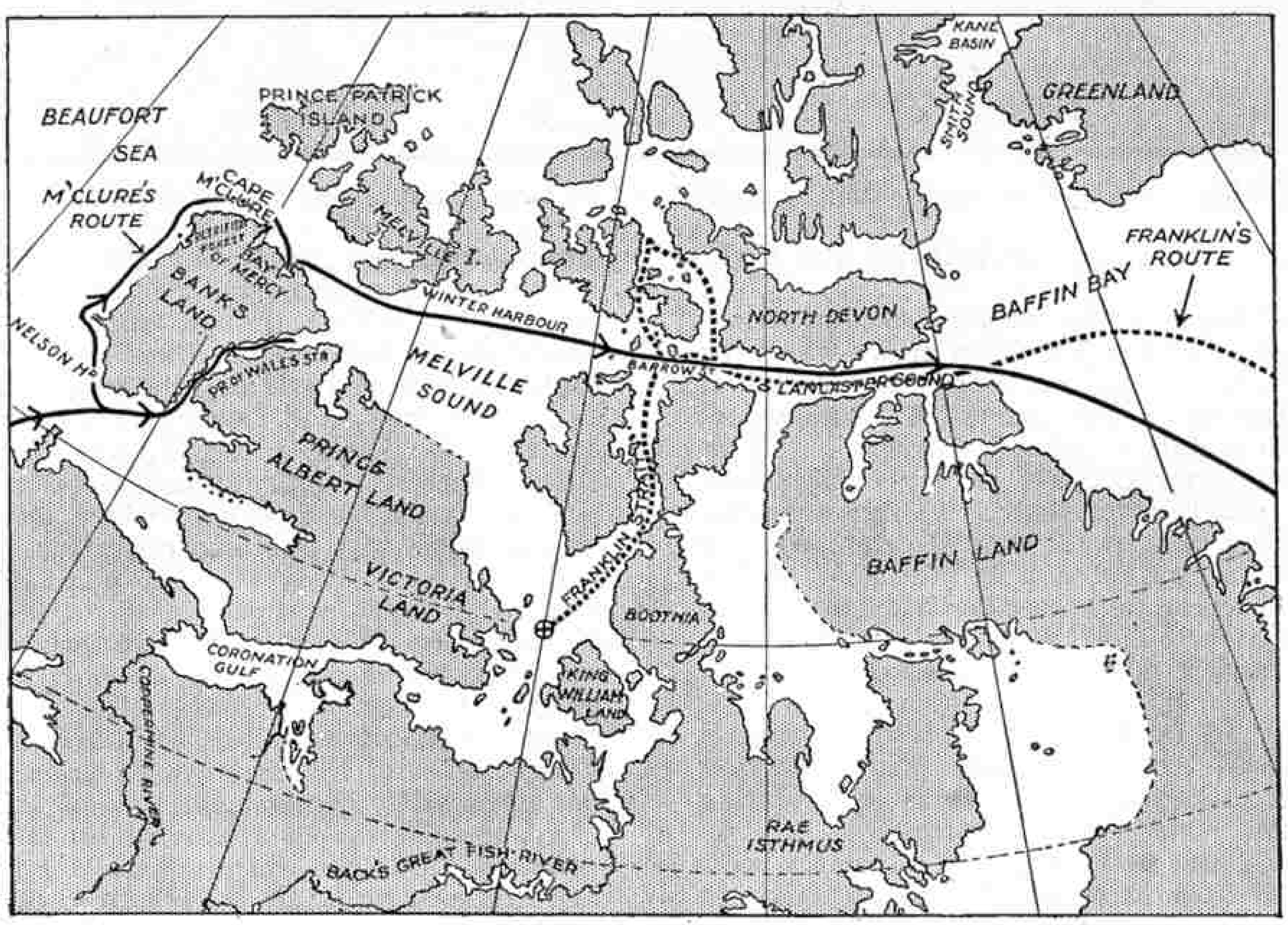
EXPLORING THE ARCTIC

Famous Explorers and their Attempts to Reach the Pole.

XIV. NORTH-WEST PASSAGE DISCOVERED BY M'CLURE

LAST month we described the remarkable voyage of Captain Collinson in search of traces of the Franklin expedition. Collinson entered the Arctic through Bering Strait and during his progress along the northern coast of Canada a separate portion of his command was undergoing a remarkable and dangerous experience farther north. This portion was under the command of Captain, afterwards Sir Robert Le Mesurier M'Clure.

As was the case with practically all the British explorers of the Arctic during last century, M'Clure was a naval officer. He was an Irishman and previously had been in the Arctic twice, the first time as mate of the "*Terror*" in Back's expedition of 1836 and the second time as lieutenant on the "*Investigator*" in the first Franklin search expedition led by Sir James Clark Ross in 1848. In between, he had experienced a period in command of a vessel on the Canadian Lakes during the rebellion of 1838.



Map showing the north-west passage discovered by M'Clure while searching for Franklin

M'Clure had shown his mettle during his earlier expedition in Northern seas. In the words of one of his brother officers he was "stern, cool, and bold in all perils, severe as a disciplinarian, self-reliant but modest. With a granite-like view of duty to his country he would in war have been a great leader and it was his good fortune during a period of profound peace to find a field for all these valuable qualities."

M'Clure's character and ability and experience marked him out for further work in the Arctic and it was no surprise when he was given command of the "*Investigator*" to accompany Collinson in a further search for Franklin from the western side. Collinson in the "*Enterprise*" was in command of the expedition, but circumstances left M'Clure in a position of independence, and all the qualities of leadership that he possessed, together with all his knowledge of Arctic work, were needed to preserve his party from serious disaster.

The two ships of the expedition left Plymouth on 20th January, 1850, and did not reach Bering Strait until the late summer. It must be remembered that the explorers of eighty years ago used sailing ships and on this occasion much valuable time was wasted on the slow journey through the Straits of Magellan and up the Pacific coast of America. The ships soon lost sight of each other, although they were never more than about 60 miles apart. When M'Clure reached Port Famine, a wretched little convict settlement on the coast of Chile, he found that Collinson had already been there and had taken all the bullocks provided for the expedition, so that no fresh meat was available for the crew of the "*Investigator*" until the ship reached Honolulu. Collinson was first at this port also and M'Clure was left to follow him to Bering Strait.

Kotzebue Sound, on the Alaskan Coast, was the final rendezvous for the ships of the expedition before the plunge into the Arctic Ocean, but when the "*Investigator*" reached this spot there was no trace of Collinson's vessel. After waiting a day or two M'Clure determined to push on to the north, knowing that every hour was valuable to the important service upon which he had been sent and that in Arctic work a day lost often entailed a whole season of fruitless labour. He left a letter stating his intention of following the northern coast of the American Continent until he reached the longitude of Banks Land, discovered by Parry 31 years previously, and then sailing north-east in the hope of finding his way to Barrow Strait. The course thus indicated was the reverse of the one Franklin intended to follow and therefore offered great possibilities of finding traces of the lost explorer. It may be said at once that nothing connected with Franklin was found by M'Clure, whose journey resolved itself into a highly adventurous voyage of discovery that nearly ended in a similar tragedy.

Before leaving Bering Strait immense herds of huge walrus were seen, some of which must have weighed 30 or 35 cwt., for they were so big that the ice floes rose two feet higher from the water when the animals slipped off them into the sea! It is a regrettable fact that ruthless hunting has greatly diminished the number of these animals since M'Clure's time.

On reaching the longitude referred to in his letter, M'Clure turned north-east and very soon sighted land to which he gave the name Baring Land. It was proved later that this was actually the Banks Land discovered by Parry. The point first seen by M'Clure was a high promontory which he named Nelson Head. This formed the southern extremity of the island, and his subsequent course led him through a narrow passage between Banks Land and more new land now called Victoria Land. Later M'Clure learned that this new land discovered by him formed a part of the large island, the southern coast of which already had been explored, and in the meantime he gave it the name of Prince Albert Land.

Captain Sir Robert J. Le Mesurier M'Clure

The Strait was quite practicable for navigation and M'Clure pushed boldly forward amid considerable excitement, for it seemed to promise a way into Melville Sound. The excitement grew intense when it was discovered that only 60 miles remained between the ship and Melville Sound, which Parry had reached in 1819. Unfortunately, however, ice conditions then intervened to render further progress impossible, and the ship was compelled either to winter in the Strait or to return. Without hesitation M'Clure decided to remain in the Strait—to which he had given the name of Prince of Wales Strait—partly through reluctance to relinquish the ground he had gained and partly to give him the opportunity to cover as much new ground as possible in the search for relics of Franklin.

Although the season was far advanced, sledge parties left the ship on various journeys, the first of which nearly ended in disaster. A small party had sledged across the ice in order to climb a hill in the hope of obtaining a clear view to the north. On their return journey they found a stretch of open water across their path. They were five miles from the ship and night was closing in, while the only food they had left consisted of one tin of meat, frozen so hard that it could neither be cut nor bitten. Fortunately they were able to attract the attention of the ship by firing a gun and before any harm was done boats were brought to enable them to cross the water.

The great event of 1850 was, however, the sledge journey up the Strait. The sledges were heavy, each man pulling about 200 lb., and the temperature was low; but in spite of these difficulties a party of eight men pushed on until they reached the northern end of the Strait. One morning before sunrise M'Clure climbed a hill 600 ft. in height and there waited anxiously until the light became sufficient for him to see what lay beyond. To his delight he found only frozen sea, and he realised that he was looking over Melville Sound with no land intervening between him and Winter Harbour, the headquarters of the Parry expedition.

In a sense this was an actual discovery of a north-west passage. As we now know, Franklin had discovered an alternative route some four years earlier, but M'Clure's discovery was the first one known to the world at large and he and his crew were subsequently awarded the Government grant of £10,000. By way of celebration of the actual event a bonfire was made on the inhospitable coast of Banks Land with the aid of a broken sledge and the dwarf willows, while the seamen enjoyed the unwonted luxury of an extra glass of grog.

After enclosing in a cairn a record of the visit to this spot the party returned south. On approaching the position of the "*Investigator*" M'Clure left the sledges and pushed on in order to make sure that a hot meal should be ready for his men on their arrival. When he was six miles out night fell, and a dense mist made it impossible for him to find his way. After waiting an hour he saw, as he thought, a blue light in the direction of the ship and fired two shots in order to attract attention. These shots were not heard and unfortunately he was unable to fire again for lack of ammunition. After a further wait of two hours without any signs of assistance or relief he struck his only match in order to see his compass, but before he could take his bearings the match fizzled out and he was left in total darkness.

M'Clure's position was now decidedly precarious, for he had no hope of being able to reach the ship during the eleven hours of darkness that remained. He was without ammunition to protect himself from prowling bears and the temperature was so low that he was in danger of being frozen to death. For a time he walked to and fro on the ice, but finally he made himself as comfortable as possible on a bed of dry snow on the lee-side of an ice hummock and slept for three hours. He then woke in the mistaken belief that he saw the light of a flare, and afterwards he walked about in various directions until daybreak. When the light returned he discovered that he had actually passed the ship during his wanderings and he was extremely fortunate to have survived the experience.

A remarkable feature of this sledge journey was the small amount of food consumed. During nine days eight men had only eaten 18 lb. of pemmican, 21 lb. of biscuits and 2 lb. of oatmeal. The fact is that the men were too exhausted every night, after pulling the heavy sledges an average distance of 20 miles, to care for anything but water. The sledges weighed 100 lb. more on their return than at the start on account of the accumulation of ice and snow on them and all that they carried.

A photograph taken in Baffin Bay, showing pack ice

The ship was now made snug for the winter, a covering being spread over the deck to keep out as far as possible the icey blasts of the Arctic gales. It was hoped that when spring came the ice would break up sufficiently to enable the ship to pass through the remaining portion of Prince of Wales Strait, and thus enter Melville Sound with a fair prospect of accomplishing at last the north-west passage, although in the reverse direction.

While waiting for the break-up of the ice, sledge parties were sent out as soon as the temperature and weather conditions permitted. One party followed the coastline of Banks Land for no less than 170 miles and showed it to be an island. This party was away from the ship 32 days and two of the members suffered so severely from frost-bite that exposure for one or two more days would have proved fatal to them.

Two other parties explored the land on the east side of Prince of Wales Strait. One of these parties actually reached a point only 40 miles from where Rae turned back about a week afterwards. This was on the east side of Victoria Land, where Rae had penetrated from the mainland in search of Franklin. It is of interest to note that on this journey Eskimos were met with who must have belonged to the tribe afterwards known as the Copper Eskimos, found by Stefansson and described in his book *"My Life with the Eskimos,"* which was reviewed in the July *"M.M."*

The *"Investigator"* was at last set free from the grip of the ice but it was soon realised that any attempt to reach Melville Sound direct would be futile. M'Clure immediately decided to attempt to reach the Sound by passing round the western side of Banks Land, and accordingly on 16th August the expedition retraced its steps and the ship was steered to the north-west after once more rounding Nelson Head.

The voyage proved very dangerous and on several occasions serious disaster threatened. The coast was as precipitous as a wall and the water was very deep. The ship was compelled to sail in a narrow track between the cliffs and the piled-up ice of the Beaufort Sea, which in some places was 100 ft. in height, and on many occasions the yardarms almost touched the cliff.

A particularly narrow escape from destruction was experienced on 29th August, as is shown by the vivid description in the official narrative of the voyage. "A moving floe struck the huge mass of ice to which the ship had been secured, and to the horror of those on board, such was the enormous power exerted that the mass slowly reared itself on edge until the upper part was higher than the foreyard and every moment appeared likely to be the *"Investigator's"* last; for the ice had but to topple over to sink her under its weight. At the critical moment there was a shout of joy, for the mass, after oscillating fearfully, broke up and rolled back into its original position and they were saved."

Immediately after this terrifying episode the berg to which the ship was fastened pressed forward on to a low point of land and nipped the ship between it and a smaller berg that had grounded offshore. The slightest increase in pressure inevitably must have crushed the ship, but by good fortune one of the bergs broke up and all was well. So tightly wedged in between the two bergs was the ship that it would have been impossible to drop a lead line anywhere around her, and the copper sheathing on the ship's bottom was rolled up like brown paper.

A remarkable discovery made further north was a petrified forest in a ravine a few miles inland. This ravine was about 200 ft. in depth and the ground around the wood or trees was formed of sand and shingle. Some of the wood was petrified and the remainder rotten and useless even for burning. At a later date a similar petrified forest was discovered on Prince Patrick Island, still nearer the Pole.

After several narrow escapes the *"Investigator"* succeeded in reaching a bay about half way along the north coast of Banks Land, before ice conditions made progress impossible. Refuge for the winter was sought in this bay, well-named by the explorers the Bay of Mercy, which was under the shelter of the three capes seen 31 years previously by the Parry expedition.

From the Bay of Mercy M'Clure set off in the following spring with six men to visit Parry's old winter quarters at Winter Harbour. This was a trying journey, for the surface of the ice proved very rough and the temperature fell considerably. When Winter Harbour was reached the explorers were disappointed to find no ship and no store of provisions. Before returning M'Clure visited the famous rock on which Parry had inscribed the names of his ships and chief officers in 1819, and on its summit he left documents giving the position of the ship still firmly locked in the ice of the Bay of Mercy, and the information that relief was urgently needed.

A curious circumstance of this journey to Winter Harbour was that M'Clure's party narrowly missed meeting a party from the *"Enterprise,"* the ship that should have accompanied the *"Investigator."* As described last month, a sledge party under Lieut. Parkes from Collinson's winter quarters actually reached Melville Island and observed the tracks of sledges and heard the barking of dogs. Readers will remember that Parkes made no attempt to meet the party because he thought they were Eskimos. Thus for the second time members of the M'Clure expedition were within easy distance of other expeditions but failed to come in contact with them.

As the summer drew to a close it became evident that still another winter must be spent in the Arctic. This was a serious matter. Food began to run short and it was certain that not enough remained in store to carry the expedition through the winter unless additions could be made by shooting deer, caribou and other game. Some indication of the condition to which the explorers were reduced may be gathered from the fact that cooking was to all intents and purposes abandoned. Salt meat, for instance, was merely thrown into boiling water to thaw it and extract the salt, and was eaten practically raw. Officers and men shared alike in regard to food.

A special effort was made on the anniversary of the discovery of the north-west passage and also on Christmas Day, when an extra allowance (*Continued on page* 907)

Staffing a Liner for a World's Cruise

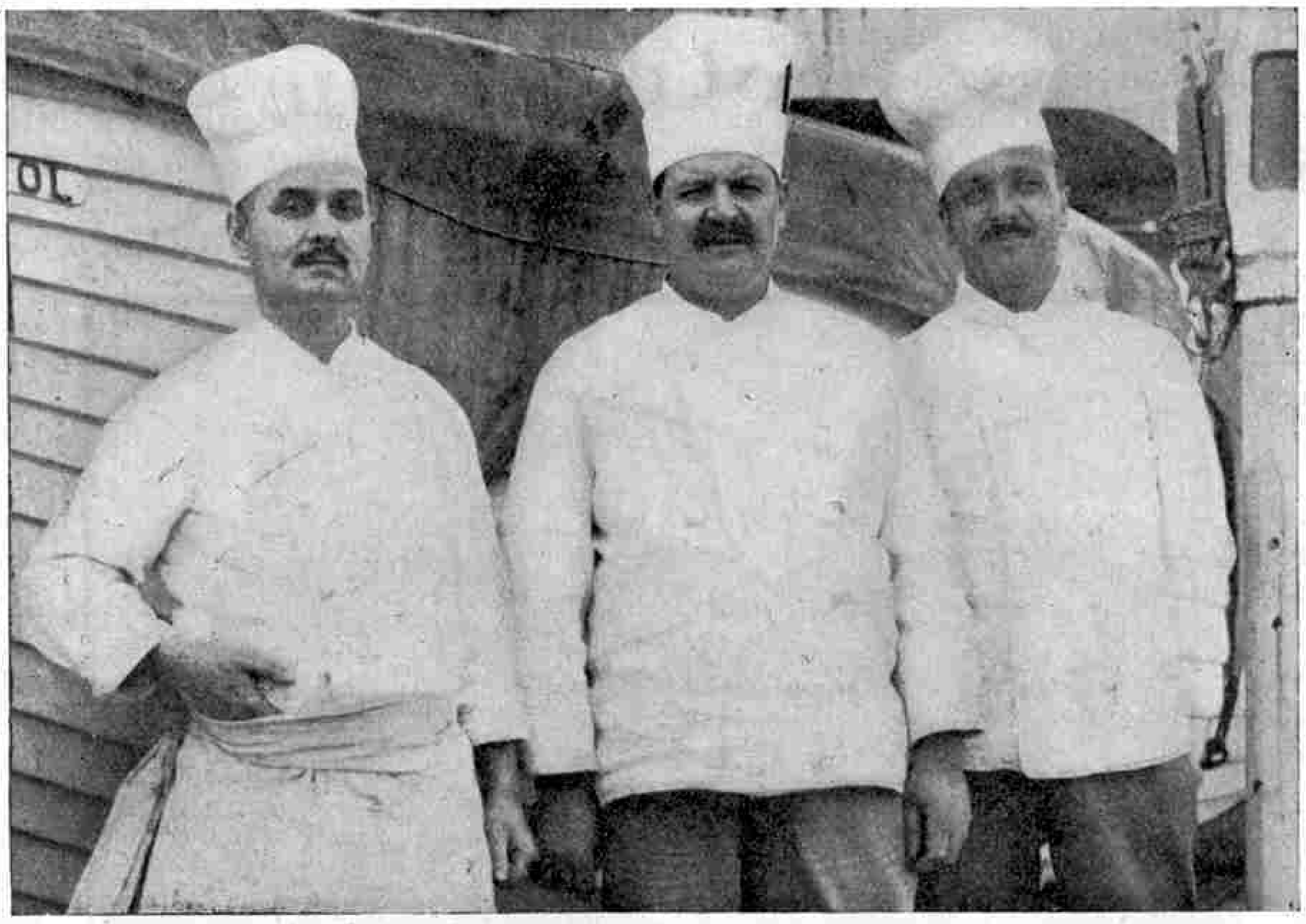
By Captain John R. Mackay, Chief Engineer, "*Belgenland*"

This is the fifth and concluding article of a series of talks broadcast from the "Belgenland" when in the Bay of Bengal last year. We are indebted to the "Ocean Ferry" for the following details and also for the illustration below

THE staff in the "*Belgenland*" consists of over 400 men and women, under the chief steward. The second steward and three assistant second stewards act as executives. The barkeeper is the chief storekeeper and has four assistants for handling and distributing the provisions, wet and dry, under instructions from the chief steward.

The ship has five storerooms for bulk-stores, groceries, root-vegetables, and spirits; also fourteen refrigerated chambers, and three service larders, each of which can be regulated in temperature to suit its contents.

With this great storage capacity, and a large range of temperatures at his disposal, the chief steward is enabled to use good judgment in his purchases of provisions at the ports of call. He can buy in large or small quantities and is governed by the quality, not by the quantity, of the fresh provisions on the market.



Called from their jobs to face the camera

Heading the culinary staff of over 100 on the "Belgenland," are the three experts shown above. From left to right they are: H. Serries, chief baker, who is famous for his Belgian pastry; Paul Germain, French chef, whose experience was gained in European hotels; and P. Boulet, his second in command in the kitchens

May I say, in passing, that there are four factors, in my opinion, upon which the health of the passengers and crew greatly depend on a world cruise, with its range of temperature and climates. Three of these are taken care of by the ship, namely, good ventilation, pure, cool drinking water, and an ample supply of hot and cold washing water, and a menu, varied to suit the climate, of well-cooked food, made from fresh provisions, or provisions maintained at a temperature which preserves them in the best condition. The fourth factor is the passengers, a wise selection of diet from the menu, and suitable clothing.

The good health of the passengers and crew on this cruise testifies that the necessary conditions have been fulfilled by both parties.

To continue with the list of the personnel, the baggage master is an important member of this department, especially on such a long cruise as this.

The chef is in charge of the galley staff, and has a number of specialists to assist him, such as the sauce, entree, fish, roast, grill, soup, and vegetable cooks, and half a dozen others.

The chief baker has six bakers and confectioners to assist him, and the chief butcher has four assistants. There is a chief pantryman and four assistants.

The silver plate and glassware is in charge of another half-dozen, and the result of all the work in the galleys is brought to your table by one of the ninety table-waiters, assisted by twenty-five "commis," or helpers, under the supervision of the chief steward, second stewards or head waiter.

If you are athirst for other than iced water, or iced tea at meals, your wants will be attended to by one of the six wine butlers.

After the meal is over the silver and glass is cleaned by silvermen, the plates by platemen, a total of fifteen, while the galleys are cleaned up by fifteen scullions. If you feel that a little refreshment in the public rooms would be acceptable, there are waiters in charge of these places to attend you. There are the deck stewards to make you comfy, or bring you meals there, if you feel like it.

The service in your cabins is carried out by one of the twenty-five bedroom waiters, or by one of those twelve women of infinite patience, the stewardesses.

There are five night watchmen who patrol the decks while you sleep, and the five bath waiters who prepare your tub, at any time you wish it.

Then there are the four printers, the twelve musicians, the four hairdressers, manicurist, gymnasium instructors, four in the Turkish bath and swimming-pool staff, playroom attendant, interpreter and gardener.

We must not forget to mention the bell-boys, with their lady chief at main indicator board, and the lift boys. All the boys are trained in the way they should go by the senior assistant second steward.

There are the chief boots and his five assistants, who besides cleaning your shoes, clean the passages and companions.

The laundry staff of thirty-six persons under the laundry manager, are also included in this department, and turn out over 6,000 pieces a day for the ship's use, besides the work for passengers and crew.

Each member of the staff has been carefully selected for his job, and many of them (*Continued on page 907*)

FROM OUR READERS

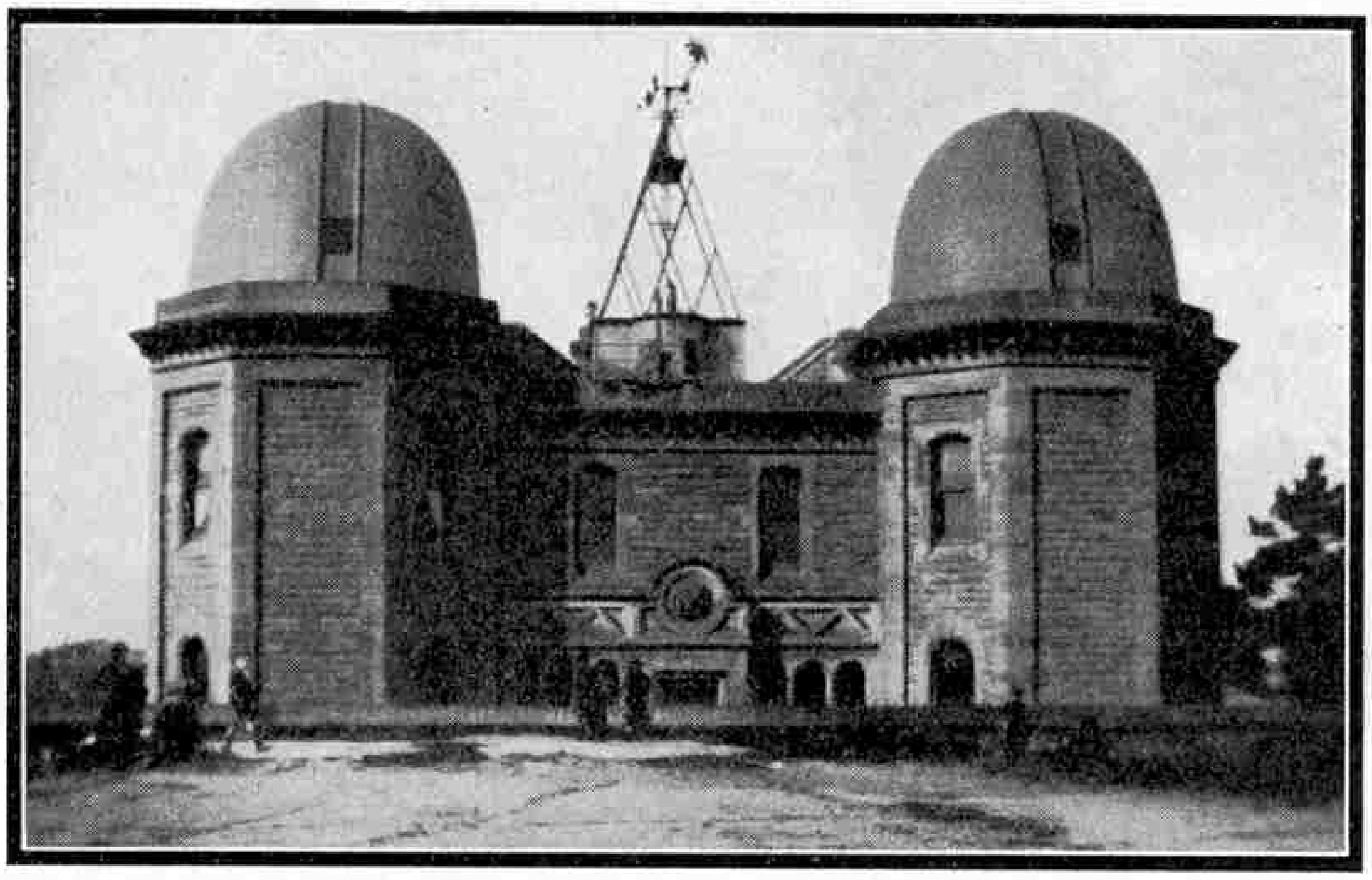
Contributions not exceeding 500 words are invited, with or without photographs or sketches for use as illustrations, and payment will be made for all articles published. The Editor takes no responsibility for the accuracy of statements contained in such articles, nor for the opinions of contributors.

Observatories

Observatories are buildings in which astronomical, meteorological, or scientific observations are made. Up to about 300 B.C. there is no record of the existence of an actual observatory but individuals are recorded as having at spasmodic intervals made observations with the aid of the simplest and crudest apparatus.

The first observatory recorded is that at Alexandria which continued about 400 years, or until the end of the 2nd century of the Christian era. It was here that Hipparchus of Rhodes discovered the precession of the Equinoxes, and investigated the motion of the sun, moon and planets. Ptolemy, also of Alexandria, was a well-known astronomer who carried on the work of Hipparchus in the 2nd century A.D.

Later several observatories were founded by Arabian princes, including one at Damascus, another at Baghdad, and one near Cairo where the famous Hakimite tables showing the positions of the sun, moon and planets were constructed. Their example was followed by the Mongol Khans, and at Maragha in North West Persia, about the year 1260, Hulago Khan is reputed to have founded an observatory. The first European observatory appears to have been that at Nuremberg, attributed to Bernard Walther in 1472. Later the now well-known national observatories were founded.



Bidston Hill Observatory, Birkenhead

Modern observatories are readily distinguished by the domes or cupolas containing the telescopes. Sliding shutters are so fixed that they enable the telescopes to be pointed from the horizon to the zenith, while observations of any point in the heavens can be carried out by rotating the whole dome on rollers.

In some observatories hydraulic lifts raise or lower the floors of the domes, thus enabling the observer to accommodate himself to the changing height of the instrument. Two indispensable parts of the equipment of an observatory are the transit instrument and the sidereal or star-time clock. The transit instrument is a telescope fixed so that it points north and south, moving only up and down, and it is used for observing the time a star crosses the Meridian of the instrument. This checks the sidereal clock.

In Great Britain there are eight important meteorological observatories, of which Greenwich and Kew are the best known, while many other smaller ones are dotted about the country. A well-known and useful observatory at Bidston, Birkenhead, Cheshire, was founded by the Municipal Council of Liverpool in 1838, being transferred to the Mersey Docks and Harbour Board in 1856, and ultimately moved to Birkenhead in 1867. It was built specially for testing the rates of chronometers at various temperatures. It contains a transit instrument and an 8-in. refracting telescope by Merz.

It is often in the interests of a borough council to be able to record the rainfall, number of hours of sunshine, wind pressure, etc., as affecting its particular district, and the necessary meteorological instruments used in this connection are generally installed in a small building in a public park or open space, no attention being needed beyond keeping the instruments in order, and taking the readings when required in order to write up the record charts.

ANNIE E. RANDALL (Oldham).

A Visit to Loughborough College

A short time ago I had the pleasure of visiting Loughborough College, a unique institution where students are trained by "production." The College consists, therefore, of a number of workshops of every kind.

We first visited the X-ray room, where we saw the apparatus, including a huge induction coil, used in taking X-ray photographs, and many photographs taken with it of steel hooks, bars and other apparatus. The blow-holes in the steel were clearly seen.

On leaving this interesting room we visited a laboratory fitted with every kind of apparatus for testing the quality of metal goods produced in the college. One of the testing machines here was capable of exerting a force of 30 tons on a piece of steel, either twisting, compressing or stretching it. The quality of the metal can be learnt from the break.

We next visited a workshop where lathes were at work making bolts of varying sizes. Other workshops contained apparatus for making gear wheels, cylinders and countless other articles that were to be built into various machines.

The automobile laboratory, which we visited later, contained aeroplane and motor-car engines of many types. One of the most interesting engines seen here was the engine from a tank, which must have taken up nearly all the space in the tank from which it came. We were thrilled when a 100 horse power Beardmore aeroplane engine, used for driving a generator, was started up for our benefit. The roar of the engine was terrific since there was no exhaust pipe or silencer, and sheets of flame a foot long spurted from the cylinders.

The woodwork section contained mechanical apparatus for performing all operations on the wood except nailing it together. A huge plane cut a shaving four inches wide and about 10 ft. long, in one huge piece from a plank. The wood was "fed" into the machine by a rubber roller. Circular saws, pendulum saws and band saws were all used for cutting the wood up for various purposes. Discs and rollers of "sandpaper" polished the wood finally, after it had been filed smooth with a mechanical file two feet wide.

In turn we visited laboratories for the study of steam plants, hosiery manufacture, metal-working and all branches of engineering.

Perhaps the power house was the most interesting place of all, however. The whole of the electric power for the college is supplied by two huge Diesel engines taken from two German submarines which were presented to the college. These are driven by oil and are started by compressed air. We were fortunate enough to see one of them started. When running, the whole room shook with its vibration. 120 of the 300 accumulators from a submarine store the electricity. Each unit weighs half a ton.

It is interesting to note that the students of Loughborough College are digging their own open air swimming bath. They will make their own concrete and line the bath with it to a depth of two feet, and even the water pipes are being made in the college.

D. W. A. MINETTE (Leicester).

Underground in Peakland

A considerable part of North Derbyshire has a limestone formation that is honeycombed with caves of all sizes, and Castleton is the centre of a region particularly rich in this respect. In addition to the famous Peak Cavern, there are the Blue John Caves and the Speedwell Mine. The last-named is an old adit driven into the hill by miners in search of lead. Some 800 yds. of almost barren tunnelling brought them to the so-called Bottomless Pit, a huge natural cavity with a stream pouring through it. The miners proceeded several hundred yards beyond this, but although they threw into the pit all the material excavated, there was no visible difference. Visitors are now taken along the flooded adit by boat to the Cavern.

The neighbouring cave at Windy Knoll has yielded numerous remains of prehistoric animals. In the Giant's Hole the explorer can penetrate along the bed of a small stream about 150 yds. into the hillside. The roof of the cave then comes within 12 inches of the floor but—if one is not too stout—it is possible to wriggle through until, in another 50 yds., the stream falls into a pool with no visible outlet.

The accompanying photograph shows Eldon Hole, a vertical fissure nearly 200 ft. in depth and which can be descended only by means of rope ladders.

There are many smaller caves in the district and the tramper who has a taste for underground exploration will find plenty to occupy his time.

P. N. B. (Prestwich).

Eldon Hole, near Castleton

Walking Over the Forth Bridge

Very many readers of the "*M.M.*" must have crossed the Forth Bridge by train, but probably few have had the experience of walking over it. On a recent visit to Scotland I obtained this privilege and my impressions may be of interest.

The weather was fine on the day of my visit and there was practically no wind. Starting from Dalmeny Station I walked along the line to the watchman's house, where I presented my pass and signed the visitors' book. Then, after an interesting chat with the watchman, who can claim acquaintance with the bridge since the first girder was laid in place, I set out along the narrow footpath that borders the permanent way. There is a path on each side of the lines and people walking over the bridge are ordered to keep to the right-hand path in each direction. These paths seem wide enough when seen from the train, but one does not feel so safe when a train rushes past at 40 m.p.h., which is the highest speed allowed over the bridge.

The approach to the bridge, when one can see little of the girders above, is tame, but when one has passed through the stone arch on to the bridge proper it is thrilling indeed. The red-painted girders towering far above, interlaced with the delicate-looking "tension members," make one feel as though standing in a vast steel cathedral of the heavens.

To the waters of the Forth below the drop seems enormous, but it is even worse when one climbs a painters' ladder to the summit of the cantilever. Then one seems to be standing on the very roof of the world. On a clear day the views that can be obtained from the top of the bridge are so widespread and wonderful as to be beyond description. Below, the waters of the Forth ripple silver-tinged in the sun and trains crossing the bridge appear toy-like. A cargo steamer under the bridge looks like a rather dirty little model!

No praise can be too high for the men who work year in and year out painting the bridge. To see them swing nimbly from girder to girder with nothing but a few ropes and scantlings to hold on to, and a yawning abyss below, is as unforgettable an experience as that of standing crouched against the railings while the Perth-Aberdeen portions of the "*Flying Scotsman*" thunder past in a veritable tornado of sound.

DEREK BARRIE (London).

FAMOUS TRAINS: X.

The "*Midland Scotsman*," L.M.S.

By Cecil J. Allen, M.Inst. T., etc.

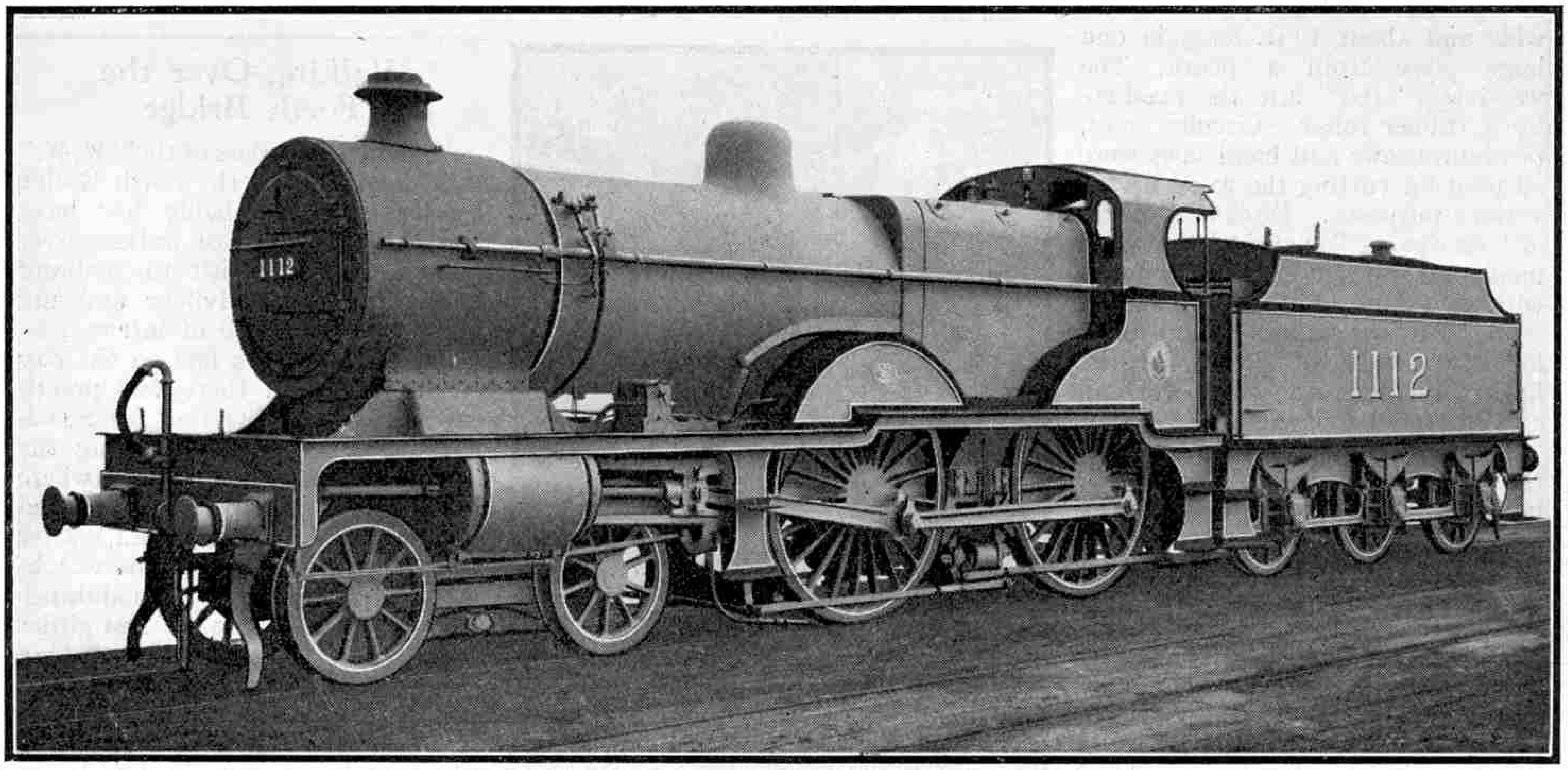


Photo Courtesy] **One of the L.M.S. 3-cylinder compound 4-4-0 locomotives, No. 1112** [L.M.S. Railway

It is said that, at the time of the "Races to Scotland," in 1888 and 1895, when the East and West Coast companies were straining every nerve to beat each other, first to Edinburgh and Glasgow and then to Aberdeen, the Midland route to Scotland became unexpectedly popular. Nervous old ladies found a sudden preference for Midland travel because the longer overall times of the Midland inferred lower average speeds. "It is so much safer," they said! They little knew that even then the maximum speeds of the Midland trains were very often as high as those achieved by their racing neighbours, the heavier gradients and longer distance covered by the Midland easily explaining the necessity. So it is to-day. The journey by the Midland route from London to Glasgow will take us an hour longer, roughly, than is needed by the West Coast Route from Euston to Glasgow. Yet the chances are that our 9.50 a.m. out of St. Pancras will do, in places, some far faster travelling than the more famous "*Royal Scot,*" which leaves Euston 10 minutes later and reaches the Scottish city 50 minutes in front of us.

To start with, the 9.50 a.m. from St. Pancras—which, for the purpose of this article, I have christened the "*Midland Scotsman,*" though unfortunately it has no official title—has to travel 424½ miles against the 401½ miles of the "*Royal Scot.*" It has to make stops at Leicester, Chesterfield, Leeds, Hellifield, Carlisle, Dumfries, Kilmarnock and, generally, also at the suburb of Glasgow that enjoys the entertaining name of Strathbungo, before reaching St. Enoch terminus. On the other hand the "*Royal Scot*" has but two brief stops, one at Carnforth to change engines and the other at Symington to divide the train. Then, as previously mentioned, the Midland grades are, on the whole, the heavier of the two routes, notwithstanding the West Coast ascents to Shap and Beattock Summits; the Midland tops both with 1,167 ft. altitude at Ais Gill, among the Westmorland fells. Again, both in England and in Scotland, the Midland route is hampered in places by the necessity for cautious running over certain lengths of line where colliery workings underneath have caused subsidences of the track; here is another reason for minutes added to the train schedules.

Despite the extra time involved, however, the Midland route is still a favourite with many travellers. At the time when the railways were grouped together it was freely prophesied that Scotch expresses would cease to run from St. Pancras to Edinburgh and Glasgow. But all the intermediate towns and cities have to be considered, for these trains convey passengers from London to Leicester, Sheffield, Leeds

Leading Dimensions of L.M.S. 4-4-0 3-cyl. Compounds (Latest Series)

Cylinders H.P. (One) Diameter ...	19 in.
,, Stroke	26 ,,
,, L.P. (Two) Diameter ...	21 ,,
,, Stroke	26 ,,
Driving Wheels, Diameter ...	6 ft. 9 in.
Heating Surface, Tubes	1,170 sq. ft.
,, ,, Firebox	147 ,,
,, ,, Superheater ...	291 ,,
,, ,, Total	1,608 ,,
Firegrate Area	28.4 ,,
Working Pressure	200 lb. per sq. in.
Tractive Effort (at 85 per cent. working pressure)	24,065 lbs.
Water Capacity of Tender	3,500 gals.
Coal ,, ,, ...	5½ tons
Weight of Engine and Tender, in working order	104 tons 8 cwts.

and Bradford, as well as from the same towns to Carlisle and Scotland. To those to whom scenery is a more important consideration than time the Midland route will always appeal, because it is, without question, the most scenically attractive of all the three ways to Scotland.

So it is still possible, fortunately, to go to St. Pancras and take a ticket for Glasgow, and somewhere about half-past nine in the morning we find ourselves, after a brief pause to admire the handsome Gothic exterior of the terminus — the most artistic station building in London —passing into the station and on to No. 4 platform.

As terminal stations go, St. Pancras is small. It has only seven platforms in all, but most of the trains from the northern suburbs dive downward to join the Metropolitan line for Moorgate, so that St. Pancras has little more than main line trains to deal with. It is the one great roof span that is the chief internal feature of the station. Actually the trains are up in the roof, the main ties of which pass completely under the platforms. The major part of the building is a vast storage for the beer produced at Burton-on-Trent. It is said, indeed, that the unit of measurement to which the architects worked was the dimension of a standard beer-barrel, in order to obtain the maximum amount of storage space possible. Thus the trains live, as it were, up in the attic!

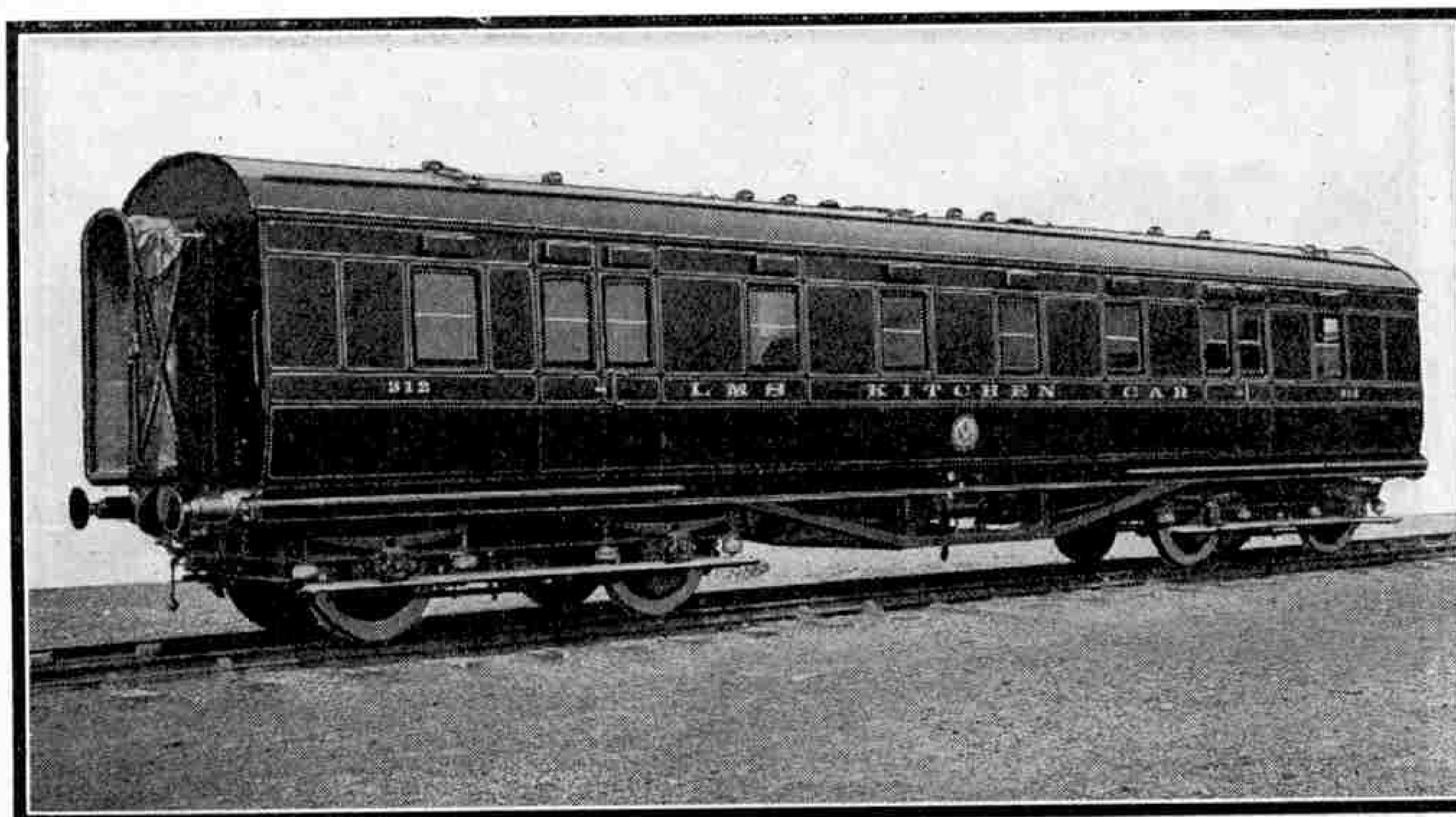


Photo courtesy] [*L.M.S. Railway*

Exterior View of L.M.S. Kitchen Car

The limited size of the station is typical of the train service. Light passenger trains and locomotives of moderate weight and power have always been the ruling principle on the Midland. No 4–4–2 or 4–6–0 engines have ever yet been built for Midland metals. Up till now, 4–4–0 designs have been regarded as sufficiently powerful, but in order to maintain the fast timings of the Midland it has been necessary strictly to limit their maximum loads. Until comparatively recently the figure was fixed at 240 tons for the compound 4–4–0 engines on the fastest, or "Special Limit" trains. They are now allowed to take rather more, but anything over 285 tare tons—ten eight-wheeled bogie vehicles—on our 9.50 a.m. down is likely to occasion the provision of a pilot engine.

However, we shall find our train well within the one-engine limit. The increasing popularity of the old 9.30 a.m. down "Scotsman" led ultimately to its division. Now the Edinburgh portion leaves as a separate train at 9 a.m., serving Nottingham, Sheffield, Leeds and Skipton on the way to Carlisle; we stop, as previously mentioned, at Leicester, Chesterfield, Leeds and Hellifield. Thus, as the Edinburgh train hands over to us at Carlisle a through coach that it had "collected" at Nottingham—the coach having come down from London by a train calling at Bedford, Kettering and elsewhere—practically the whole of the Midland system in this ingenious manner gets a through service to Scotland.

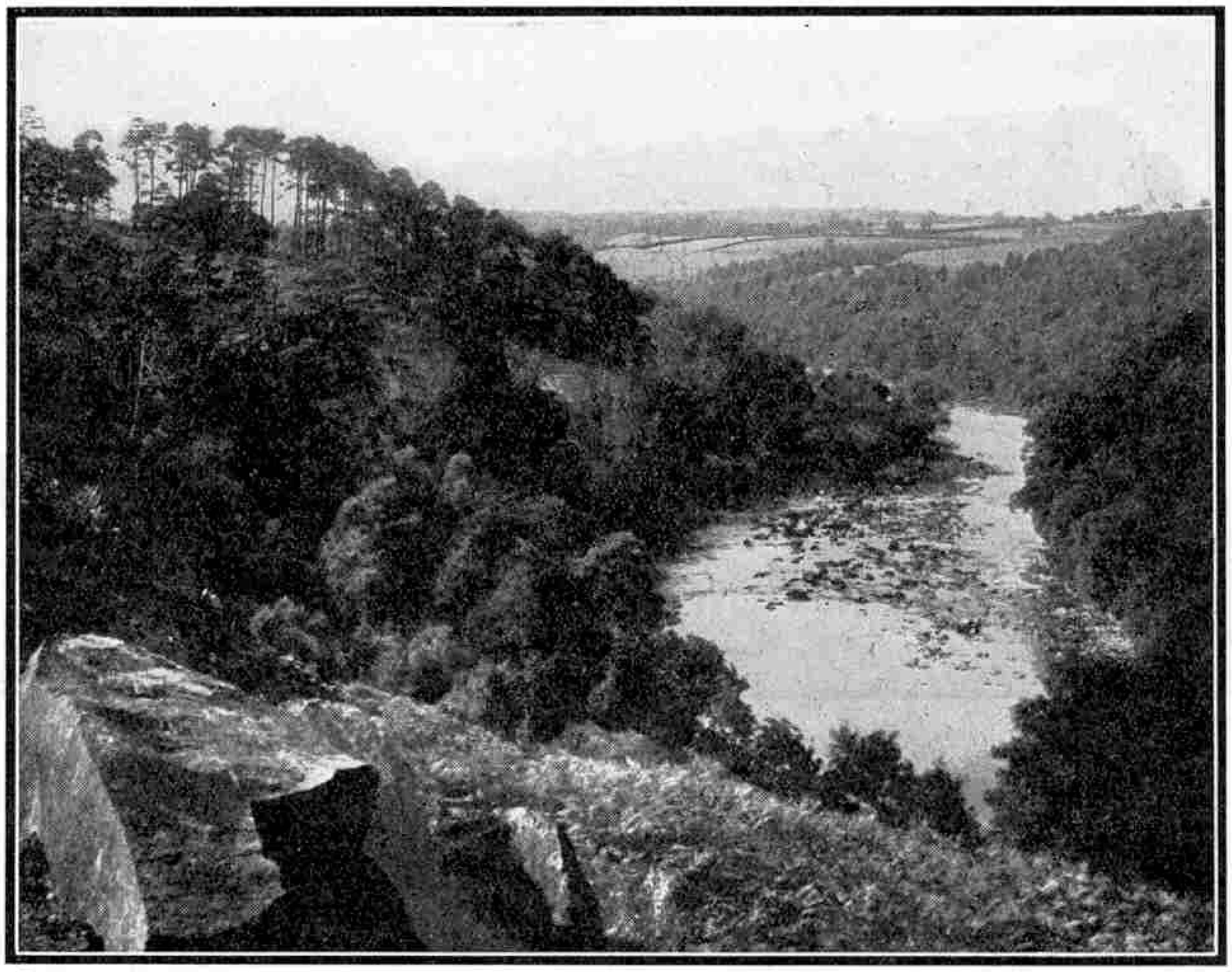
We shall find our train marshalled, from the rear, in this order—six-wheeled brake, first-class brake, open first-class car, kitchen car, two open third-class cars in succession, third-class corridor coach and third-class brake with, next the engine, a composite corridor coach that has come through from Tilbury in connection with the new Continental steamer service from Dunkirk. Extra coaches are added to the formation at busy times, but this 9-coach load is the minimum figure that applies throughout the winter months. The total weight behind the engine tender may be taken as about 250 tons.

Restaurant car fashions have undergone a considerable change on the L.M.S. system during recent years. On all the chief trains it is now the practice to use an independent bogie kitchen car, containing kitchen and pantry, with accommodation for the restaurant car staff, but none for passengers. The latter travel in the beautiful open saloon cars that flank the kitchen on both sides. These are now quite a standard feature on the L.M.S., and are so popular that a second open third-class car is run in our train formation for passengers who prefer that kind of travel to confinement in a compartment.

Our engine, of course, is a three-cylinder compound 4–4–0 of the Midland. In all the chequered history of locomotive compounding in this country, only the familiar Midland compound design can be held to have achieved real success. It originated with Mr. S. W. Johnson away back in 1902, and so is now a quarter of a century old. Subsequently Mr. R. M. Deeley introduced modifications of the design, and in particular of the regulator and valve-motion, and further improvements have been made by Sir Henry Fowler. To-day the Midland compounds share with the latest Great Western 4–6–0 types the distinction of being the most efficient express locomotives—on the true thermal efficiency basis, that is, of power developed in proportion to coal burned—that we have in the country. In recent years, therefore, this has been the most-multiplied of all L.M.S. express passenger designs, the 45 engines that comprised the Midland "stud" at the time of the grouping having now expanded to something like 200 in all. These are at work on all parts of the system, in both England and Scotland.

This is not to say that the Midland compounds are the most powerful engines on the L.M.S. system: far from it. When first they appeared on the Western division—the late L. & N.W.R.—the mistake was made of imagining that they could do the same work, in maximum conditions, that could be done, say, by the 4–4–0 " George the Fifths " of corresponding weight. They could not do this, however. The double expansion of the steam has the effect of so lowering the " terminal " pressure—at which the exhaust leaves the blast-pipe—as to make it practically impossible to " thrash " the Midland compounds by driving them at long cut-offs and wide regulator openings and then burning coal at a very uneconomical rate to furnish the necessary amount of steam. But, within their limitations, the Midland compounds are extremely economical engines, and in these days of costly coal this is a consideration of no mean importance. They probably need more " brains " to drive properly than a simple 4–4–0, but drivers who have learned to handle them are loud in their praises—provided they are not overloaded.

The " tare," or empty weight of our train to-day is 235 tons, and this is a nicely manageable load for our engine. There is a fairly steep incline out of St. Pancras, and for years past it has been the custom to allow the engine that has brought in the coaches to assist in the departure by giving a friendly " shove " out of the platform and for a few hundred yards beyond. Thus we get a good start, which is the more needed in that we have only 109 minutes in which to complete the first 99 miles, to Leicester.



Courtesy] [*L.M.S.*

Samson's Chambers, a magnificent view from the line in the Eden Valley

If you were on the footplate, you would be interested to notice that our driver only opens his regulator a very little way on starting. The secret of the Deeley regulator is that in this position, known as the " first port," a small opening on the back of the regulator takes high-pressure steam direct to the two outside low-pressure cylinders, so that the engine starts as a two-cylinder simple. As soon as the train was well under way, we should see the driver bring the cut-off well back and then push the regulator right over, so changing to full compound working. The steam is now being carried to the centre, or high-pressure cylinder, and then, after a partial expansion there, on into the receiver, from which it passes to the two low-pressure cylinders for further expansive working.

In common with all the Northern lines, the Midland has to climb out of the Thames Valley. The Midland climb is in three distinct stages. First of all there are 4½ miles up, largely through tunnels, steepening from 1 in 182 to 1 in 162, nearly to Cricklewood. From here we get a sharp drop of a couple of miles to the point where we cross the southern arm of the sheet of water known as the " Welsh Harp." Just beyond Hendon, which we pass at a shade under 60 miles an hour, there begins a five-mile rise to Elstree, skirting for some distance on the left the Hendon Aerodrome and finishing through Elstree Tunnel. Then follows a second " breather," of three miles down to Radlett, on which we may expect to reach between 65 and 70 an hour, as a preliminary to the five-mile climb past St. Alban's, mostly, like the Elstree climb, at 1 in 176 or so. From the 21st to the 34th mile-post there are sharp undulations, during the course of which we dash through the big town of Luton, jointly famous for straw hats, Vauxhall motors and Skefco ball bearings. It is 30¼ miles to this point and we shall have taken, probably, about 36 minutes.

Now there is a glorious " racing-ground " ahead. Shortly after passing Leagrave—which, singularly enough, marks the beginning of the River Lea and not the end of it !—we begin, at mile-post 34, a descent of 15 miles almost without a break, mostly at 1 in 200, and superbly fitted, by the absence of curves, for very high speeds. If the driver be so minded we shall touch 80 at Flitwick and again below Ampthill ; in any case the speed is almost certain to reach or exceed 75 miles an hour. At 70 or so we dash across the Ouse, which marks the bottom of the descent, and fly through Bedford by means of the avoiding line, which leaves the station on the right. All but 50 miles from London here, in about 54 minutes' travelling time.

The gradients now steepen. For six miles from Bedford there are undulations, in the course of which we get our first replenishment of the tender water supply, from Oakley track-troughs. Then comes the worst " bank " on the line—or during the first 200 miles of our journey, at any rate—the ascent past Sharnbrook to mile-post 56¾ being for 3¾ miles at 1 in 119. The descent on the farther side, past Irchester to Wellingborough, is pretty nearly as bad. To ease the working of freight trains, when the goods lines were added, this " peak " was cut out completely by the adoption of a different location, well to the east of the main line. The goods lines can be seen on the right, dropping below the main line into Sharnbrook Tunnel, over a mile in length, whereas the main line is in the open air all the time. The effect of the ascent will be to reduce our speed to rather under 40 miles an hour, and in the subsequent descent the line winds rather too much to encourage high speeds by way of compensation.

Another nasty climb begins at mile-post 70 and continues for eight miles past Kettering, which town, 72 miles from St. Pancras, will be passed in 77 minutes or slightly less. There are bits as steep as 1 in 118 and 1 in 132 in this climb, which leads to Desborough. Then follows a fall of 4½ miles at 1 in 132 to Market Harborough, where again the momentum of the descent is lost by the necessity for slowing to 45 miles an hour over the sharp curve through the station. Yet another four-mile climb to Kibworth, a drop to Wigston, a slack over the Wigston junctions, and we roll under the roof of the fine Midland Station at Leicester at 11.39 a.m., on time.

This run of 99 miles is the longest non-stop break that we shall make to-day. To the credit of the Midland Scotch services, too, it may be said that the 109-minute booking from London to Leicester, and the even faster 107-minute timing up—involving average speeds of 54.5 and 55.5 m.p.h. respectively—are the fastest made by any Anglo-Scottish trains on all the three routes, with one Midland exception that we come to presently.

Our engine probably will work through to Leeds—quite a strenuous four hours for the engine-crew, with a total mileage of 196 from St. Pancras. The Leicester-Leeds stage of the journey is not so interesting as there is little opportunity for speed, except along the beautifully level reaches of the Soar valley from Leicester to Trent, where we cross the famous river of that name. We shall attain from 65 to 68 miles an hour at Loughborough, taking a fresh water supply from Hathern troughs, and shall cover the 20¾ miles to Trent Junction in between 22 and 23 minutes. The complicated junctions, with their sharp curves, are threaded at a funereal pace, after which we climb up the Erewash Valley at 45 miles an hour or so. Special note should be taken, just beyond Ilkeston Junction, of the fine all-steel lattice viaduct of the L.N.E.R., which spans the valley at a great height.

To Chesterfield, the twisted spire of whose parish church is a singular and very prominent object on the left of the line, the 47 miles from Leicester require an hour; for the next 50 miles, to Leeds, we have 58 minutes allowed. By taking the direct line from Chesterfield down to Rotherham we miss Sheffield—and also, more important to the engine, the toilsome 1 in 100 ascent to Bradway Tunnel—and then ensues tolerably level travelling through a country of coal-mines, past Cudworth and Normanton, until we draw up in the Wellington Station at Leeds at 1.45 p.m. This is a terminal station, so our train is reversed.

A fresh three-cylinder compound is now attached, and we leave behind us the engine that has brought us from London. Five minutes are allowed at Leeds for the big exchange of passengers and luggage that takes place at this important station. When we leave at 1.51 p.m., it is possible that we may be piloted, as the train is now faced with the 65-mile climb to Ais Gill. This begins modestly enough. Away through Shipley and Keighley to Skipton, although the tendency is rising, there are few severe grades; then follows a stretch of eight miles up, partly at 1 in 130, almost to Hellifield. For the 36 miles from Leeds to Hellifield we have 48 minutes allowed which, despite slacks over the Shipley and Skipton curves, is an easy schedule.

A three-minute "breather" at Hellifield, and then away again, at 2.43 p.m. Now comes the real test of compound ability. After 3¼ miles falling to Settle Junction, down which we shall rapidly accelerate to 60 miles an hour or very slightly over, our driver has in front of him no less than 14½ miles continuously, not only up, but very steeply up—mostly, in fact, at 1 in 100—until we pass into the shelter of Blea Moor Tunnel. That temporary shelter is particularly welcome at times when the wind is blowing like a hurricane across the fells, for the railway is in parts terribly exposed, and the tunnel is over a mile in length. On the upper part of the climb, and again after the tunnel, as we run round the head of Dent Dale at a great altitude, the views are simply magnificent—Nature at her wildest. The Yorkshire summits of Whernside, Ingleborough and Penyghent are prominent features in the landscape. From Blea Moor to Ais Gill is an elevated table-land, the summit signal-box, at Ais Gill, being 1,167 ft. above the sea. Incidentally we take water, at Hawes Junction, from the highest track-troughs in the world.

In covering the 28½ miles from Hellifield to Ais Gill we shall do well if we take no more than 41 minutes, maintaining 35 miles an hour or so up the 1 in 100 climb to Blea Moor.

Now we have a swift run down to the Westmorland county town of Appleby, not more than 17 minutes being needed for the 17½-mile spin from the summit. A stop of one minute suffices here, after which the gradients are again mostly falling to Carlisle, the booked time for the 30¾ miles being only 33 minutes, start-to-stop, including the slow approach to Carlisle, and affording the fastest start-to-stop run of the journey. We may attain 80 m.p.h. in keeping this 55 m.p.h. schedule, but speeds from Ais Gill down to Carlisle are not generally allowed to exceed 75 or so, owing to curves.

There is more wonderful scenery on the way down from Appleby to Carlisle, first of all on the left, where Helvellyn, Skiddaw and other Lake District mountains come into view, and then on the right, where we overlook the sinuous course of the River Eden, flowing between sandstone cliffs far below. On reaching the Border city of Carlisle—most outstanding of all railway centres, with the possible exception of York, in the opportunities of locomotive observation that it offers to the railway enthusiast—at 4.15 p.m., we have travelled 309 miles from London. The "*Royal Scot*," with 10 miles less to go, sailed through half-an-hour previously.

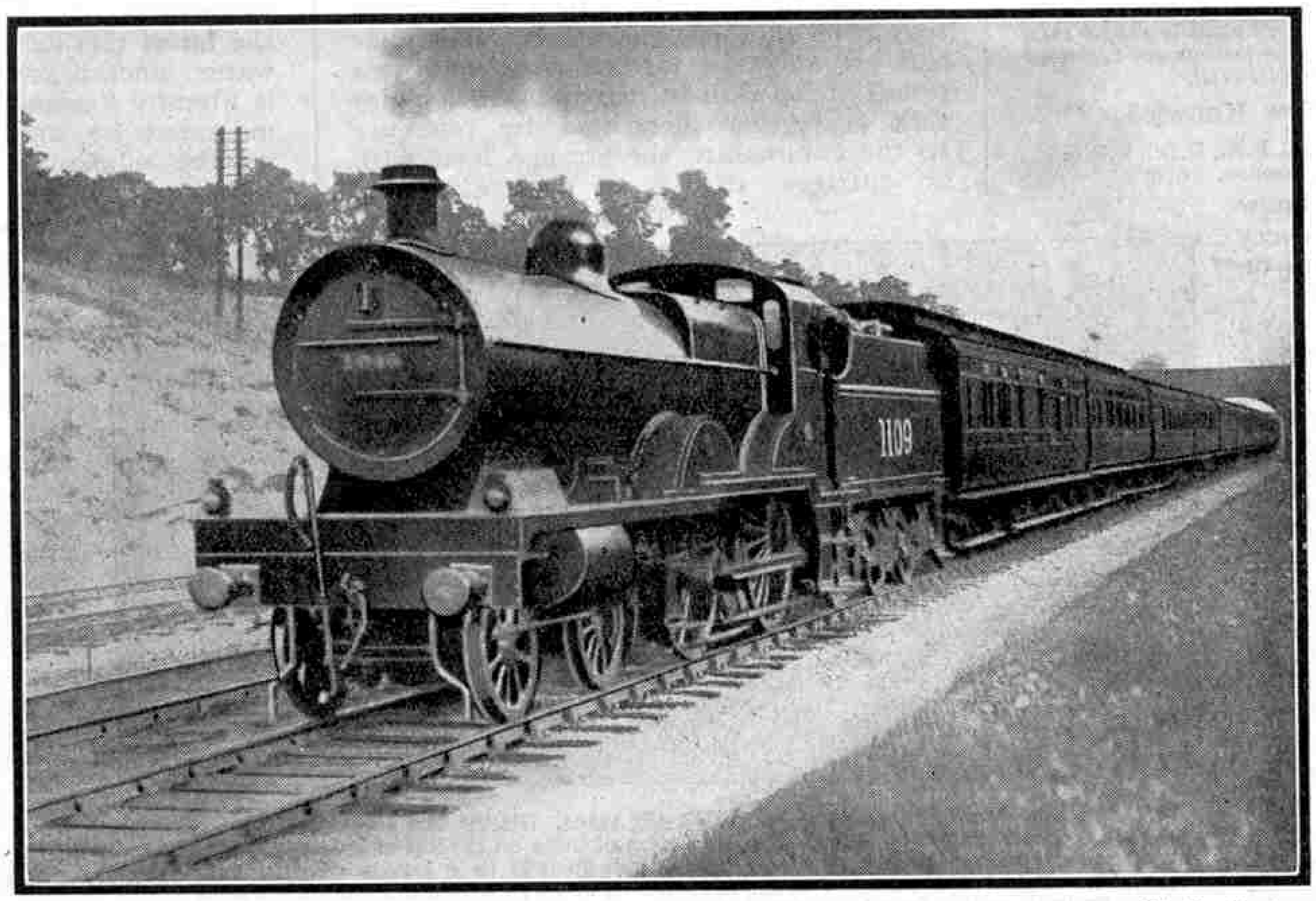
Off comes our compound, and on comes yet a third, for the remainder of the journey to Glasgow. Three engines thus divide up between them the 424½-mile journey, in the proportions of 196, 113 and 115½ miles respectively. With the fresh engine comes on the coach that left London at 7.45 a.m., more than two hours before us, travelling down by way of Nottingham and Sheffield. Possibly another third-class corridor coach may be added as well, in which case the gross load will be now round about 310 tons.

Little space remains in which to describe the rest of the journey, but it is of unfailing interest. For the 33 miles of undulating grades to Dumfries we are allowed 44 minutes, but within the compass of this time may be required to stop and set down passengers at the mid-way station of Annan. We run out of Carlisle over the old Caledonian main line to Gretna and then diverge to the left, skirting the Solway Firth on the left, with the mass of Skiddaw across the water opposite, and Criffel a prominent object in front of us. Just before Gretna track-troughs have recently been laid—the first to make their appearance in Scotland.

After Dumfries comes some stiff climbing, although the old Glasgow and South Western main line falls far short in maximum altitude of the neighbouring Caledonian 1,015 ft. at Beattock. Still, there is not much intermission in ascending between the 29½ and the 57th mile out of Carlisle—27½ miles in all—with many miles up at 1 in 200 and then at 1 in 150, past Thornhill and Carronbridge. There is a welcome downhill break of 4½ miles from Carronbridge Tunnel, where the line winds through a deep wooded gorge, amid magnificent scenery. On the level stretch of the bleak uplands of Ayrshire, near New Cumnock, further water-troughs have been laid—the last over which we shall pass. Then we have 17 miles of falling grades, nearly to Kilmarnock, down which speed is usually strictly moderated owing to curves and speed reductions through colliery areas. The descent does not become steep, however, till we have threaded Mossgiel Tunnel, beyond Mauchline, after which there are 4½ miles down at 1 in 100. From Dumfries to Kilmarnock, 58½ miles, we are allowed 72 minutes.

Much the steepest grades of the journey occur in the final 24 miles between Kilmarnock and Glasgow, where we may need pilot assistance. The climb from Kilmarnock to Dunlop includes 1½ miles at 1 in 87 and two miles at 1 in 75; and from the other side of the flat "table-land" past Lugton and Caldwell we descend even more steeply, with 3½ miles continuously at 1 in 67 to 1 in 70. We are now in the southern outskirts of Glasgow, and after making the conditional—but customary—halt at Strathbungo, we roll slowly over the Clyde round the wide curve into St. Enoch terminus punctually at 7.6 p.m.

Since these lines were written, announcement has been made that the 9.50 a.m. express from St. Pancras to Glasgow is to run on an accelerated timing throughout the winter, the arrival time at St. Enoch's Station in Glasgow being at 7 p.m., instead of at 7.6 p.m. Details of the speeding-up are not at the moment available, but it is probable that the 6 minutes' gain will be lopped off the easy schedules north of the Border, for there is very little time to spare, as we have seen, between London and Carlisle. New names, too, are to be bestowed on certain of the expresses on this service. The 11.45 a.m. from St. Pancras to Glasgow, over the same route, is to be known as the "Thames-Clyde Express," and the 9.0 a.m. from St. Pancras to Edinburgh, which has preceded us to Carlisle, as the "Thames-Forth Express."



Photo] [F. E. Mackay

Down Midland Scotch Express near Mill Hill
It should be noticed that compound No. 1046 has "borrowed" No. 1109's tender!

Books to Read

Readers frequently write asking if we can recommend books that are both of interest and of use. On these pages we review books that will specially appeal to readers of the "M.M." We do not actually supply these books, which may be obtained either through any bookseller or direct from the publishers.—EDITOR.

"Old Trades and New Knowledge"

By Sir WILLIAM BRAGG, K.B.E., D.Sc., F.R.S.
(G. Bell & Sons, London. 8/6)

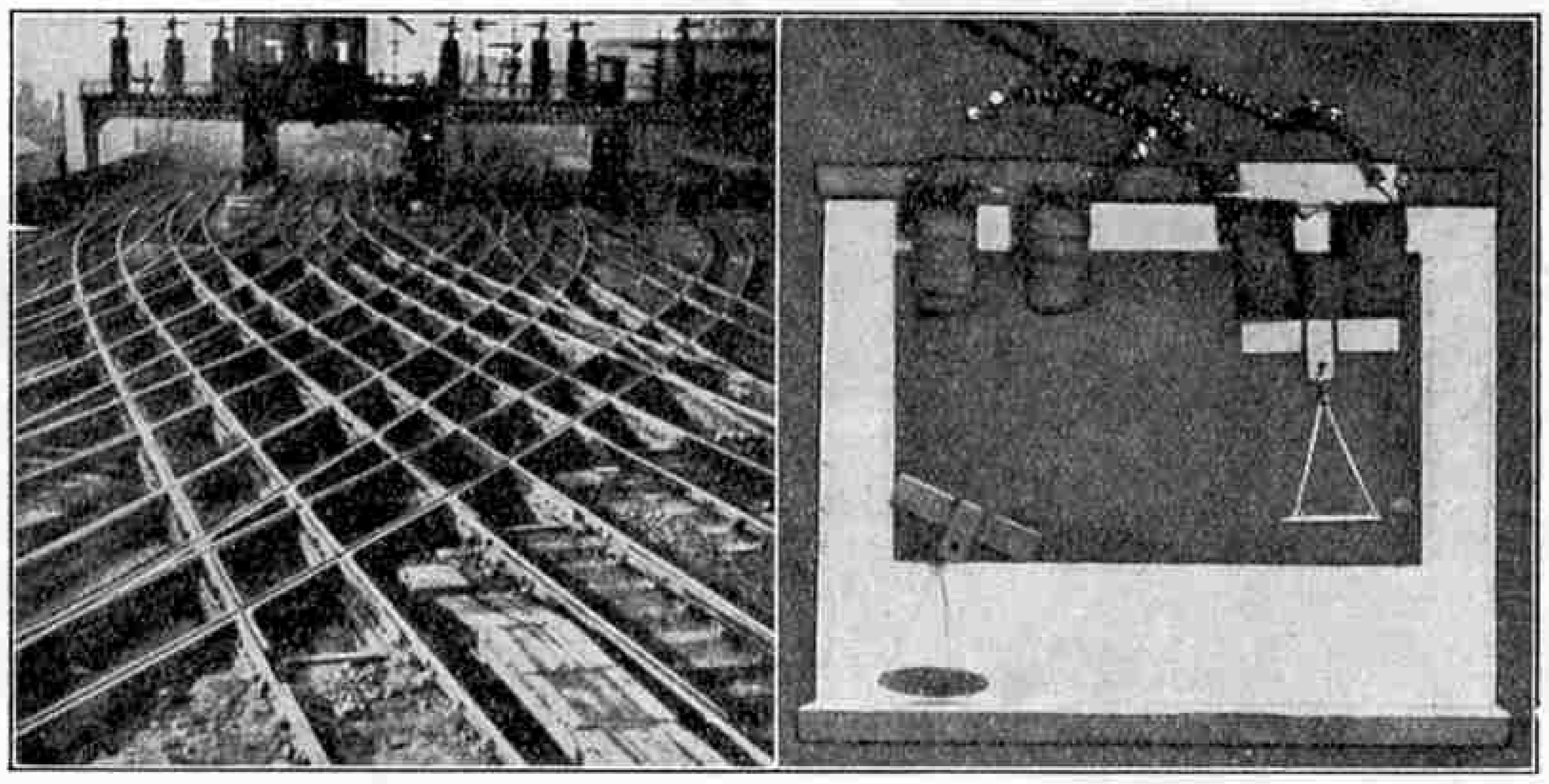
Many readers will know that at Christmas time every year a series of lectures on scientific subjects for a "juvenile audience" is given at the Royal Institution in London. This series is an historical one, for the first lectures were delivered nearly a century ago by Michael Faraday, whose talent for telling the story of scientific discovery in a simple and interesting manner is justly famous. Sir William Bragg, his successor in the post of Director of the Royal Institution, has already shown that he is no less able to awaken interest and wonder, and his previous lectures have been a source of enjoyment not only to his "juvenile audience" but to many grown up people also. For his Christmas lectures of 1925 he chose a really fascinating subject, the application of scientific discoveries to six very important trades. These lectures have now been published under the above title and the book is one that should appeal strongly to all our readers.

The six staple trades dealt with are those of the sailor, the smith, the weaver, the dyer, the potter, and the miner, all of them trades in which science plays a great part at the present day, and the title "Old Trades and New Knowledge" indicates the lines on which Sir William proceeds.

He points out in the first lecture that "the history of an old trade is always of interest, because it is a story of human efforts to achieve something. Every little success has come, in all likelihood, only after many failures. The very tools of the trade have something to tell us, if we can understand their language. The shape of a hammer or of a sail, the design of a loom or miner's lamp—each of them is the result of years of experience in actual use."

This story of the accumulation of knowledge in each of the trades considered is extended by an account in simple language of the striking advances made as a result of the application of modern scientific methods.

In "The Trade of the Sailor," for instance, we start from the primitive dug-out and the papyrus boats of the Egyptian bird-hunters. It is made plain that even in those early times the sailor had an affection for his boat and was proud of his skill in managing it, a point that is further illustrated by reference to the catamaran, the strange boat with an outrigger that is of such absorbing interest to the natives of the Western Pacific.



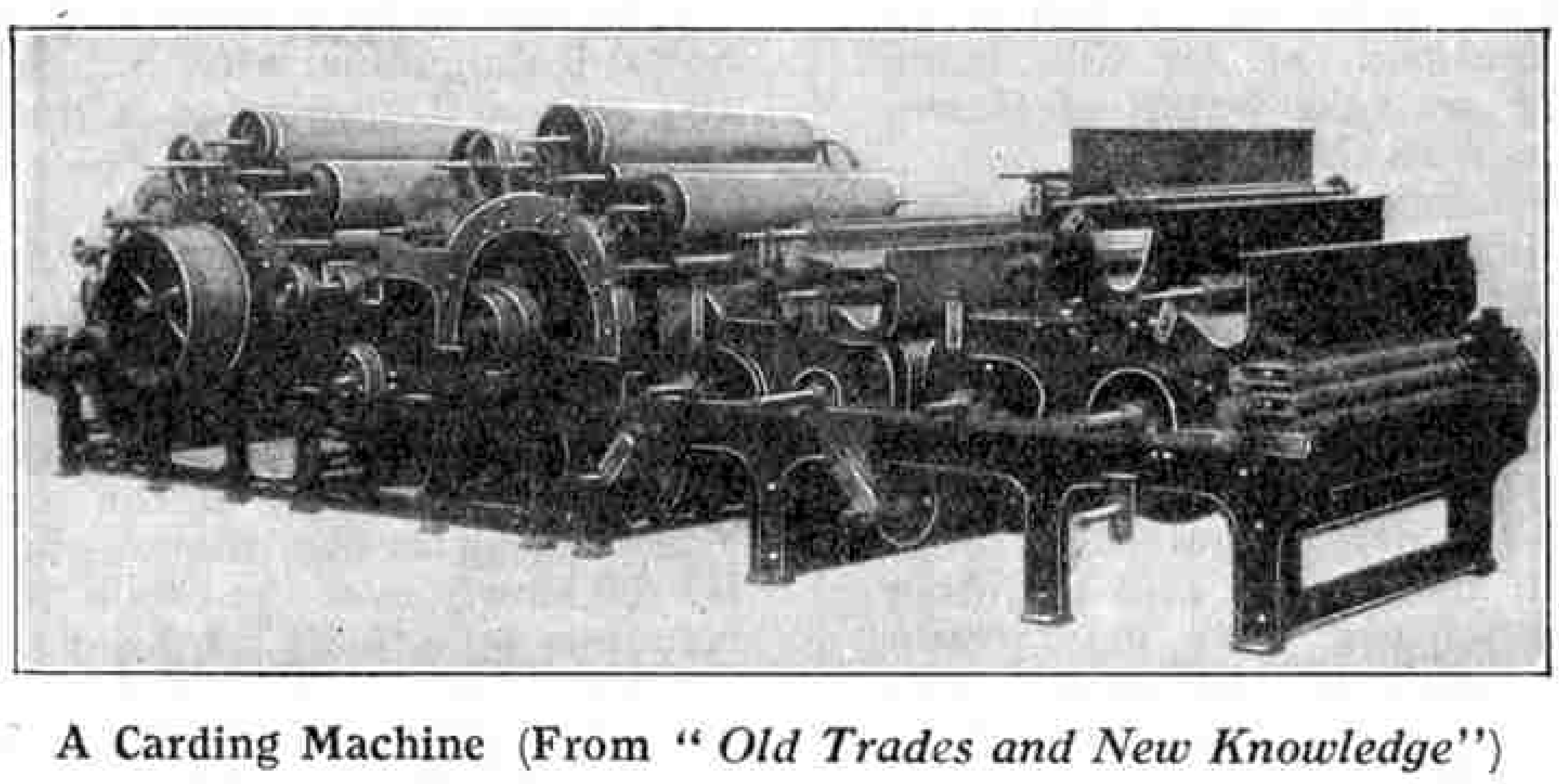
(Left) Crossing where Manganese Steel is of great value. (Right) The cores of the two electro magnets on the right are of soft iron and the cores of those on the left of mumetal. When the same current runs through both they are each able to hold up a certain weight. When the current is switched off the magnet on the left instantly drops its weight but that on the right holds on to its weight for a brief period, by virtue of the residual magnetism in the iron (From "Old Trades and New Knowledge")

Of the many problems that were solved in the development of the sailor's craft, one is considered at length. This is how to find position when land is lost sight of, and Sir William shows how the early navigators made use of the astrolabe and the cross-staff for this purpose. These instruments and a crude magnetic compass were sufficient to guide Columbus across the Atlantic Ocean, but gave way later to the more useful and accurate sextant. Finally, in the seventeenth century, John Harrison, a Yorkshire carpenter, solved the long outstanding problem of finding longitude by his invention of a chronometer that varied less than two minutes on a voyage to the West Indies and back again.

The tale is completed by lucid accounts of more recent inventions such as the gyroscopic compass, the leader cable, and the latest method of finding the depth of water underneath a ship. This latter is literally "sounding," for in it depth is measured by finding the time required for the echo of a sound to return from the bottom of the sea.

The talks on other trades follow a similar course. In "The Trade of the Smith," the story proceeds from the crude smelting operations of early civilisation to the study of the structure of metals by the microscope and X-Rays. In "The Trade of the Weaver" we read how the main problems were solved long ago by the distaff, the spindle and the crude hand-loom, and how the advent of machinery has affected the trade. This leads to a discussion on the effect of moisture on cloth, and from this we pass to the nature of the fibres themselves, a subject that is greatly interesting scientists at the present time.

The lecture on "The Trade of the Miner" is particularly interesting as it not only deals with the principles of mining in a simple manner, but also describes the invention of the steam-engine and its application to mining machinery. Great interest is added to this lecture and that on the smith by the quaint illustrations from old books, particularly from Agricola's "*De Re Metallica,*" a treatise on metals written nearly 400 years ago.



A Carding Machine (From "*Old Trades and New Knowledge*")

The illustrations, whether plates or drawings in the text, are in fact a feature of the book. They are illustrations in the literal sense of the word and add greatly to the charm of Sir William's naturally interesting style. The result is a really delightful book.

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"How to Make Models"

By G. E. HOPCROFT
(Brown, Son & Ferguson Ltd., Glasgow. 1/- net)

For the boy who likes to make things for himself—and how many boys do not?—this little book should prove very useful. Its price is very modest in view of the amount of information it contains, for there are complete instructions for making twelve good models, including an aeroplane, a paddle-wheel steamer and a yacht.

Hornby Train enthusiasts will be particularly interested in two of the models, a tunnel and a tubular bridge, both of which are designed for use with model railways.

"The Locomotive of To-day"

(The Locomotive Publishing Co. Ltd. 5/-)

In its eighth edition this book incorporates a useful feature in the inclusion of special pages facing the diagrams. On these pages a reader may supplement the drawings illustrated, with sketches of his own, or with any special arrangements of detail that he may desire to record and keep for reference. In its new edition the book has been entirely re-written by competent experts in locomotive design and operation and the illustrations have been brought up-to-date.

The book is divided into five sections, each of which deals with a distinct portion of the locomotive. These are :—
(1) The boiler and its fittings; (2) the engine—its motion, valve gear, etc., (3) the framing or carriage; (4) the tender and its equipment and (5) special types and designs of locomotives with illustrations of many in service.

Whilst the compilation must necessarily be incomplete as an encyclopædia of locomotive detail and working, there is no doubt that the book will be found sufficiently comprehensive to form a useful book of reference for all interested in the design, manufacture and operation of the steam locomotive of to-day.

There are 64 full page plates of drawings to make clear the text and an excellent folding chart showing a sectional view of a 4–6–2 three-cylinder "Pacific" express locomotive (designed by Mr. H. N. Gresley, C.B.E., Chief Mechanical Engineer, L.N.E.R.) adds considerably to the value of the book. There are 241 number references on this chart.

It is pleasing to find that the book has been well indexed as in a volume of this nature a good index is of inestimable value.

* * * *

"Mechanisms"

By E. S. Andrews

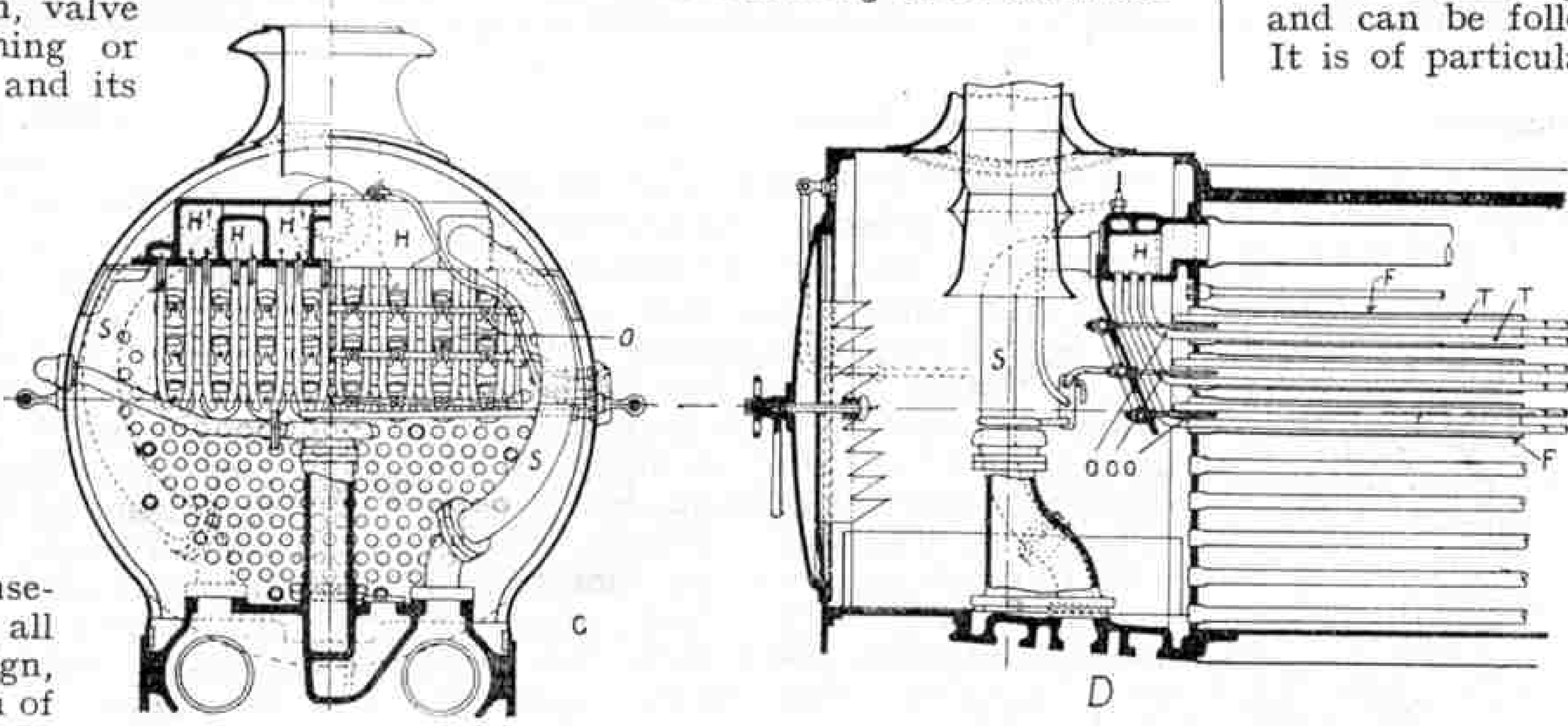
(University Tutorial Press Ltd. 3/6)

This text book, for the use of non-technical students, will be of particular interest to readers of the "*M.M.*" Dealing with that part of applied mechanics commonly called "mechanism," it is intended for the use of those to whom the more advanced text books on this subject are either unavailable or unintelligible on account of their involving advanced mathematics and graphics.

The book attempts to explain in more ordinary language than is usually used in the orthodox text books, the principles involved in the leading types of mechanism, and to illustrate these principles by descriptions of modern machines that incorporate them. It is pleasing to recommend a book of this nature in which the author has come to the conclusion that many students fail to understand the principles of mechanics because of the common practice of reducing nearly everything to mathematical formulæ. As he points out, this may help students to pass examinations but it tends to obscure the real meaning of the results. In the present volume the author has attempted the difficult task of making the complicated matters of mechanism appear lucid. The illustrations are in keeping with this endeavour, for it has been assumed that those for whom the book is intended are not used to the complicated drawings of the professional engineer. The figures are therefore made easy to follow and in the earlier chapters the diagramatic illustrations are given in perspective form.

The book is divided into eleven chapters covering the following subjects :—General principles of mechanisms and machines; levers and pulleys; screw and linkage mechanisms; belt, chain, toothed, epicycle and differential gearing. Cam and ratchet mechanisms; governors; bearings; couplings; clutches and brakes; heat engines, etc.

To those interested in mechanisms and desirous of obtaining some classified knowledge of how they work, this book will be of great value, especially as it does not assume that the reader has undergone previous training, such as that given in the first years in an engineering college.



Two of the many excellent illustrations from "The Locomotive of To-day." These figures show superheaters and smoke-box arrangements

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"Heard This One Dad"

By Harold Pridham. (Fisher Unwin. 2/-)

Here is a collection of stories that boys have told to their fathers. It will appeal to all who have any sense of humour, and we have no hesitation in saying that both our youngest and our oldest reader will find "a laugh on every page." Here is one of the stories :—

First Boy: "I call my dog 'Sausage' because he's only half-bred."

Second Boy: "That reminds me of a goat we called 'Nearly' because he was all butt, and a prize cock we named 'Robinson' because he crew so!"

* * * *

"Field Astronomy"

By David Clark, M.A., B.Sc.

(Constable & Co., London. 10/6)

Primarily intended for engineers and surveyors and written by the Professor of Civil Engineering in the University of Dublin, this book deals with astronomical field work and describes the principles and practice of observations as performed by surveyors and engineers. Although the majority of readers may not have occasion to use the precise field methods employed in connection with the most extended surveys, an account of these is also given, it being considered that some knowledge of the methods and of their probable accuracy is desirable. One of the sections of the book deals with the interesting subject of the determination of longitude by means of wireless telegraphy.

The volume will prove of special service as a reference book for engineers who have not regularly to undertake astronomical work, and it should also meet the requirements of university and private students interested in the subject of surveying and geology. The book is divided into three parts—principles, instruments and observations—and is illustrated by diagrams and cuts. It has a useful index.

* * * *

"Pictorial House-Modelling"

By Hobbs. (Crosby Lockwood & Son. 6/-)

A practical manual explaining how to make models of buildings, this book will be of particular value to those who take an interest in this hobby. The modelling of small buildings is a fascinating pursuit and can be followed by old and young. It is of particular service to an architect and the making of models frequently enables his clients to appreciate the appearance and the suitability of the contemplated building in a manner that is impossible when only ordinary drawings are available. House-owners and estate agents should also find much practical interest in the subject.

There is, perhaps, no other pursuit that offers such a wonderful opportunity for the development of powers and observation. Even the construction of a simple model calls for a degree of accuracy and care, and develops the powers of observation necessary if the model is to represent an actual building and to incorporate its essential features.

A great recommendation for this pastime is the fact that the work can be carried out anywhere and does not require the use of extensive or elaborate tools. In the more advanced stages, of course, very complicated models are made for business firms, or for technical purposes, and there should be a good opening here for anyone who has a particular bent for this class of work.

The purpose of the present book is practical advice and assistance based on many years' experience of the subject, and the author hopes that it will be of service to the reader in introducing this novel and fascinating pastime. The book is excellently illustrated and not only shows views of different models and detailed views of the construction of different parts of a model, but also gives plans and diagrams.

Interesting New Books

We hope to deal with the undermentioned books in an early issue.

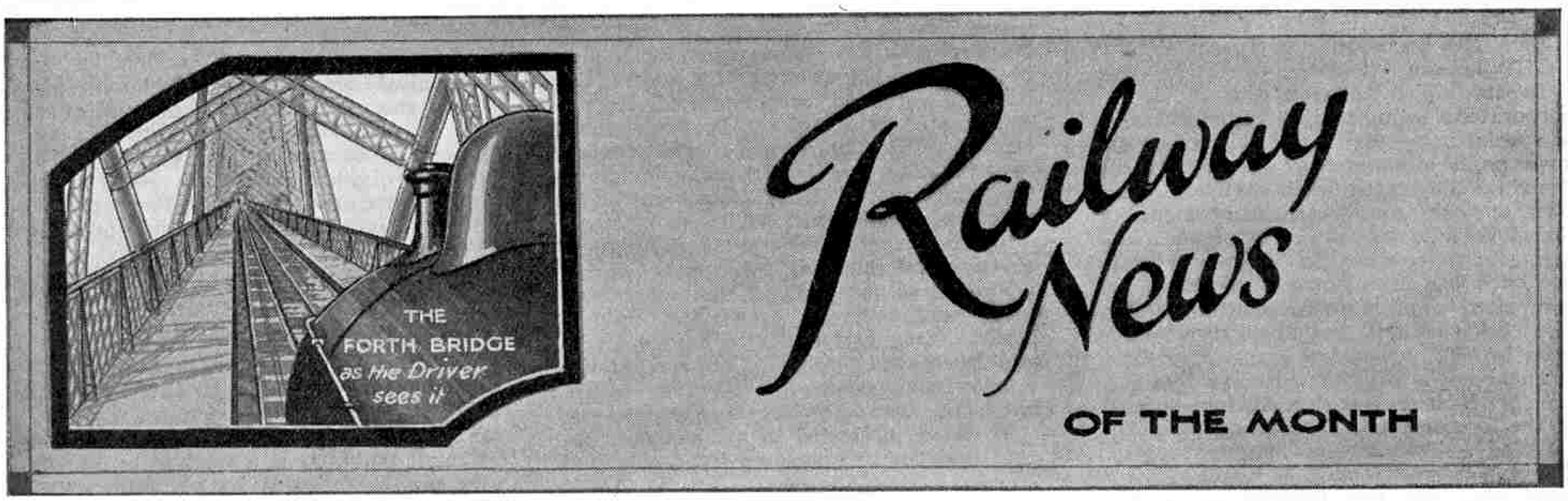
"Flags of the World, Past and Present" *by* W. J. Gordon (Warne), 6/-

"Bird Life, at Home and Abroad" *by* T. A. Coward, M.Sc. (Warne), 7/6

"The Fascination of our Railways" *by* "Mercury" (John Bale, Sons & Danielsson) 5/-

"How to make Clipper Ship Models" (Brown Son & Ferguson), 10/6

"Machine Sketches and Designs for Engineering Students" *by* A. Cruickshank, M.E Mech. E., and R. F. McKay, M.Sc. (Arnold), 2/6



L.M.S. Power Classifications

Several readers have enquired as to the meaning of small numbers appearing on the sides of the cab framing of L.M.S. locomotives. These are power classifications, under which both freight and passenger trains are placed in one of five groups numbered 1–5. No. P5 represents the most powerful classification in the passenger list and it is interesting to note that the latest Horwich built 2–6–0 locomotives are doubly classified as P5 and F4. Apparently they are graded separately for passenger and goods traffic.

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New Stock for Indian Electric Railways

All-steel passenger coaches to the number of 160 are at present being built at Messrs. Cammell Laird & Co.'s Nottingham works, for service on the electrified sections of the Bombay-Baroda and Central Indian Railway. This total includes 40 composite coaches each providing accommodation for 80 first-class and 90 second-class passengers; 40 composite coaches each seating 25 second-class and 110 third-class passengers ; 40 composite third-class and luggage driving trailer coaches each seating 108 third-class passengers, and 40 third-class motor coaches each seating 140 third-class passengers.

The coaches are 68 ft. in length and 12 ft. in width and have a total height from the rail to the top of the roof of 14 ft. 6 in. The exceptional width is accounted for by the fact that the coaches have been specially constructed for dealing with heavy traffic on suburban services.

* * * *

Paris to the Congo by Rail

The French Government have under consideration a scheme for the construction of a railway line across the Sahara desert. The ultimate destination of the line will be the French Congo and, using a train ferry for the Mediterranean crossing, goods and passengers will then be able to travel by rail direct from France into the Congo.

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Record Run by "*Flying Scotsman*"

On the Saturday before Whitsuntide, despite a crowded train weighing over 435 tons, the up "*Flying Scotsman*" succeeded in regaining nine minutes lost time between Grantham and King's Cross. The 82¼ miles from Stoke Summit to Hatfield were covered at an average speed throughout of 65 miles per hour. The locomotive responsible for this splendid recovery was Pacific No. 2545, "*Diamond Jubilee.*"

Busy Times at York

No less than 268 trains (320 on Saturdays) arrive at or leave York Station during the 24 hours, and on the occasion of a recent visit during the holiday season these figures were considerably exceeded. It is interesting to note that this famous station covers the site of an ancient Roman burial-ground, and that as many as 494 railwaymen are employed in or about it.

The down "Flying Scotsman," made up to 15 coaches, arrived on time behind "Pacific" No. 4471, "*Sir Frederick Banbury,*" and was taken on by No. 2579, "*Dick Turpin.*" The corresponding up "Flying Scotsman" arrived with 2573, "*Harvester,*" and left for the south with 4473, "*Solario.*" This train had duplicate sections in each direction, with engine changes as follows :—down section, 2557 "*Blair Athol*" giving place to 2577 "Night Hawk"; up section, 2581 "*Neil Gow*" giving place to two Great Northern "Atlantics," Nos. 4438 and 4424.

An express from Glasgow and the North with through coaches for the Harwich Continental Boat service arrived behind N.E. "Z" type "Atlantic" No. 734 and was taken on by Great Central 4–4–0 No. 5113. This was followed by another express from Scotland consisting of Great Western carriages and bound for that line via Sheffield and Oxford. Brought in by "Z" No. 2195, it departed with a Great Central 4–4–0, No. 5108, attached as pilot.

"Pacific" No. 2562 "*Isinglass*" arrived with an express ex King's Cross with through coaches to Fort William and North Berwick, also a portion for Scarborough. The Scottish portion of this train, consisting of ten cars was taken on by North Eastern mixed traffic 4–6–0 No. 2374.

One of the fastest L.N.E.R. expresses of the day is the "Scarborough Flyer." This train stops at York only in order to change locos. The up express was brought in to time by "Pacific" No. 4478 "*Hermit,*" and left again behind two North Eastern 4–4–0's, Nos. 1533 (pilot) and 2101 (Class R).

Several heavy special expresses were noted. An L.M.S. excursion Liverpool-Newcastle was taken through by "Z" type 4–4–2 No. 728, with 12 carriages on. A Scarborough-Manchester special had 14 vehicles behind a Class R 4–4–0, whose place was taken by one of the new L.M.S. "Moguls." This was followed by a second heavy train from Scarborough to King's Cross, whose engine No. 6072, a Great Central mixed-traffic 4–6–0, gave place to a Doncaster-built "Mogul." R.S.M.

L.M.S. Named Trains

After many years of apparent indifference to the public interest aroused in "named" trains, the L.M.S. have allotted distinctive titles to several of their important main line expresses. Among these are "*The Royal Scot,*" "*The Welshman,*" "*The Ulster Express,*" "*The Lakes Express*" and "*The Manxman.*"

"*The Royal Scot*" is the 10 a.m. express from Euston to Edinburgh and Glasgow, and the 10 a.m. Edinburgh and Glasgow train to London will form its counterpart, bearing the same name. "*The Welshman*" will leave Euston at 11.50 a.m. "*The Ulster Express,*" as its name implies, is for travellers to and from Ireland, and the train times are 6.10 p.m. out of Euston for Fleetwood and 6.5 p.m. Fleetwood to London. "*The Lakes Express*" will run between Euston and Windermere, the times being 11.35 a.m. from Euston and 11.25 a.m. from Windermere.

"*The Manxman*" will be essentially a holiday-makers' train and is intended for Isle of Man traffic. The train will leave Euston for Liverpool at 10.40 a.m. to connect with the Manx afternoon steamer, and leave Liverpool, Lime Street, for Euston at 2.0 p.m., thus affording a connection from Liverpool for the morning boats from the Island.

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"One-Piece Suits" for Engines !

The new 0–8–0 shunting locomotives introduced on the St. Louis Terminal Railway, U.S.A., embody a remarkable deviation from orthodox lines of construction, in that their cylinders, valve chests, etc., form part of one big steel casting with the underframe. In the mass production of locomotives this arrangement undoubtedly affords a big saving, for the single casting replaces 30 separate pieces. In addition to a saving of time in fitting, there is a big weight reduction, which in the case in point amounts to nearly 2½ tons.

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Joint Rolling Stock

From time to time various readers have asked how railway companies adjust the charges in respect of vehicles belonging to other companies working over their system. For regular services between two systems, one of the two companies concerned provides the coaches for half the working days and the other for the remainder. In the case of jointly-owned stock, payments are made in proportion to the mileage of the route over which the vehicles run. The adjustments are made through the Railway Clearing House, to which regular returns of the movements of rolling stock are made.

Locomotives' Home Addresses

In continuation of the list of locomotive depôt identification plates, we give below the principal particulars relating to the L.M.S. :—

Western Division (late L. & N.W. section) : Engines carry a label above the footplate, which bears the number of the shed to which they are allocated, as follows : 1, Camden ; 2, Willesden ; 3, Bletchley ; 4, Nuneaton ; 5, Northampton ; 6, Bescot ; 7, Netherfield and Colwick; 8, Rugby ; 9, Walsall ; 10, Aston (Birmingham) ; 11, Warwick ; 12, Burton ; 13, Bushbury ; 14, Stafford ; 15, Crewe (North and South) ; 16, Longsight ; 17, Farnley Junction : 18, Birkenhead ; 19, Chester ; 20, Huddersfield ; 21, Bangor ; 22, Holyhead ; 23, Warrington ; 24, Sutton Oak ; 25, Springs Branch, Wigan ; 26, Edge Hill ; 27, Preston ; 28, Tebay ; 29, Carlisle ; 30, Salop ; 31, Abergavenny ; 32, Workington ; 33, Swansea (Victoria Station) ; 34, Patricroft ; 35, Speke Junction ; 36, (not allocated) ; 37, Mold Junction ; 38, Llandudno Junction.

Late L. & Y. Section : Number of the Depôt to which the engine is allocated is shown by a small number plate attached to the centre of the engine cab, as follows : (1) Newton Heath ; (2) Low Moor ; (5) Mirfield ; (6) Wakefield ; (10) Goole ; (13) Agecroft ; (14) Bolton ; (16) Wigan ; (18) Bank Hall ; (19) Aintree ; (20) Bury ; (21) Bacup ; (22) Accrington ; (25) Lower Darwen ; (27) Lostock Hall ; (30) Fleetwood ; (32) Blackpool (Central). Omitted numbers apply to smaller and local depôts.

Midland Division : (1) Derby ; (2) Burton ; (3) Birmingham ; (4) Worcester ; (5) Brecon ; (6) Upper Bank ; (7) Gloucester ; (8) Bristol ; (9) Peterborough ; (10) Leicester ; (11) Wigston ; (12) Kettering ; (13) Wellingborough ; (14) Bedford ; (15) Cricklewood ; (16) Kentish Town ; (17) Toton ; (18) Nottingham ; (19) Liverpool ; (20) Buxton ; (21) Manchester ; (22) Westhouses ; (23) Hasland ; (24) Staveley ; (25) Sheffield ; (26) Normanton ; (27) York ; (28) Leeds ; (29) Bradford ; (30) Skipton ; (31) Carnforth ; (32) Lancaster ; (33) Carlisle. The higher numbers represent small depôts.

Northern Division : Aberdeen, Beattock, Carlisle, Carstairs, Dundee, Edinburgh, Forfar, Glasgow, (Balornock, Polmadie and Dawsholm), Greenock, Hamilton, Motherwell, Oban, Perth, Stirling, Corkerhill and St. Enoch (Glasgow), Kilmarnock, Dumfries, Stranraer, Ayr, Ardrossan, Inverness, Aviemore, Helmsdale, Wick, etc. These depôts do not, however, bear any distinguishing number, neither is the home station indicated on individual locomotives.

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"Gladstone's" Haul for Charity

On the day that the Southern Railway locomotive "*Gladstone*" was exhibited at Waterloo, as mentioned in our August notes, over 4,000 people paid for the privilege of inspecting the veteran, and £26/7/- was raised for the Woking Railway Orphanage. "*Gladstone*" was exhibited also at Brighton from 2nd to 7th May, during which period a further sum of £20/3/- was collected.

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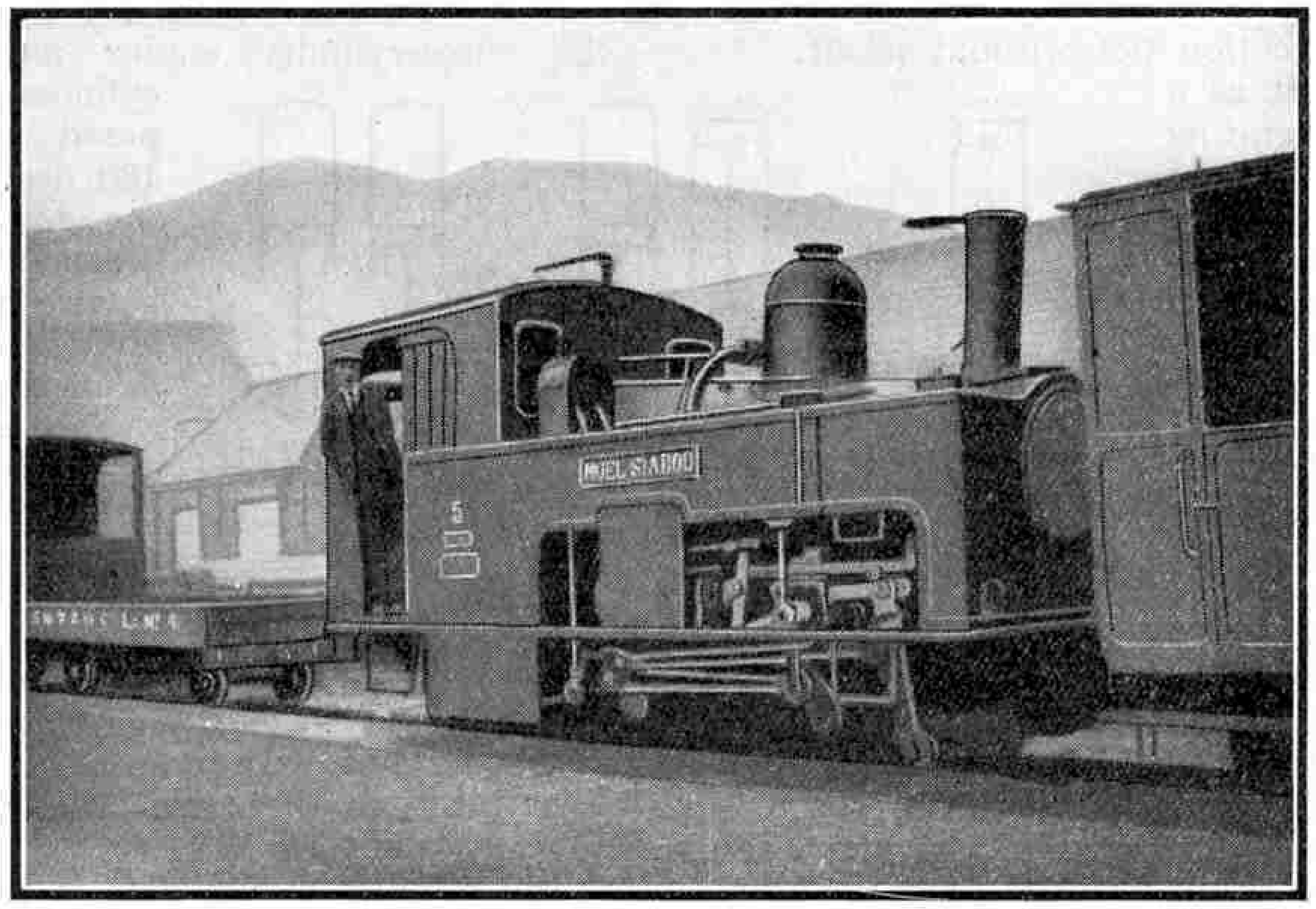
The L.M.S. "Garratts"

The L.M.S. Railway have taken into service three new locomotives of the "Garratt" type. These are to be employed for hauling heavy goods trains between Brent Sidings in London and Toton in Derbyshire, and will be the first "Garratt" locomotives to be engaged on ordinary traffic working in this country. They are not restricted to this route, however, for their dimensions are such that they can be employed on any of the L.M.S. Sections.

The wheel arrangement is 2–6–0 : 0–6–2 and an interesting feature of the coupled wheels is that their diameter, 5 ft. 3 in., is exactly the same as that of the new "Mogul" type mixed traffic engines recently introduced on this line. The total engine wheelbase is 79 ft., while the overall length is 87 ft. 10½ in. The boiler pressure is 190 lb. per sq. in. and there are four cylinders each 18½ in. diameter by 26 in. stroke. The tractive effort at 85 per cent. of the boiler pressure is 45,620 lb. The tender provides accommodation for seven tons of coal and 4,500 gallons of water and the engine in full working order weighs 148 tons 15 cwt.

A Railway up a Mountain



This interesting photograph of the engine used on Snowdon Mountain Railway was taken at Llanberis by E. Hall, of New Mills, Derbyshire

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G.W.R. Locomotives Change Names

Consequent upon the introduction of the new "King" class the Great Western Railway have found it necessary to allot new names to those locomotives of the "Star" class that have hitherto borne the names of various Kings. The complete list of changes is given below.

4021–"*King Edward*" to "*The British Monarch.*"
4022–"*King William*" to "*The Belgian Monarch.*"
4023–"*King George*" to "*The Danish Monarch.*"
4024–"*King James*" to "*The Dutch Monarch.*"
4025–"*King Charles*" to "*The Italian Monarch.*"
4026–"*King Richard*" to "*The Japanese Monarch.*"
4027–"*King Henry*" to "*The Norwegian Monarch.*"
4028–"*King John*" to "*The Roumanian Monarch.*"
4029–"*King Stephen*" to "*The Spanish Monarch.*"
4030–"*King Harold*" to "*The Swedish Monarch.*"

Engine No. 3257 of the "Duke" class, previously named "*King Arthur,*" has been deprived of its nameplate and for the present at least it is not intended to rename the engine.

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During the past few weeks several readers have written drawing our attention to the alteration in the decoration of the exterior of the Great Western coaching stock. The difference in appearance is created simply by the omission of the "lining out" previously used on the upper and lower panels.

News from Glasgow

L.M.S.R.

Of the new Deeleys in Scotland 900-908 (incl.) appear to be shedded at Polmadie, and 910-5 are on the G.S.W.R. section.

A recent excursion to London left with 1067 piloting 14637 on a 500-ton train—it was interesting to note that the Deeley was pilot engine.

For brisk starting there is no engine to touch 14438 of Dalry Road, and she has recently been observed getting away in great style.

The Royal Train to Scotland on 9/7/27 carried from Carlisle with Deeleys 1146 and 1144 (train engine).

Recent Leeds excursions from Glasgow left Queen Street as follows :—(1) "M" 4-4-0 9217 piloting Mogul 4694. (2) 9363 "*Hal o' the Wynd.*" (3) Director 6390. The first was easily the hardest run on 400 tons, and it was a magnificent piece of work for such a small 4-4-0 running throughout as pilot.

L.N.E.R.

On the Sunday express to Thornton, 9409 stuck on Cowlairs bank on 146 tons, and had to crawl back slowly to Queen Street Station, where 6381 (in from Edinburgh) coupled on at the back, and between them the two engines surmounted the bank.

There are now seven "Directors" at Haymarket, 6400 having been transferred from Eastfield. Atlantic 9877 is now at St. Margarets and 9904 "*Holyrood*" is at Haymarket. New 'N.2' G.E.R. 0-6-2T's observed in Glasgow are 2642/4. A Sunday excursion Edinburgh-Fort William changed engines at Eastfield, Atlantic 9903 (feed-water heater) giving way to 9496 and 9493 (train), on 310 tons.

The Sunday excursion to Crian Larich recently had Mogul 4691 (in from Fort William on the Saturday) and more recently N.B.R. suph. goods 9098. It is a pity to see this train worked by a black goods engine, but the men report that the engine is excellent on the job.

A recent 9.15 p.m. Sunday express to Edinburgh was overloaded (total 425 tons) and Director 6381 had as assistant 9494 "*Glen Loy*" (train engine). Another double header was the Crail excursion (800 passengers) 9256 piloting 9153.

Shortage of engines at Eastfield on Saturdays has sent 9185 and 9194 ('B' goods) to Grangemouth, 9329 'B' Abergoyle, 9103 'S' to Crail and 9143, 9518 'S' to Perth.

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L.N.E.R. Notes from London

G.E. Section—0-6-0 7875 was recently seen working with a weatherboard on the tender.

G.E. Section—4-4-0 8027, not yet in the L.N.E.R. livery, is owned jointly by March and Stratford sheds.

G.E. Section—4-4-0 8856 has recently been rebuilt as a "Super-Claud" ; other engines of this class are 8780—8789, 8791, 8805, 8813, 8818, 8819, 8846, 8847, 8853.

4-4-0 8794 has been fitted with top feed and 8898 with Ross Pop safety-valves.

Goods trains have been seen on the G.E. Section with various types of L.M.S. Brake vans, including one in the North Staffordshire livery.

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The United Dairies Limited, the largest milk distributing agency in London, has applied to the Ministry of Transport for powers to construct a light railway at Finchley in order to carry milk from its farms into London. It is proposed to use specially constructed glass lined tanks.

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Sixty locomotives for service as expresses and freight locomotives have just been built for the Polish State Railways at the Polish Chrzanow Works. For some considerable time the shortage of really powerful engines has been the cause of considerable inconvenience on the principal Polish routes.

The Music of Internal-Combustion Engines

By J. R. Nichols *

THE rhythmic beat of a smoothly running engine is music indeed to any one who takes pride in its performance and regards it as something more than a mere machine. To attempt to write down this music in ordinary musical notation may seem to be fantastical but it is a recreation not without profit.

Apart from its interest as a simple means of demonstrating the relative merits of various arrangements of multi-cylinder engines, the 'score' shows why it is that many a motorist can distinguish, by sound, not merely a two-stroke from a four-stroke engine, but even one make from another. In so doing he is helped, no doubt, by the different 'note' of various engines, but the 'beat' is at least of equal importance. To attempt to define the note in particular cases would lead us too far, but much may be learnt by confining our attention to the beat.

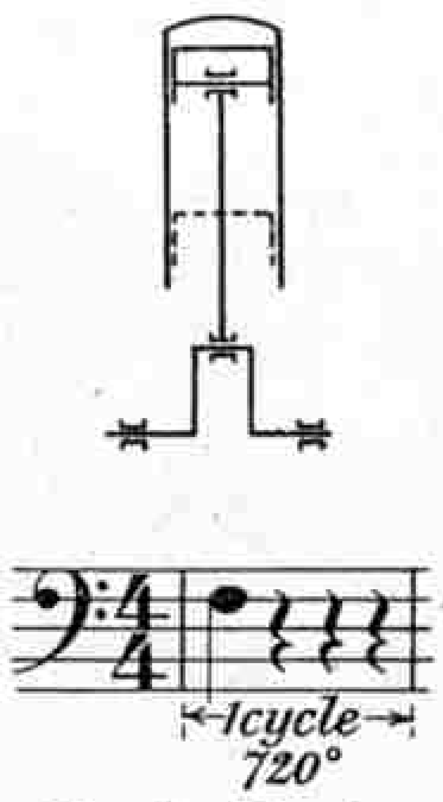

Fig. 1—Single-Cylinder Engine

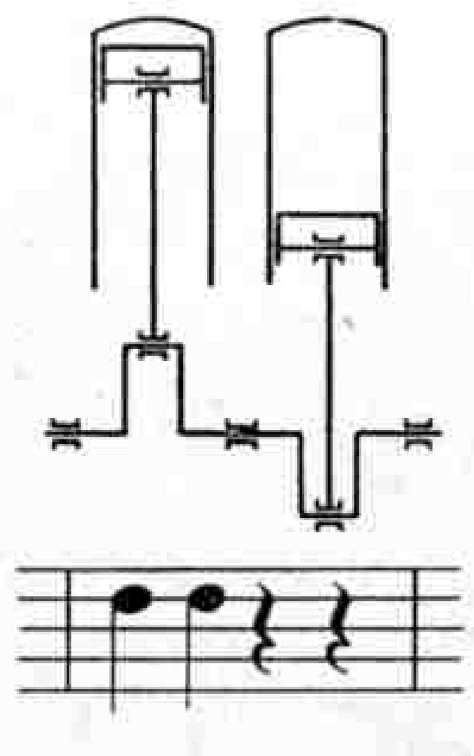

Fig. 2—Two-Cylinder Engine ; Cranks at 180°

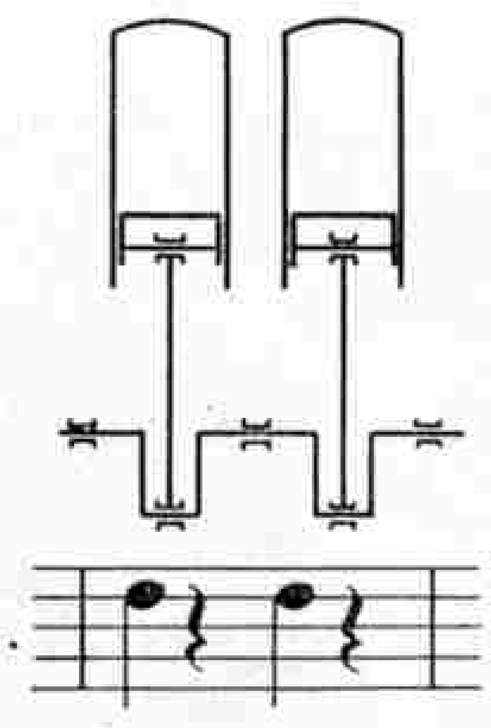

Fig. 3—Two-Cylinder Engine ; Cranks at 360°

Representing one complete cycle of suction, compression, power and exhaust by one bar, we may indicate the firing by one note—say F in the bass clef—and the other events by 'rests.' Each cycle being a repetition of its predecessor we need only consider one bar.

Taking first the case of a single-cylinder, four-stroke engine, there are four strokes to the cycle and each stroke (180 degrees of crank revolution) may be represented by a crochet. The engine will then be running in 'common time,' four beats to the bar ; the firing stroke being represented by a crochet and the three idle strokes (idle only inasmuch as they are not power strokes) by three crochet rests, as shown in Fig. 1.

As is well known, the single-cylinder four-stroke engine does not give by any means an ideal turning moment. A heavy flywheel is needed to maintain the speed during the three idle strokes, particularly if the engine is to be used for driving an electric generator.

With two side-by-side cylinders firing on consecutive strokes, the cranks being at 180 degrees, the musical notation is as shown in Fig. 2. This represents power strokes for two beats, followed by two 'rests.' This is obviously preferable to the one power stroke in four of the single-cylinder (Fig. 1), but we can do still better with two cylinders by using a crankshaft with its 'throws' at 360 degrees (Fig. 3). There are still only two power strokes per cycle (two notes per bar) but these are distributed evenly, each note being followed by a rest.

Four cylinders may be arranged with their cranks in either of the two settings shown in Fig. 4, the sequence of firing being (a) 1-2-4-3 or 1-3-4-2, and (b) 1-3-2-4 or 1-4-2-3. Whichever arrangement be used, the musical notation consists of a bar of four notes, i.e., there are four evenly-spaced power strokes per cycle, and this is the best result so far obtained.

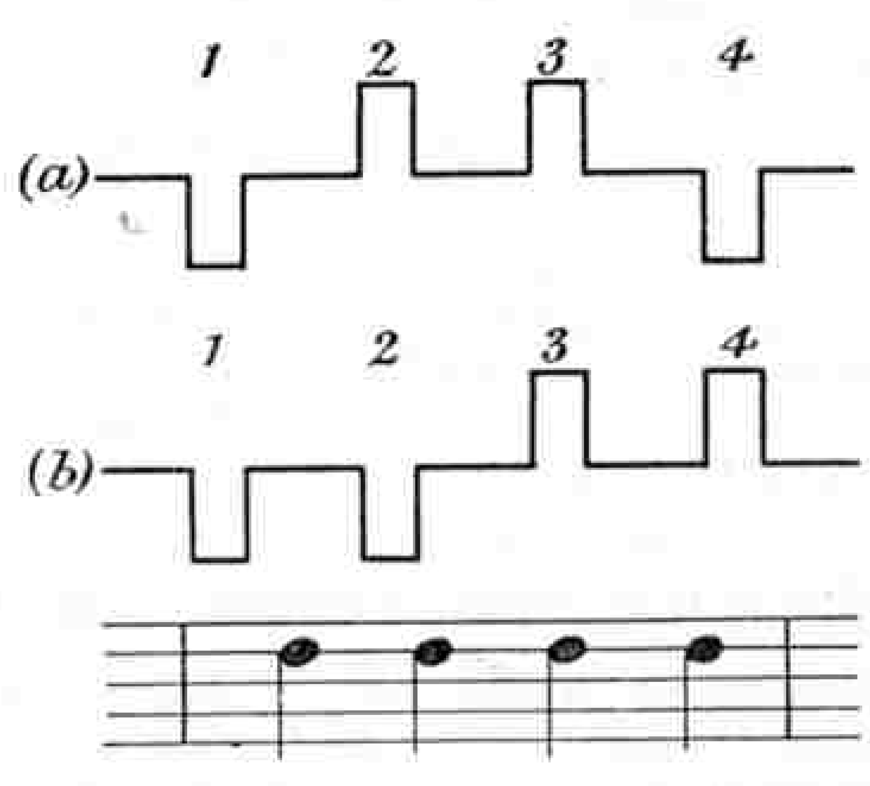

Fig. 4—Four-Cylinder Engines

It is now convenient, for the moment, to overlook the three-cylinder engine and consider an eight-cylinder engine. With opposed cylinders and cranks at 180 degrees (*opposing connecting rods being coupled to a common crankpin*), there would be two cylinders firing at once, giving four beats to the bar, as in the score of Fig. 4.

This arrangement of eight cylinders is no improvement on four cylinders, as far as uniformity of torque is concerned, but each power impulse is derived equally from two cylinders.

In an eight-cylinder engine, as above, but with cranks at 90 degrees, there are eight beats to the cycle or bar, which we may write down as quavers (Fig. 5).

Fig. 5

The number of impulses is the same as before but, by using cranks at 90 degrees instead of 180 degrees, one set of four impulses is moved forward by one-eighth of a bar, with considerable improvement in the uniformity of the turning moment.

Exactly the same effect is obtained with a 'straight eight' having its cranks at 90 degrees. The possible variations in firing sequence do not concern us—the eight even beats remain the same.

For a three-cylinder engine, having cranks at 120 degrees and firing at intervals of 240 degrees it seems that we must go into 'triple time.' Each 60 degrees of crank revolution may be represented by 1 quaver ; then 3 quavers = 1 stroke and 12 quavers = 1 cycle. The notation for a complete cycle is then as in Fig. 6.

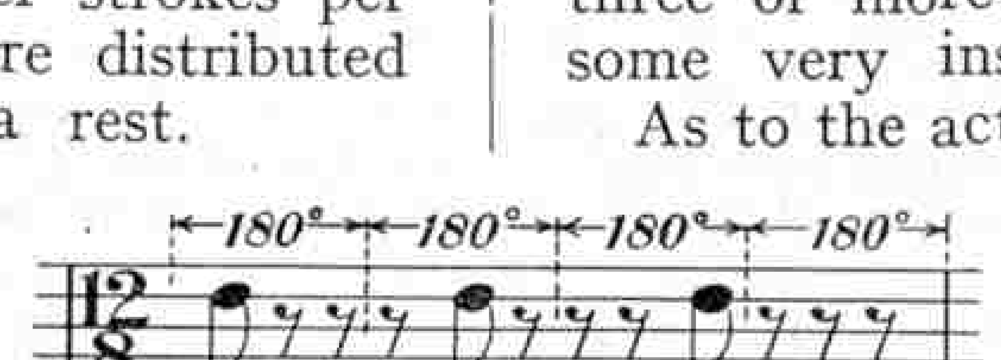

Fig. 6

It should be noted that here the complete firing stroke is represented by one quaver and the two following rests. The 45°, 60°, and 90° 'twin,' 4-cylinder, 6-cylinder, etc., the 'swash-plate' engine, and various other types all present problems which it may interest the reader to puzzle out for himself, both for two-stroke and four-stroke operations. By drawing the bars to scale and using chords of two, three or more notes to represent simultaneous firing, some very instructive comparisons can be made.

As to the actual musical note of an engine, it may be noted that on one occasion a blind man named correctly the engines of the machines taking part in a motor cycle trial.

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Southern Pacific Locomotive Development

By G.H.H. HUMPHRIES.

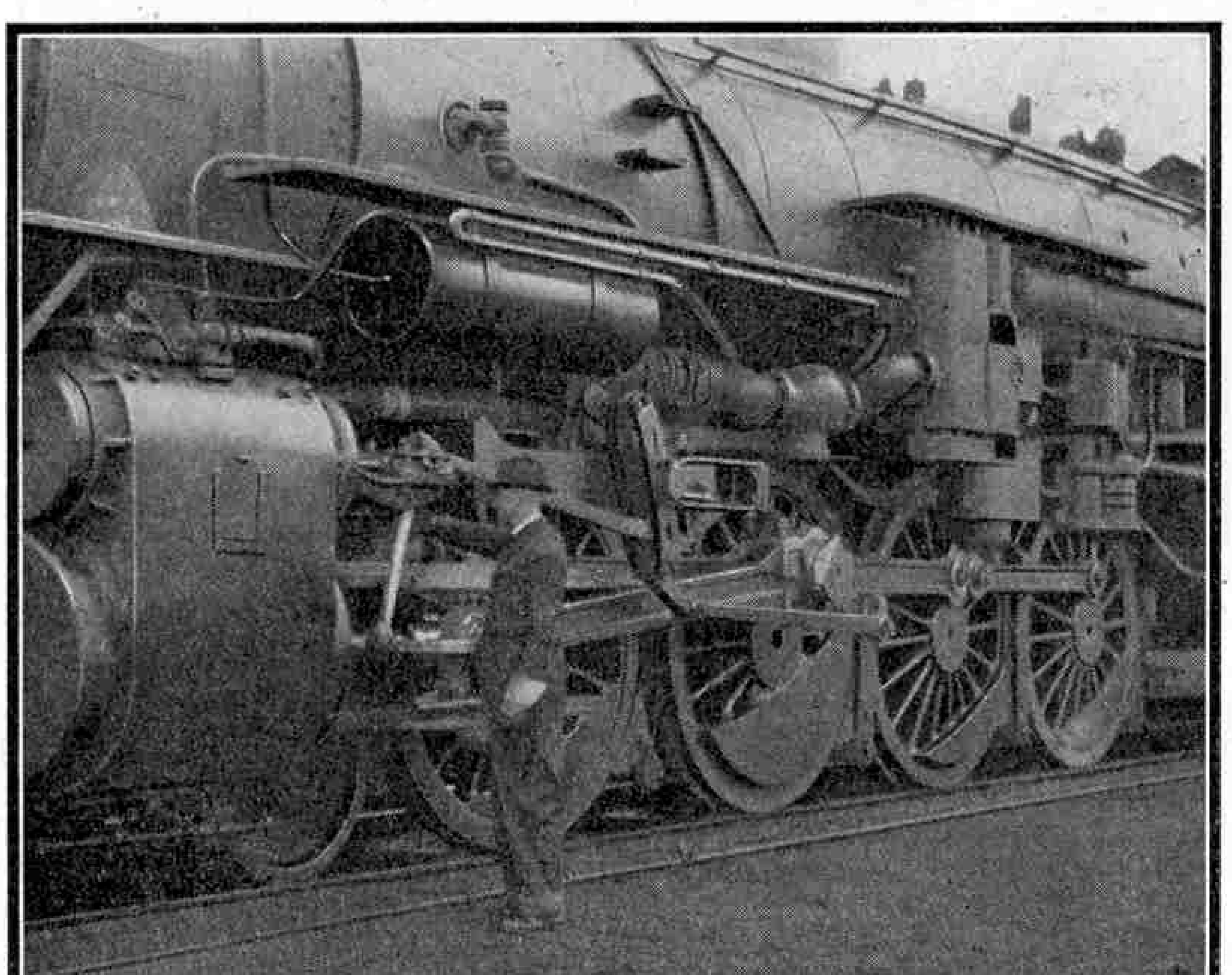
Sixty-three years of progress. "Southern Pacific No. 1" alongside latest "Mountain" type

ON 19th August, 1863, the freighter *"Herald of the Morning"* slowly made its way through the Golden Gate, and docked at San Francisco after the long voyage "round the Horn" from New York.

With difficulty there was unloaded from the hold the first locomotive for the Central Pacific Railroad that ran east from San Francisco. It was christened *"Governor Stanford,"* in honour of the then Governor of California who, with C. P. Huntington, Charles Crocker and Mark Hopkins, was responsible for the daring project to build a railroad over the Sierra Nevada Mountains to the East. The first rails for the railroad also were unloaded from the ship.

The locomotive and rails were transferred to the schooner *"Anna R. Forbes"* for shipment to Sacramento, arriving there on 7th October, 1863. The locomotive was almost lost in the river in unloading, but it was set up finally and its trial trip was held with great ceremony on 11th November. The *"Governor Stanford"* may be seen to-day in the museum at Stanford University, California.

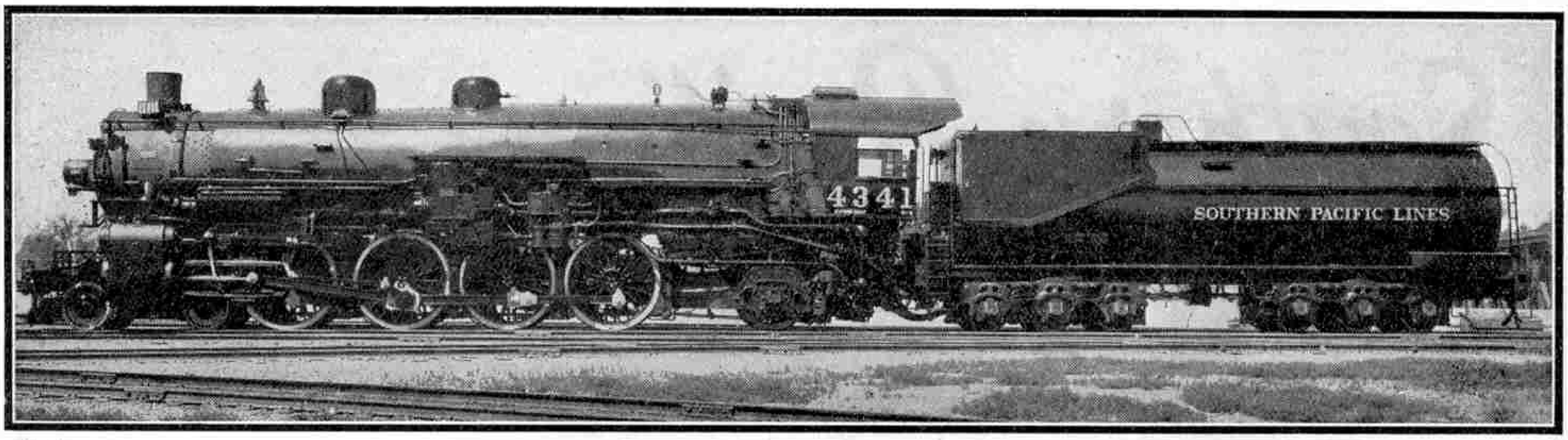
The locomotive *"C. P. Huntington,"* or Central Pacific No. 3 (renumbered later Southern Pacific No. 1), was placed in service in 1864. It was 29½ ft. in length, weighed 39,000 lb. and could haul four cars weighing 22 tons each at 35 miles an hour up a grade of 26 ft. to the mile. It is still in serviceable condition, but is now only used for exhibiting purposes. The illustration at the head of this page shows this noteworthy little locomotive alongside a modern "Mountain" engine of the type referred to later.



Photo] [*Southern Pacific Photo Service*
Details of one of the Southern Pacific 4-8-2 freight and passenger locomotives. These are a companion type to the tremendous 2-10-2 freight locomotives that the S.P. has placed on heavy freight service during the last two years

Picturesque Early Locomotives

The early locomotives were highly picturesque in appearance. They had large diamond-shaped smoke stacks, and their brass fittings and gay paint made them exceedingly ornate. While it was the fireman's job to keep the brass polished, it is said that some engineers were so proud of their engines that they worked on days off to help to polish them. The drivers and engineers of to-day do not polish, clean, and overhaul the engines on their rest days, but they still take a great pride in their charges, as a visit to any great



Photo] [Southern Pacific Photo Service

A powerful and economical 4–8–2 passenger locomotive of to-day, which regularly maintains the record through run of 815 miles without change, over mountains and desert between El Paso and Los Angeles

terminus will demonstrate at any time.

Instead of merely having serial numbers as at present, the pioneers of the rails had names. Some of them were of historical significance and others indicated the emotions evoked in the minds of those who first beheld them. Thus names such as "*Governor Stanford*" and "*T. D. Judah*" were reminders of the men who built the railway; "*Red Deer,*" "*Piute,*" and "*Grizzly*" had Indian or Rocky Mountain associations; while "*Jupiter*" and "*Colossus*" were obviously considered enormous engines at the time of their construction.

Wood was the fuel for the first locomotives, familiarly known as "hayburners." Large quantities of wood were piled along the tracks for use of passing trains and the firemen of those days had a real job. Even after the introduction of coal some of the monsters consumed so much fuel that with hand firing two firemen (one probably a negro helper) would find the work almost beyond them. The advent of the mechanical stoker now installed on some of the big locomotives has now made the fireman's task much easier.

Photo] [Southern Pacific Photo Service

Modern Southern Pacific freight locomotive hauling 100 cars without banking engine up a gradient of the Sierra Nevada mountains

As the communities of the West grew in size and in business importance, better and more powerful locomotives became necessary to enable heavier trains to be handled. At the same time the size of cars was increased. Heavier rolling stock necessitated heavier rails, and the strength of the supporting roadbed also had to be increased.

The First "Decapod"

One of the most interesting of the early locomotives built by the Central Pacific at the Sacramento shops was the 4-10-0 "*El Gubernador,*" which was in actual service from 1884 to 1893. This iron monster was then said to be the heaviest and most powerful locomotive in the world. When loaded it weighed 234,000 lb.

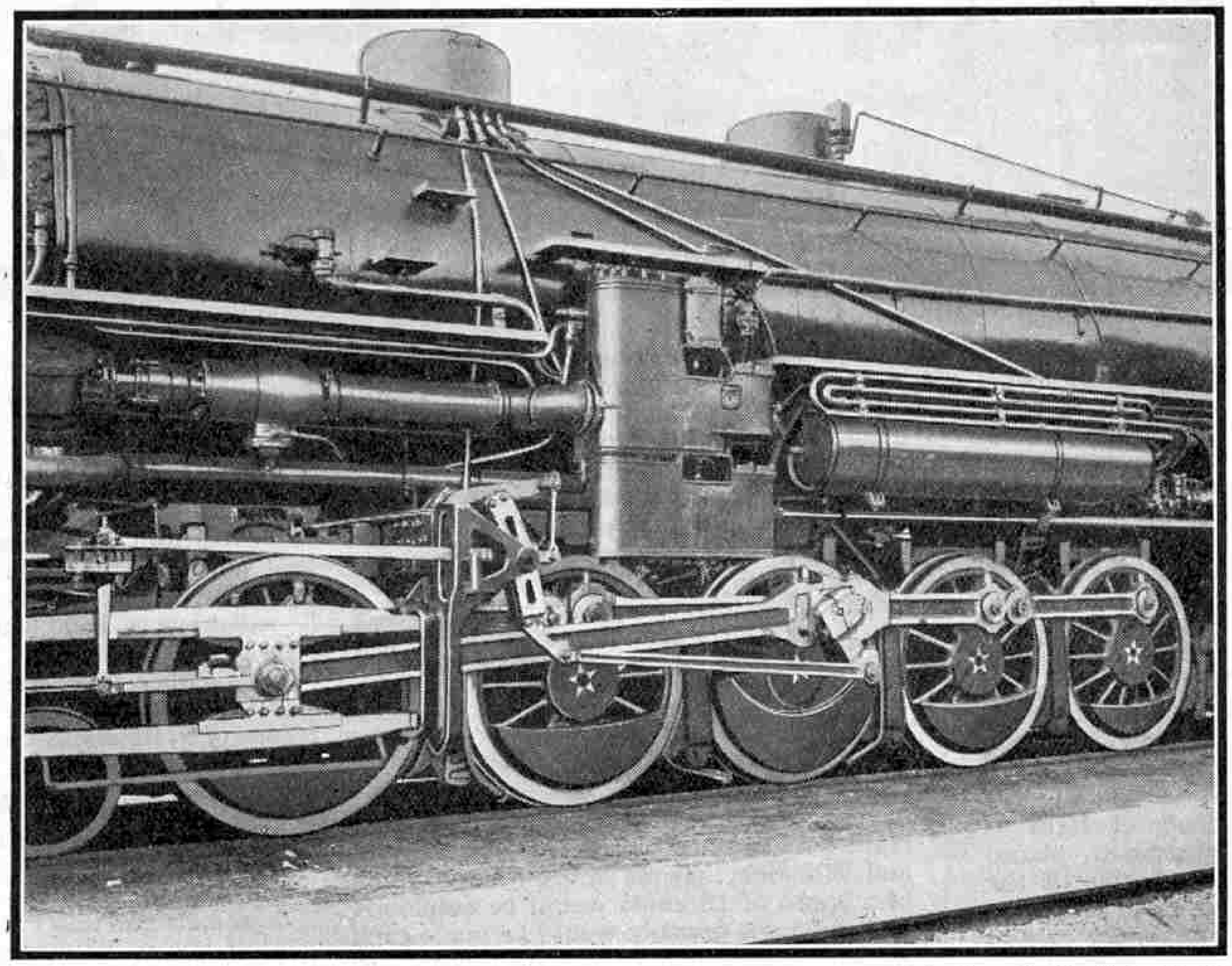
Tourists were amazed at the size of "*El Gubernador.*" It was considered too big to be turned on a turntable, for fear it would tip over, and therefore it was kept on the main line, all trains taking sidings when meeting it so there would be no danger of its leaving the rails. Great difficulty was experienced in raising sufficient steam for the large cylinders, but in spite of this defect it did excellent work. A proposal was made to fit a larger boiler, but this did not materialise, and eventually the engine was sent to the scrapheap.

During 1886 and 1888 a number of 4-4-0 type locomotives were built at Sacramento. These engines were very odd in appearance, with only one dome on top. The boiler had a straight top with short front ends and diamond stack. Counterweights on the "drivers," instead of being next to the tyre of the wheel, were placed in the wheel centre between axle and tyre.

Thirteen locomotives of the 2–8–0 type, familiarly known by enginemen and trainmen as "monkey-hogs," were built at Sacramento during 1887 and 1888. They were equipped with A. J. Stevens valve gear and originally had steam brakes. They had 19 in. by 30 in. cylinders set at an angle, 51 in. driving wheels, and weighed 202,850 lb. loaded. Three or four of them are now being used by outside firms to whom they were sold.

The demand continued for greater and greater service to supply the increasing transportation needs of the growing Western States. Western fruits and products generally were gaining more attention in the East and each year still greater quantities were handled. The West also needed larger supplies each year from eastern manufacturers. By 1894 thirty-ton cars were being used, while the locomotives had more than twice the power of the earlier ones. Two types were then in general use, the 4–6–0 type of passenger locomotive and the 4–8–0 type for freight service, and these were the pride of the rails at the time.

The passenger locomotives of the 4–6–0 type were 57 ft. 3 in. in length, weighed 239,680 lb. and were capable of hauling six coaches weighing 30 tons each at a speed of 50 miles an hour up a grade of 26 ft. per mile. These engines handled the "*Sunset Limited*," the famous "Millionaire's Special" that travels over the route between New Orleans, Texas, El Paso and San Francisco, picturesquely described as the "*Sunset Route*."



Photo] [Southern Pacific Photo Service

A Close-up view of a Southern Pacific 4-10-2 type showing valve gear, connecting rods, the feed-water heater and other interesting details

Freight engines of the 4–8–0 type of 1894 were 60 ft. 9 in. in length, weighed 272,300 lb. and could haul 65 cars weighing 30 tons each at a speed of 10 miles an hour up a grade of 26 ft. per mile, a remarkable achievement at the time.

Giants of the Rails

The Southern Pacific locomotives built to meet the conditions of to-day are truly giants of the rails.

The most powerful and economical non-articulated (single engine unit) locomotive yet designed was placed in service in 1925 by the Southern Pacific to handle heavy trains over mountain sections of the West. It is known as "Southern Pacific" type, or 4–10–2. This locomotive is of new design, combining all latest developments that have passed the experimental stage to increase both economy and hauling capacity. It has a third cylinder placed inside the main frames and works with a boiler pressure of 225 lb. The locomotive is 101 ft. 1 in. in length overall and weighs 682,400 lb. It will further increase efficiency in handling heavy trains, for at a speed of 25 miles an hour, up a grade of 116 ft. per mile, it has 25 per cent. more hauling capacity than any locomotive previously built for the Southern Pacific.

The most powerful locomotives in passenger service prior to the advent of the "Southern Pacific" type three-cylinder locomotives were of the 4–8–2, or "Mountain" type. They are 97 ft. 6 in. in length, weigh 610,300 lb. and are 20 times more powerful than Southern Pacific No. 1. Each can pull 14 modern passenger cars, weighing 70 tons each, at 50 miles an hour up a grade of 26 ft. per mile. Their great power enables these locomotives to handle heavy trains with ease, while new appliances and refinements in design assure smooth starting and stopping, thus adding to the comfort of passengers. The lower illustration on page 877 conveys an excellent idea of the enormous size of the driving wheels of these remarkable locomotives.

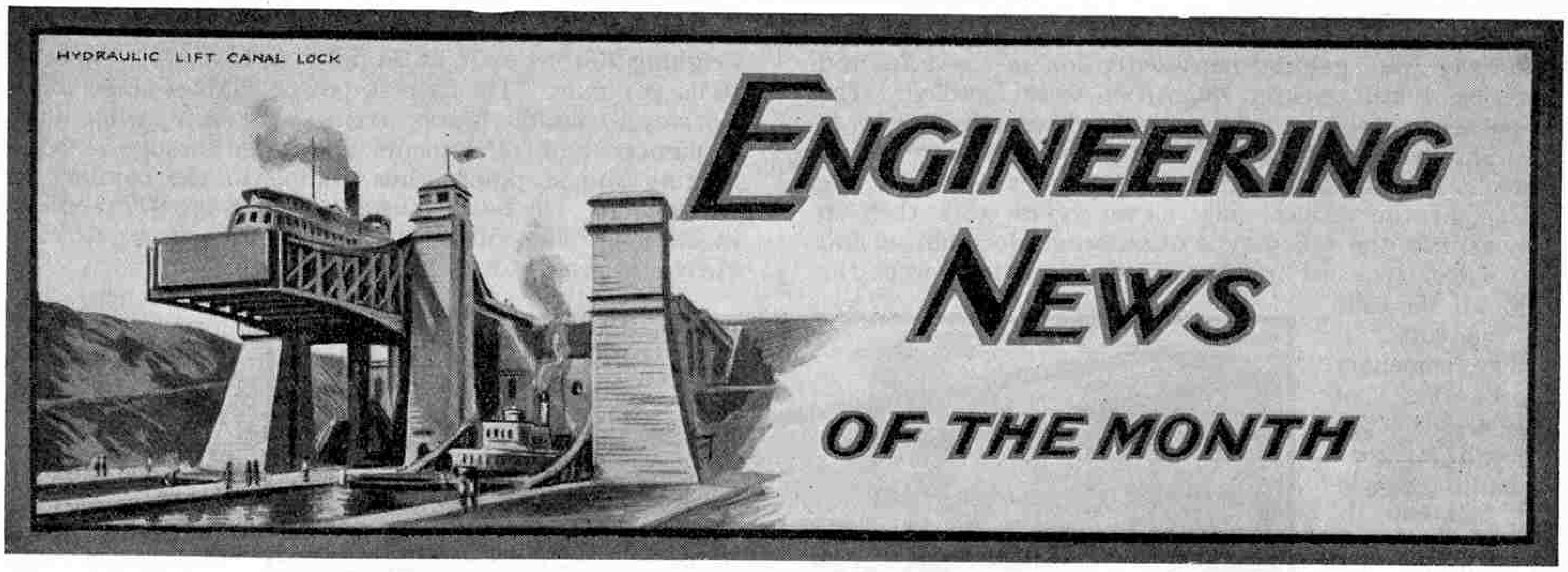
The feats performed by some of the giants of the Southern Pacific Railway are truly remarkable. A new record for a regularly maintained locomotive run was established by the 4–8–2 engines during the latter part of 1923, when the 815 miles between Los Angeles and El Paso was made without change of locomotive. This is now a regular practice, but formerly a relay of four locomotives was considered necessary in speeding transcontinental passenger trains across the mountain and desert territory between the two cities.

A companion type to the 4–8–2 passenger locomotive is the tremendous 2–10–2 engine that the Southern Pacific has placed in heavy freight service during the past two years. These powerful locomotives are 97 ft. 9 in. in length and weigh 623,200 lb. They can haul 19 modern freight cars weighing 50 tons each, or a total weight of 4,800 tons, at a speed of 10 miles an hour up a grade of 26 ft. a mile.

All the latest type locomotives are equipped with auxiliary booster engines, superheaters, feed-water heaters and other recently approved devices for increasing economy and power. Running gear and frames and other parts have been designed with a view to making them as light as possible without sacrificing strength. Piston rods, driving axles and main crank pins are of heat-treated steel, hollow bored. Another weight reduction was attained through the use of high tensile strength steel in the connecting rods.

The booster is a separate two-cylinder steam engine geared to the axle of the trailing truck wheels, and its function is to assist the main engine in handling trains at starting and on heavy grades.

The feed-water heater performs the double operation of pumping water from the tender to the boiler and heating it on the way. It utilizes exhaust steam from the main cylinders to heat the water. Part of this steam is condensed and returned to the boiler for use again, thus reducing sediment and the (Continued on page 885)



World's Greatest "White Way"

The seven blocks of State Street which lie within Chicago's "Loop" district, called the most concentrated shopping district in the world, have been turned into the world's greatest "White Way" by the installation of the most powerful street lighting system ever built. This length of street was first dressed in its new clothing of light recently, when President Coolidge touched a button controlling the system.

Before the lights flooded the broad street, these seven blocks had illumination of comparative weakness. Now, however, the street is stated to be fully three times brighter than any other street in the world. The immense flood of light is furnished from seventy standards, placed ten to a block, five on each side of the street. From each of these poles shine two huge 2,000-watt Mazda lamps, the largest ever used for street lighting purposes.

This intensive lighting system is being financed by the owners of the shops lining the street. A huge army of 75,000 workers are employed in the buildings on this short stretch of street, and more than 700 acres of floor space are given over to the various shops and department stores, the aggregate sales of which amount to £500,000 per day.

* * * *

A New Royal Yacht

A very handsome river yacht has recently been completed by Messrs. J. I. Thornycroft & Co. for His Majesty King Fuad of Egypt. As the King proposes to use the yacht for touring on the Nile, it has been designed with a particularly shallow draught and is of suitable dimensions for passing through the locks below Cairo. A particular feature of the vessel is a large observation room forward, on the promenade deck. This is fitted up in the nature of a palm-court and is completely surrounded with large sliding plate-glass windows. The yacht is fitted with two tall masts each carrying wireless aerials; the deck houses are constructed of teak, while on the bow, stern and paddle-box, decorations have been carved by native workmen since the yacht's arrival in Egypt. The yacht was dismantled for shipment to Egypt and was re-assembled in the Government Workshops at Cairo.

* * * *

New Seine Flood Reservoirs

As a means of preventing a recurrence of the disastrous floods that have occurred within recent years in the Seine Valley, the Port of Paris Commission has approved of the scheme to construct the Crescent and Chaumacon reservoirs. These will hold 24,000,000 cubic metres of water during periods when the valley is threatened with flood and it is proposed to hold the water there and return it to the river in dry seasons. The reservoirs can also be adapted to provide a head of water for the purpose of hydro-electric generating stations. It is also proposed to draw upon them for the Paris water supply. The estimated cost of the complete works is slightly less than £500,000.

* * * *

New North Sea Ferry Service

A scheme is being considered in Copenhagen for the establishment of another train ferry service plying between Esbjerg and Harwich. Three ships each capable of a speed of 19 knots would be employed and two trips per ship would be made each week. The voyage would occupy 18 hours in each direction. It is proposed to build ships large enough to accommodate trains composed of 800 tons freight or between 40 to 50 passenger coaches.

The present North Sea train ferry service is operated by the L.N.E.R. between Harwich and Zeebrugge and has achieved considerable success despite its comparatively recent establishment.

* * * *

Restriction of Motor Weights

The Ministry of Transport has recently issued a new order restricting the design and weights of heavy motor vehicles, such as omnibuses, charabancs and transport wagons. The overall length and overhang of heavy cars is to be limited and, in addition, vehicles will now be required to be able to make a turn within a prescribed area. For four-wheeled types, the registered axle weights must not exceed a total of 9 tons in the case of public service vehicles, and 12 tons for other cars. The overall length of any car, other than a six-wheeler, must not exceed 27 ft. 6 in. or 26 ft. if it is proposed to draw a trailer.

In view of the special advantages possessed by six-wheeled rigid frame vehicles, certain interesting modifications of the order apply to these. The maximum overall length allowable is 30 ft. and the sum of the registered axle weights 12 tons for public service vehicles, and 19 tons for others. The greatest unladen weight may be as much as 10 tons. The Government financial support given to users of six-wheeled vehicles is leading to the gradual adoption of this type by public authorities. The London General Omnibus Company has recently placed its second covered-top, six wheeled omnibus on the road.

* * * *

World's Largest Grain Elevator

The largest grain elevator constructed in one unit is at present being erected at Thunder Bay, Canada. This elevator, which will be completed in February next, will have a 5,500,000 bushel capacity and will cost £400,000. The building will be of all-concrete construction, and a new dock, 1,000 ft. in length, is to be made for the use of grain ships loading from it.

* * * *

15-Ton Drop Forging Hammer

A most interesting 15-ton steam-lift hammer for use in drop forging has been constructed. In the construction of hammers for this type of work a difficulty that has to be overcome is that a certain rebound is necessary to ensure that the plastic metal can flow freely in the dies. An ordinary steam-driven hammer delivers a positive dead blow and is, therefore, unsuitable for this purpose. This recently-constructed hammer, however, is designed in order to eradicate this fault. The steam drive only operates during the lift, the hammer dropping freely under its own weight and being at liberty to rebound.

The height of this machine, which has been constructed by a Cologne firm of manufacturers, is 30 ft., while the anvil block is sunk about 10 ft. below the ground level. It is said to be the largest hammer on the Continent.

* * * *

Stone Laying by Electricity

A unique method of enabling a large number of people to witness a stonelaying ceremony was adopted when the foundation stone of a new Masonic Lodge was laid in London recently. A model of the operating crane was erected in the Albert Hall where the audience was assembled. This was linked up electrically with the crane on the working site and the two were carefully synchronised so that it was possible by operation of the model to lower the real foundation stone into position.

* * * *

The Rumanian Admiralty have decided to construct a naval base for the Rumanian Black Sea Fleet at Sudghiol, near Constantza. As Sudghiol is a lake and has no communication with the Black Sea, it will be necessary to excavate a channel through the dividing strip of land in order to reach the open sea.

Britain's Super-Battleships

The two newest additions to Britain's navy, the super-battleships "*Nelson*" and "*Rodney*," have recently been undergoing their speed and gunnery trials. The results are believed to have been very satisfactory, but naturally details are not available for publication.

The secrets of these huge ships are very closely guarded and only their main details are known. Each has taken five years to build and has cost over £7,000,000. The dimensions of each ship are approximately the same, the figures for the "*Rodney*" being as follows:—Length, 702 ft.; beam, 100 ft.; displacement, 35,000 tons.

The "*Nelson's*" main armament consists of nine 16-inch guns, twelve 6-inch guns, sixty 4.7 guns and 20 smaller pieces of artillery. The 16-inch guns are believed to be the largest of their calibre in existence. Some idea of their power can be gained by reference to ordnance tables, which disclose that one type of 16-inch gun discharges a shell weighing 2,461 lbs. at an initial velocity from the gun barrel of 2,525 ft. per second. The gun itself weighs 108 tons.

The general appearance of these two super-battleships is extraordinarily different from that of their immediate predecessors. They lack impressiveness. One funnel only is fitted and this is placed so far toward the stern that nearly three-quarters of the ship's length lies before it. The weather deck is flush with the top of the hull and the placing of a single tripod mast between the funnel and the stern lends to these mighty ships the appearance of oil tankers! We cannot offer any explanation of the peculiarity of the design, which leaves a vast space forward almost entirely clear, but "aircraft-carrying" may be the solution.

* * * *

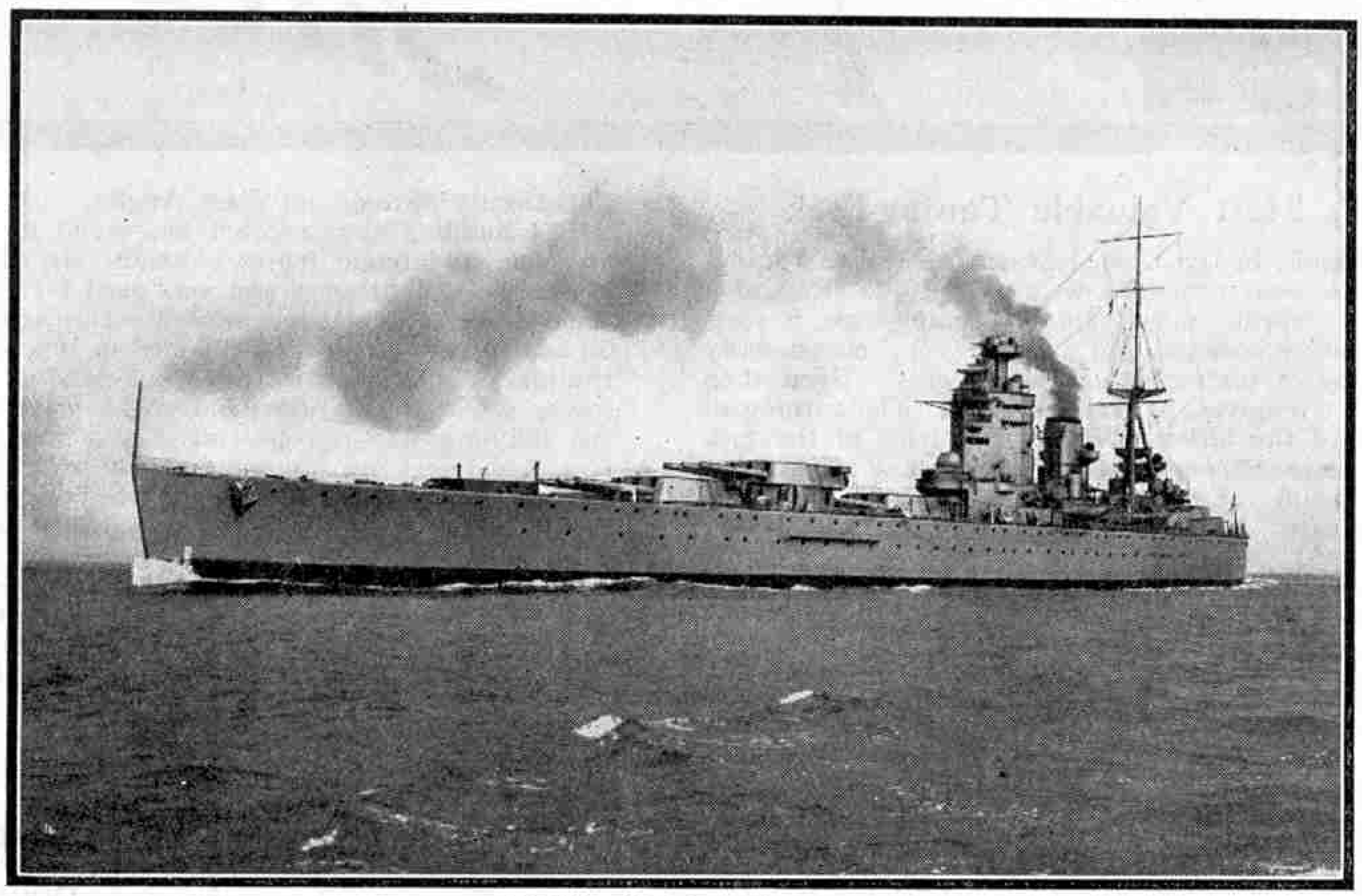
The Last of the Channel Tunnel

Some 25 years ago a pumping station was built at Cape Gris Nez, near Calais. It connected with a shaft leading to what was to be the French entrance to the proposed Channel Tunnel to connect France with England. From this shaft two miles of the tunnel actually were bored before British opposition put a stop to the work. Later, the declaration of war in 1914 caused the complete abandonment of the scheme, and now the pumping station is to be destroyed.

Thus is closed a page in European history. Good as the Channel Tunnel scheme may have appeared to its supporters 25 years ago, rapid transit facilities between the two countries are immeasurably better afforded by air than underground.

Future Warship Sizes

Despite the breakdown in the negotiations between France, America and Britain at the recent Geneva Conference on the subject of limitation of armaments with particular reference to warship tonnage, certain decisions have already been made that will influence considerably the future trend of design of certain naval types. It was decided that in future no destroyer flotilla leader was to exceed 1,850 tons displacement, and that destroyers themselves were to be limited to 1,500 tons. Submarines are limited to 1,800 tons, but it should be noted that these figures do not allow for fuel and water supplies. Actually, so far as the British Navy is concerned, these figures are above the average. Our largest flotilla leaders and destroyers are 1,800 tons and 1,330 tons respectively, and with one single exception, our submarines are all smaller than 1,600 tons.



H.M.S. "*Nelson*" at sea

* * * *

What is stated to be the longest stretch of concrete roadway in the world has just been completed in America. 137 miles in length, the road passes through nearly 30 different towns and villages.

* * * *

The first automatic telephone exchange in Ireland has recently been put into service in Dublin. This is the Ship Street Exchange. A second exchange, to be known as Merrion, will be opened this autumn.

* * * *

Radio on Goods Train

It is anticipated that many of the big American long-distance freight trains will be fitted up with wireless, as a result of a test recently carried out on a train $1\frac{1}{4}$ miles in length. The engine and brake van each were equipped with a transmitter and receiver, and conversation was carried on between the driver and guard throughout a long run. The difficulties of communication on trains of great length has hitherto proved an obstacle to complete efficiency in operation.

Eight Storeys on the Move

In past issues we have recorded instances of wood frame buildings having been moved short distances in America and Canada, but the following remarkable feat eclipses them all. The American Government, having acquired a site for a Government office in Albany, N.Y., the ground had to be cleared of all existing buildings. With one exception, these were all of an old type. The exception was an eight-storey building, 45 ft. in depth by 85 ft. in width, constructed of steel framing with walls of brick, concrete and terra cotta. This building was erected only ten years ago, and its demolition would have involved considerable expense to the Government and loss to its owners. After consultation, it was decided to move the building en bloc to a site 500 ft. distant, and a contract to perform the task was accepted by a Pittsburg firm. The first job to be done was to lay bare the twenty-five 10 in. H section steel girders that supported the whole structure. These were stripped up to a point 3 ft. below the underside of the main floor and pieces of 24 in. steel joist, 2 ft. in length, were fixed to the flanges of the columns by their webs. Other lengths of steel joisting were bolted to these until eventually there were eight lines of running beams placed longitudinally under the building. Underneath these 1,000 20-ton screw jacks were placed, set on a cribbing consisting of 8 in. × 8 in. timbers and 6 in. × 8 in. cribbing blocks arranged on a 3 in. plank floor. The jacks having taken the strain, the ends of the main columns were sawn off and the whole building raised 2 ft. In order to facilitate its movements three lines of rails were arranged on each of the eight lines of cribbing and on these and underneath the running beams 1,200 steel rollers were placed. The jacks were then lowered and the load placed on the rollers.

The first step of the move was 375 ft. forward and then 60 ft. sideways. At several points of the journey, quicksands were known to exist below the level of the ground, and careful tests were made to ensure that the ground would take the strain. At one point a very strong matting of timbers was necessary to distribute the 4,000 ton load over a wide area, so that there was less than one ton per sq. ft. on the ground. At the end of the 430 ft. move it was found that the building had remained absolutely intact, the amount of settling being practically negligible. The building was lowered 4 ft. 6 in. on to its new site by 40 men, each working 25 jacks, which were given a quarter turn by signals. A special reinforced concrete mat foundation had been prepared to take the building and the column ends that had been sawn off at the old site were reclaimed and placed in position on the new site.

Of General Interest

The World's Most Valuable Tuning-Fork

At Riverbank, Illinois, in the United States, there is a tuning-fork that is worth several times its weight in gold. Regarded by its owners as the world's most valuable tuning-fork, it rests in a glass-topped silver cabinet and is only very occasionally used for the purpose of testing other instruments. Even then it is sounded without removing it from its case. The turning of a knob at the end of the latter stretches the arms of the fork slightly and then releases them quickly, the ensuing note being strengthened and made easily audible by a resonator below the fork.

The skill and the care required for making such a fork are almost inconceivable. After every operation time is necessary to allow the disturbed molecules of iron in the fork to settle down again. Gentle rubbing with emery cloth spoils the fork, as far as accurate musical pitch is concerned, for several hours, while the resentment shown by the molecules towards such harsh treatment as filing does not disappear for several weeks!

After minute adjustment of the weights of the prongs the fork now gives out a note that is the equivalent of middle C, the number of vibrations per second being 256. This is only the case when the temperature is exactly 68°F., as the fork is exceedingly sensitive to slight changes in temperature. Altogether it is extremely delicate, a tiny fleck of rust or corrosion produced by merely handling it with damp fingers being sufficient to upset the exact adjustment of the fixed rate of vibration.

An even more accurate fork is now being prepared from special French steel. The present one loses or gains one vibration only in 500,000, but the new one is expected to be even more accurate and to be so near perfection that it will only vary from absolute truth by one vibration is 1,500,000!

The Oldest Church in England

A building that is claimed by some antiquaries to be the oldest church in the country has been restored to its original use after a long interval. This is a small stone building at Bradwell on the Essex coast, a lonely place 10 miles from the nearest railway station, and its history is probably stranger than that of any other building in England.

Centuries ago the place was an outpost of the Romans, who built there a fort to serve as a centre for the Legion guarding the eastern shores of Britain. They built the fort with characteristic care and thoroughness, but as time passed it suffered the fate of many Roman buildings and ultimately was used by the Saxons as a source of building material. In its place a church was built with the stone of the fortress by Bishop Cedd of Northumbria, who left Lindisfarne, at the invitation of King Sigebert, to spread Christianity throughout East Anglia.

The building thus erected has stood for 1,200 years or more and has undergone many changes. In the reign of Elizabeth it became a lighthouse and was used for this purpose under the Stuarts until the belfry collapsed. During the Great War soldiers on coastguard duty were billetted in it and on its stones appear the marks of many fires that the defenders lighted to keep themselves warm during the cold night watches. Seven years ago the building was re-consecrated and recently was the scene of special services in commemoration of the Northumbrian saint who originally erected it.

The necessary renovations have been carried out with due regard to the preservation of as much of the original building as possible. There seems no reason now why the church should not stand for centuries more, except that its existence may be threatened by the encroachment of the sea.

Over a Hundred Years Ago!

"The public may view the Thames Tunnel near Rotherhithe Church on the payment of 1s. per person."—"SUNDAY TIMES," 29th April, 1827.

* * *

"It is rumoured that the new residence intended for the late lamented Duke of York will be converted into the proposed National Gallery."—"HANTS ADVERTISER," 5th Feb., 1827.

Gastronomical!

"A Gigantic Pie! The Christmas pie made by Mrs. Tagg, of the King's Arms Hotel, Eccleshall, contained a goose, a turkey, a hare, a brace of pheasants, a couple of rabbits, a couple of pigeons, and two tongues."—"LIVERPOOL MERCURY," 16th Feb., 1827.

Shades of Nelson!

"It is said to be the intention of the Admiralty to build six steamships of the largest size, capable of carrying 100 carronade guns of increased calibre, and to be propelled by two engines of 100 horse-power each."—"HANTS ADVERTISER," 19th Feb., 1827.

Send for the Police!

"There is a regular gang of organised thieves, including two burglars from London, at Winchester, who carry on their operations in the most open and audacious manner, to the great terror of the inhabitants."—"HANTS ADVERTISER," 8th Jan., 1827.

Photographing the Body from Inside

For some time past a great deal of valuable knowledge of the workings of the interior of the human body, and especially the stomach, has been obtained by X-ray examination and by the taking of X-ray photographs. A new method has now been evolved that enables actual photographs of the stomach to be taken from the inside.

A tiny camera attached to the end of a narrow tube is lowered into the stomach. This sounds rather an alarming process, but according to reports from Germany, where the method originated, it is quite painless. The camera contains seven films and a complete set of photographs of the interior of the stomach can be taken in 14 seconds, the necessary light being provided by the instrument itself.

The pictures obtained in this manner are stated to be more satisfactory than X-ray photographs, which is quite probable, for the latter are really silhouette transparencies.

An Interesting Relic from Africa

A relic of great interest has been discovered recently in Africa and is to be brought to Ostend. This is the boat used by H. M. Stanley during his explorations in the Belgian Congo.

Stanley is best known on account of his great journey in search of David Livingstone, who had been lost to civilisation for some years in the heart of Africa. He also made numerous journeys across the continent and discovered the famous Mountains of the Moon in Uganda and Lake Albert Edward Nyanza. Stanley's fame as an explorer led King Leopold II. of Belgium to invite him to undertake explorations in the Congo Basin in 1879. During this expedition he built a boat 53 ft. in length and about 6 ft. in width, and it is this boat that has been found at Boma, a town near the mouth of the Congo River.

Canada's "Luxury" Bell

"Number 51" of the Carillon for the Canadian Parliament Buildings at Ottawa, the largest Carillon in the world, has been shipped from Croydon by the Canadian National Railways on the Cunarder "*Antonia.*" The bell is 84 in. in diameter at the base, 3 ft. 9 in. high, and weighs $6\frac{1}{4}$ tons; it is tuned to Low G.

It has been dubbed the "Luxury" bell because it is used only occasionally in rendering Carillon music and is rarely included in any but the largest Carillons. The first note on this bell was struck by the King through the completion of an electric circuit between London and the Parliament Buildings at Ottawa on 1st July, the Diamond Jubilee of Canada's Confederation.

His opinion is based partly on figures and partly on his own experience. Not more than six cases of sharks attacking human beings are known, according to Dr. Beebe, and as for his own experiences, he found that sharks did not attack him when he went overboard in a diver's suit at the Galapagos Islands in the Pacific. They were ferocious enough to tear in pieces a shark that had been hooked on a fishing line above his head, but they never ventured to attack him.

Needless to say, this opinion has not met with much support, and bathers in the shark-haunted waters of the tropics will certainly be quite content to leave to Dr. Beebe himself any further practical tests of the ideas to which he has given expression.

Canada's "Luxury" Bell, weighing over six tons

Boxing Extraordinary

The following interesting account of how three bullies met their match appeared in "*The Times*" a century ago (24th March 1827) and will, we think, interest our readers.

"The drivers of three dust-carts were yesterday morning amusing themselves in Holborn by rattling the dust from their carts into the eyes and upon the clothes of every decent person who met them. Unfortunately for themselves, they set up a huge laugh after perpetrating this outrage upon two individuals who were driving a gig up Holborn Hill. One of the parties, who found himself thus unexpectedly covered with dirt and derision, leaped out of the gig, collared the driver of the last cart, and before he could call for assistance laid him sprawling in the middle of the street.

"The fellow, on recovering his feet, immediately began to show fight: but before he was well aware of the means by which it was effected, found himself in contact with his mother earth. His brother drivers, who expected that their comrade, a man of bulky stature, would soon overpower the spirited individual who had attacked him, on finding that he had got a very awkward customer to deal with, rushed forward to his support, when, to the surprise of the spectators, they were both immediately floored by the person whom they had insulted.

"One would have thought that not even Hercules himself could have withstood this triple alliance; but such was the strength and activity of the gem-man of the gig, that in a few moments he reduced every one of his assailants to bite once and again the articles in which they dealt. Though defeated in two rounds, they were still thinking of a third when the cry of 'Well done, Cy. Davis' reached their ears, and warned them, when too late, of the pugilistic prowess of their antagonist.

"Instead of repeating their attack, they quietly took up the whips, which they had thrown on their carts at the commencement of the scuffle, and proceeded on their journey amid the scoffs and hootings of the rabble which this unequal conflict soon attracted. Cy. Davis then remounted his gig and drove off, without waiting to receive the applause to which he had entitled himself by the severe castigation he bestowed upon these three bullying and boisterous blackguards."

The Shark Finds a Friend

The commonly accepted idea that the shark is a dangerous and ferocious fish has just been challenged. Dr. Beebe, who says that it is not dangerous, ought to know, for he specialises in the study of sea life in the tropics, as readers of the note on his deep sea expedition on p. 119 of the February "*M.M.*" will remember.

A Famous Prism

The British Museum has recently acquired the prism that was used by Sir Isaac Newton, and it is very satisfactory to know that it is now in a safe place. There is scarcely any doubt that it really is Newton's prism, for as far as can be ascertained it has never left the possession of families related to Newton.

This prism may not be as efficient as those made with modern heavy glass, but it will always be an object of great interest on account of the amazing developments that resulted from Newton's work with it. The simple experiments in which he used it to demonstrate the composition of white light have since been extended until we know definitely the constituents of stars millions of miles away, and are even able to say whether any particular star is moving towards or away from us and at what speed. A knowledge of the temperatures and pressures of the vapours constituting the hot stars and of the existence of magnetic effects in the Sun are among other marvels that have followed in the wake of Newton's famous experiments with this three-cornered piece of glass.

A representation of the prism appears in the hand of the famous statue of Newton at Trinity College, Cambridge, and it is fitting that the original itself should be in our national museum.

The World's Largest Rope

Records of the size of ropes are not kept with the same care as those of the record performances of athletes, but a rope recently made in America should be well in the running for the record. It was delivered to a Boston shipping firm in a special freight car on account of its size, for it is nearly a quarter of a mile in length and weighs about five tons! Its circumference is 15 in., and altogether it is a cable fit to hold the "*Majestic*" or the "*Leviathan*" in the most violent storm. It is interesting to note that even in these days of steel wire, hemp remains the most satisfactory material for rope making.

The High Priest

"Atatapsi, iksiraruaIub ok' arkattiringmasi tawa" may look like a typographical blunder, but actually it is the salutation for a radio address broadcast recently in the Eskimo dialect from the Canadian National Railway's studio at Ottawa to the Eskimo settlements in Canada's North West Territories. The above alphabetical conglomeration informed the Eskimos listening-in that they were being addressed by their "Father, the High Priest," Mgr. Arsene Turquetil, of the Order of Mary Immaculate and Apostolic Prefect of Hudson Bay. This is the first time the Eskimo language has been put "on the air."

Renewing a Small Railway Bridge

By R. D. Gauld, M. Eng., A.M. Inst. C.E.

SOME time ago the writer was an assistant district engineer on a railway in Ireland, and the following description applies to several small under-line bridges that were renewed under his supervision. The particular one to which the photographs apply was situated on the line between Mullingar and Sligo in a fairly wild part of the west of Ireland.

When a railwayman speaks of a bridge renewal, he nearly always means the renewal of the metal portion only. It is practically never necessary to renew the brickwork or masonry portions, a little pointing being the most that is required. The ironwork, however, deteriorates. Corrosion takes place, rivets work loose, and the bearing surfaces of the masonry wear down so that the ironwork is subject to twisting strains. Then engine and train loads continue to become heavier and heavier, so that the bridges under the line become too weak for their work. Long before they give way, of course, they show their weakness by bending excessively under the trains, which action gradually loosens the rivets, a sure sign that the bridge is weak. Loose rivets often can be detected by the drip of water that has percolated through the rivet holes.

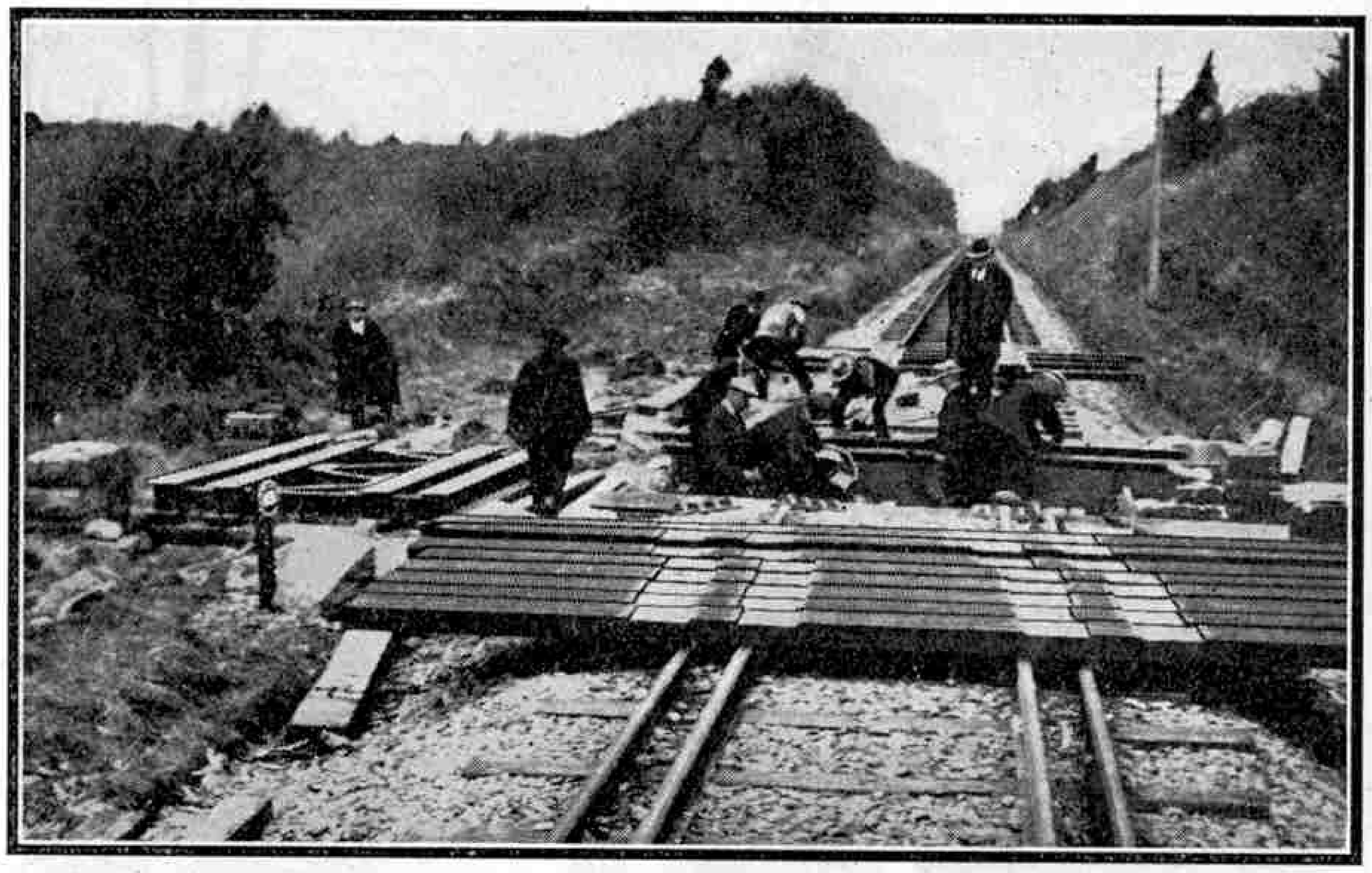


Fig. 1. The rails over the bridge having been lifted out, are laid in the "four foot"

The bridge we are considering had a span of only 12 ft. or thereabouts. It formed what is called a "cattle creep," that is a passage under the railway to allow cattle to be driven from one field to another. It only carried a single track, for, as most readers may know, many railways in Ireland, even main lines, are only single tracks.

But when the bridge was built provision was made for two sets of rails because it was hoped that traffic would soon require two tracks. Hence the bridges over the line are all of a sufficient span to pass two tracks underneath, while the underbridges have their abutments, that is, the walls carrying the steelwork, made wide enough for a second span parallel to the first if it should ever be needed.

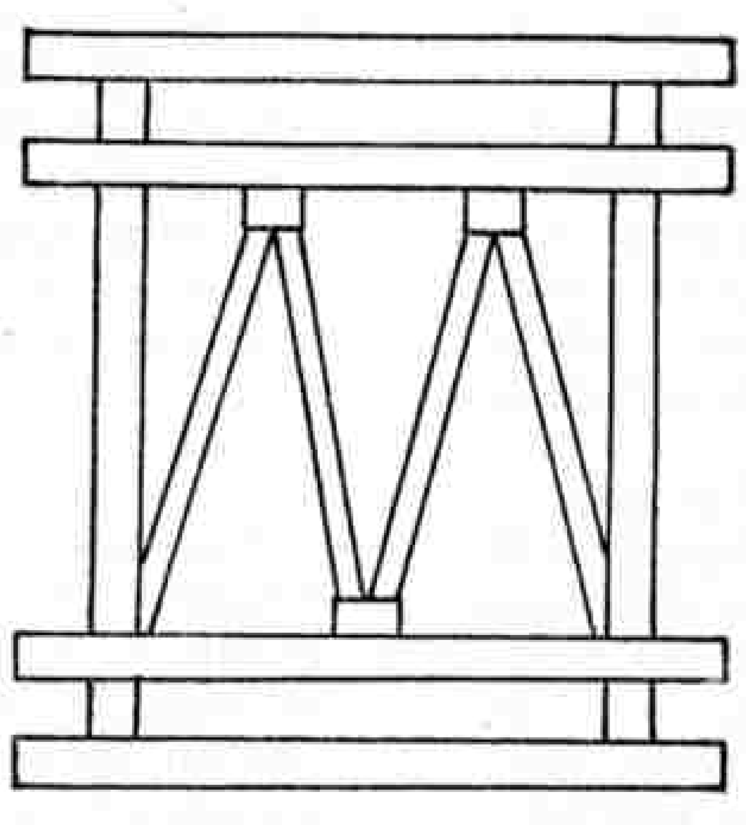


Fig. 2

This fact very much facilitated the work. The new steelwork looked like Fig. 3 in section and Fig. 2 in plan, and was laid out by a crane on the spare part of the abutments some time beforehand. The crane travelled as a vehicle of a works or "ballast" train, the steelwork being loaded in an adjoining wagon.

The old bridge consisted of two small I-shaped girders, one under each rail, with 3 in. planks laid across the tops, then 4 in. × 10 in. timbers across them again, that is, the same way as the girders and on these the flat-bottomed rails were fixed directly. I should explain that in Ireland lots of the lines are laid with flat-footed rails, as is usual in America and on the Continent. This type of road is cheaper than the bull head.

The new bridge was much stronger, there being two I-shaped steel joists under each rail, all very stoutly braced together. The ends of each joist had half-round rollers fixed under them, and these were to rest in cast-iron shoes or sockets, having a large flat undersurface resting directly on large concrete blocks, or bed stones, with bolts cast in them, by which the shoes are held down. Fig. 4 shows these clearly.

As the new steelwork was much deeper than the old, some of the abutment walls had to be taken down to allow the new bedstones to be put in. As much of this work as possible was done beforehand, because the essence of success in this kind of job is thorough preparation in advance. A few of the rail fastenings were taken out, also a bolt out of each rail joint affected, that is, a pair of joints on each side of the bridge, as there was no joint on the bridge. Railway engineers always avoid joints in rails over bridges if they can because the joint means that a train causes a knock or impact on the bridge, which increases the strain.

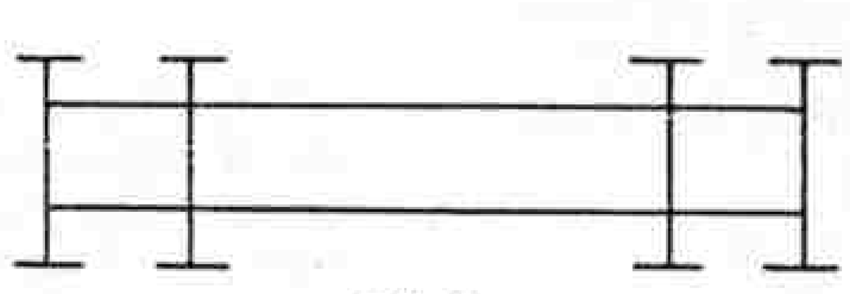


Fig. 3

As with most railway renewal jobs, this one was done on a Sunday. Traffic is lighter then, and for double lines one line is usually put out of action while single line is worked on the other, the bridge being renewed in two halves. This is not possible in every case, of course, because the design of the bridge may not allow it. On our job there were no trains to consider, because we had chosen a Sunday when we knew there would be none!

The "*Weekly Circular,*" which is issued each week and gives all the engineering jobs affecting the running trains, list of speed restrictions, etc., had contained a note from our department saying the line would be closed from 8 a.m. to 6 p.m. Due notice of all such work has always to be given in the "*Weekly Circular,*" which is usually compiled by the Traffic Department. But no risks were taken. We sent out a flagman with red flag and detonators, three-quarters of a mile in each direction, so that if a train unexpectedly did come along it would be possible for him to stop it in time. This procedure is explained in the "*Rule Book*" of which every railwayman has a copy—an indispensable book catering for every contingency.

By 8 a.m. our flagmen were posted, and we then "broke the road." The two rails over the bridge were lifted out and brought clear of the bridge, then laid in the "four foot," the space between the running rails. The illustration on the previous page shows this. Then the old decking was removed and stacked on one side, also the two old girders.

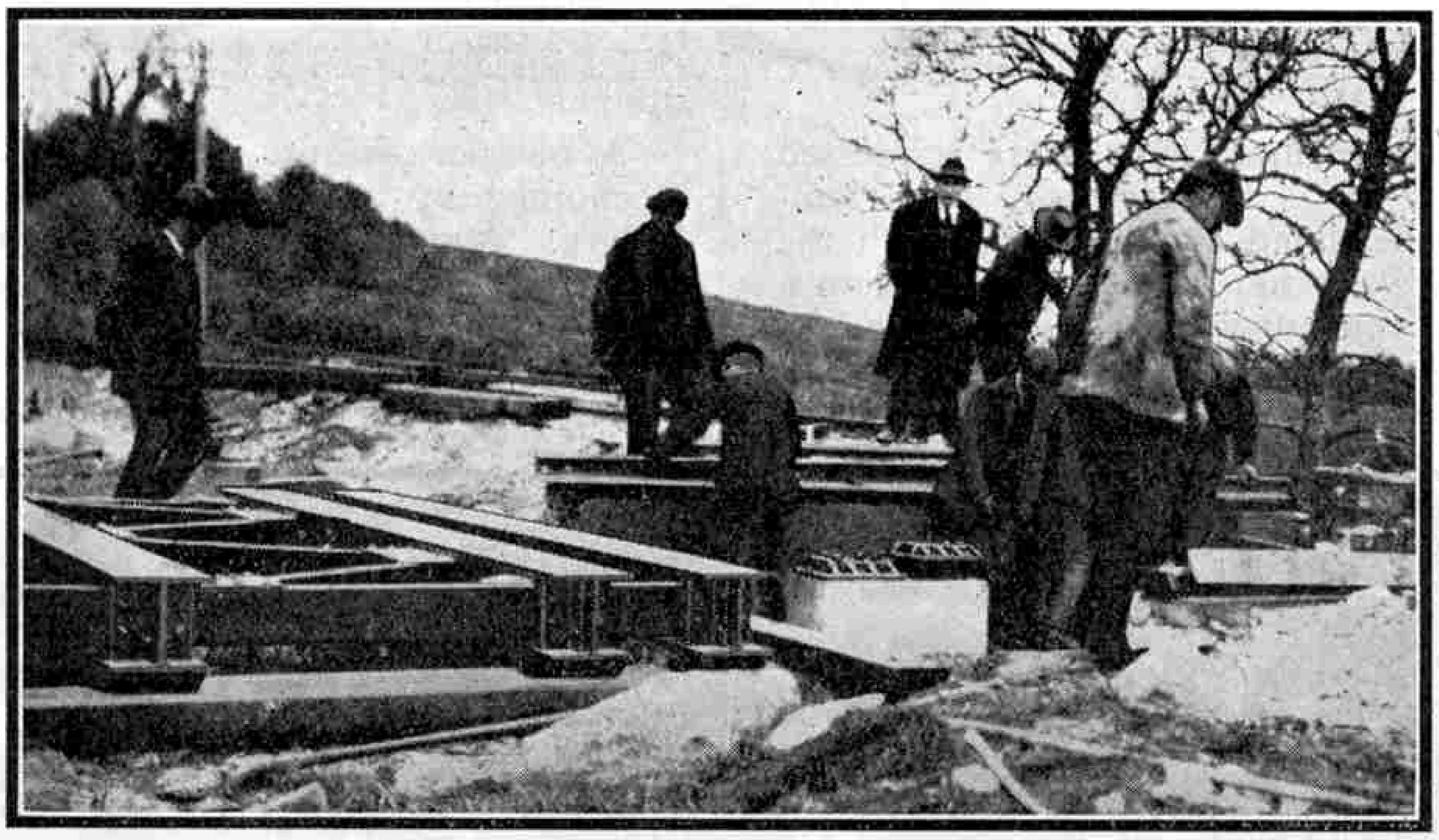


Fig. 4. Preparing the new steelwork at the side of the track

The masons then got busy taking out the old bedstones and taking down part of the abutment walls, making good seats for the new stones and laying them in. This requires very careful measuring, because the holding-down bolts are firmly fixed in the concrete, and if one block is slightly out of place the girders will not "bed" properly.

Then the bed plates were put on with a layer of grout, or fine cement, under them, and screwed down. The grout ensures that all small holes between the stone and iron are filled up, thus providing an even bearing. Then, as the job was working out all right to time, our men, about twelve in all, took a well-earned rest of half-an-hour and had a meal, one of them previously having made a fire with some of the old decking, and boiled the dixies.

Then back to work again, all hands to the job of sliding over the new steelwork by means of crowbars on to a prepared pair of greased rails. Jacks were then put under the girders, the rails removed, the jacks lowered out, and the girders bedded accurately into their sockets. Then, while the masons finished off the walls, the other men put on the creosoted timber decking, adzing it to fit over the girders and bolting it down, for which purpose special "hook bolts" are used.

Next the runners for the rails were fixed on by coach screws, also the outer timber forming an edging for the decking, and the iron standards for the handrails. The Irish gauge is 5 ft. 3 ins., and allowing room for a man to stand on the bridge while a train is passing, the planks were about 15 ft. long. The rails were put back, nicely lined up, their level checking-in well on account of the careful measuring when the bed stones were set. You see how important it is to get the level of the bottoms of the stones absolutely right.

By 5-30 the job was done, and everybody but the "bosses" was very tired after a hard day's work. The two flagmen were called in and we all made off to our depot station, a distance of about two miles—quite far enough in the circumstances—two of the men bringing back on a trolley the old girders and decking, to be relegated to the scrap yard. So ended an interesting and useful day's work.

Southern Pacific Locomotives—

(*Continued from page 879*)

amount of water required to operate the locomotive.

While constantly striving to develop the finest new locomotives, the Southern Pacific Railroad is not neglecting its old ones. Many passenger and freight locomotives that have been in service for some years are being "rejuvenated" by the addition of superheaters, feed-water heaters, boosters and other modern appliances. In fact 66 per cent. of all Southern Pacific locomotives at the beginning of 1925 were equipped with superheaters, more than 12 per cent. with feed-water heaters, and many with booster engines. The results are proving most satisfactory, adding greatly to the efficiency and economy of these older locomotives. These as well as other improvements of a highly technical nature are made with the view of giving improved service to shippers and added comfort to passengers.

A few words on the comfort provided for passengers on the trans-continental routes may prove of interest. On all these routes are splendidly equipped trains, which may aptly be described as "travelling hotels," lighted by electricity, heated throughout or cooled as conditions require, and having spacious smoking and reading rooms. The provision of oil-burning locomotives and rock-ballasted road bed assure a safe and agreeable journey free from soot and cinders.

On account of the great distance from the chief markets of the country, the Pacific coast depends more for its prosperity upon good and adequate transportation than other sections. A vast, well-built transportation machine and a highly efficient organisation are required to take fruit fresh from a Pacific coast orchard, move it over two or three ranges of mountains, and carry it across deserts and plains with such dispatch that it may be placed on someone's breakfast table in New England as fresh and appetizing as if just gathered from the orchard. The Southern Pacific's swift, powerful locomotives help to make possible this triumph in transportation.

The progress of any country, it has been well said, is indicated by the progress of its transportation service, and surely this is particularly true of the West and its pioneer railroad, the Southern Pacific.

Overhauling London's Buses

A Visit to the Wonderful Works at Chiswick

By J. Harrison, A.M.I.A.E.

VISITORS to London cannot help being impressed by the efficiency of its bus services. The Londoner, on the other hand, is so familiar with the myriads of red "*Generals*" that he rarely gives them a thought. When one remembers, however, that the London General Omnibus Company own 4,150 vehicles, of which 3,500 are in continual service, one realises that this thoughtlessness on the Londoner's part is really a tribute—a tribute to the maintenance methods that triumph over all the difficulties caused by London's gigantic area and the congestion of its streets.

As each vehicle runs for some 18 hours per day, a complete overhaul is necessary after a yearly mileage of 40,000 in order to maintain the traditionally high standard of efficiency of the fleet. The Metropolitan Police regulations, too, demand a yearly examination, but in fairness to the company it should be stated that their own examination is even more strict than that of the police.

Special Reamering and Crank-fitting Machine

Until 1921 this overhaul was carried out at several of the forty-odd garages that the company own, but this procedure entailed a considerable cartage of stores and, in the opinion of those concerned, each garage did not undertake sufficient of the work to enable it to operate on efficient lines. In 1922 new overhaul works were opened and now form the central renovating department of the fleet.

The works are located at Chiswick, where both road and rail transport facilities are excellent.

Most of the work is carried on in one huge building, 857 ft. in length and 352 ft. in width. In addition, completed buses are tested and experiments are carried out on the concrete track, test hill and artificial rough road that have been constructed on a site of some 32 acres.

There is a large sports ground equipped for football, tennis and cricket. Meals are provided, at very low cost, in a mess-room capable of seating 1,220 people at once. If need be, this hall can be cleared and used for entertainment and various social functions.

A pleasant feature of the works policy is to effect economies by up-to-date methods and not by cutting wages. All workers are paid a rate well above that set by the trade unions, the company having found that, in the long run, the best results can be attained only by the highest class of labour.

The works are divided virtually into two parts, one of which is devoted to bodies and the other to chassis. Between them are the stores, so arranged as to feed either side with equal facility.

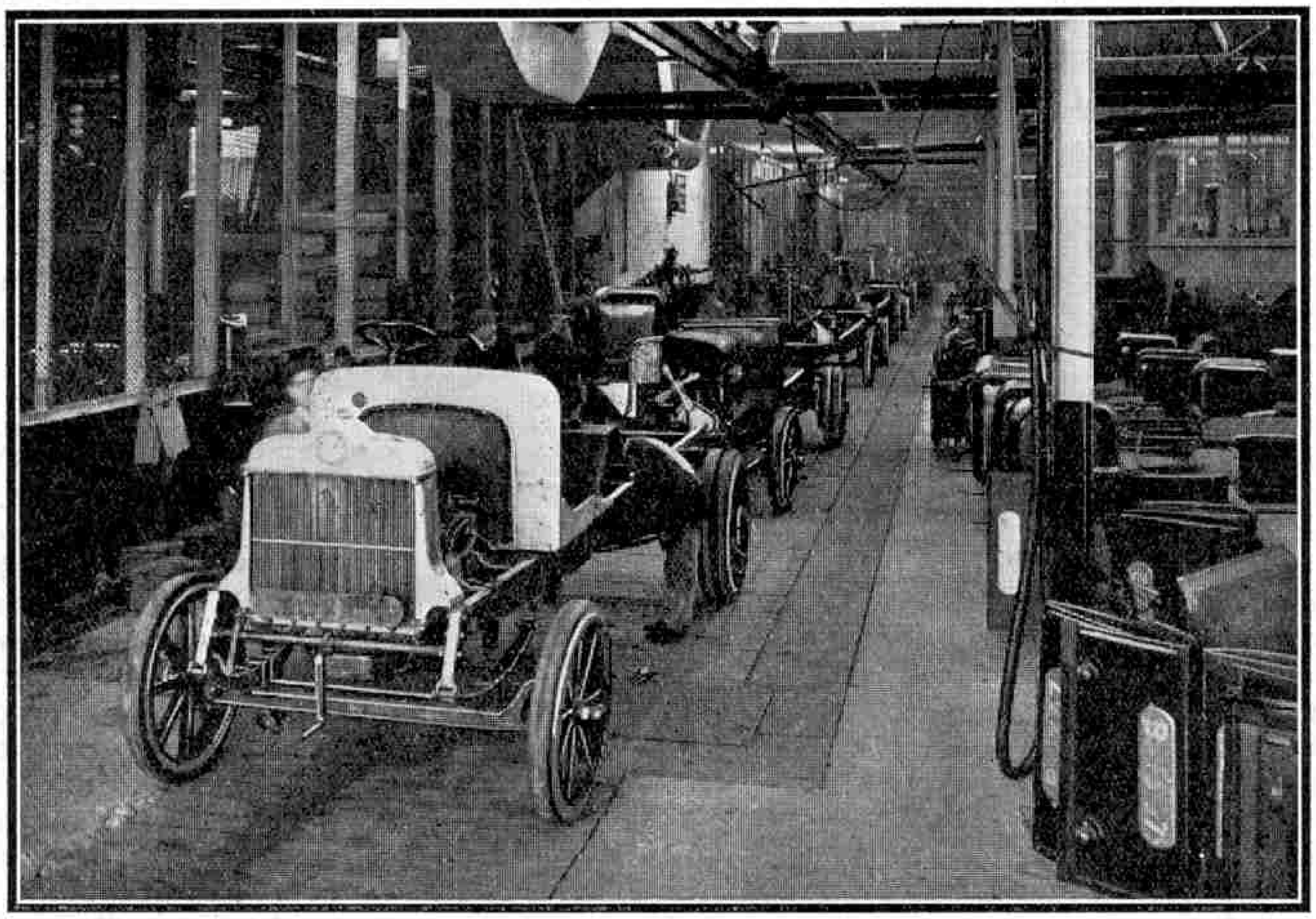
When a bus arrives for overhaul, all the small easily removable fittings such as lamps, destination boards and cushions are stripped off, and after the body bolts have been unscrewed the bus is driven over a multiple-headed hydraulic jack which lifts the body off. The chassis drives away under its own power, while a tractor pushes a light bogie under the body and tows it to the "stripping" conveyor.

This consists of a cable let into the floor, and the bogie on which the body is mounted is attached to this cable, which drags it slowly along. Each man who works on the conveyor has onlv one special job, which he performs as the body passes him. A bus that has been badly damaged in a smash is dealt with by the "accident squad," but all normal overhauls go to the cable conveyor.

An inspector carefully examines the bus, and by the time it has moved down the length of the conveyor it is completely stripped of all defective material. With a view to rapid overhaul the buses are completely standardised into three types, and many units can be removed by undoing a few screws only. Mudguards are made of wood to enable them to be easily overhauled and spliced, for the congested state of London streets calls for frequent mudguard repairs.

In an incredibly short time the body is reduced to a mere skeleton, and the tractor then tows it to the next conveyor where the re-building is commenced. There are in all four body conveyors, of which the first is devoted to stripping only. Gradually the body takes shape, and owing to the fine standardisation adopted there is little fitting required—old parts come off and new ones grow on in their place. It is interesting to note that as recently as 1925 from four to seven days were required to overhaul a body, but now 96 men repair 18 bodies daily.

To save needless handling, the wood-working department runs parallel to the conveyor so that the parts are made on the spot.



Chassis Assembly Platform

From the repair shop the conveyor pulls the body to the paint shop where two coats of paint are flowed on, first a grey and then the familiar *"General"* red. The paint is stored in overhead tanks and flowed over the surfaces from a hose. The drippings are caught in troughs, filtered, and pumped back to the overhead tank. Mudguards and small parts are sprayed with paint by a small "spraying pistol," which in principle is not unlike a scent spray.

When the paint is dry it is slightly transparent, and the old lettering is faintly discernable beneath it. The new letters, notices and lines are transferred on with large paper transfers, exactly over the old marks.

Bill Sticking on the Route Boards

Before describing the chassis shop one must mention some of the other departments. There is, for instance, a special one that deals with destination boards, cleaning and overhauling them with the same thoroughness that is applied to engines or gearboxes. The new lettering is already printed upon sheets of stiff paper, and these are glued in place and covered with varnish to weatherproof them. Then there is a well-equipped laboratory, which not only makes routine tests on materials, lubricating oil and fuel, so as to assist the purchasing department, but tries out all the new devices that are submitted to the company. Three bus chassis are loaned to this department to enable new inventions to be given a road test. Another scene of activity that must not be overlooked is the boiler house that supplies the works with steam for heating and cleaning. This is located near the main building, and close to it is the department that reclaims the oil from the cleaning rags and metal turnings. There are three turbine oil extractors in this shop, with a water extractor and two drying machines. All the reclaimed oil is burned under the boilers, while the cleaned rags are re-issued to the shops.

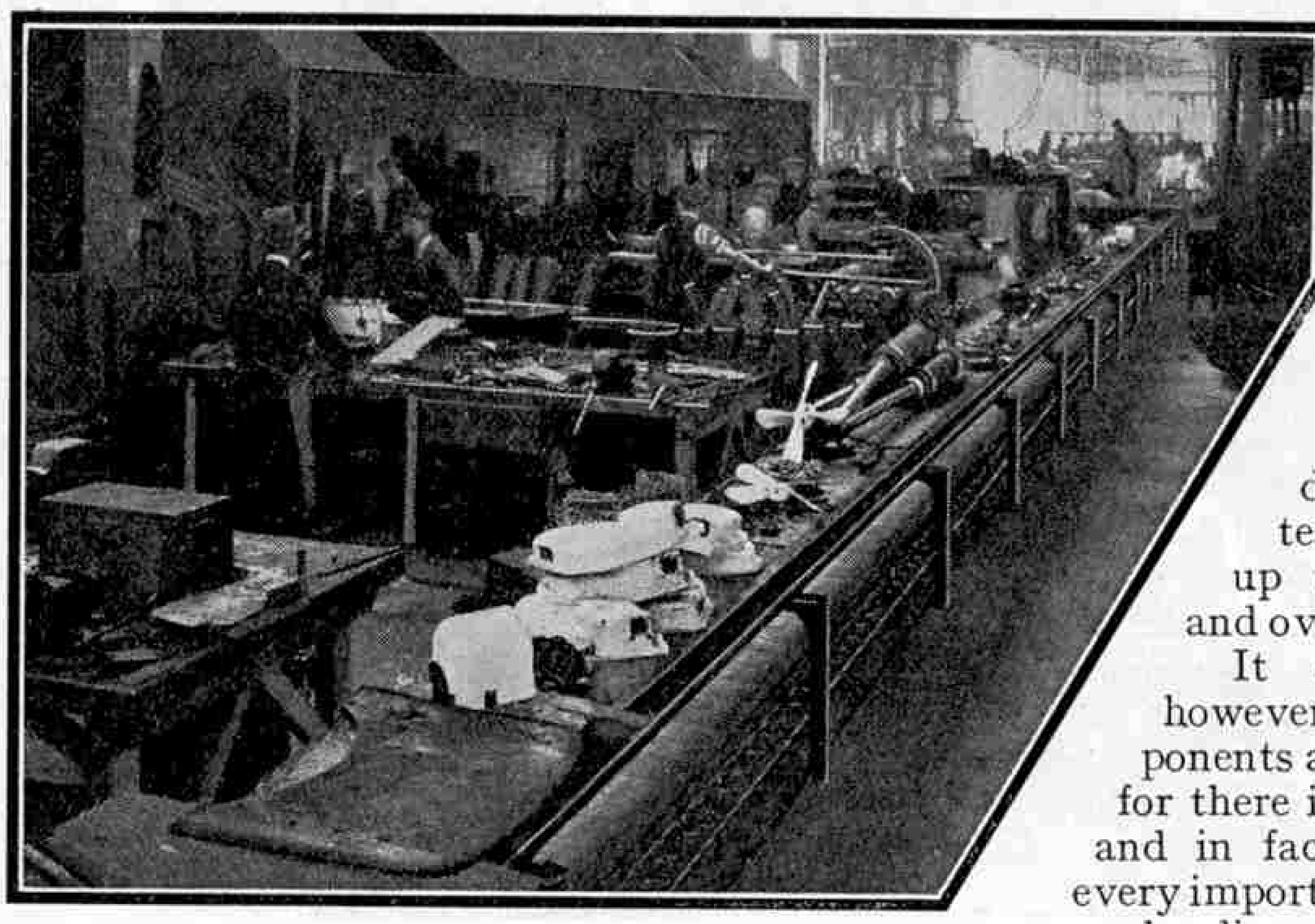
At present many of the buses—those of the N.S. type—are being converted from open-top vehicles, and this work is being undertaken in the repair shop.

As the chassis moves along, the operators strip the parts, starting with the petrol tank and radiator and concluding with the axles. At the end of the line only the bare frame is left. Wherever possible, work is facilitated by pneumatic hoists and overhead runways and, to reduce the handling, the shops dealing with the units are at right angles to the stripping conveyors.

Three different washing machines, looking like huge iron boxes, are installed, and through each moves a roller conveyor. As the parts are moved through, steaming hot caustic soda solution is squirted on them to remove the dirt and oil. Radiators are dismantled and their cases are washed in caustic soda, preparatory to being dipped in a bath of corrosive acid that eats off the scale. Heat is applied to the gearboxes to render fluid the lubricant before dismantling.

After the parts are cleaned they are inspected, and gauges are used to assist visual examination of the dismantled parts. A three-colour system is employed by the inspection department. A splash of red paint denotes that a component is to be scrapped ; green that it is for re-issue in its present condition, while blue indicates that it is for repair.

The machines in the repair department are grouped in relation to the work that they have to do. Thus all machines for engines are together in one group. A die-casting machine turns out bearings at the rate of 60 per hour, and one operator can make the white metal bearings for 36 engines per day. An ingenious jig is clamped over the cylinders, which are then immersed in water, and the jackets are tested under a pressure of 15 lb. per sq. in.



Material Conveyor

I noticed, as I went round the works, that bus components and scrap parts were used considerably in the manufacture of the special purpose machines, of which there are many. The valves are ground in, four at a time, on a special machine, and an ingenious conversion of a drilling machine is used to true-up brake linings. The shoes are clamped to the rotating table while the cutter is fixed to the spindle. Another adaptation is a wheel lathe that is used to true-up brake drums.

Perhaps the most impressive special machine, however, is the big cross-shaped machine that fits the crankshaft. It has four arms, and on the end of each will be seen a crankcase, and beside each an operator. Each crankcase on its arm is rotated through 90° to the reamer head, which machines the main bearing to size. A further 90° brings the crankcase opposite the point where the crankshaft is fitted, after which the next movement connects the crankshaft up with the fast revolving spindle that runs it in. The next move completes the circle and the case is removed and placed upon the engine conveyor. As all the four arms and the four operators are continually engaged, one crankcase is delivered up every 20 minutes. Previous to the adoption of this machine one man often spent two days on this set of jobs.

The engine conveyor, which takes the form of a chain, moves at a speed of 7½ in. per minute, and as the crankcase passes each mechanic a part is added until, at the end of the line, the engine is complete. It is now placed upon a special running-in bed and coupled up with a powerful electric motor. Naturally, every part is a little stiff and the engine takes a lot of power to rotate it. As the engine becomes freer less power is required, and when the electrical instruments indicate that 5 h.p. is sufficient to turn the engine, the running-in process is deemed complete. On goes the engine then to the chassis conveyor.

Here the reverse process to that of the stripping conveyor takes place, and gradually the machine assumes shape. As it nears the end of the line six gallons of fuel are put into the tank, a measured quantity of oil is fed into the gearbox and rear axle, and all the greasers are filled. The driver now takes his place on the seat. The final stage is reached when the rear wheels pass over a pair of rotating rollers in the ground. These rollers, by the way, are discarded bus road wheels. The top gear is engaged to start the engine. The chassis is then driven away under its own power and the engine is allowed to continue running without load for two hours at 800 revolutions per minute. Then the bus is handed over to the test driver, who runs it on the test track round the works, up and down the test hill and over the artificially bad road.

It must not be thought, however, that the chassis components are not tested individually, for there is a magneto testing shop, and in fact tests are arranged for every important unit. All road springs are also dismantled and the leaves taken apart. They are re-set, tempered and, after being lubricated, subjected to a 50 per cent. overload test.

An overhead hoist lifts the body on to the chassis, and the finishing touches are given to the bus before it is driven to the licensing department. Here final inspection takes place before the vehicle is sent out on the road again, to take its place in London's vast transport organisation.

Many of the machine tools used are naturally special to the job and the factory demonstrates the fact that it is possible to apply the most advanced of production ideas to repair and overhaul work, for only in the most modern of mass-production car factories does one see each operation so carefully studied as at Chiswick. As an example of applied ingenuity I might cite the ordinary big pillar drilling machine that was converted for trueing brake shoes as already described.

The normal capacity of the works is 75 buses per week, but on one occasion 120 buses were overhauled and 11 supplied with covered tops in 5½ working days.

One of the features that struck me particularly about the Chiswick works was their cleanliness and spaciousness. There is nothing mean or dirty about them. In order to prevent theft and at the same time economise floor space the coat racks for the workers' clothes are all mounted on pulleys so that they may be hauled up well out of the way after work commences. Adequate provision for washing is made and all over the factory one notices rows of washing basins.

As previously stated, the company operates 4,150 buses, but together with its associate companies the total is brought up to 4,571 out of a total of 5,045 buses licensed for service in London.

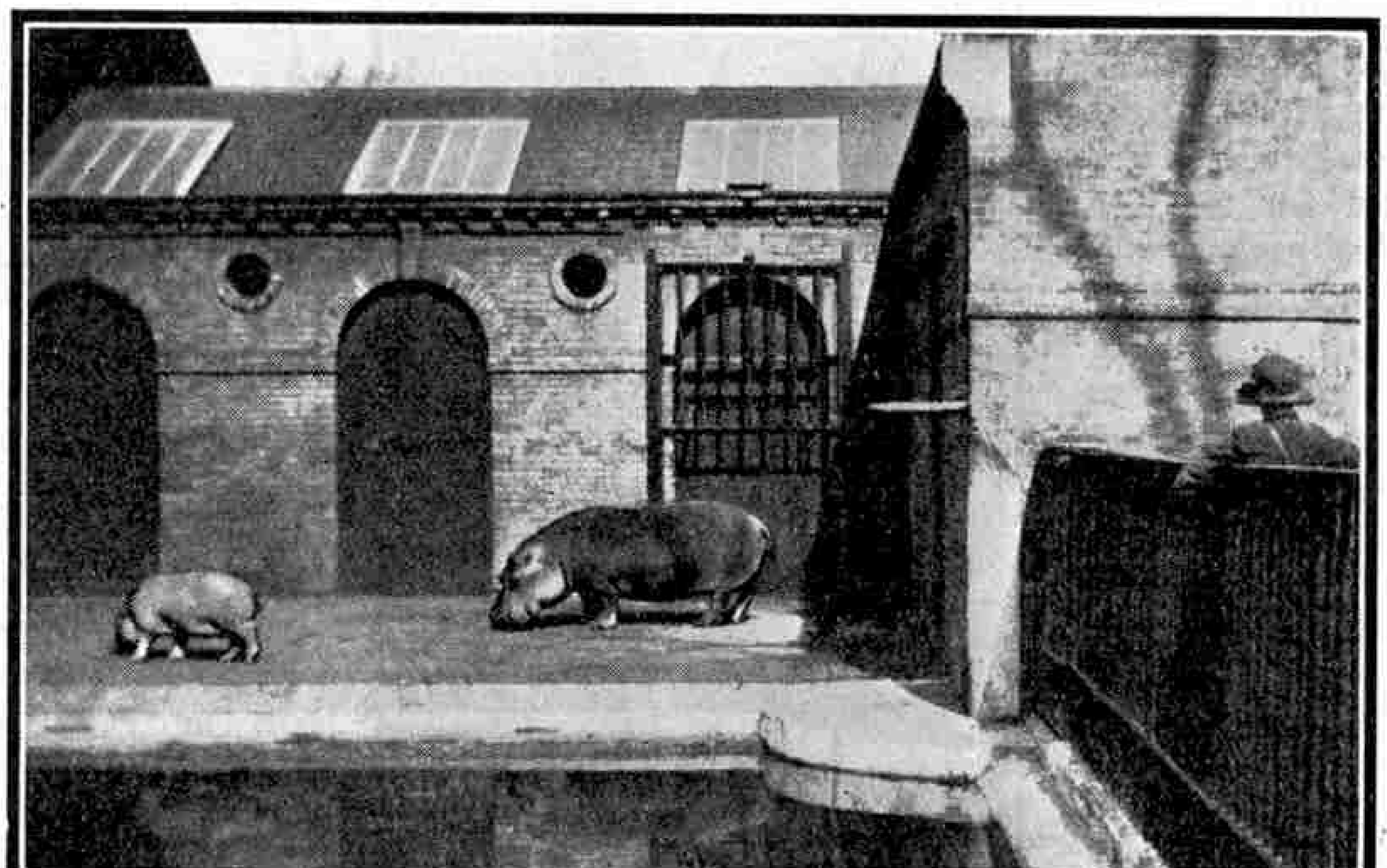
The average number of car-miles per week is 3,000,000, operating over 860 miles of road and carrying 27,000,000 passengers.

ZOO NOTES

New Reptile House at the London Zoo

The great event of the year at the London Zoo has been the opening of the new Reptile House, a splendid building designed to provide its inhabitants as far as possible with the conditions of living best suited to them. Every possible method of providing for their natural habits has been adopted. For instance, the stonework of the dens in which the giant pythons live has a strange appearance on account of the hollows in which the pythons are able to coil themselves up for a long sleep, and the roughened walls up which they can climb when they feel the need for basking in the rays of the ultra-violet lamps that form their sun.

Electric heating is employed on a large scale. If the temperature in any one house rises too high, the heat is shut off automatically until the temperature falls to a certain degree. Defects in any circuit are signalled by the appearance of an electric light in a central position. If the result of the defect is to raise the temperature too high a red light appears, while in the opposite circumstances the light is green. The warmest places in the dens, where the reptiles naturally will spend most of their time, have been cunningly arranged so as to bring the creatures into the positions in which they will be seen best by visitors.



The above photograph (taken at the Zoo by one of our young readers, J. Bompas Smith, Manchester) shows the famous baby hippo. " Jimmy " and his mother taking the air during one of the few days this summer on which the Sun has been shining

A noteworthy feature of the new house is that for the first time a Komodo lizard is in on view. These fearsome creatures were referred to in "*Zoo Notes*" in the March "*M.M.*" The specimen on view is not as large as some that have been seen on the Island of Komodo in the Dutch West Indies, but a length of 8 ft. gives him a distinctly formidable appearance.

Considerable trouble was experienced in removing the reptiles from their old quarters to the new house. Most of them were either lured or forced into boxes and temporary cages for the transference, and as they had no notion of the gorgeous apartments awaiting them many struggled hard to avoid capture. One of the crocodiles in particular caused his capturers a great amount of trouble, and even when he had been hauled into the travelling box ropes had to be tied round him to hold him there. Curiously enough, the notoriously aggressive alligator " George " proved quite easy to move. Perhaps he had heard a rumour of the good time coming!

The beneficial effect upon the reptiles of more suitable quarters is clearly shown by the fact that they are now far more vigorous and active than they were in their old home.

"Steve" Remembers

A hippopotamus weighing a few tons does not sound very promising as a pet, but a recent episode appears to show that this huge creature possesses a memory and is capable of feeling affection for those from whom it has received kindly treatment.

A young hippopotamus rejoicing in the name of " Buster " was brought up at the National Zoo at Washington and when two years old was transferred to St. Louis, his name at the same time being changed to " Steve." He quickly settled in his new home and steadily grew larger and larger, apparently being oblivious to everything except the daily routine of absorbing the immense quantities of food provided for him. Two years after the removal, however, the keeper who had charge of him at Washington had occasion to visit the Zoo at St. Louis. He went into the hippo. house at feeding time and hailed his friend with " Hello Buster," just as he had done in the old days. The hippo. was a little puzzled at first, but memory was awakened after a thorough and prolonged examination of his old keeper and he was so delighted that he actually forgot to finish his meal!

Chameleons Demand More Flies

The value of ultra-violet rays at the London Zoo has been proved in several ways, but perhaps the most remarkable evidence is the effect they have had on the chameleons. Until comparatively recently it has been very difficult to persuade the reptiles to continue to live, although flies were provided and brought within reach of the amazingly rapid flick of the tongue by which they are captured. The application of ultra-violet rays and the provision of new quarters more in keeping with the natural surroundings of the chameleons have worked wonders. The difficulty now is not to keep the creatures alive but to prevent them from overfeeding, for they are now extremely vigorous and active.

The temperature of their room is maintained at over 80°F. by the liberal use of hot-water pipes and gas fires. The atmosphere is kept moist, and light is provided by special lamps that emit ultra-violet rays. The result is that the chameleons are rapidly increasing in numbers and are keeping the fly hatchery at the Zoo extremely busy in providing them with the necessary insects.

Terrapin Dies Without Giving Notice!

There is a story told concerning a former London club that was conducted on very staid and conservative lines, dignity being first and foremost. It is said that one of the members died in a chair while reading a newspaper and his death was not noticed for nearly a week! An event not unlike this actually occurred at the London Zoo, the laziest animal in the establishment dying without giving notice. This was the mata mata terrapin, a creature of the tortoise tribe that is common in the Guianas and Brazil. It is very difficult at any time to catch this animal moving and nobody felt at all surprised when it was discovered that it had been dead for some weeks!

Plimsoll Makes His Mark!

The Story of a Great Shipping Reform

By A. W. Jackson

PROBABLY the majority of "*M.M.*" readers are familiar with the curious disc-and-gridiron design seen on the sides of ships, and know that this is called the "Plimsoll Mark." The origin of the mark is not so well known, however, and the story is one of great interest.

Samuel Plimsoll, M.P., caricatured in "*The London Sketch Book*"

On 10th February, 1824, Samuel Plimsoll, politician and social reformer, was born at Bristol. He was one of twelve children and was brought up in an atmosphere of work. After a brief period of schooling he left home and went to Sheffield, where he became clerk to a brewer. At the age of 26 he commenced a coal business in London, where at first he had to live in a model lodging-house on $7/9\frac{1}{2}$ per week, and knew how much—or rather how little—roast mutton could be got for 2d. for his Sunday dinner! Subsequently he invented a system of loading coal which, when patented, brought him in a considerable royalty.

Through his lodging-house experience Plimsoll learned to sympathise with the sufferings of the poor, and when he became a rich man he began to search for a wider sphere of activity and usefulness. This wider field was opened out to him in 1868 on his election as Member of Parliament for Derby.

At this period of our history ships were built almost entirely of wood, and disasters at sea were of far too frequent occurrence. Plimsoll realised that this state of affairs was due very largely to ships being unseaworthy and overloaded, and he directed his efforts against what were commonly spoken of as "coffin ships." These cargo carriers were often heavily insured and unscrupulous owners were allowed by law to send them to sea without the slightest consideration for the lives of the seamen.

A great impression was made on the public in 1872 when Plimsoll published a book entitled "*Our Seamen*," which was really an attack on the British shipowner against "rotten and overloaded ships." A Royal Commission to consider the matter was appointed in 1873 on Plimsoll's motion. This Commission reported strongly in favour of "a reserve of buoyancy" as being the main guide to a suitable loadline, but stated that it would be impossible to make a universal rule applicable to the safe loading of all ships.

In 1875, a Bill was introduced in Parliament which, although totally inadequate from Plimsoll's point of view, was accepted by him as being a step in the right direction. So many alterations and amendments were made to the proposed measure, however, that it was dropped for the time being. Plimsoll was greatly indignant, called the shipowners "villains" and shook his fist at the Speaker!

The Government did not act with undue haste nor on the other hand did they let the matter slide, for iron and steel were rapidly replacing wood for the construction of ships and these materials themselves would make for greater safety at sea.

Plimsoll's allegations undoubtedly were exaggerated, but they appealed to the man in the street and popular agitation brought pressure to bear upon the Government. As the result a short Bill was passed which, in the following year, was amended to the Merchant Shipping Act of 1876. This Act made the Board of Trade responsible for the detention of overladen vessels and compelled shipowners to cut in the side of each vessel a Plimsoll Mark showing what, in their opinion, was the greatest draught to which the ships should be loaded.

In 1882 Lloyds Register of Shipping published tables of reserve of buoyancy which, on account of the experience behind their preparation, were of great help to shipowners in fixing the positions of the Plimsoll Mark. Their use was not compulsory, however, and in fact one shipowner placed the mark on the funnel in an endeavour to ridicule the Act!

Then followed the Load Line Bill of 1890 which gave authority to the Committees of Lloyds Register of Shipping, the British Corporation and the British Committee of the Bureau Veritas under the Board of Trade. These authorities are now empowered to fix loadlines on nearly all trading vessels of 80 tons and upwards, which will make it clear why the letters "B.T.," "L.R.," "B.C." and "B.V." appear above the Plimsoll Line.

In 1906 the Shipping Laws were amended so that all foreign vessels loading at British ports were required to be provided either with a freeboard assigned by one of the authorities previously mentioned, or else under the freeboard tables of a foreign country which had been certified by the British Board of Trade to give the same degree of safety as that which would obtain if the freeboard had been assigned under the British tables.

The mere fact that the freeboard marking is on the sides of the vessel is an indication that she has been carefully examined structurally and found to be in a seaworthy condition, and this affords shippers and underwriters alike a guarantee without which it would be difficult to carry on business.

A heavy cargo such as rails or iron ore would sink a vessel down to the loadline and still leave stowage space; whereas with a light cargo every available cubic inch of space might be used and yet the vessel not sink to her marks. Plimsoll declared that often, in vessels with heavy cargoes, the vacant stowage space or safety margin was used for the stowage of cargo, with the attendant risk of dangerous immersion.

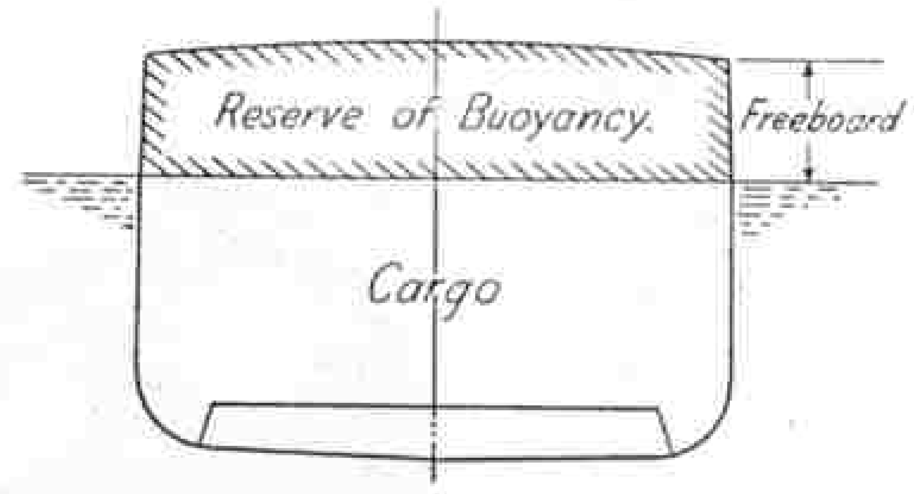


Fig. 1

In order to prevent a ship from being loaded to such a depth in water as to leave her without a margin of safety, a certain height of the side of the ship above the waterline, at the middle of her length, is measured from the top of the deck at the side, and this is termed her "freeboard." A vessel's loadline is the line the water makes when she is full of cargo, and freeboard is the space between this line and the upper side of the deck, that is "reserve of buoyancy" (see Fig. 1). This will vary with the design of each ship.

One of the duties of Surveyors to the Board of Trade is to see that vessels do not leave port loaded with the Plimsoll Mark submerged.

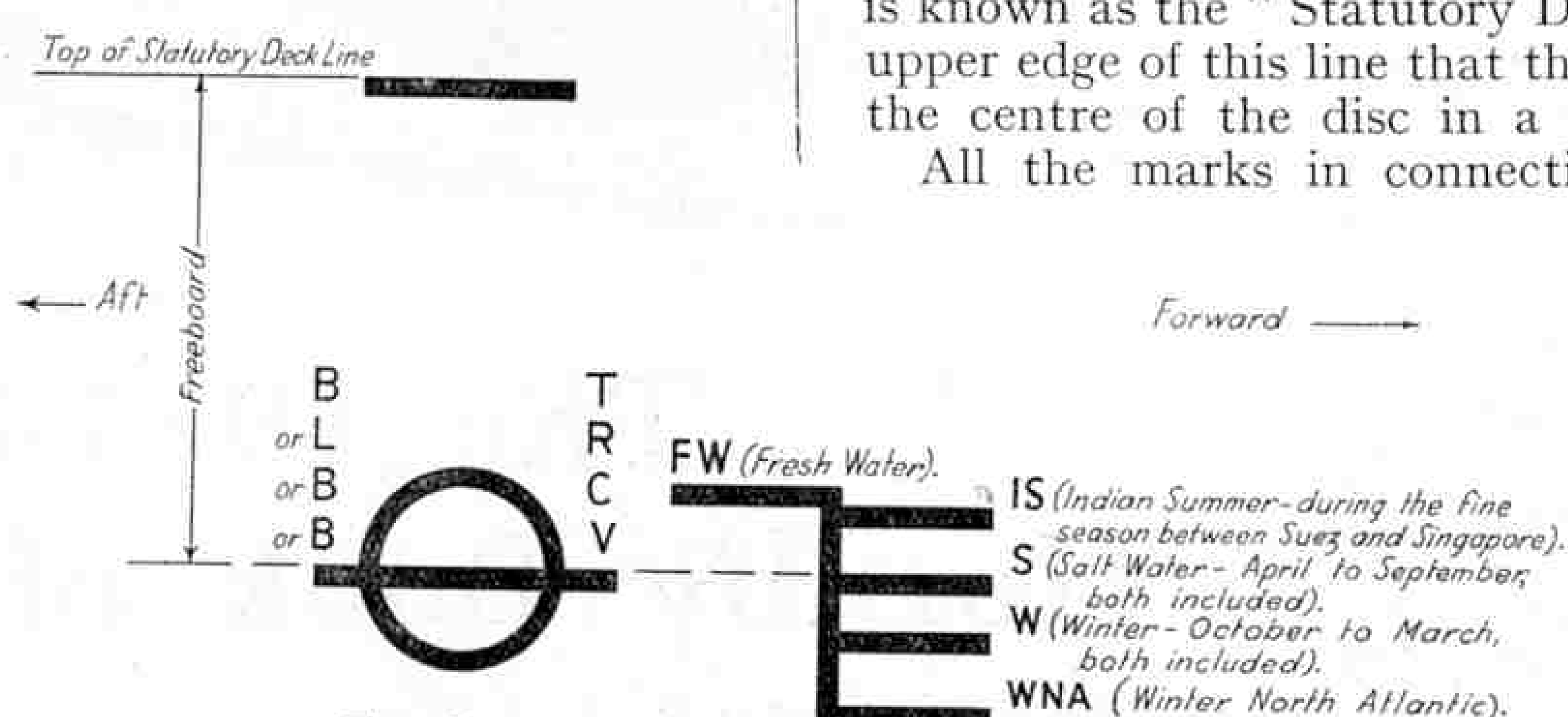


Fig. 2

The loadline, the upper edge of which passes through the centre of the disc, Fig. 2, is cut on both sides of the vessel at the centre of the length along the waterline, and indicates the maximum draught to which she can be loaded in salt water. This line is to some extent movable, depending upon whether the vessel is loaded in fresh or salt water and also upon the season of the year. If, for example, a vessel is loaded in fresh water, when she gets into salt water the greater buoyancy of the latter will allow of her being loaded to a greater depth.

Fig. 2 shows the freeboard marking for steamers. The marking for sailing vessels is similar, but only the Fresh Water and the Winter North Atlantic lines are included. When the freeboard marks have been cut in on the sides of the vessel they are painted with white or yellow letters on a dark background, or black letters on a light ground. Passenger liners, which seldom load down, are content with a certain freeboard for all seasons, and so have a mark placed considerably below the lowest mark. They sometimes dispense with the "gridiron" and show only the disc.

As the freeboard deck is sometimes obscured by erections above it, such as a bridge or a boat deck, a line is cut in on the ship's side above the centre of the disc and is known as the "Statutory Deck Line." It is from the upper edge of this line that the freeboard is measured to the centre of the disc in a vertical direction, Fig. 2.

All the marks in connection with a freeboard are carefully measured by a surveyor to the Authority whose initials appear above the line through the centre of the disc, and carefully certified. By Act of Parliament a framed Freeboard Certificate must be put up in a conspicuous part of the vessel (usually the chart-house), so as to be visible to all on board, and it must continue in that position so long as the certificate is in force or the ship in use.

Plimsoll devoted his long life to the service of mankind in general and to seamen in particular. He died at Folkestone on 3rd June, 1898, having gained for himself the name of the "Sailors' Friend."

The Story of Silk—(*continued from page* 857)

associated with the monastery of Syon and when the latter was closed down the tapestry was taken to a convent at Lisbon. Ultimately it found its way back into this country and is now in the safekeeping of the Victoria and Albert Museum.

In the 16th century large numbers of Dutch silk weavers, driven from their country by religious persecution, came to England and introduced the draw-loom. The first of these machines is said to have been erected in 1567 at Norwich, where many of the Dutch refugees had settled. In the 17th century steps were taken to establish silk weaving in England as an organised trade, and for this purpose the Livery Company of Silk Throwsters of London and the Company of Silkmen were formed in 1629 and 1631 respectively. The emigration of French Protestant families to England in 1685, already referred to, further aided the progress of English silk weaving.

Somewhere about the year 1717 a Derbyshire man named John Lombe went to Piedmont in Italy and, in the guise of an ordinary workman, secured a job in a silk factory. His object was to obtain details regarding the machinery and he succeeded in making drawings, but was caught in the act. He managed to escape, however, with sufficient information to enable him to construct machinery very similar to that of the Italians, and in 1718 he installed this in a five-storey factory that he built at Derby. This factory was erected on the bank of the river Derwent so that water power could be utilised to operate the machinery. When in full swing Lombe's factory was capable of producing daily 318,000,000 yards of prepared silk thread.

During the later years of the 18th century the prosperity of silk weaving in England suffered from various causes, notably from the ill-effects of numerous trade disputes. The trade revived, however, and to-day the products of the English factories are equal to any others in the world.

Lombe did not live long to enjoy the success and prosperity of his enterprise, for he died four years later. There is some mystery as to the cause of his death, but it is said that he was poisoned by a woman who had followed him from Italy, probably from some motive of revenge.

This pioneer silk business was subsequently carried on by Lombe's cousin who acquired vast wealth and received a knighthood.

Next month we shall describe in detail the fascinating and delicate business of rearing silk worms in the vast quantities necessary to maintain the needed supplies of silk thread.

Salt Fish Cause Shipwreck!

Casualties to ships at sea are often brought about by very unexpected means but it is probable that the cause of the loss of the schooner "*Ponhook*" is unique. The "*Ponhook*" was bound from St. John's for Gibraltar with a cargo of salted codfish in boxes. When three days out she ran into a severe gale, and presently a heavy sea crashed on her deck and broke through a hatch. Before the damage could be remedied several tons of water had found their way into the hold, but there was little indication of danger as the pumps were capable of dealing with the water.

The unexpected now occurred. The water found its way through the crevices in the boxes and the salt fish immediately absorbed it and began to swell. This swelling was so rapid that box after box was burst open by the pressure. Gradually the expanding fish began to press hard against the sides of the ship with the result that in a few hours her plates were loosened and water entered faster than it could be dealt with by the pumps.

Fortunately the crew were able to attract the attention of a passing vessel and were taken off in safety shortly before the "*Ponhook*" gave a final lurch and sank.

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

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

A. Bradley (Middlesbrough).—We look forward to receiving a copy of the Meccano song and our only fear is that, if the tune is as catchy as you say, our staff will be indulging in community singing instead of getting on with their work! We like your last sentence:—"Mr. Editor, may thy shadow never decrease and may the shadow of the "*M.M.*" ever increase until a bookstand is needed to hold it." To that, A.B., we can only say "Amen!"

S. H. King (London).—We welcome you to England and we wish you every success in your studies. Your friend Eric has not yet visited us, and it looks as though you may yet be the first one to arrive at the editorial offices.

T. Buchanan (Brisbane, Queensland).—The new Meccano colours were decided upon after much thought and experiment, and they have proved most acceptable. Of course, we always supply nickelled parts where desired, to fit in with the older type, but the demand is almost nil. Your suggestion for special pages in the "*M.M.*" to be detached and inserted in the Meccano Manual is interesting but scarcely practicable we fear.

A. Hodgkinson (Fleetwood).—What has your local shopkeeper done to deserve being called "a blooming humbug" and what are "The vitals of Wrath" that you fear we may pour on your head? Every word of your letter was interesting.

Rodney Brown (Newcastle, N.S.W.)—We note that you have repainted your Hornby Loco, and christened it "The Green Goddess," which tells us at once what it looks like. From your description of the work it does, it must be a veritable giant. We hope your father is fully restored to health again.

M. Kravtchenko (Rome).—. . . I always imagine an ideal Meccano salesman as a kind old man with spectacles, who knows all about wheels and things, listens to your technical grievances, and has some sound advice up his sleeve." There are quite a number of fine Meccano salesmen in all countries, Michael, but we occasionally hear of others like the one you mention, who are not quite so helpful. Meccano calls for a lot of study before it can be understood in all its ramifications. We are cheered when we learn that you consider Englishmen to be even more "exuberant and enthusiastic" than your own countrymen. Reading your letters always gives us pleasure.

J. A. Gomes (Bombay).—Quite right J.A., you were born under a lucky star. May prizes continue to fall into your lap all through your life. As desired we are devoting a part of your last prize money to renewing your subscription to the "*M.M.*"

G. Alston (Sedbergh).—"When the other boys all had Meccano Outfits and Hornby Trains and I didn't have any, I felt small enough to walk under a duck wearing a top hat." It's a terrible feeling George, and we are glad you've now expanded back to normal size.

F. Crowhurst (Tilbury, Ontario).—To go into a hatter's and, after asking for a hat to suit your head, to be handed a soft one certainly gives one something to think of! He didn't mean it that way though, we feel sure—and if he did it was a very bad shot, judging from the intelligent letters we get from you.

D. Ware (Burnham).—We are very interested to hear that you have a row of multiheaded marigolds in your garden. We much appreciate your offer to send us a few seeds. We congratulate your son on his prize-winning habits and it is interesting to know that he is "following in father's footsteps."

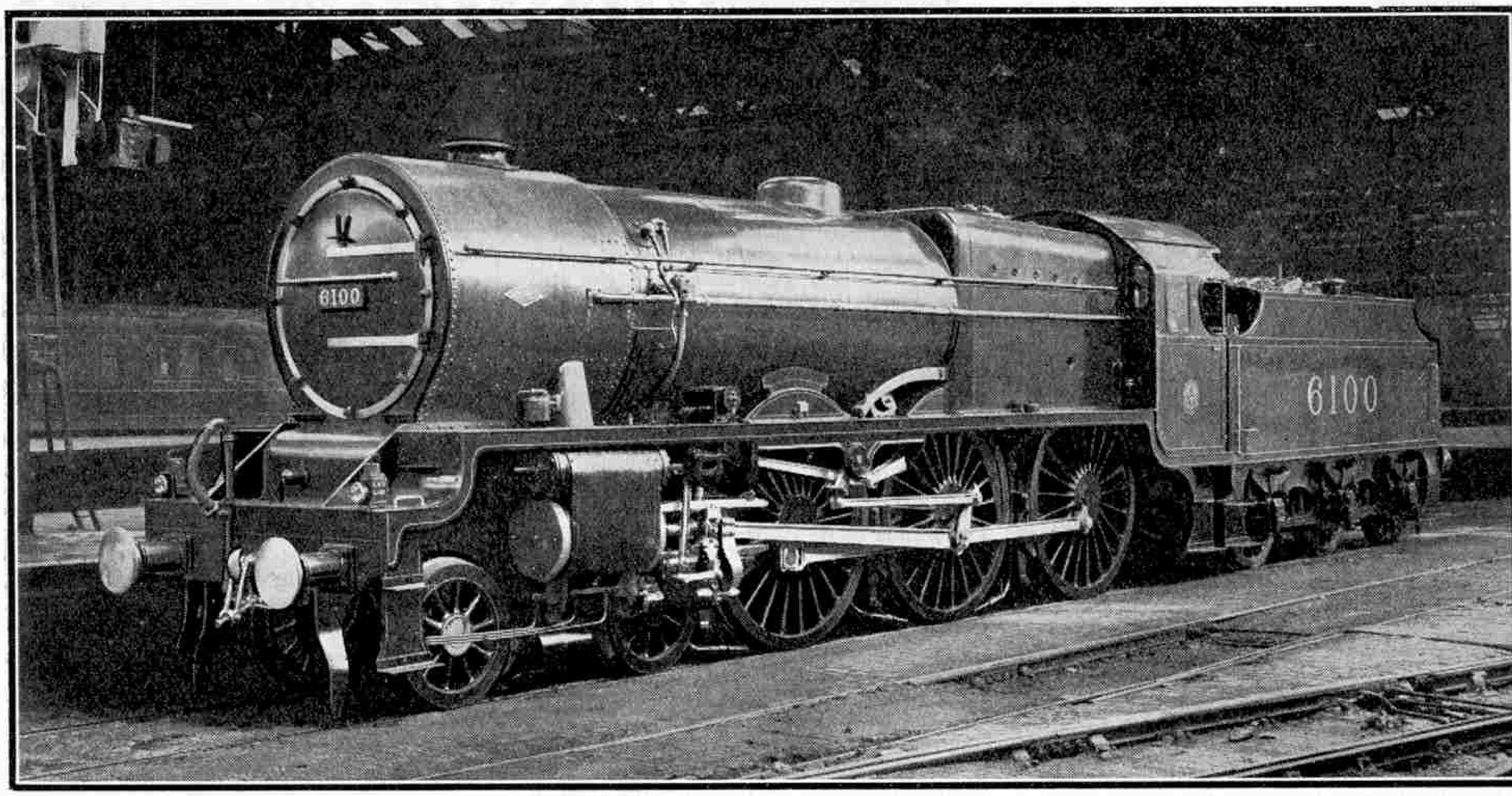
H. H. B. Dixon (Epping).—We are extremely interested to hear of the Hornby locomotive that has been running for nearly seven years without requiring a new spring. We are not surprised that the spring is becoming a little weak, however, and we agree that you would be wise to have a new one fitted.

R. Overy (Johannesburg).—"I am afraid I shall have to discontinue getting the Magazine because as soon as it comes the whole family have a 'rough-and-tumble' fight for it and by the time I come home from school it's all in pieces and useless for my binder." This is a very sad state of affairs, Roy; you will really have to take the family in hand and speak seriously to them!

Hugh H. Eccles (Manchester).—We have mislaid your address and shall be glad if you will kindly write us as we want to ask for some information in regard to the High Lea Railway.

Latest L.M.S. Passenger Locomotives

To Work London-Glasgow Expresses



The first of the 50 new L.M.S. 4-6-0 three-cylinder express locomotives : No. 6100, "*Royal Scot*"

ONE of the most interesting recent locomotive orders is that given by the L.M.S. Railway to the North British Locomotive Co. Ltd., for fifty 4-6-0 express passenger engines.

These engines have been designed by Sir Henry Fowler, Chief Mechanical Engineer of the L.M.S. They are intended to give a tractive effort of 33,150 lb. at 85 per cent. of the boiler pressure which, it is estimated, will provide sufficient power to haul economically the heavily-loaded passenger trains on the main line between London (Euston) and Glasgow (Central). They are fitted with three simple cylinders, each of which is provided with an independent Walschaerts valve gear.

The first of these 50 engines is No. 6100, "*Royal Scot*," and several interesting features have been embodied in its design to give economic running. The boiler pressure is high, being 250 lb. per sq. in. The grate area is 31¼ sq. ft., and a large firebox volume is provided in conjunction with ample heating surface. The standard type of superheater is fitted. Other items are an exhaust steam injector and a steam tube cleaner. Standard locomotive fittings have been provided wherever possible in order to facilitate interchangeability.

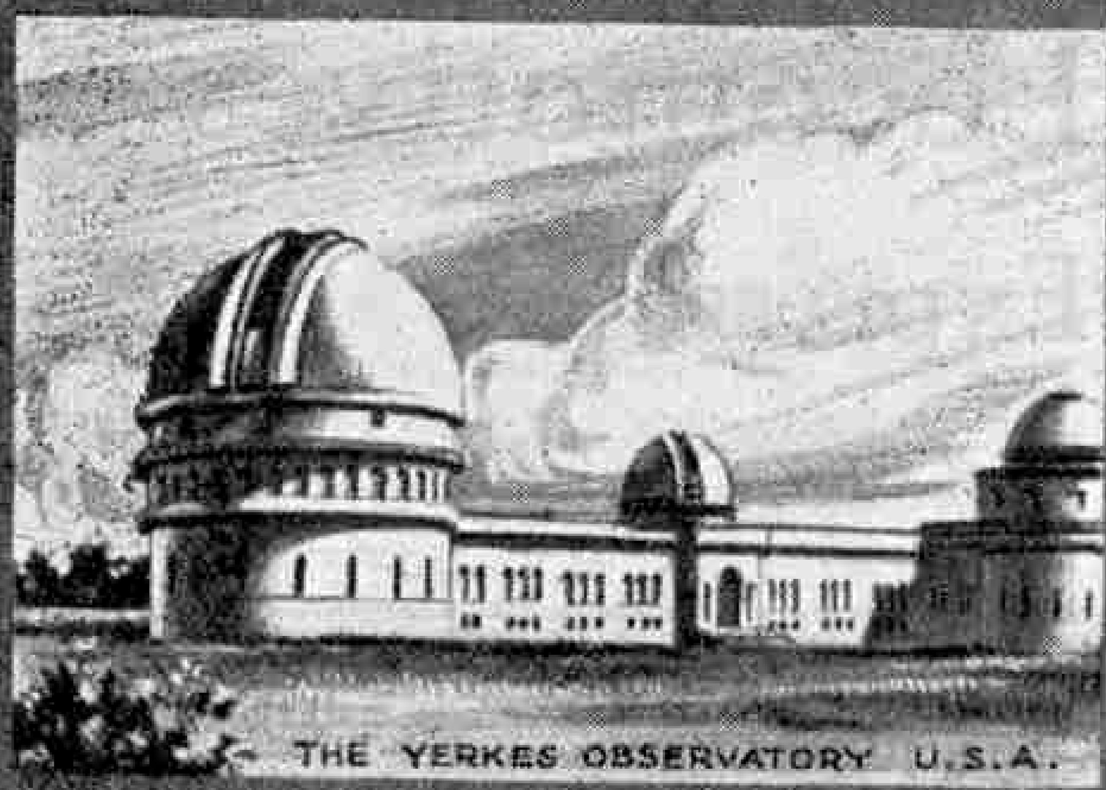
Leading Details of L.M.S. 6100
"*Royal Scot*"

Boiler pressure ...	250 lb. per sq. in.
Heating surface :—	
Tubes	1,892 sq. ft.
Firebox	189 " "
Total	2,081 " "
Superheater	445 " "
Grate area	31.2 " "
Cylinders (three)	18 in. dia. by 26 in. stroke
Coupled wheels	6 ft. 9 in. dia.
Weight of engine in working order	84 tons 18 cwt.
Weight of tender in working order	42 " 14 "
Total	127 " 12 "
Water capacity of tender ...	3,500 gallons
Coal " "	5½ tons

The long firebox—10 ft. 3 in.—increases the difficulty of dropping fires manually, and in order to help in this direction a drop grate has been incorporated, which is operated from the cab by means of a hand lever. Special attention has been given to the cab, which is comfortable, roomy and well ventilated ; while easy control of all fittings is provided.

The company's standard 3,500-gallon tender, with water pick-up apparatus, has been coupled to this engine, but a new departure has been made by fitting in the tender front a folding door, which enables the enginemen to get into the coal bunker with ease. The engine is provided with steam brake on the coupled wheels and the 4-wheeled bogie and the tender is fitted with steam and hand brake on all the wheels. The engine is fitted with a vacuum pump and a "Dreadnought" combined large and small ejector, and is piped throughout and to the back of the tender. The brake is controlled by the driver's brake valve in the usual manner.

The boiler is pitched rather high, and on this account the whistle has had to be set in a horizontal position in order to clear the gauge, while for the same reason a special pop safety valve has been designed.



OUR WONDERFUL WORLD

What is Sea Level?

The usual method of stating the height of mountains is to say that they are so many feet above sea level. By this is meant the average sea level after taking into account the tides, and the average level thus determined is usually spoken of as "mean sea level." In reality the sea is by no means level, however, a fact of which we are reminded by recent measurements taken by the Coast Survey of the United States Government. These measurements showed that sea level at a port in Florida is nearly 10 in. below that at Galveston in the Gulf of Mexico, and more than 12 in. below that at Portland in Maine.

In this matter, however, America cannot claim a record, for the difference above quoted is scarcely worth notice in comparison with one found in India. The level of the Indian Ocean at the mouth of the Indus is no less than 515 ft. higher than at Cape Comorin, the most southerly point of the peninsula, 1,200 miles farther south. The water of the Indian Ocean is piled up to the north in this manner by the attraction of the great mountain mass of the Himalayas and the high table-land in Central Asia; whereas in the south there is no mass of land nearer than the Antarctic continent, several thousand miles away.

* * * *

Sun makes Lead Radio-Active

A preliminary account of some experiments carried out by a Rumanian scientist in Paris makes very interesting reading. Until now it has always been supposed that the peculiar properties of radium are spontaneous, and no method of modifying them has been discovered, but Mlle. Marcineanu has now come to the conclusion that the Sun's rays are instrumental in promoting radio-activity.

Actually the discovery was not made with radium but with polonium, an element discovered by Mme. Curie and named by her after her native country, Poland. Like radium, this element gives off radiation of various kinds, including a type of X-ray of very short wavelength and great penetrating power, and Mlle. Marcineanu discovered that its measured activity depended on exposure to the Sun. The effect was more remarkable with lead on which a little of a polonium compound was placed, the radio-activity of the lead being 10 times greater after exposure to sunlight than before. Following the suggested explanation of the variations observed, tests were made with samples of lead, zinc and copper from the coverings of the instruments on the roof of the Observatory of Paris, which all proved to be slightly radio-active and to show variations in proportion to the power of the solar rays to which they were exposed.

Very delicate measurements are necessary to detect the slight degree of radio-activity of these substances and the still more minute variations they exhibit, and on that account great caution is being shown in accepting the results. Professor Deslandres, a well-known and experienced astronomer, is convinced of the existence of the effects observed, and certainly there is nothing absolutely improbable about them.

The full measure of the capabilities of the radiations from the Sun is unknown. The atoms at its centre are certainly at a temperature of more than 10 million degrees Centigrade and a large proportion must be radio-active. These shoot off at tremendous speeds electrons, which collide with other atoms and, either by knocking electrons out of them or disturbing them in some manner, excite them into an activity that may also be of a radio-active type. Very few of these radiations from the centre of the Sun escape into space, as they are absorbed in the relatively cooler outer layers of that body, but it is quite reasonable to suppose that the radiations that do escape will retain to a slight degree the properties of those at the centre. Repetition and extension of the experiments will in all probability influence the ideas that are at present held with regard to the constitution of the Sun and also of the stars.

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Nature's Chief Colouring Matter

A substance of extraordinary importance that is now becoming better known is chlorophyll, a very complex organic chemical that is concerned in the life processes of plants. It has been discovered in two forms of slightly different composition, and it is through them that plants make use of the carbonic acid gas, or carbon dioxide, that they absorb from the atmosphere while growing. The end of the process is the production of oxygen, so that the breathing process of a plant is exactly the opposite of that of an animal, which breathes in oxygen and exhales carbon dioxide.

One reason for the great interest taken by scientists in chlorophyll is that it is the medium by which the radiant energy of the sun is utilised in building up the complex materials found in plants, for its proportion is decreased in plants not exposed to sunlight.

It is chlorophyll that gives plants their green colour, and the bleached appearance of a decaying leaf is an indication of the absence of this all-important substance. A somewhat surprising and interesting feature is that it contains a small proportion of the metal magnesium, in addition to the carbon, hydrogen, oxygen and nitrogen that are the constituents of this and countless other chemicals connected with the living process of plants and animals.

It is not yet known exactly how this somewhat mysterious substance acts, but its immense importance to the world may be realised by considering wheat alone. It has been calculated that with its aid 114,000,000 tons of carbon dioxide are absorbed annually from the atmosphere by the wheat crop of the world, and that 80,000,000 tons of oxygen are liberated at the same time.

The compounds built up in the wheat and other plants from carbon dioxide by its aid are called carbohydrates and are very important foods, sugars and starches being members of this class. The value of a food is usually estimated by calculating or measuring the heat produced by burning it, the value of any particular food being given as so many calories, a calorie being the amount of heat required to raise the temperature of one gramme of water through one Centigrade degree.

A gallon of water would require 453,600 calories to raise its temperature from freezing point to boiling point. A pound of starch, the main constituent of rice and sago, gives out 1,856 calories in burning, so that more than 2 cwt. would have to be burnt to produce the heat necessary to raise a gallon of water to boiling point from freezing point. Now the world's wheat crop contains no less than 70,000,000 tons of carbohydrates, and some idea of its food value is given by the fact that the heat of combustion of this quantity would raise through the same range of temperature the water of a lake four miles square and 40 ft. in depth. Such a lake would be nearly 10 times the size of the Gatun reservoir, the largest in the world.

* * * *

Why Insects are Stronger than Animals

In proportion to their respective weights a bee is much stronger than a man, for whereas a man is scarcely capable of lifting anything heavier than himself a bee can lift more than 28 times its own weight. This superiority of insects over the animal groups is general and has been attributed to the breathing system of the former. In man, the blood is brought up to the lungs, which are special respiratory organs, in order to receive the oxygen necessary for revivication. In the case of insects, and also of spiders and centipedes, the oxygen taken in by the breathing tubes is transmitted direct to the various cells in their bodies, thus liberating for outside use a proportion of energy that is required in man for maintaining blood circulation.

Truces Between Wild Animals

For a short period in early summer there exists a temporary peace between the wolves and the wild reindeer of the Siberian tundra. The Samoyedes who live on the banks of the River Yenesei call this peace a "Truce of God," but this does not describe the true state of affairs. The fact is that the wolves refrain from attacking the reindeer during this period merely because they can live more easily on the lemming. This little animal is a rodent, similar to the short-tailed field mouse but larger. It is found in very large numbers in the Arctic regions of Asia, Europe and America, where it lives on grass, moss, roots and the catkins of the birch. It is the universal food of Arctic beasts of prey, and if it were to disappear half the animal life of the north would disappear also. It is in the spring and early summer that lemmings are most plentiful and the wolves feed on this easy prey in preference to the reindeer, which can only be brought down after a long hunt.

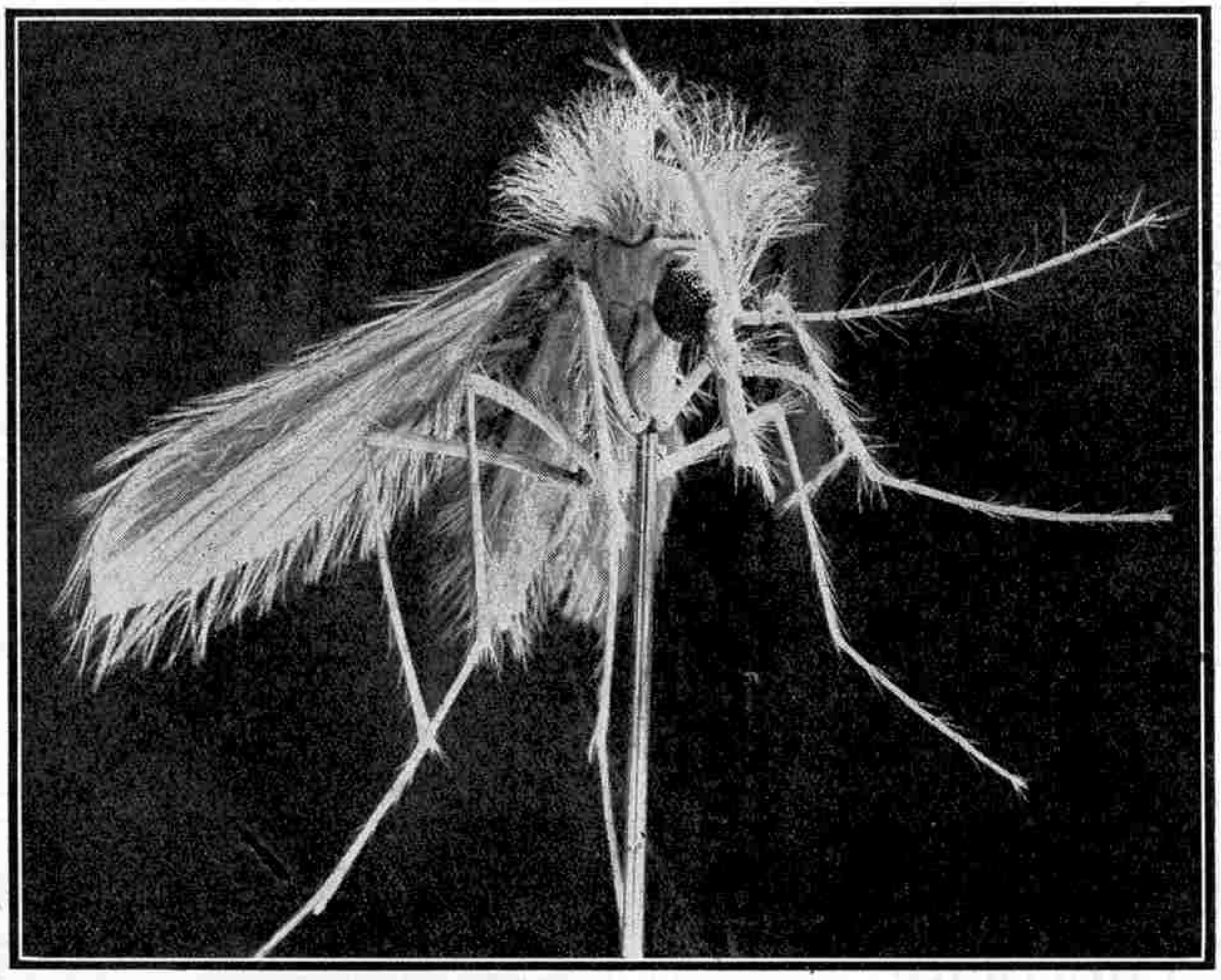
The snowshoe hare of North America affords an even more striking example of an animal "truce." This hare increases greatly in numbers for a period of about seven years, during which time it forms the staple food of the country. The larger game animals, such as the caribou, then have a peaceful time, because the wolves and other carnivorous animals leave them alone in favour of the hare. Even the Indians do not trouble to hunt, for as many hares as are required can be knocked on the head with great ease. At the end of the seven-year period, however, disease attacks the hares and their numbers are so greatly diminished that the truce comes to an end and men and wolves alike are compelled to find other food. Hunting recommences and continues until the hares once more become sufficiently plentiful.

* * * *

Fishing for Sharks

There has been a serious decline in the magnitude of the whaling industry during the past hundred years, but the place of this huge creature appears likely to be taken by the shark, from which many valuable industrial products may be obtained. A beginning has been made in this industry by a vessel named the "*Istar*," which is wholly occupied in catching sharks and extracting from them oil and other products. The vessel is equipped with motor-boats to facilitate laying the nets in which the sharks are caught and in them members of the crew have had many encounters with the giant fish. When the sharks swim into the nets they struggle so fiercely to force their way through that their gills are closed by the meshes and they are suffocated.

Once on board—for the ship is a floating factory—the fins and other portions of the fish are cut off and dried for export to countries, such as China, where they are considered great delicacies. The skin is turned into leather, while from the liver a valuable oil is extracted. Finally the rest of the fish is converted into an efficient fertiliser.



Last month we described the wonderful series of large models illustrating disease-carrying insects now on view at the Natural History Museum, South Kensington. We illustrate above another of these fine models showing the sandfly. The model measures 2 ft. in length and has inserted in it over 2,000 hairs. In actual life the insect is quite small and it carries Sandfly Fever, a malady from which many of our soldiers suffered when on service in the East during the war

* * * *

Attracting Insects by Scents

A scientist attached to the United States Department of Agriculture is experimenting upon the effects upon insects of various scents or smells, and for this purpose he has devised a simple but ingenious instrument. This consists of a Y-shaped tube, the leg of which is connected to a dark chamber containing the insects to be studied. Along the two arms of the tube are drawn currents of air, one of which is scented by some plant extract. The insects are attracted from the dark chamber by means of a light placed between the two arms of the tube and equidistant from them, so that the only difference between the two available paths consists in the fact that one is scented. It has been found that when the insects arrive at the junction they almost invariably choose the scented path.

These experiments indicate the possibility of protecting plants or fruit trees from harmful insects by luring the latter away through the medium of some scent that is specially attractive to them.

Earth Vibrations Produced by Traffic

The vibration of the earth produced by traffic is far greater than is generally supposed. Except in cases of unusual severity this vibration cannot be detected by ordinary means, but its effects are sufficiently great to make it necessary to take it into account in building scientific laboratories in which delicate instruments are to be used.

A striking instance of this was experienced by Professor Edward C. C. Baly of Liverpool University, in the progress of work in which he used a very sensitive galvanometer to measure heat radiation by an electrical method. The radiated heat was directed on to a junction of two different metals and this produced a tiny electrical current in a circuit containing the junction. The instrument for measuring the magnitude of the current consisted of a minute coil of wire suspended between the poles of an electro-magnet by a quartz fibre of hair-like fineness, the current being measured by the amount through which the suspended coil turned.

The buildings in which the work was carried on rest on sandstone, which is pierced by two tunnels carrying the railway lines from Lime Street Station, and the passage of the heavy trains through the tunnels, together with the traffic in the streets, produced so much vibration that the instruments first tried proved utterly useless. It was found possible to time the starting of trains from the station nearly half a mile away by the effect on the suspended coil of the vibration produced by the first thrust on the driving wheels of the engine.

Better results were obtained by shielding the instrument from vibration by standing it on a wooden plate resting upon three tennis balls and by working at night only. Even then, however, it was found that accurate measurements were impossible, and it was necessary to try other designs in order to find an instrument that could be used in the circumstances.

* * * *

Thieves by Heredity !

The caste system in India has resulted in trades becoming hereditary in certain families, so that an Indian boy may be born a carpenter or a teashop keeper. He may also, strange to say, be born a highway robber, a pickpocket, or a coiner ! The last-named form a tribe known as the chapparbands, and 30 years ago they were so active in distributing base money that it was necessary to test every coin before accepting it.

"Every Boy Will Have His Own Aeroplane"

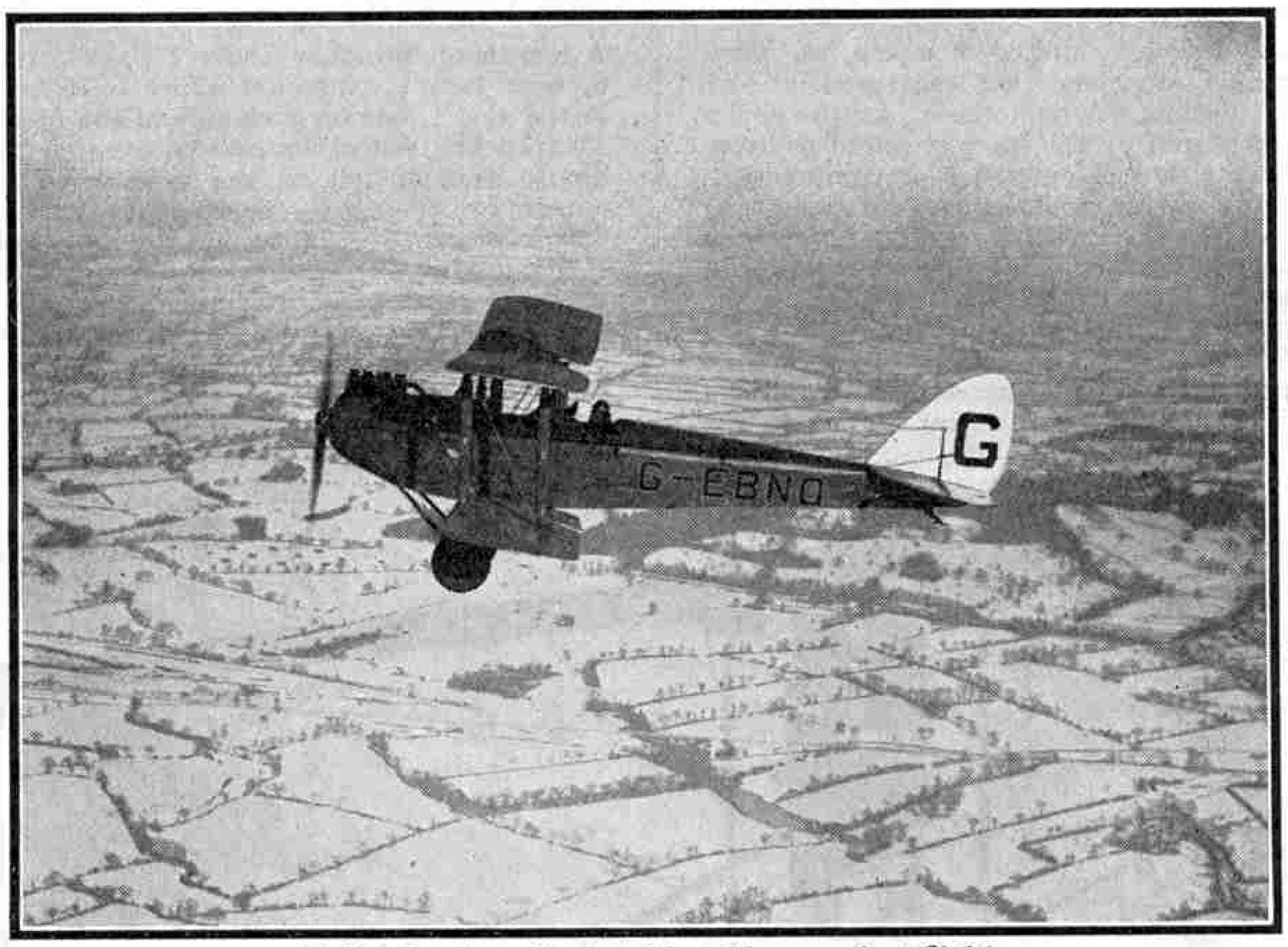
Prophesies Britain's Youngest Airman

By T. J. Willis

ROBIN SANDERS CLARK, aged 15, who has the distinction of being the youngest airman in Great Britain, has already been referred to in the "*M.M.*," and knowing that readers would be interested to know a little more about him, I went to the aerodrome at Stag Lane. Just as I arrived Robin made a perfect landing and I went up to him and introduced myself.

"The readers of the '*Meccano Magazine*' want to know something about your aeroplane," I said. "They have all heard how you took this machine up by yourself after only eight hours' tuition and naturally they are interested."

Robin slipped out of his thick fur-lined helmet and goggles. "All right," he said. "I will give you a few figures first. Small as my 'plane is—it can be housed in an ordinary garage—I can travel in it at a speed of 90 miles an hour. Of course, mind you, that's top speed. When I go for my flight every morning I rarely fly faster than 75 or 80 miles an hour."



Robin Sanders Clark taking his morning flight

"She knows how to climb, too. With a weight of over 1,200 lb. my Moth is capable of reaching an altitude of 15,000 ft."

I suppose I must have looked rather incredulous at this statement, for the young airman continued: "You'd hardly think so small a machine could do it, but that's because you've never been in her yourself. It's a fact, though, and that at a climbing rate of 635 ft. in a minute."

"But look at the engine," he added, by way of explanation.

"The de Havilland Moth is fitted with a "Cirrus" engine that develops 80 h.p. at 1,800 revolutions per minute. It is as straightforward as an ordinary motor-cycle engine and it can be kept in perfect order without skilled attention. The power developed by this engine enables the machine, with a full load, to get off after a run of about 100 yds., and gives it its amazing speed."

My eyes wandered over the beautiful little aeroplane, from the graceful folding wings to the aluminium fuselage, and finally rested on the dashboard in the cockpit. Robin noticed that I was gazing in wonderment at the array of glass-covered dials and he hastened to explain the various "gadgets."

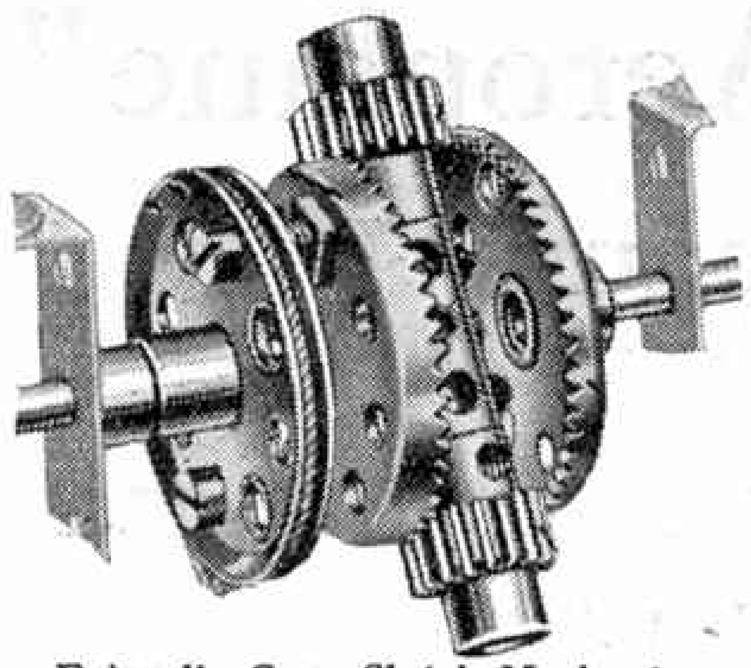
"Starting from the left," he said, "we have a watch and a revolution indicator; then comes the altimeter and airspeed indicator. Just above that centre dial is the inclinometer. There is the oil pressure gauge and here on the extreme left is the telephone mouthpiece."

"I think I could go on praising my Moth for ever," said the young airman with a smile of pride. "Next time I am flying high above the Hertfordshire countryside I shall think of the readers of the "*Meccano Magazine*" and wish they could enjoy the thrills with me. But perhaps before the world is much older every boy will have his back-garden aerodrome complete with aeroplane!"

I am afraid that Robin's last words were uttered more in hope than faith for the existing regulations covering private flying are so strict that a private owner simply cannot land or take off from anywhere he likes. Forced landings and casual visits excluded, no person is allowed to fly from or alight on other than an aerodrome, and aerodromes have to be licensed.

There are other regulations, many of them irksome at first thought, but all of them are framed with the object of increasing the margin of safety in the air. Any one who possesses a driving licence may take out an unsafe motor cycle or car and risk his life, and provided that no one else is endangered, he can move along the roads without let or hindrance. Not so with an aeroplane. An unsafe machine simply has to stay in its hangar. To take it out without first securing a licensed inspector's certificate of airworthiness is courting the wrath of the powers that be. But those regulations are building up for Britain an air tradition that is securing for us a reputation in the air as great as that so proudly maintained by our railways and ships on land and sea.

There can be little doubt that flying has a greater future than any other form of transport, and the day will certainly come when a trip in an aeroplane will be no more unusual than a taxi ride is to-day. As regards safety, statistics show that even now one is safer in an aeroplane than when walking the streets of London.



Epicyclic Gear Clutch Mechanism

Suggestions Section

Edited by "Spanner"

(100)—"Tatham" Transmission Dynamometer

(*G. S. Cunliffe, Fortis Green, London, N.*)

A DYNAMOMETER is a device by means of which the force or power of an engine, etc., may be measured. Any kind of brake may be used as a dynamometer, for the power of a rotating shaft can be measured by the force required to bring it to rest. A spring, capable either of extension or compression, forms the basis of a simple type of dynamometer used for measuring compressive or tensional forces. For finding the tractive effort of a locomotive, the pull is usually transmitted through a powerful spring balance, and the actual force exerted is indicated by the extent to which the spring is compressed.

Transmission dynamometers are specially designed so that they can be used to measure the force of an engine while transmitting the power without other loss than that caused by friction in the apparatus. Thus the power exerted by an engine can be noted throughout its period of motion.

Fig. 100 shows an interesting Meccano model of a "Tatham" transmission dynamometer, the operation of which will be readily understood when the model is constructed. The Meccano model may be used to ascertain the power of the Clockwork or Electric Motors, and with its aid a number of interesting and instructive experiments may be made.

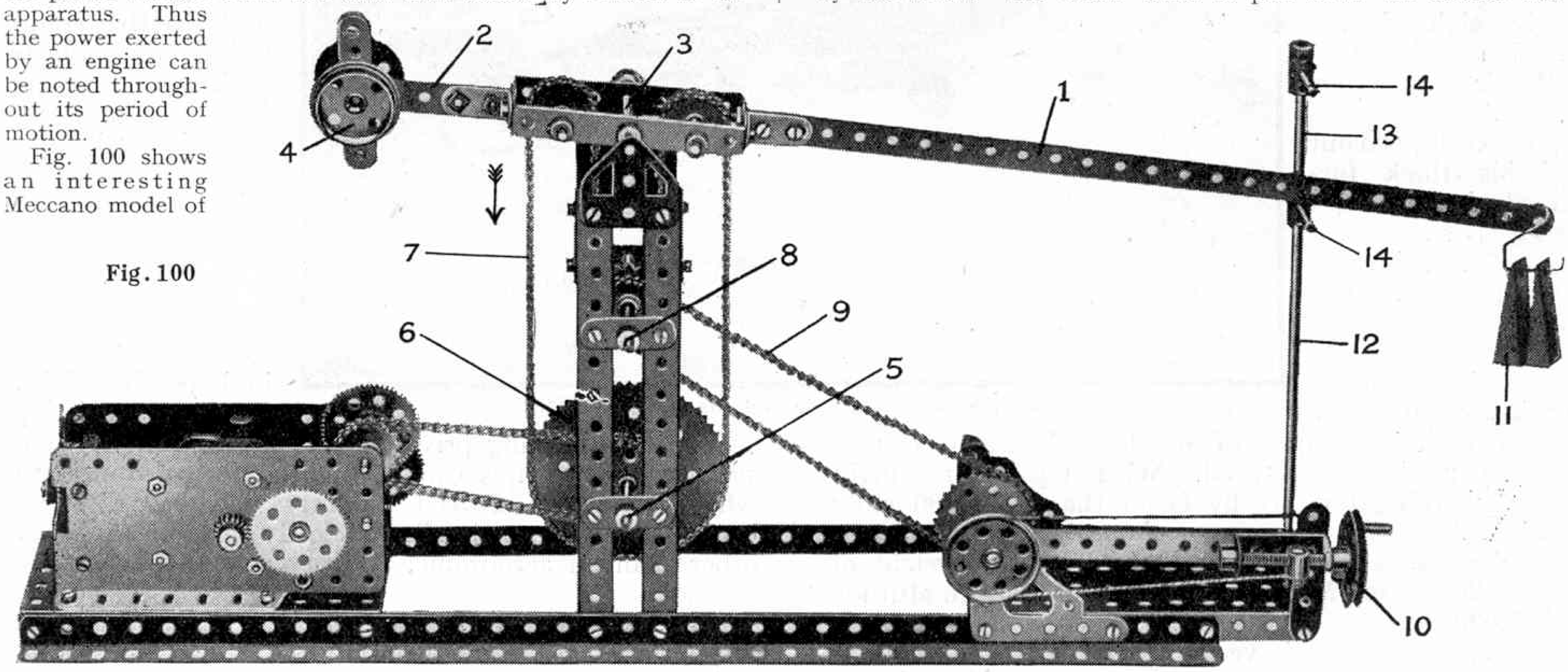


Fig. 100

Construction of the Meccano Model

The construction of the framework is quite simple. The base consists of two $18\frac{1}{2}''$ Angle Girders and the upright is built up from four $7\frac{1}{2}''$ Angle Girders connected near the top by two $2\frac{1}{2}''$ Strips and two Flat Trunnions. The movable arm, or steelyard, 1 consists of a $12\frac{1}{2}''$ Strip connected by means of two $1'' \times \frac{1}{2}''$ Angle Brackets to two $3\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips, and the other ends of the latter are connected by two further $1'' \times \frac{1}{2}''$ Angle Brackets to a $2\frac{1}{2}''$ Strip 2.

The arm pivots about a $3\frac{1}{2}''$ Rod 3, and suitable weights should be added at 4 so that it is exactly balanced about this point. The balance weight shown in the illustration consists of a $1\frac{1}{2}''$ Axle Rod carrying two Flanged Wheels and seven $2\frac{1}{2}''$ Strips.

The drive from the Motor is led on to a 2″ Sprocket Wheel secured to a $3\frac{1}{2}''$ Rod 5. The latter is journalled in $1\frac{1}{2}''$ Strips secured to the upright and carries also a 3″ Sprocket Wheel 6. A length of Sprocket Chain 7 passes round this Sprocket Wheel 6, over two 1″ Sprocket Wheels secured to 2″ Rods journalled in the arm 1, one on each side of the fulcrum 3, and round a third 1″ Sprocket Wheel secured to another $3\frac{1}{2}''$ Rod 8. The drive is finally transmitted to the machinery, etc., that the motor is required to operate by means of another length of Sprocket Chain 9, which passes over a second 1″ Sprocket Wheel on the Rod 8.

For testing purposes the Rod driven by the Chain 9 must have varying degrees of resistance, and the necessary adjustments are effected by a strap and screw brake 10, which is identical to Standard Mechanism No. 85. The Motor must be started in such a direction that the Chain 7 travels in the direction indicated by the arrow. The Chain tends to pull down the shorter end of the arm 1 and the power of the Motor is gauged by the extent of this pull, which may be ascertained by placing the weight 11 (two Meccano 50-gramme weights attached to a Scientific Hook) in different positions on the arm.

The movement of the arm 1 is kept within certain limits by the stops 14. These stops consist of $1\frac{1}{2}''$ Rods secured in Couplings and supported by a $6\frac{1}{2}''$ Rod 12, which is gripped in the boss of a Crank bolted to the base of the model. The $6\frac{1}{2}''$ Rod is extended at the top by a 2″ Rod 13.

In order to test its power, the Motor should be started and the brake 10 adjusted, so that the mechanism only just rotates and the Chain 7 pulls the short end of the arm hard down. The weight 11 should then be moved along the arm and a note made of the position in which it must be placed to counteract the pull on the Chain and balance the arm about the fulcrum 3.

In the illustration it will be seen that the drive from the Motor is led through a train of reduction gears consisting of three $\frac{1}{2}''$ Pinions and three 57-teeth Gear Wheels. It is then transmitted to the Rod 5 by means of a 1″ Sprocket Wheel and a Sprocket Chain driving on to a 2″ Sprocket Wheel. Hence the speed ratio between the motor armature and the Rod 5 is 1 : 54. (Particulars of different ratios obtainable by means of Meccano gearing will be found in Section 1 of the Standard Mechanisms Manual). With this ratio the pull of the Chain will be found to raise the 100-gramme weight 11 if the latter is placed about 14″ from the fulcrum 3.

Different speed ratios should be arranged by changing the gears on the Motor, and the variation in the pull of the Chain 7 should be ascertained for each ratio. By changing the final ½″ Pinion and 57-teeth Gear Wheel of the gear train shown in the illustration for a ¾″ Pinion and 50-teeth Gear Wheel, a ratio of 1:36 will be obtained. Again, if two 1″ Gear Wheels are used at this point the ratio will be 1 : 18. The following is a table of results obtained by using the three different ratios mentioned above :—

Weight = 100 grammes.

Ratio = 1 : 54 ; distance of weight from fulcrum = 14″.

Ratio = 1 : 36 ; distance of weight from fulcrum = 9½″.

Ratio = 1 : 18 ; distance of weight from fulcrum = 4½″.

Since the force exerted by the weight 11 varies according to its distance from the fulcrum 3, it will be seen that the pull on the Chain 7 increases more or less in proportion as the speed at which it is driven decreases.

The above figures should be regarded as approximate only, for it will be found that they will vary slightly with the individual Motor used. The slightest difference in the tension of the different chains, or in the friction created in the various bearings, etc., also will affect the results slightly.

The parts contained in the Meccano demonstration model illustrated on the preceding page are as follows :—

1 of No. 1	2 of No. 20	1 of No. 64
1 „ „ 2	3 „ „ 26	2 „ „ 66
11 „ „ 5	3 „ „ 27A	1 „ „ 81
4 „ „ 6A	46 „ „ 37	60″ „ „ 94
2 „ „ 7A	2 „ „ 37A	1 „ „ 95B
4 „ „ 8B	6 „ „ 38	2 „ „ 95
4 „ „ 12B	2 „ „ 48B	5 „ „ 96
1 „ „ 14	1 „ „ 48	2 „ „ 108
4 „ „ 16	2 „ „ 52	1 „ „ 111C
3 „ „ 16A	1 „ „ 57A	1 „ „ 115
1 „ „ 17	14 „ „ 59	2 „ „ 126A
5 „ „ 18A	1 „ „ 62	1 4-volt Motor
2 „ „ 21	2 „ „ 63	

A "Century" of Suggestions

With this issue the total number of Suggestions so far published in the "Suggestions Section" passes the three-figure mark. Since the appearance of the first "Suggestions Page" in the November 1925 "*M.M.*" it has been always our aim to publish as far as possible only those suggestions that may be incorporated with considerable advantage in numerous Meccano models or that contain some particularly ingenious uses for standard Meccano parts. How far we have succeeded in our aim we leave our readers to judge for themselves. We think they will agree, however, that the majority of the hundred and three suggestions that have now appeared establish not only a striking demonstration of the versatility of the Meccano system, but also bear testimony to the ingenuity of the average Meccano boy.

We thank all those readers who have helped to make the "Suggestions Section" a success by sending in original contributions.

(101)—Four-Wheel Bogie

(P. D. Larkin, Wembley, and S. Johnson, Bristol)

A simple but efficient four-wheel bogie of the type shown in Fig. 101 often is required when constructing Meccano locomotives, tram cars, and other vehicles that are designed to run on rails. The principal advantage of this bogie lies in the fact that the axles are mounted on equalising beams which are attached centrally to compression springs, thus allowing for independant vertical movement of all four wheels.

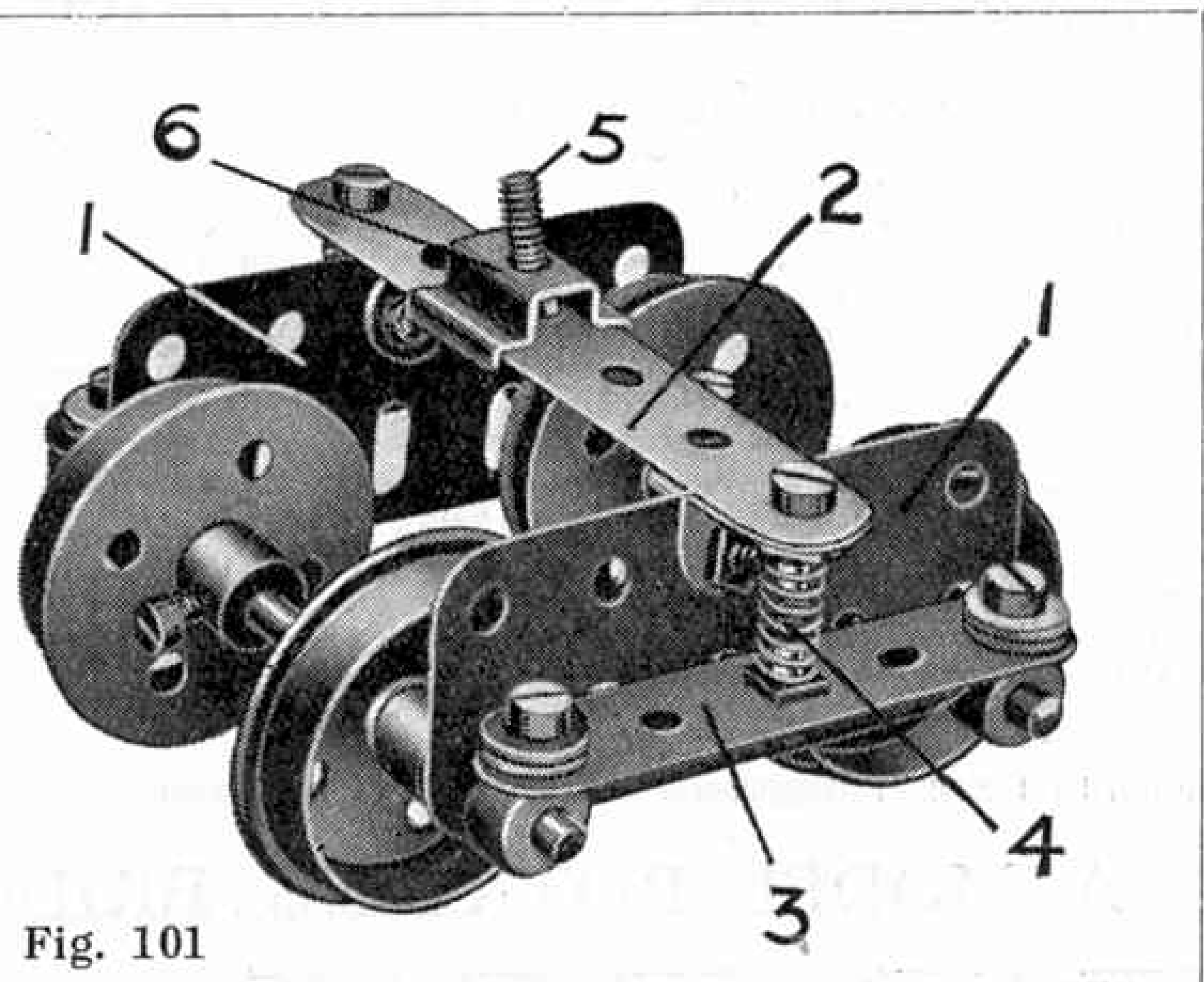


Fig. 101

The bogie frame is built up from two 2½″ Flat Girders 1 connected together by a 3″ Strip 2, which is bolted to each Flat Girder by an Angle Bracket. The axle boxes are represented by Collars, and each pair of Collars is connected by an equalising beam consisting of a 2½″ Strip 3. A ⅜″ Bolt secured in the centre hole of the latter enters the coil of a Compression Spring 4 (part No. 120b), which is retained in place by the shank of another ⅜″ Bolt that serves to secure the Strip 2 to the Angle Bracket.

The equalising beam 3 is secured to the Collars by set-screws, and it will be noted that two Washers are placed under the head of each screw to prevent its shank touching the axle, which must be quite free to turn in the Collars. The axles are journalled in the elongated holes of the Flat Girders and since the weight of the vehicle is taken by the Spring 4, attached to the centre of the equalising beam, each axle is able to move in a vertical direction simultaneously with, or independently of, the other axle.

The bogie should be attached to the frame of the vehicle by means of the bolt 5 inserted in the Eye Piece 6. The bolt should be secured by two nuts in such a way that the bogie is quite free to pivot about it (see Standard Mechanism No. 262). The lateral movement of the bogie caused by curves in the track is allowed for by the Eye Piece 6 sliding on the Strip 2.

As illustrated, the wheels are spaced to fit Gauge 0 rails. The bogie may easily be adapted to Gauge 1 rails by replacing the 3″ Strip 2 by a 3½″ Strip.

(102)—Safety Catch for Winding Gears

(J. Hutter, Summertown, Oxford)

The device shown in Fig. 102 is intended primarily for incorporation in hand-operated cranes or winches, and its object is to provide a means of arresting the load immediately the hand is removed from the winding shaft. Such a device may be adapted to practically every model that is operated by turning a shaft by hand, and its advantages will be obvious.

The parts required to construct the safety catch are two Collars, one Compression Spring (part No. 120b), a Washer, two bolts, and one nut. The spring 3 is mounted on the Crank Handle 1 between the Collar 4 and the Washer, the latter being placed against the plate through which the Crank Handle is journalled. The spring normally holds the Collar 2 against the inner side of the plate. It will be noted that the set-screw of the latter Collar has been replaced by a ⅜″ Bolt, and should the Crank Handle commence to rotate, the head of this bolt strikes against the stop 5 (a nut and bolt secured in the side plate) and thereby prevents any further movement of the Crank Handle.

Hence it will be seen that in order to operate the model it is necessary to push the Crank Handle inward slightly in order that the ⅜″ Bolt clears the stop 5. Immediately pressure is removed from the handle 1, the Collar 2 slips back to its normal position, and the ⅜″ Bolt strikes the stop. There is no fear of the load running down in a model crane to which the safety catch is fitted, even if the Crank Handle is released accidentally while the load is in mid-air.

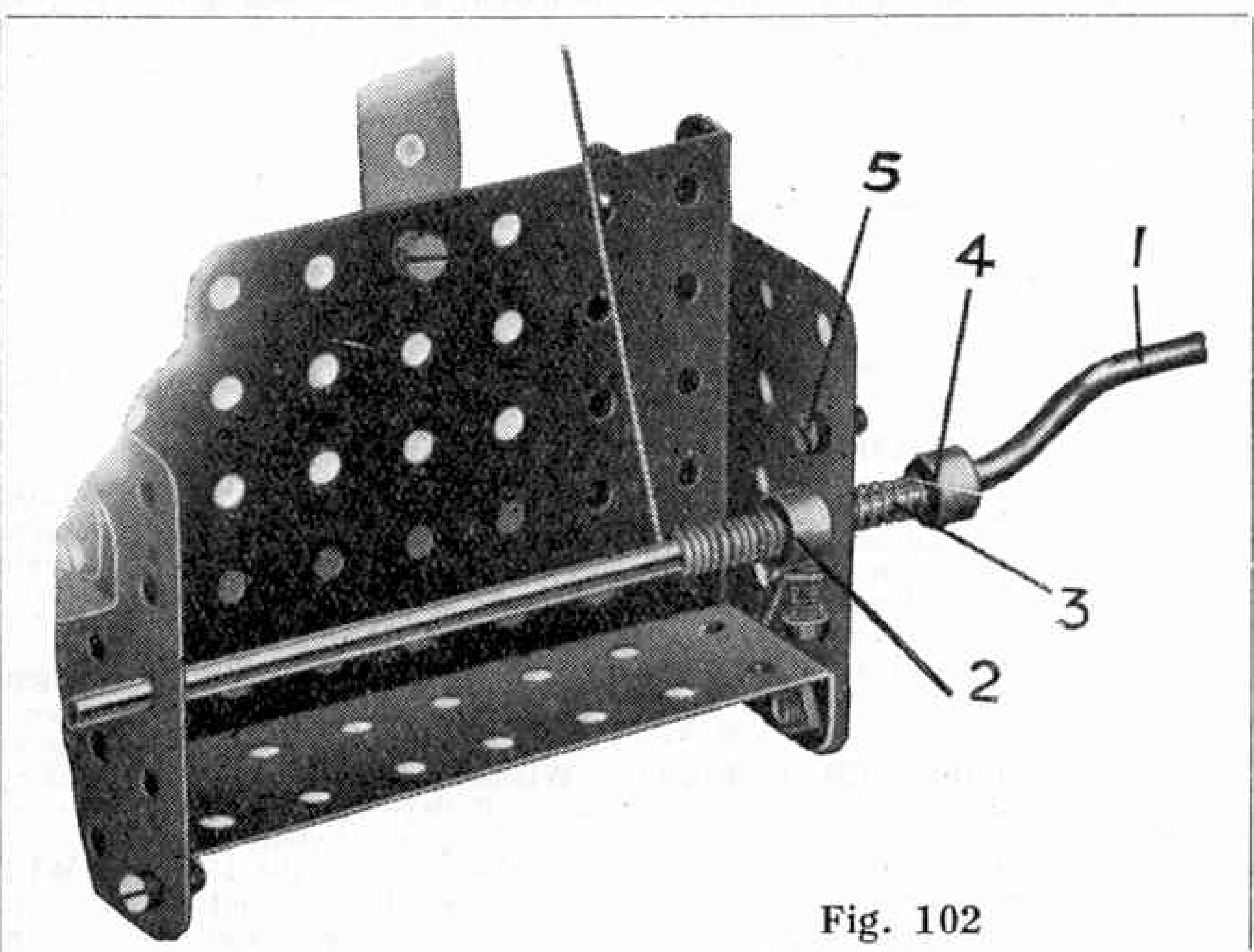
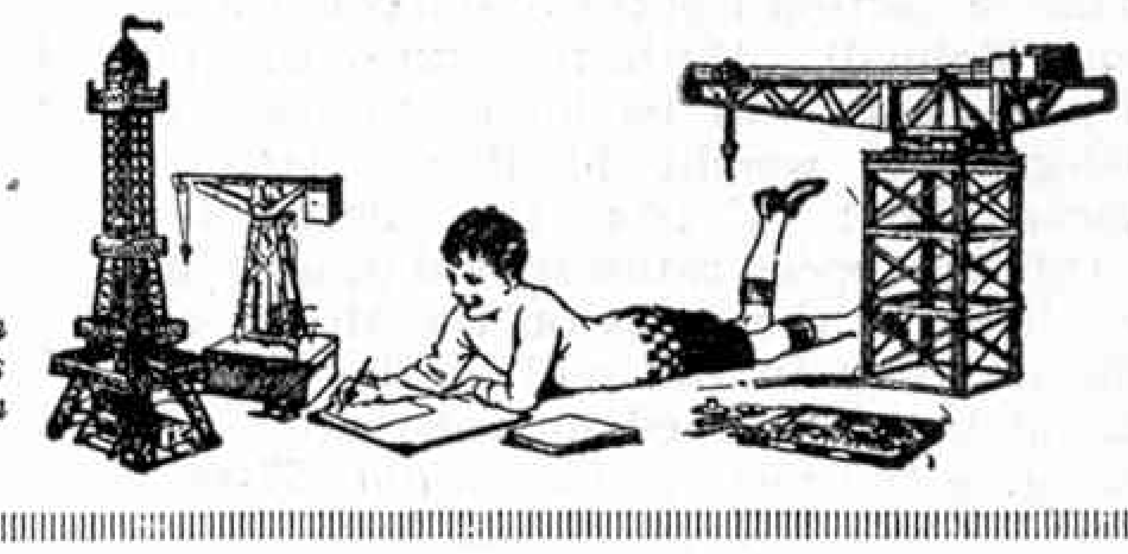


Fig. 102

The safety catch also proves of very great value if used as an automatic brake device for countershafts in models driven by any of the Meccano motors. For example, suppose the Rod 1 is a shaft operating the jib-hoisting movement in a model crane that is driven by an Electric Motor. By means of a suitable hand lever the Rod 1 may be arranged so that it is in engagement with the main driving shaft only while the spring 3 is depressed. On releasing the hand lever the Rod 1 is thrown out of gear and the jib is locked in position immediately.

In Reply



In these columns we reply to suggestions regarding improvements or additions to the Meccano and Hornby Train systems. We receive many hundreds of such suggestions every week, and consequently we are able to publish only ideas that show particular interest or ingenuity. Suggestions submitted for consideration in this section must be written on separate sheets of paper and the name and address of the sender must appear on each sheet used.

Suggested New Meccano Parts

IMPROVED DOG CLUTCHES.—Further to our announcement in the March, 1927 "*M.M.*," we are experimenting with a view to ascertaining the advantages of rounding the edges of the jaws in the Dog Clutch, in order to facilitate their engagement with the corresponding sockets. Meanwhile, we may mention that a few touches with a file at the points of contact will considerably improve the operation of the existing Clutches. (*Reply to E. B. Smith, Dunstable; S. B. Lucas, Malvern; and many others*).

FRAME PIECE.—We note your suggestion regarding the introduction of a strip specially shaped to form a square. This would be a difficult part to manufacture and we cannot see that it would be of any real use. A square frame of this type can easily be built up from existing Meccano parts, and the difference in strength and appearance between the built-up square and the manufactured article would be very small. (*Reply to P. Pottier, Purley*).

IMPROVED DOUBLE BENT STRIPS.—We are interested in your suggestion regarding the addition of an extra hole to each end of the Double Bent Strip, but we must receive many more requests for such a part before we can add it to the system. We agree that the revised part may have certain valuable uses. (*Reply to P. J. Stephens, Edinburgh*).

NEW CIRCULAR STRIPS.—Your proposed part, similar in design to the Circular Girder but without the flange, would be almost identical to the existing Circular Strip (part No. 145), and we do not think that it would fulfil any important functions not already covered by the latter part. (*Reply to C. Walker, Nottingham*).

IMPROVED 3" PULLEY WHEELS.—We have noted your proposal that two set-screws should be provided in the boss of each 3" Pulley Wheel, so that an increased grip may be obtained on the Rods. In the near future we hope to extend the threaded bore in the bosses of various Meccano wheels and pinions, etc., so that a set-screw may be inserted on each side of the Axle Rod. (*Reply to F. Marquand, Woodville, N.Z.*)

SPECIAL MECCANO BALL RACE.—We are considering the introduction, as a single unit, of a small Meccano ball bearing. A further announcement on this point will appear shortly. Meanwhile, numerous suggestions regarding the construction from existing Meccano parts of roller and ball bearings of different sizes will be found in Section VII of the "Standard Mechanisms" Manual. (*Reply to H. G. Surman, High Wycombe, Bucks.*)

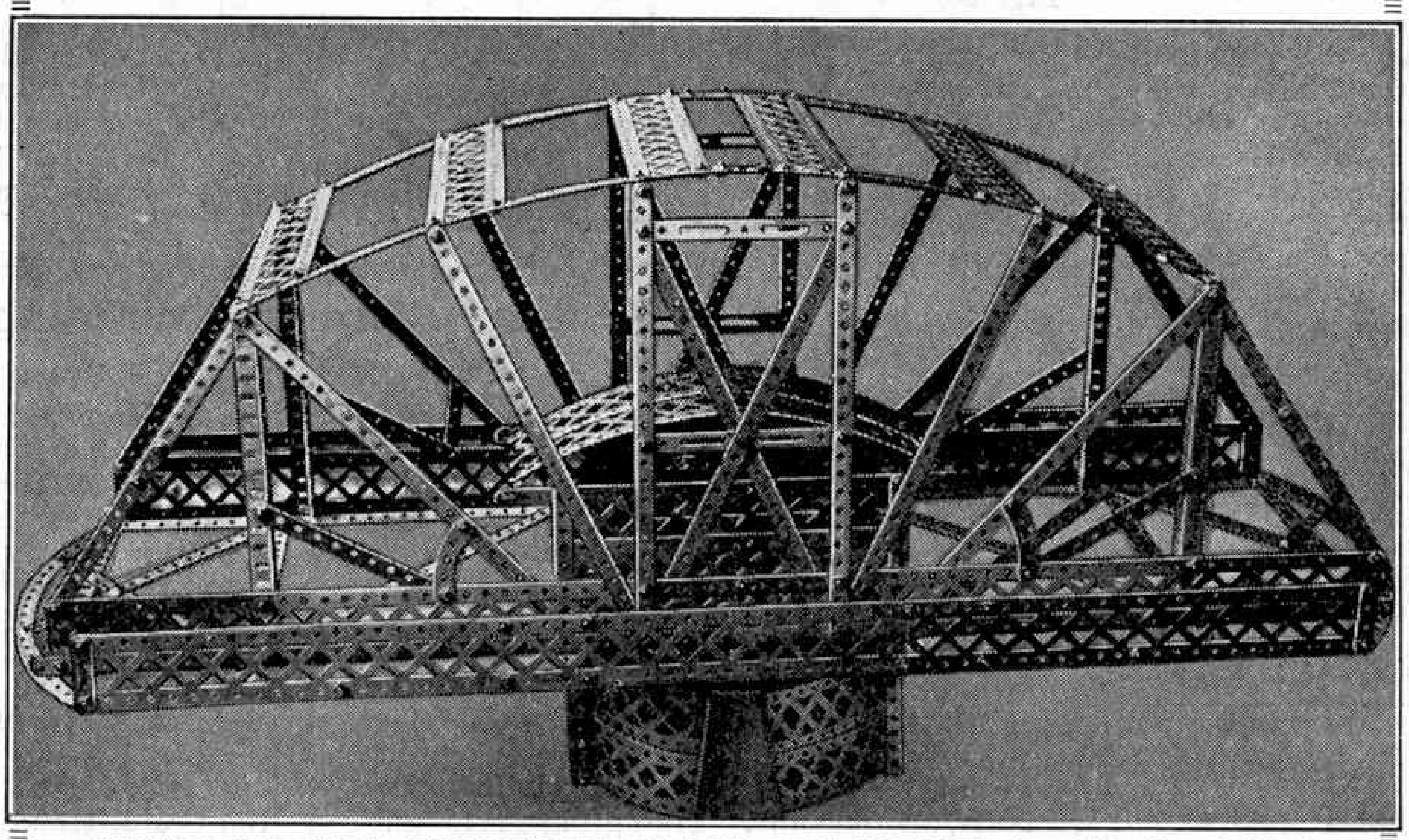
HEAVY BASE FOR MODELS.—We fear it is not practicable to supply heavy metal or stone bases on which to secure Meccano models, owing to the excessive cost of carriage and other charges on such accessories. As a rule, a sufficiently strong and rigid base for almost any type of model can be constructed from existing Meccano Plates and Girders, etc., or, alternatively, most Meccano boys will have in their possession a stout piece of wood that will serve admirably as a base for a model. (*Reply to N. G. Bird, Gigglesthorne*).

HEAVIER TYPE CHAIN.—We do not consider that there is any necessity to introduce heavier chains, as the present Sprocket Chain is suitable for nearly all purposes where miniature chains are required. (*Reply to P. Slade, London, S.E.5*).

SPECIAL MECCANO MEASURE.—The addition to the Meccano system of a special steel ruler for measuring Strips, Axle Rods, etc., would tend to complicate the system unnecessarily. The Strips form rulers in themselves, for they are all punched with the $\frac{1}{2}$" standard equidistant holes and by counting these holes their size can be ascertained immediately. Thus, a $3\frac{1}{2}$" Strip has seven holes, a $5\frac{1}{2}$" Strip eleven holes, and so on. In the case of Axle Rods, their lengths may be ascertained by placing them against a Strip and counting the corresponding holes in the latter. (*Reply to A. C. McLaren, Chapel Allerton, Leeds*).

$4\frac{1}{2}$" PULLEY WHEEL.—We do not think that there is any special demand for a Pulley Wheel $4\frac{1}{2}$" in diameter. We shall bear your idea in mind, however. (*Reply to B. Bolitho, Castle Hill*).

A MODEL ROTATING BRIDGE



This Meccano model of a centrally-pivoted swing bridge was built by W. Koster, of Haarlem, Holland. It is of very massive construction, as will be gathered from the photograph, and will bear considerable loads. The weight of the rotating roadway is distributed over four Flanged Wheels running in a circular guide, and the entire superstructure is turned by means of a Motor mounted in the centre of the roadway, the drive being directed through worm gearing to the fixed vertical shaft that forms the pivotal centre of the bridge. The base or stationary portion is built up from Braced Girders bent to circular form and buttressed by four Sector Plates

LONGER FUNNELS.—The long narrow steamship funnels that you suggest would not be suitable for many Meccano models, but we may say that we hope to introduce shortly an improved type of funnel which we think will suit all requirements. (*Reply to F. Marquand, Woodville, N.Z., and S. Philips, Johannesburg*).

NEW CIRCULAR PLATE.—We shall give further attention to your suggestion regarding the introduction of a circular plate fitted with boss and set-screw, although we doubt whether such a part would fulfil many important functions. We would point out that when a large flywheel is required of the type suggested by your proposed part, the existing Circular Plate (part No. 146) may be adapted to the purpose by bolting a Bush Wheel or Face Plate to its centre. (*Reply to K. Brooks, Leek, Staffs.*)

IMPROVED 1" PULLEY WHEEL.—We do not consider that the utility of the 1" Pulley Wheel with set-screw would be increased to any large extent if it was provided with holes similar to those in the 1" loose Pulley. The diameter of this wheel is not large enough to permit the introduction of the Meccano $\frac{1}{2}$" standard equidistant holes. (*Reply to H. King, Glasgow*).

IMPROVED GEAR WHEELS.—We note your suggestions regarding the introduction of a gear wheel with a section of a Dog Clutch fitted in place of a boss. This idea is interesting and it will receive careful consideration. (*Reply to J. Somerville, Torquay; E. Conradii, Croydon; and A. E. F. Spence, Manchester*).

6" DIAMETER FAN.—We note your suggestions regarding a four-bladed fan, 6" in diameter, but we do not consider that this forms a suitable subject for a new Meccano part. It might be used as a means of retarding the speed of the Clockwork Motor, or as a cooling fan, as you suggest, but it is much better to build up fan wheels for these purposes from existing parts. (*Reply to H. James, Coupar-Angus, Perthshire, and E. C. Vitel, Jersey, C.I.*)

MOTOR CAR ACCESSORIES.—We regret we are unable to introduce number plates or mats for the footplates of model motor cars, as these parts could be used for no other purposes. Every part added to the Meccano system must be capable of fulfilling at least three or four important functions, for the secret of Meccano success lies in the adaptability of the various accessory parts. (*Reply to V. Rosewarne, London*).

COUPLING AND CRANK UNIT.—We do not think much advantage would be gained by the introduction of a unit resembling a Coupling rigidly secured to a Crank. Perhaps you will let us have some suggestions regarding the possible uses of your proposed part. (*Reply to J. Fairhust, Keston*).

NEW BEVEL WHEELS.—In reply to your suggestions regarding different sizes of Bevel Wheels, we would refer you to the announcement on another page of this issue, from which you will find that three new sizes are now available. We consider that these wheels, together with the existing Bevel Wheels (Part No. 30), will meet all requirements. (*Reply to S. Wigget, Norwich, G. F. Simpson, Dover; S. Grant, Newcastle, and many others*).

IMPROVED BUSH WHEELS.—We do not think that the Bush Wheel would be improved if the holes in its face were rearranged so that their number was divisible by three. Holes so arranged would not agree with the Meccano standard and the existing arrangement of eight holes is much more useful than would be, say, six or nine holes. (*Reply to L. E. Campion, Bradford, Ontario*).

LONGER THREADED PIN.—Your suggestion regarding a longer Threaded Pin is a good one. We will consider the manufacture of such an article in the future. (*Reply to E. C. R. S. Agner, Belfast, and M. D. Armitage, Crook, Co. Durham*).

NEW GEAR WHEEL.—We are interested in your suggestion concerning a sectional gear wheel, but your idea appears to be covered already by the Rack Segment (part No. 29). (*Reply to A. C. Coomber, Kirton*).

WIRE WHEELS.—We regret that the cost of manufacture of wire motor car wheels on the Meccano scale would be very great indeed, and for this reason we do not think their introduction is desirable. (*Reply to M. Murphy, Mount Brandon*).

Suggested Hornby Train Improvements

"CANADIAN PACIFIC" TYPE TRAINS.—We continue to receive a very large number of requests for Hornby Trains and accessories modelled on the Canadian Pacific Railways, and we are reconsidering the question of introducing trains of this type. We shall be glad to receive further suggestions on the subject. (*Reply to S. E. Sinclair, Windsor; O. P. Collins, Richmond, Surrey; and others*).

STEAM DOMES.—We note your remarks concerning an alteration to the colour of the steam domes on Hornby engines. In actual practice the steam domes are of the same colour as the boilers, of course, but the brass domes fitted to the Hornby locomotives give the complete models a more finished appearance. We consider that red or green domes would detract considerably from the appearance of the locomotives, but we shall keep your suggestions before us. (*Reply to R. M. Steven, Woodford Green; Eric Roper, Westcliff; and V. Eckersall, Manchester*).

NEW STATION.—We note your suggestion regarding the addition of another station to the Hornby system, but we think your proposal is covered already by the new Wayside Station, now available. This is similar to the existing "Windsor" station but is without ramps or fencing, etc. (*Reply to Alan Richardson, Bournemouth*).

MINIATURE LOGS FOR No. 1 LUMBER WAGONS.—As we have pointed out previously, we do not consider that miniature logs are a necessary addition to the No. 1 Lumber Wagon, as small pieces of wood of the size required can easily be found at home. We agree that a great increase in realism is obtained in model railways by loading and unloading goods trains, but we do not think it would be worth our while to introduce miniature merchandise for the purpose. Match boxes, toy building bricks, even scraps of wood, are all eminently suitable. (*Reply to C. Jenny, Barton-on-Humber, and Alan Richardson, Bournemouth*).

NEW BRAKE RAILS.—We note your various suggestions regarding new brake rails, and in reply we would point out that Curved Brake Rails in both 1 ft. and 2 ft. radii may already be obtained, price 6d. each. A Straight Brake and Reverse Rail for controlling Hornby Nos. 1 and 2 locomotives that are not fitted with Control Mechanism is also included in the Hornby system, price 1/6. It consists of a standard length of rail fitted with a sliding catch operated by a hand lever. The locomotive is stopped by pushing the lever forward and reversed by pulling the lever back, or vice versa, according to the direction in which the locomotive is travelling. The central position of the lever corresponds to "neutral," and when it is so placed the locomotive passes unaffected. A Straight Brake Rail suitable for stopping "M" Series engines and No. 0 engines may also be obtained separately, price 5d. (*Reply to O. P. Collins, Richmond, Surrey, and G. F. Simpson, Dover*).

SIX-WHEELED BRAKE VAN.—We are interested in your proposal regarding the introduction of a six-wheeled brake van for goods trains, but we do not consider that such a van would constitute any important improvement over the existing brake vans. Moreover, in your proposed wheel arrangement the centre axle would have to be loosely mounted so that the vehicle could negotiate the small radius curves. (*Reply to F. Selfridge, Glasgow*).

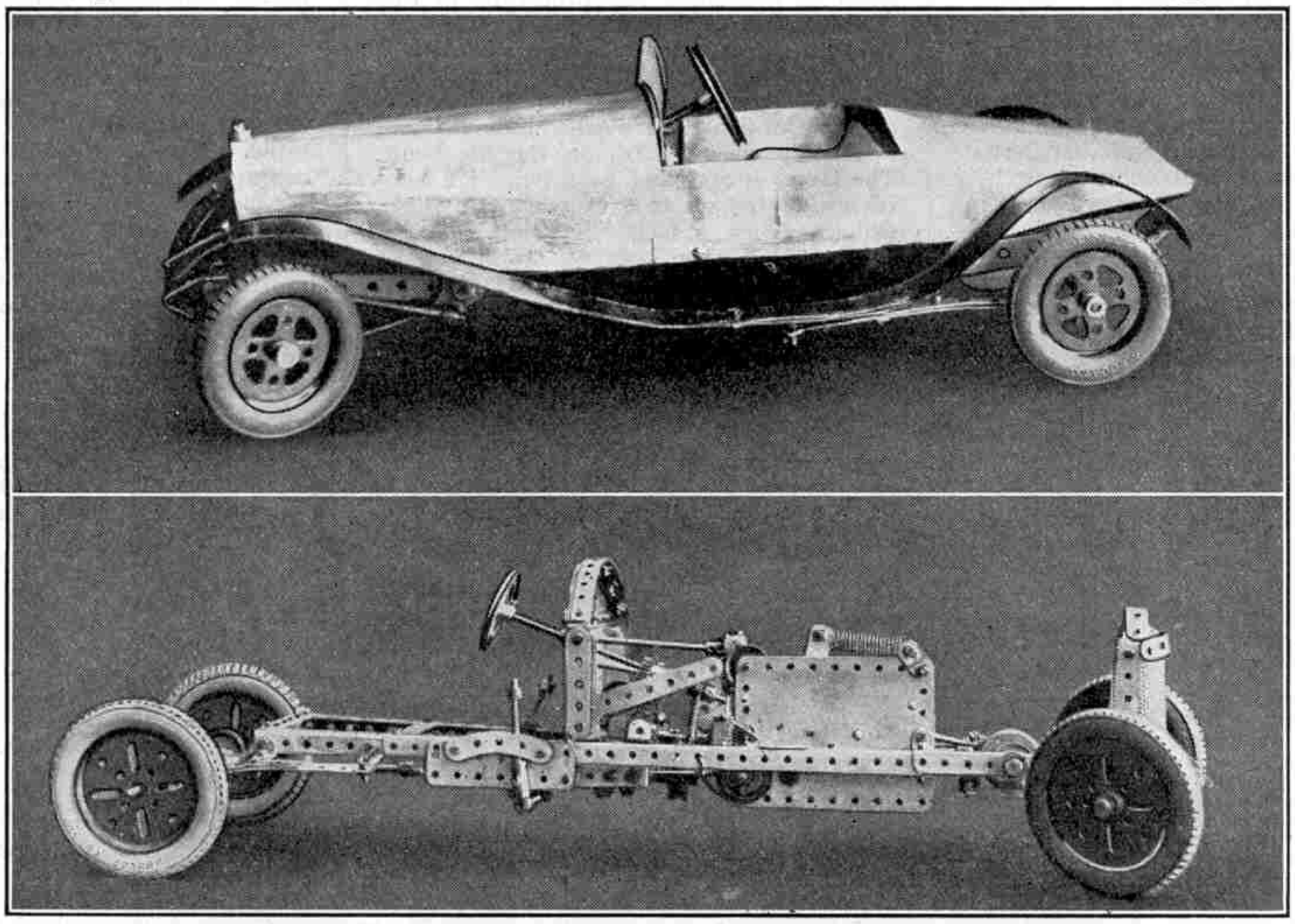
OIL LAMPS ON SIGNALS, ETC.—With regard to your suggestion concerning the fitting of oil lamps to Hornby signals, brake vans, etc., we fear that an accessory of this kind would be difficult to manufacture on such a small scale. Moreover it would prove inefficient on account of the very small amount of oil that could be placed in the lamps at each filling. When it is particularly desired to illuminate Hornby accessories it should be a fairly simple matter to use electricity for the purpose. The Meccano 4-volt bulbs and lamp-holders, etc., should be of value in this connection. (*Reply to N. E. Woods, London*).

BARREL WAGONS.—We have made a note of your suggestion regarding the manufacture of barrel wagons, although we fear that such wagons are not sufficiently common in actual practice to warrant their addition to the Hornby system. (*Reply to R. Smith, Hythe; Alan Richardson, Bournemouth; J. Cameron, Edinburgh; J. Thorburn, Kilmacolm; and W. Parker, Carlisle*).

MODELS OF FAMOUS TRAINS.—We have received a very large number of suggestions concerning the introduction of Hornby Train sets modelled on the "Caerphilly Castle," the "Flying Scotsman," and other famous trains, and we hope to make an important announcement concerning them very shortly. (*Reply to G. F. Simpson, Dover; B. E. Smith, Dunstable; S. Hart, Wolverhampton; F. Howard, London, S.W.1; and many others*).

SMALLER TURNTABLES.—In response to numerous requests we have now added to the Hornby system a Turntable of smaller dimensions. The new accessory is 8½" in diameter and is intended for use in connection with No. 0 or No. 1 Hornby Locos only. Price 2/6. (*Reply to S. Hart, Wolverhampton*).

MOTOR ENGINEERING IN MECCANO



F. F. Penhall, of Shipley, Yorks., takes a keen interest in everything connected with motoring, and we illustrate two models belonging to this branch of engineering that he has constructed recently. One is an excellent reproduction in miniature of a modern two-seater sports car. The body is made up from a sheet of tin and the chassis frame and all mechanical details are reproduced with Meccano parts. The new 2" Meccano Dunlop Tyres are fitted to the road-wheels. Some idea of the realistic appearance of the finished car will be obtained from the upper illustration. The lower photograph shows a well-designed Meccano chassis suitable for a model racing car. It is driven by a Clockwork Motor and is fitted with a self-starter, accelerator, and gearbox giving two speeds forward and reverse. This chassis is equipped with 3" Dunlop Tyres, and the rear axle is attached to the frame by cantilever springs. It will be noted that the brake and gear change levers are mounted in quadrants consisting of 2½" Curved Strips. The Clockwork Motor drives the chassis in a most satisfactory manner

TIME TABLE BOARDS, ETC.—We doubt whether the introduction of time table boards, train indicators, etc., would be worth while, although we agree that they would help to add to the realism of the Hornby system. Miniature reproductions of station accessories of this kind may be made very easily at home. (*Reply to L. J. Cato, London*).

CLOCKWORK TO ELECTRIC RAIL CONVERSION.—Your suggestion that the ordinary Hornby Rails should be constructed in such a way that a central electric conductor rail may be secured in position if desired, so forming an electric track, is a good one. It would involve a great change in the manufacture of the standard rails, however, and we do not think it is possible to adopt your idea, although we shall keep it in mind. (*Reply to E. F. Graham, Victoria, Australia*).

NEW PASSENGER ROLLING STOCK.—We note your suggestion regarding the introduction of passenger rolling stock specially designed for each of the four main railway groups. This would complicate matters very considerably, and there are many difficulties that must be overcome before your suggestion could be made practicable. Meanwhile we would point out that the existing Hornby passenger coaches may be obtained in different colours and with special lettering, etc., to represent the L.M.S., L.N.E.R., and G.W. Railways. (*Reply to L. Cooper, Leeds*).

SAFETY VALVE ON G.W. ENGINES.—Your suggestions regarding the substitution of a brass safety valve in place of the black one fitted to the G.W.R. locomotives have been noted for further consideration. If possible, we shall adopt them in the future. (*Reply to J. Masters, Cheltenham, and R. F. Beckett, London, S.E.9*).

HORNBY CONTROL LEVEL CROSSING.—We are considering the introduction of Level Crossings and other fixed accessories fitted for operation by the Hornby Control System. We agree that Level Crossings so operated would form extremely interesting additions to Hornby railways, but many difficulties must be overcome before your suggestion can become a practical proposition. We may mention here that several Hornby enthusiasts have written at different times to say that they have succeeded in setting up a very realistic control cabin and wheel from which to work the existing Hornby Level Crossing. (*Reply to H. Hauptman, Summer Hill, Sydney, N.S.W.*)

FOOTBRIDGE FOR CONTROL SYSTEM.—We are at present experimenting with the possibility of adapting various fixed Hornby accessories for use in connection with the Control System, and in this connection the Footbridge is receiving special attention. (*Reply to F. G. Robinson, Leeds; O. Cuthbert, Yarmouth, and several others*).

IMPROVED RESISTANCE CONTROLLER.—We are very interested in your suggestion that the operating lever of the Hornby Resistance Controller should be drilled with a standard Meccano hole. We agree that this improvement would be very useful in many ways, especially when the Controller is used to regulate the speed of the Meccano 4-volt Motor. We will give your idea careful consideration. (*Reply to E. W. White, London, N.1*).

Results of

Meccano Model-Building Contests

By Frank Hornby

"No. 4 Outfit" Competition, Home Sections

As I had expected, the "No. 4 Outfit" Competition produced some very interesting entries. This Outfit contains a number of Gear Wheels, Eccentrics, Sprocket Chain and Wheels, and other working parts that do not appear in the smaller sets, and competitors have made the most of the extra pieces available. As in the previous "Outfit" contests, it was impossible to choose between the rival merits of many of the entries and the principal prizes in each section have therefore been combined and distributed equally amongst several competitors.

The names of the prize-winners in the three "home" sections are as follows:—

Section A (competitors over 16 years of age).

The First, Second, and Third Prizes have been combined and divided between the following four competitors, each of whom will receive Meccano products to the value of one and a half guineas: E. H. Bradshaw, Attercliffe Common, Sheffield; L. Hollyoak, Earlsdon, Coventry; R. A. Pearse, Kingston-on-Thames, Surrey; J. Harrison, Tring.

Six Prizes, each of Meccano products to value 10/6: W. Mitchell, St. James, Exeter; R. Sewell, St. Ives, Hunts.; P. S. Smith, Dover; O. Roberts, Cricklewood, London, N.W.; David Newland, Hull; B. Rawlinson, Ipswich.

Section B (Competitors over 12 and under 16 years of age).

The First, Second, and Third Prizes have been combined and divided between the following six competitors, each of whom will receive Meccano products to the value of one guinea: J. M. S. Risk, Hillhead, Glasgow; Ian S. Chisholm, Trinity, Edinburgh; D. McLean, Moss Side, Manchester; F. A. Burt, Erdington, Birmingham; G. M. B. Marks, Wimbledon, London, S.W.20; Charlotte Crooks, Sherwood, Huyton, Lancs.

Six Prizes, each of Meccano products to value 10/6: C. Rowse, Redruth, Cornwall; Robert Scott, Morley, Leeds; H. G. Topham, Repton, Derby; Arthur Stanley, Lenton Sands, Nottingham; R. W. Wasley, Glinton, near Peterborough; C. Booker, Pitsmoor, Sheffield.

Specially Commended (Certificates of Merit): George King, Barking; C. Gilmour, Edinburgh; S. Morris, London, W.10; H. Pooss, Weymouth; Joseph E. Rocca, Edinburgh; A. Middlemass, Falkirk; C. Blackwell, Croydon; G. Litchfield, Leicester; J. F. Johns, Redruth; J. Stone, Wallingford.

Section C (Competitors under 12 years of age).

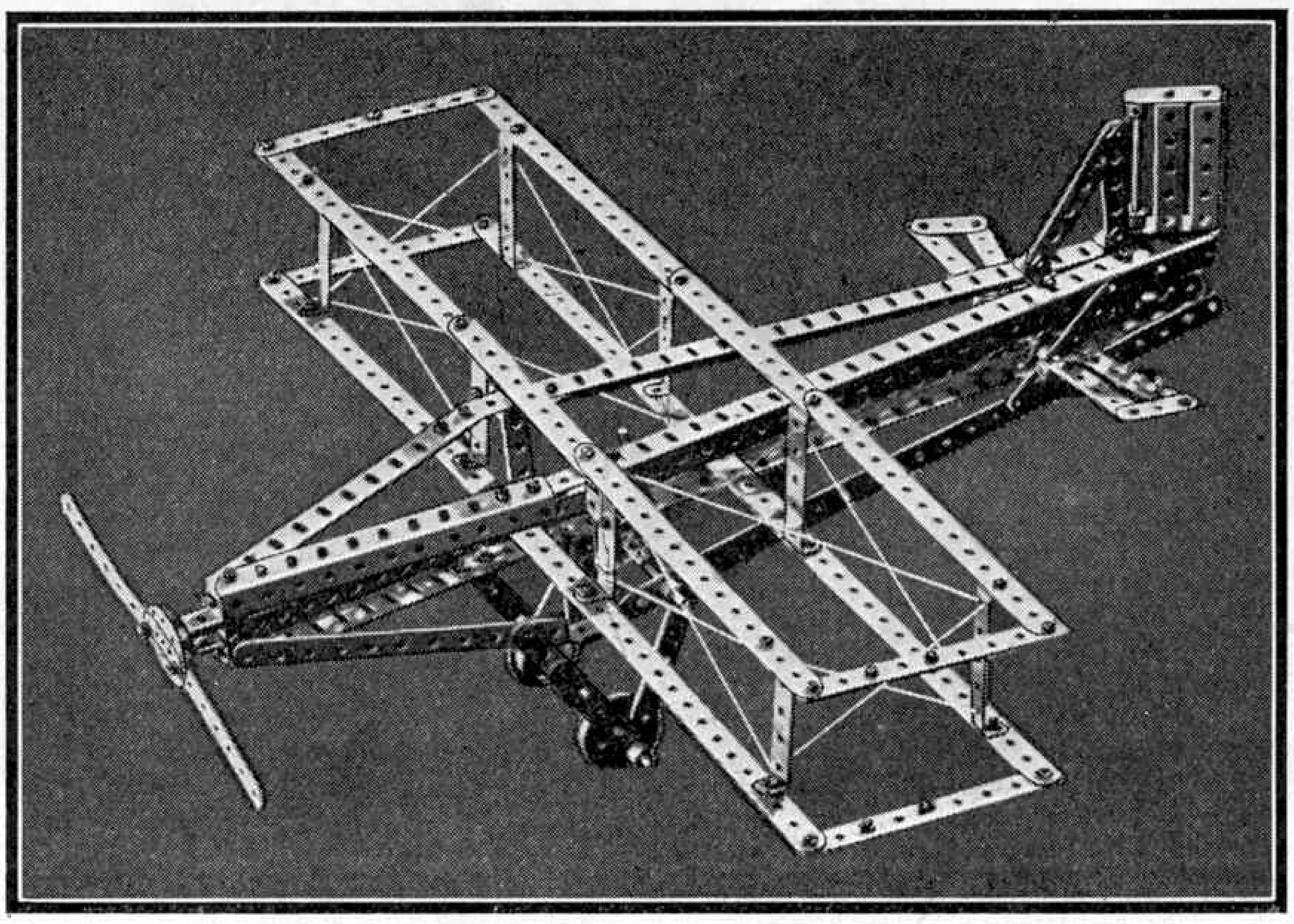
The First, Second, and Third Prizes have been combined and divided between the following six competitors, each of whom will receive Meccano products to the value of one guinea:—K. Randall, Holloway, London, N.; Angus Lamont, East Sheen, London, S.W.14; J. C. M. Salter, Redland, Bristol; David Archer, Withernsea, E. Yorks.; Seymour Baker, Paddock, Huddersfield; Ian Bottomley, Northfield Crescent, Edinburgh.

Six Prizes, each of Meccano products to the value of 10/6: P. Everingham, Eastbourne; S. Samuels, Kensington, Liverpool; F. G. Horrocks, Worcester; L. Marchmont, Swansea; A. Richardson, Bournemouth; Frank Howard, London, S.W. 1.

Specially Commended (Certificates of Merit): John Beardsmore, Leigh; A. Colbert, York; Alan Stuart, Ballymena, Ireland; Norman G. Cooper, Gosport; N. Swales, Leicester.

Gelatine Press

L. Hollyoak sent in a miniature machine press for stamping small lozenges from a sheet of gelatine. The prototype of this model was made for the Nelson Gelatine Co Ltd. by the firm in which Hollyoak is employed. The gelatine is fed automatically through rollers and over the die plate, through which the lozenges are forced by the punches on the die head. The latter is operated by a pair of Eccentrics mounted on an overhead main shaft, which carries a large flywheel built up from $12\frac{1}{2}''$ Strips bent to circular form and braced with $5\frac{1}{2}''$ Strips as spokes. The lozenges fall into a perforated scoop, which has a backward and forward motion to allow any faulty lozenges to drop down through the perforations.



A well-proportioned Meccano Biplane, by D. McLean. (Awarded Prize in Section B)

Two pairs of feed rollers are provided, one pair being placed on each side of the die plate and connected to the other by Sprocket Chain. The feed is operated by a cam motion on the main shaft. This consists of a $3''$ Pulley carrying a bolt, which after each revolution lifts an arm and imparts motion to one of the roller shafts by means of a connecting rod and Pawl and Ratchet mechanism. The punches on the die head consist of a row of nuts and bolts.

An excellent model of a printing machine secured an award for R. Sewell. It is operated by a treadle motion connected to a Meccano Crankshaft. The latter is fitted with a flywheel built up from a $12\frac{1}{2}''$ Strip bent to circular form and braced by two $5\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips. The various movements of a real printing machine are faithfully reproduced in the Meccano model. The inking rollers are caused to traverse the forme and ink table after each forward movement of the printing frame and, moving simultaneously with the inking rollers, another small roller passes over the ink duct and thence on to the ink table. A slight intermittent rotary motion is imparted to the table (a Face Plate), by means of Pawl and Ratchet gear, to ensure the even distribution of the ink. The platen is lifted and lowered at regular intervals to meet the forme.

Greyhound Racing

Charlotte Crooks sent in a very interesting model of novel type. It is described as a greyhound racing track and represents one of the newest forms of sport. The course is built up from a series of Braced Girders joined end to end and bent in the form of a circle. This circle is braced by tie pieces built up from $12\frac{1}{2}''$ Strips, and at the point where they cross in the centre of the model, a vertical $11\frac{1}{2}''$ Rod is secured. From the top of the latter horizontal Strips extend to the outer limits of the racing track. If desired the whole of the framework can be hung with suitable scenery.

On the outside of the circle of Braced Girders, a 4 ft. circle of Hornby Rails is laid and at one place in the track points lead off to a siding. The "hare" and "dogs" are attached to a Meccano trolley running on the Hornby Rails and driven by a Clockwork Motor. The hare, which is composed of $2\frac{1}{2}''$ Strips with a $1''$ loose Pulley Wheel for a head and five Flat Brackets for legs and neck, is attached to the trolley by means of an $11\frac{1}{2}''$ Rod, and the greyhounds are carried on an $8''$ Rod extended by $5''$ Rods. The dogs are represented by $2\frac{1}{2}''$ Strips with pieces of cardboard secured in position to represent their heads and legs. At a given signal the trolley can be switched on to the siding, when the hare is supposed to go to "earth." As the hare leaves the main track the hounds are knocked off their rod by a suitable catch secured to the track.

Two particularly good entries in Section C are illustrated on the opposite page.

No. 1 Outfit Competition, Overseas Section

The following are the results in Section D (for Overseas readers) of the "No. 1 Outfit" Model-building Competition. The results in the Home Section were published in the "*M.M.*" for August 1927.

THE FIRST, SECOND AND THIRD PRIZES have been combined and divided amongst the following six competitors, each of whom will receive Meccano products to the value of one guinea: L. Weston, Dannevirke, New Zealand; W. M. Flanderka, Bambalapitiya, Colombo, Ceylon; L. G. Mauger, Hauteville, Balingup, W. Australia; Carmelo Galdes, Valletta, Malta; P. T. Hewitt, Geneva; Stanley Johnson, Melbourne.

SIX PRIZES, each consisting of Meccano products to the value of 10/6: H. M. Denton, Smoky Bay, West Coast, S. Australia; W. Basson, East London, S. Africa; H. W. Turner, Hastings, New Zealand; O. Sanderson, Johannesburg; O. P. Skinner, Cape Town, S. Africa; S. L. Hickinson, Cairo, Egypt.

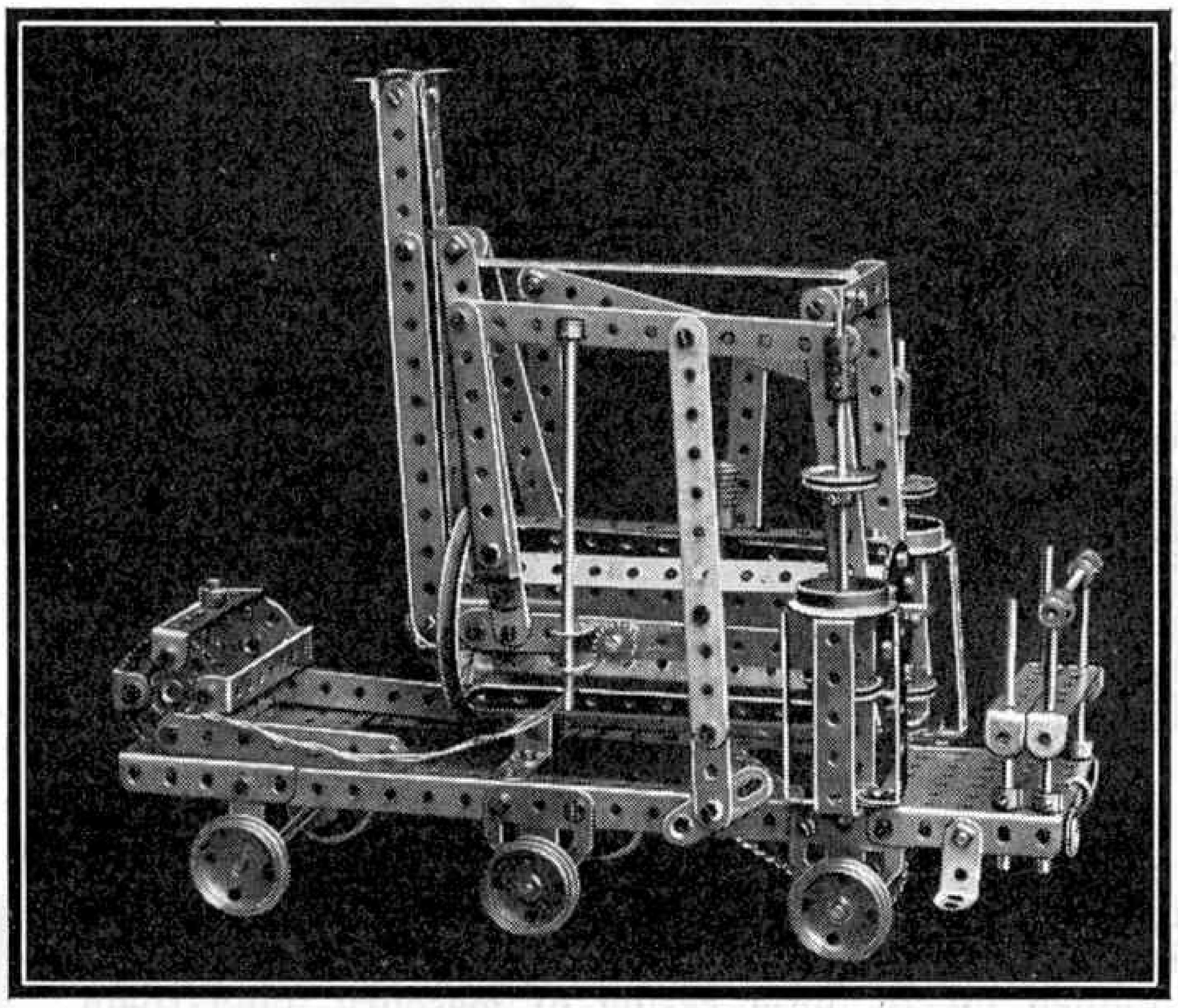
SPECIAL COMMENDATION (Certificates of Merit): Manek Jamshadji Desai, Navsari, India; D. R. White, Dunedin, N.Z.; Marcus Coughlan, Palmerston North, N.Z.; K. Langsdorf, Nobby, Queensland; Ormond Hawkins, Logan Village, Queensland; W. Hartz, Winnipeg, Canada; R. E. McGee, Hamilton, Ont.; K. A. Luby, Morningside, Brisbane, Australia; Ronald Jacob, Calcutta, India; Ratanji Cawsji Vajifdar, Navsari, India; John Langenstrass, Belgravia, Transvaal; S. E. Seneviratne, Kandy, Ceylon.

A Simple Meccano Loom

L. Weston secured his prize with an interesting model of a loom. As may be imagined, a machine of this type is not easy to construct from the parts contained in a No. 1 Outfit, but judging by the samples submitted, Weston succeeded in obtaining some very good results from his model. The loom is fitted with two heald frames, each consisting of four 2½" Strips mounted side by side on a Rod and spaced apart by Washers. These frames are caused to move up and down by a pair of levers attached to their tops. The shuttle, which also is hand-operated, consists of a small piece of pointed stick, or a large darning needle, with the weft wound round it.

The bobbins for the warp are formed by mounting small cardboard discs on a 3½" Axle Rod journalled in the base of the machine, each thread of the warp being wound on the Rod between two discs. The reed frame is constructed by tying pieces of string round two parallel 2½" Strips. The latter are connected together at each end by Angle Brackets and the frame so constructed slides on horizontal 5½" Strips, which are part of the loom frame, and is worked to and fro by means of a Bush Wheel and connecting-rod movement. The Bush Wheel is secured to the main operating shaft, and the latter is connected to the Rod on which the woven material is wound by cord and Pulleys.

L. G. Mauger's prize-winning entry is in the form of a dragline. The base of this model consists of a 5½" × 2½" Flanged Plate mounted on wheels, and the superstructure is secured to a Sector Plate which pivots about a vertical 3½" Axle Rod secured to the base plate. The two Plates are separated by a Washer. Four 5½" Strips bolted one at each corner of the Sector Plate are joined at the top by a 2½" × ½" Double Angle Strip, and five holes from the bottom of these Strips another Sector Plate is bolted into position.



This fine working model of the old "Wylam Dilly" locomotive secured an award in Section C of the "No. 4 Outfit" Contest for Ian Bottomley

Two 12½" Strips pivotally attached to the lower Sector Plate form the jib. They are bolted together at the top and supported by two cords fastened to the Double Angle Strip in the base of the model. The bucket consists of two Flat Trunnions secured together by a Double Bracket, and the hoisting cord, which is tied to a 2½" Strip bolted to this bracket and led over a ½" loose Pulley fitted near the top of the jib, is operated by a Crank Handle journalled in the 5½" Strips near the foot of the jib. Another cord is led direct from the bucket to the Crank Handle and is wound round in the opposite direction to the hoisting cord. When the handle is turned the bucket works in a most realistic manner and I think that most Meccano boys will agree that the time spent in building the model is well repaid by the many hours of fun that it affords.

Winston M. Flanderka constructed a model pit-head gear of excellent design. A pointer at the pit head is worked by the motion of the cage and shows at a glance whether the cage is in motion. It also indicates the position of the cage as it moves up and down the shaft. If the hoisting cord snaps or the machinery breaks down, the cage instead of crashing to the bottom of the pit is held fast in the shaft. It may be worked down gradually, however, by a lever situated inside the cage, and in actual practice this could be operated by the imprisoned miners. The safety catch employed is similar in principle to that described under Suggestion No. 85 (see "*M.M.*" for May, 1927).

Some Novel Entries

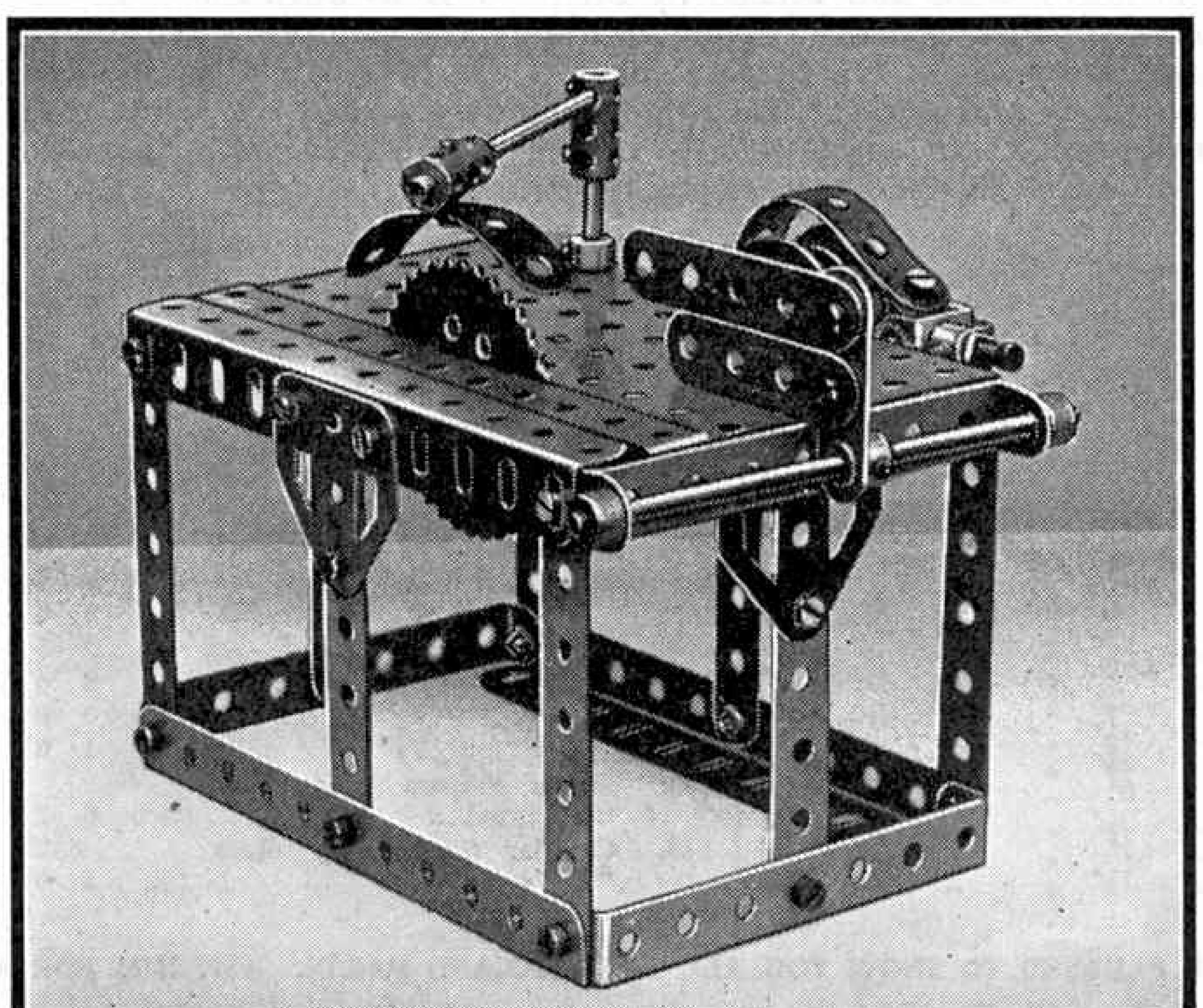
Two very original models were sent in by W. Basson. One of these is a pigeon trap that allows the pigeons to enter a cage but once they are inside effectually prevents their escape. It consists of four 5½" Strips placed in a vertical position and secured by means of Angle Brackets at their upper ends to a horizontal 5½" Strip, which is free to turn on pivots. The four 5½" Strips are pushed inward as the pigeon enters the cage, but as soon as it has passed, they fall back and a stop prevents them from being thrust outward. Hence the pigeon is safely imprisoned.

Basson's other model represents an instrument by means of which wind velocity may be measured. This consists of a series of paper cups pivoted to a large wheel turning freely upon a vertical pivot. If the wheel is suitably geared and fitted to a Meccano speed indicator a number of interesting experiments may be carried out with the model.

A motor-driven log saw is the subject of H. W. Turner's entry. The model is capable of doing light work and the saw arm is arranged so that it adapts itself automatically to the position of the saw as the latter cuts further into the wood.

H. M. Denton sent in a model of an aeroplane of excellent design and finish. He has every reason to be proud of his effort.

A fine model jib crane was constructed by Kevin Langsdorf. If a census could be taken amongst Meccano boys, I feel sure that the resulting figures would show that the various types of cranes form by far the most popular subject for Meccano models. Consequently a model of this kind must show a very high standard of merit before it can qualify for a prize, but there is little doubt that Kevin Langsdorf has reached the required standard.



Seymour Baker (aged 9 years) won a prize in the "No. 4 Outfit" Contest with this realistic Saw Bench. Note the attachment for a belt clutch

MECCANO ACCESSORY PARTS

Girders

Their Importance in Engineering

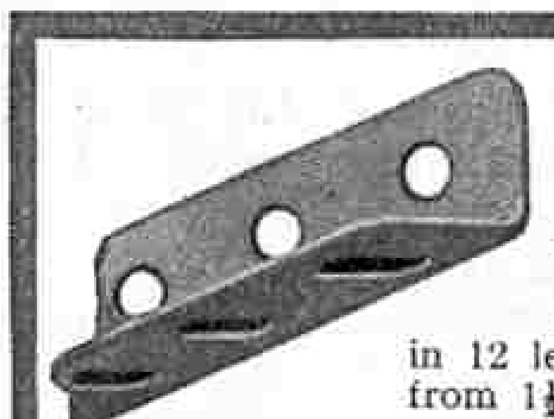
The greatest works of engineering depend for their strength and durability upon the massive girders of steel which, though sometimes hidden by an outer casing of masonry, bind them together and hold them rigid. A single rolled steel girder, if properly constructed, proves as strong as a wall of masonry.

The Forth Bridge, a steel highway 1½ miles in length, suspended high above the Forth; the Eiffel Tower, extending almost to the height of a mountain; the Woolworth Building, the tallest skyscraper in New York—these are three of the world's greatest structures that stand like monuments to man's constructive skill. The last named disguises its steel skeleton in a cloak of masonry, but the others tower into the sky like huge Meccano models. It is plain to see how even the smallest strut or tie is carefully planned and placed into position so that it may bear its allotted portion of strain or thrust.

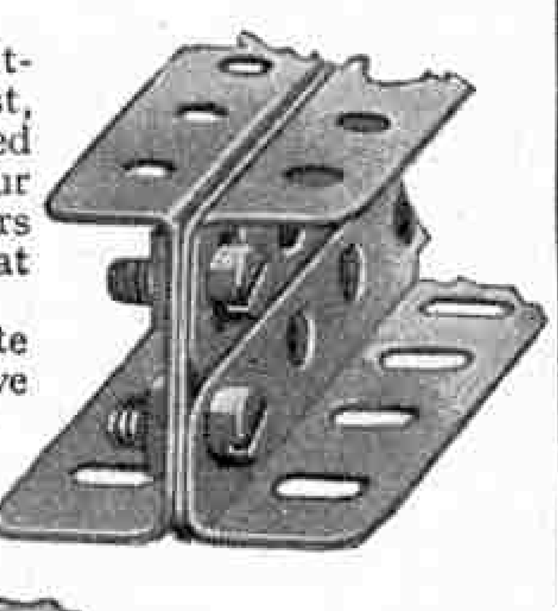
Meccano Girders fulfil the same important duty in Meccano engineering. They are fitted into models and braced by Strips or Rods until the finished structure would support a man's weight, without the slightest disruption. Meccano Girders are made of the finest steel, and are beautifully enamelled in green. The edges and corners are rounded and smoothed off, while the perfect accuracy of their manufacture makes them invaluable in the construction of even the most intricate mechanisms.

No.					s.	d.
1.	Perforated Strips, 12½" long	...	½ doz.		1	0
1a.	" " 9½" "	...	"		0	9
1b.	" " 7½" "	...	"		0	8
2.	" " 5½" "	...	"		0	6
2a.	" " 4½" "	...	"		0	5
3.	" " 3½" "	...	"		0	4
4.	" " 3" "	...	"		0	3
5.	" " 2½" "	...	"		0	3
6.	" " 2" "	...	"		0	3
6a.	" " 1½" "	...	"		0	3
7.	Angle Girders, 24½" long	...	each		0	8
7a.	" " 18½" "	...	"		0	6
8.	" " 12½" "	...	½ doz.		1	9
8a.	" " 9½" "	...	"		1	3
8b.	" " 7½" "	...	"		1	2
9.	" " 5½" "	...	"		1	0
9a.	" " 4½" "	...	"		0	10
9b.	" " 3½" "	...	"		0	8
9c.	" " 3" "	...	"		0	8
9d.	" " 2½" "	...	"		0	7
9e.	" " 2" "	...	"		0	6
9f.	" " 1½" "	...	"		0	6

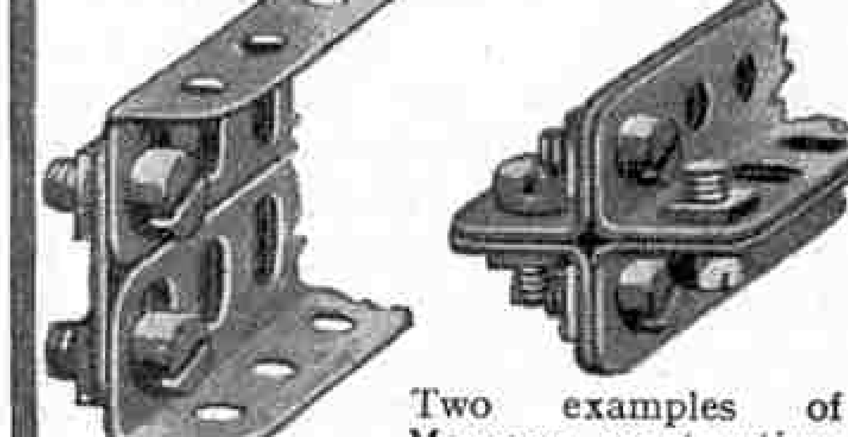
No.				s.	d.
97.	Braced Girders, 3½" long	...	½ doz.	0	9
98.	" " 2½" "	...	"	0	6
99.	" " 12½" "	...	"	1	9
99a.	" " 9½" "	...	"	1	6
100.	" " 5½" "	...	"	1	0
103.	Flat Girders, 5½" long	...	"	1	0
103a.	" " 9½" "	...	"	1	6
103b.	" " 12½" "	...	"	2	0
103c.	" " 4½" "	...	"	0	9
103d.	" " 3½" "	...	"	0	7
103e.	" " 3" "	...	"	0	6
103f.	" " 2½" "	...	"	0	5
103g.	" " 2" "	...	"	0	4
103h.	" " 1½" "	...	"	0	3
103k.	" " 7½" "	...	"	1	3
113.	Girder Frames (triangulated truss type)	...	each	0	2
143.	Circular Girders, 5½" diam. "L" section	...	"	1	0



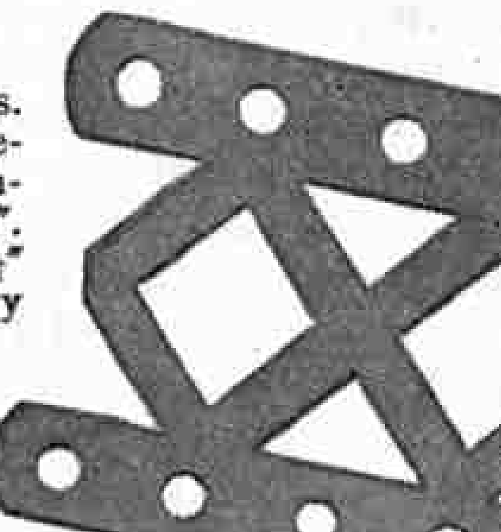
Angle Girders ("L" section, ½" × ½") in 12 lengths, ranging from 1½" to 24½".



Meccano built-up Steel Joist, constructed from four Angle Girders and one Flat Girder. The complete unit is massive and of very great strength.



Two examples of Meccano construction; Channel Section (left) and Cross Section Girders. The latter consists of a pair of "I" girders butted together.



Braced Girders. Stout lattice-work throughout. Width 2". In 5 lengths, 2½" to 12½". Very ornamental and of great utility.

YOUR DEALER WILL BE PLEASED TO SHOW YOU ALL THE MECCANO PARTS. ASK HIM FOR A COMPLETE PRICE LIST.

MECCANO LTD., BINNS ROAD, LIVERPOOL

Special Meccanograph Competitions

A Great Opportunity for Artistic Meccano Boys

THESE competitions are organised with two special objects in view, namely, to provide a means whereby our readers' model-building skill and artistic taste can be put to a simple and very interesting test, and to bring to the notice of as many readers as possible the extraordinary fascination of a remarkable Meccano model—the Meccanograph. To further these aims we are prepared to distribute free copies of the special Meccanograph Manual to all readers who resolve to enter the competitions. As most Meccano boys are aware, the Meccanograph is a machine with which innumerable designs, all perfectly symmetrical and of beautiful appearance, may be produced merely by turning a handle. The designs are changed by making slight adjustments in the model or small rearrangements in the mechanism, and prizes will be awarded in one competition to the competitors who succeed in producing the best designs and in the other to competitors who colour their designs most skilfully.

MECCANOGRAPH DESIGN COMPETITION

The prizes in this competition will be awarded to competitors who submit the designs that are considered by the judges to be the best received. Points that will weigh most in the competitors' favour when judging the entries will be the "clean" appearance of the designs, smoothness and regularity of the lines and curves, and originality. Designs should be as novel as possible.

The Meccanograph is illustrated and explained in the Complete Manual of Instructions, under Model No. 708. It is also dealt with very fully in the special 16-page Meccanograph Manual, which, in addition, contains illustrations of 31 designs, together with directions which enable the reader to reproduce them again and again on his machine. The competitor's model need not be constructed exactly the same as that shown in the Manual; he may make any alterations or additions that he thinks desirable. In this connection it should be pointed out that there are slight variations between the design of the model shown on this page and that included in the Meccanograph Manual.

Special Offer of Meccanograph Manuals

If you wish to participate in either of the contests announced on this page you should send for a free copy of the Meccanograph Manual. Write to "Meccanograph Contest Dept., Meccano Ltd., Binns Road, Liverpool," and enclose a 1½d. stamp with your order to cover cost of postage and packing of the Manual.

The Competition will be divided into the following sections: Section A, for readers residing in Great Britain, and Section B, for readers residing overseas. Closing dates, for Section A: 30th November, 1927; Section B: 29th February, 1928.

THE PRIZES

Prizes of Meccano or Hornby Train goods to the value of £1-1s., 15/–, 10/6 and 5/– respectively will be awarded to the senders of the four best designs in each Section. In addition a number of Consolation Prizes will be distributed.

If suitable, some of the prize-winning designs will be illustrated in the "*M.M.*" and included in future editions of the Meccanograph Manual.

HOW TO ENTER

Secure your copy of the Meccanograph Manual and build up the model. As already mentioned, you can incorporate any of your own ideas in it if you wish. Then produce two or three really good designs, and write on the back of each your name, address, age, and the Section in which your model is entered. Next set out as simply as possible on separate sheets of paper how the designs were produced, explaining any parts of your model that differ from the existing Meccanograph, and send these explanations together with your designs to "Meccanograph Design Contest, Meccano Ltd., Binns Road, Liverpool." Do not send more than 12 designs, but any quantity up to that number will be accepted from each competitor. Unsuccessful designs will be returned to their owners provided that a stamped addressed envelope of the necessary size is enclosed with the entry. Prize-winning designs become the property of Meccano Ltd.

MECCANOGRAPH PAINTING COMPETITION

The intricacy and wonderful symmetry of the Meccanograph designs may be used to produce some beautiful artistic effects with the help of a little colour, and the second special Meccanograph Competitions should appeal especially to readers who make a hobby of painting.

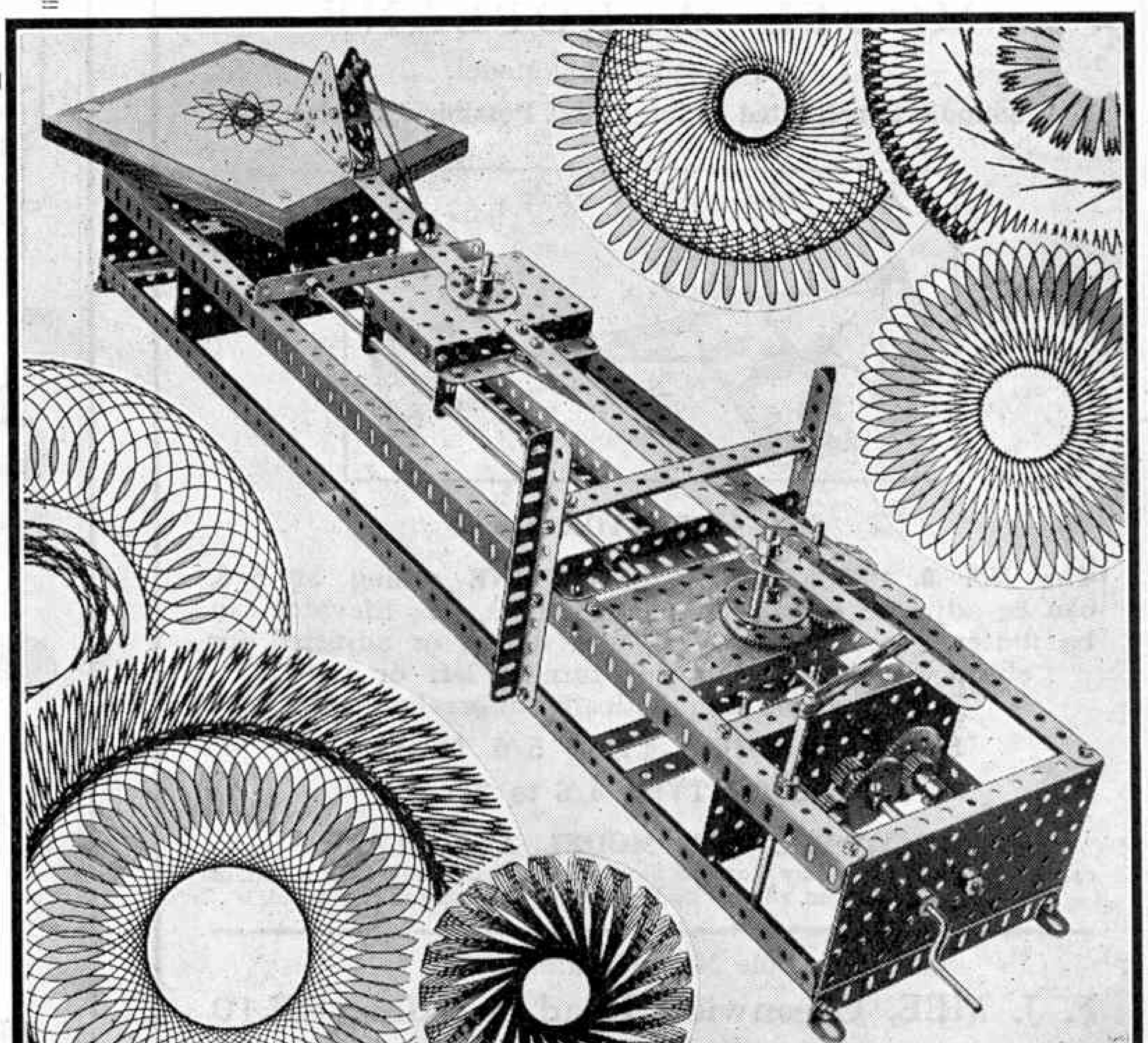
Competitors are asked to fill in the spaces in their Meccanograph designs and otherwise decorate them by means of water colours, crayons, or any other method. The prizes will be awarded to the senders of the most pleasing designs received. The originality of the designs or the construction of the model is not so important as in the "Design" Competition; the important point to consider is the skilful blending of the colours.

This contest will also be divided into two sections, as follows: Section A for "home" readers and Section B for overseas readers. Closing dates: Section A, 30th November, 1927; Section B, 29th February, 1928.

Prizes consisting of Meccano Products to the value of 10/6, 7/6, 5/– and 2/6 will be awarded respectively for the four best entries in each Section. There will also be many consolation prizes.

IMPORTANT

Do not send more than six coloured designs, but any quantity below that number will be accepted. Write on the back of each design your name, address, and age, and address the envelope "Meccanograph Painting Contest," Meccano Ltd., Binns Road, Liverpool. Each competitor may enter both Meccanograph Contests, but entries *must* be sent in separate envelopes.



The Meccanograph, and some of the designs that it will produce

Exploring the Arctic—*(continued from page 864)*

of grog was issued, and magnificent repasts were provided of "Banks Land Venison" and "Mercy Bay Hare Soup," together with musk ox beef that had been hanging in the rigging for over two years!

As the winter wore on and the men began to grow weaker and fall sick, M'Clure formed the somewhat desperate resolution to send away all but 30 of his strongest men, and with these to remain during the following summer and run the risk of being forced to remain a fourth winter if the ship could not be extricated. The travelling parties were told off in the spring and for some time before the date fixed for the commencement of their journey they were given a larger allowance of food in order to recruit their strength. One party was to attempt to cross Melville Sound and find its way to Greenland by way of Parry Strait, while the other was to make its way to the old depot and winter quarters in Prince of Wales Strait and thence to the American continent. These were desperate ventures. If the two parties had set out they actually would have attempted more than did Franklin's men, and it is more than probable that they would have succumbed. At this critical moment relief arrived.

On 6th April, 1853, a deer was being prepared for a final meal before the separation. In spite of their sorry plight the men were in fine spirits, those on the point of departure gaily promising to return with help at the earliest possible moment, and in particular undertaking to bring back a large supply of pipes, of which there was a distinct shortage. M'Clure and one of his officers were walking apart on the ice discussing the best method of digging a grave in the frozen ground for one of the men who had died after drinking the dregs in the almost emptied medicine bottles in the ship's dispensary in a spirit of foolish bravado. Suddenly they were startled by the approach of an individual who hurried up from the entrance to the bay throwing up his arms and shouting at the top of his voice. His face was black as ebony, but he introduced himself as Lieut. Pim of the ship "*Resolute*," commanded by Capt. Kellett, which had reached Melville Sound.

M'Clure's continued absence had been a cause of great alarm to the home authorities. It was known that he had reached the longitude of Banks Land and turned north-east, for Capt. Maguire, while cruising along the north coast of the American continent, had met near Cape Bathurst an Eskimo who remembered seeing white men smoking tobacco that was twisted up. This was a slender clue from which to deduce that M'Clure had passed that way, but it was sufficient, for the tobacco supply of all previous Arctic expeditions had been in the form of leaf.

In view of M'Clure's letter, the possibility of his having reached Melville Sound and Winter Harbour had been suggested, and when Kellett's expedition reached Melville Sound a sledge party was sent immediately to Winter Harbour on the chance of meeting M'Clure or at least finding some information regarding his whereabouts. The document already referred to was found on top of the rock and a party under Lieut. Pim was immediately despatched with assistance for the crew of the "*Investigator*."

Lieutenant Pim was quickly followed by a dog sledge with two men and their arrival completely changed M'Clure's plans. The medical officers accompanying him had never been in favour of sending away two sledge parties of invalids, and a further important consideration was that every member of the crew was affected to some extent by scurvy. M'Clure decided, therefore, to abandon the ship and to return to England in the "*Resolute*."

The officers and crew of the "*Investigator*" crossed the ice of Melville Sound and joined Kellett, but even then their adventures were not at an end. The "*Resolute*" in its turn was frozen in and compelled to remain in the pack during the winter of 1853-4. Fearing that the same fate would be the lot of the ship in the following winter, Sir Edward Belcher, the senior officer in the Arctic, ordered Kellett to abandon his ship and to return to England in relieving vessels. The memorable thousand-mile drift of the "*Resolute*" after being abandoned was referred to last month.

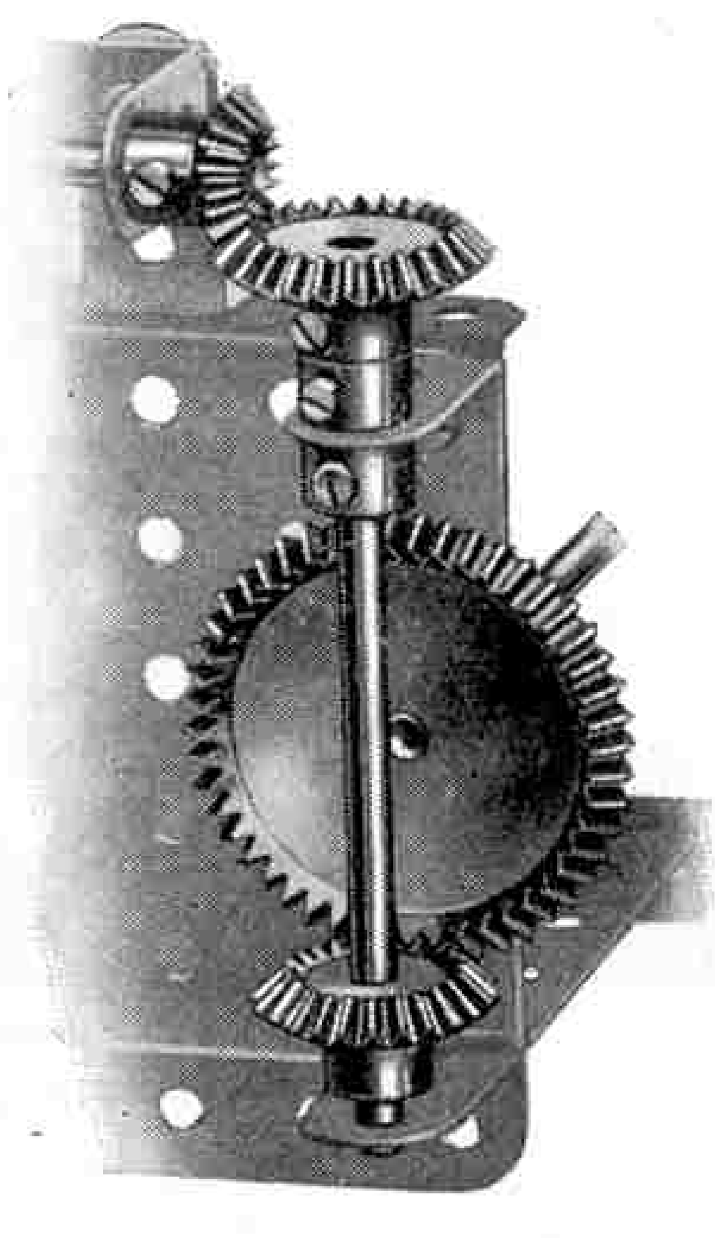
Thus M'Clure and his men spent four consecutive winters in the Polar regions and sailed in three ships, while one important link in the North-West passage discovered by them was traversed on foot. Although M'Clure failed to find any trace of the Franklin expedition, he succeeded in adding considerably to our knowledge of the Arctic. A curious circumstance of his return was that he was tried by Court Martial for losing his ship! This, of course, was merely a formality, and not only was he acquitted but, as we have already stated, he was knighted and the ship's company were awarded the Government prize of £10,000 for the discovery of the North-West passage.

New Meccano Parts

Bevel Gears

The following new sizes in Meccano Bevel Gears are now available:—

Part No. 30a, Bevel Gear, $\frac{1}{2}$", 16 teeth .. .. .. 6d. each
Part No. 30b, Bevel Gear, $\frac{3}{4}$", 24 teeth .. .. .. 9d. each
Part No. 30c, Bevel Gear, $1\frac{1}{2}$", 48 teeth .. .. .. 1/3 each



These new Bevel Gears, together with the existing size (Part No. 30), will enable several different speed ratios to be obtained when driving shafts at right-angles. In our illustration the $\frac{1}{2}$" Bevel is in mesh with the 1" Bevel (26 teeth), giving a ratio of approximately $1\frac{1}{2}:1$. Below these wheels the $\frac{3}{4}$" Bevel is shown in engagement with the $1\frac{1}{2}$" size, and the ratio so obtained is $1:2$. For ordinary $1:1$ right-angle drives, any two Bevels of the same size may be used, and their operation will be found smooth and easy.

Corner Angle Bracket

This part is designed for use in cases where two $\frac{1}{2}" \times \frac{1}{2}"$ Angle Brackets bolted together would prove either too cumbersome or insufficiently rigid. It may be used to connect two Strips situated at right angles but in different planes. Part No. 154, price 6d. per $\frac{1}{2}$ doz.

Hobbies' 1928 Catalogue

We have examined with great interest the catalogue for 1928 just published by Hobbies Limited. This catalogue continues to grow in the most remarkable manner and its latest edition contains new matter that makes it an invaluable book of reference for the handy-man. The fretwork section contains a specially interesting chapter of advice on commencing this hobby that will save the beginner from disappointment by working on wrong lines. Other sections of the book contain sound advice on the purchase of wood, the use of carpentry tools and material, picture frame making, polishing and staining and other matters of practical interest to every worker. All the best features of previous catalogues are retained, in many cases in a greatly improved form, and with each copy is presented a design for a handsome and interesting type of overmantel. The catalogue may be obtained for 9d. from any Hobbies dealer, or direct from Hobbies Limited, Dereham, Norfolk, for 1/– post free.

The Meccano Jerseys

The popularity of the Meccano Jersey and three-quarter Hose has not only been maintained from the start but has shown a decided improvement. This can no doubt be accounted for by the attractive nature of the garments, their good service in wear, the splendid colour range in which they are supplied and their moderate prices.

The thousands who are wearing these neat little garments appreciate the comfort and satisfaction they give.

A full list of the colours and sizes can be seen on page 906.

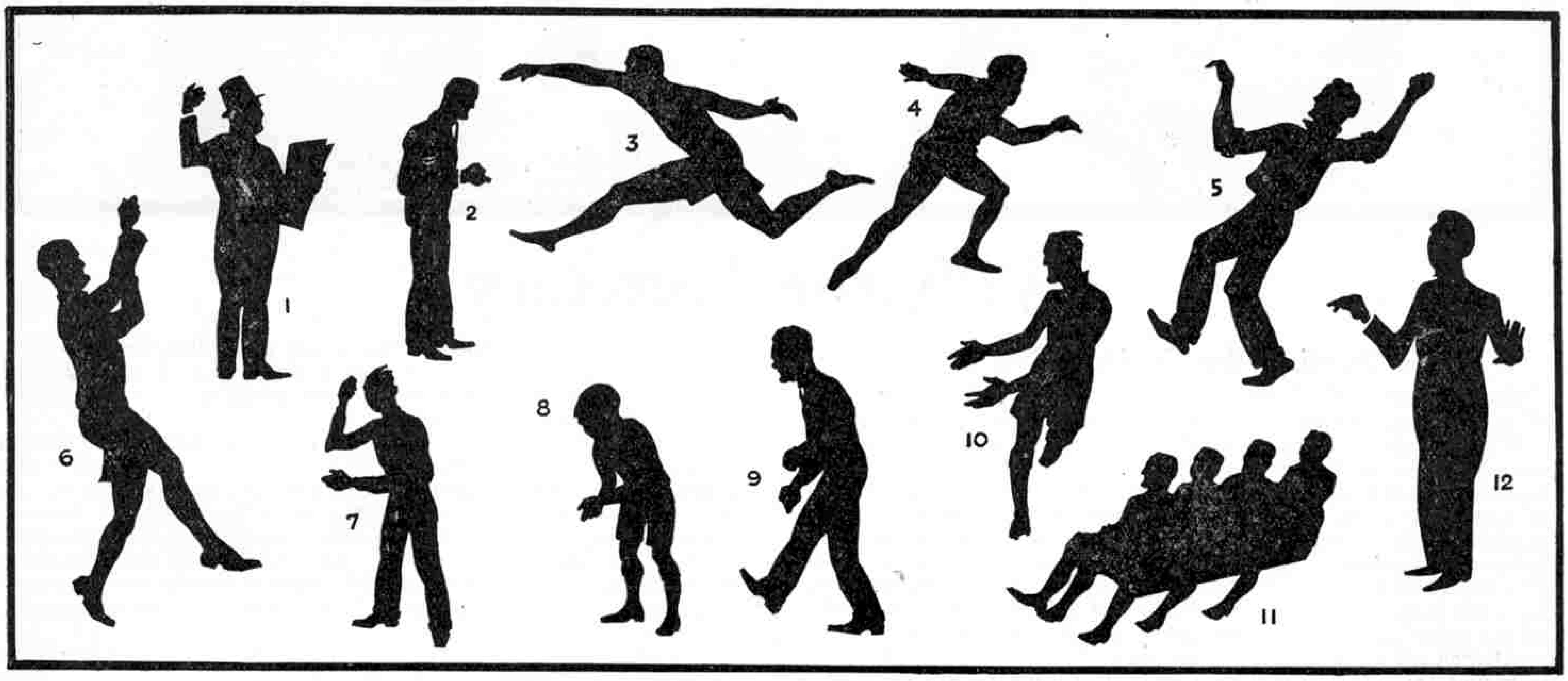
Staffing a Liner for a World Cruise—

(Continued from page 865)

have had long experience. There are but a few men on regular watches in the victualling department, the hours of service being regulated by the conditions prevailing, but it may be said that many of them work longer hours than the crew in other departments.

The ranks and ratings are graded and expect that grade to be recognized. I have not forgotten an early experience in the Line, when I went down to the bakery, about some work, and, seeing a man standing there, I asked, "Are you the baker?" A distinctly hurt expression crossed his face as he replied, "Oh, no, sir: I am the confectioner!"

Competition Page



What Are These People Doing?

This month we introduce a new form of competition to our readers. Each of the silhouetted figures in the picture above is performing some common action. Certain of the pictures represent characteristic attitudes struck in athletic sports and other pastimes, while the remainder depict everyday incidents. In order that competitors may grasp the underlying idea, we have deliberately introduced one or two obvious poses. There is compensation for these, however, in two pictures that should prove a real test for even the most observant Meccano Boy. That, however, remains to be seen!

Prizes of Meccano products to the value of £1/1/–, 15/–, 10/6 and 5/– respectively, will be awarded to the competitors who submit the four best lists of the actions represented by the various silhouettes. In addition, there will be a number of consolation prizes. The lists must be submitted on post cards, the items being numbered 1 to 12 to agree with the numbering of the silhouettes.

Entries must be addressed to "Silhouettes, Meccano Magazine, Binns Road, Liverpool," and must be sent to reach this office not later than 31st October. Overseas closing date, 31st January, 1928.

"Aeronames" Contest

The collection of engine names has been one of the most fascinating of pursuits for boys of all ages ever since railways became a popular form of travel. The possession of a name seems to confer some degree of life to an engine until in the eyes of its beholders it acquires personality.

The giving of names to machines does not begin and end with railway locomotives however, but is rapidly becoming a popular form of identification for aeroplanes. We want to encourage our readers to take an interest in this branch of the "naming" fashion, and this month we offer prizes to the boys who submit the longest list of named aeroplanes.

As a start to the list and to show what we want, we instance the "*Spirit of St. Louis*" and "*Columbia*," the machines in which Lindbergh and Chamberlin respectively flew the Atlantic. Type names, such as D.H. "Hercules," are not eligible.

Prizes of Meccano products to the value of £1/1/–, 15/–, and 10/6 will be awarded to the senders of the three longest lists, and in addition there will be a number of consolation prizes. Lists must be written on one side of the paper only and must be addressed to "Aeronames, Meccano Magazine, Binns Road, Liverpool." Closing date 31st October. Overseas closing date, 31st January, 1928.

Home Results

Locomotive Puzzles

The appeal to readers to have a shot at this competition whether they were able to identify all the locomotives or not, met with an excellent response. In making the request we wished to ascertain the extent of the popularity of this type of picture puzzle. The number of entries left no room for doubt and we are arranging for further competitions of the same type. Despite the fact that one or two of the pictures were considered to be very difficult, a large number of readers succeeded in giving a completely accurate list.

In awarding the prizes it was necessary to take into consideration the neatness and novelty of the presentation of the solutions, but we had no hesitation in awarding the first prize to a solution submitted in rhyme, the first of which read

"What did GLADSTONE say in '82?
But you get no marks 'cause it's given you."

The second rhyme also was good.

"If the kids in the COTS WO(u)LD keep from *ruin*
They must keep to the track like the engine's doin'."

The following is the list of successful competitors:—
1. K. G. Haig (Chatham, Kent); 2. R. H. M. Aldridge (Christchurch, Hants.); 3. W. Cowlishaw (Swindon, Wilts.); 4. J. K. Evans (Stone, Staffs.) Consolation Prizes: J. B. Ashby (Hitchin, Herts.); H. J. Brough (Worcester Park, Surrey); J. D. Hampton (London, N.19); H. G. W. Howsehold (Marygate, York); L. A. Murphy (Birmingham); C. Smith (London, N.W.6).

32nd Photographic Contest

The subject of this competition, it will be recalled, was "A Waterside Scene," and we doubt whether it would be possible to choose a more comprehensive subject. The prints submitted ranged from seascapes showing vast expanses of ocean down to intriguing little pieces of wayside ditches. Bridges over roaring mountain torrents and lighthouses on rocky islets were found in profusion, and as could be expected from such a variety of subjects, the judges found it no easy task to allot the awards. These went to the undermentioned:—

First prizes: Section A, E. Shimmin (Armley, Leeds); Section B, N. Rowntree (Tottenham, N.17). Second Prizes: Section A, F. Driscoll (Buckingham); Section B, C. O. J. Jones (Bootham, York). Consolation Prizes: L. W. Aldworth (Saltley, Birmingham); H. F. Chandler (Woodford Green, Essex); M. F. Couchman (Bognor); G. Cupon (Abergavenny, Mon.); H. Hayfield (Bayswater); P. Lloyd (Newport, Mon.)

With the Secretary

Starting the Session Well

The majority of Meccano Clubs will commence their First Winter Session during this month. The old saying, " Well begun, half done," applies very definitely to the commencement of a new session. It is of the greatest importance to arouse the utmost possible interest among the old members as a preliminary to gaining new ones. Many Leaders make a practice of visiting personally the parents of as many of the members as possible before the opening of the session. The result of such visits is to give the parents a better idea of the objects of the club and also to make them feel that they have a personal interest in its work. At the same time the Leader is very likely to come in contact with gentlemen who are not only qualified but also willing to give lectures to the club from time to time. Many interesting lectures from engineers, mechanics and others have been obtained in this manner and permission to visit various works or factories has often been secured.

A Recruiting Campaign

This is in many respects the best time of the year for carrying out an active recruiting campaign, for many boys are looking round for some congenial activity for the winter nights. The main work of such a campaign must, of course, be carried out by existing members of the club, but the Leader can do a great deal by securing as much publicity as possible. It is usually not a difficult matter to persuade the local paper to insert a short notice regarding the club, and this often results in bringing the club before people who otherwise might never have known of its existence.

Another good plan is to prepare a number of circular letters, which may be printed or duplicated, giving a short account of the club's objects and activities, and inviting the recipients to become honorary members of the club at a cost of a small subscription, say, 2/6. Honorary members are entitled to visit the club at any time during the session, and when they realise the good work that is being carried on they almost invariably take a permanent and practical interest in the club's welfare.

Several clubs make a practice of combining the Meccano resources of all members and building a working model on a large scale for exhibition in the local dealer's window or some other convenient place. Models such as the Eiffel Tower or the Big Wheel are obviously suitable for this purpose, but the possibilities of such models as the Horizontal Engine should not be overlooked. The important points are that the model should be large and should actually work. In some cases a reproduction of a local structure is very successful in attracting attention. One club, for instance, built a large model of the Cathedral for which its city is famous, and this model aroused an extraordinary amount of interest wherever it was exhibited. The result was that people began to make enquiries about the builders of the model and eventually the club received many recruits, in addition to gaining a large amount of publicity of a general nature.

Arranging the Programme

During the past two or three years there has been an increasing tendency for clubs to widen the scope of their programme and thus secure sufficient variety to cater for the interests of all the members. First Aid work, for instance, is now a permanent feature in the programme of many clubs, whereas three or four years ago it was unheard of. Another feature that is assuming a position of prominence is Miniature Rifle Shooting ,and next month I hope to publish an article dealing in detail with the setting up and running of an air gun range of a type specially suitable for Meccano Clubs.

The usual method of arranging the programme for the session is that of calling a meeting of all the members of the club and asking for suggestions and subsequently voting upon them. In such cases many of the items that have been popular features during previous sessions will receive a unanimous vote and thus be adopted without discussion. In addition to these features there will be others upon which differences of opinion are expressed and when a vote is taken the result may be only a small majority either way.

Although the Leader is more or less bound to accept majority votes, it is important that he should not overlook schemes that are supported by a fairly substantial or influential minority. It frequently happens that schemes that on first consideration do not appeal to the majority of members prove afterwards, when tried out, to be a great success. Where the voting upon a new proposal is very close, it is a very good plan for the Leader to announce that the proposal will be given a trial for a period sufficiently long to test its value, and then will be voted upon again for final decision.

* * * *

The secretaries of several clubs have not yet sent in their applications for Membership Cards, Subscription Cards and Report Forms for the coming session, and I shall be glad to have all such applications within the next few days.

* * * *

Leaders are reminded that recommendations for Special Merit Medallions for the Summer Session should be forwarded at once and that any club photographs taken during the session will be very welcome.

* * * *

I should be glad to receive more regular reports from the secretaries of clubs that are not yet affiliated. There appears to be an impression that the " *Club Notes* " page is intended for notices of affiliated clubs only, but this is entirely wrong. Many unaffiliated clubs are doing splendid work and carrying out interesting programmes, and I shall always be glad to receive reports from their secretaries and to publish them.

Proposed Clubs

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

AIRDRIE—A. M. Henderson, Milverton, Airdrie, Scotland.
ASHTON-UNDER-LYNE—Percy Booth, 273, Oldham Road, Limehurst, Ashton-under-Lyne.
BARRY—D. B. Lloyd, 12, Clifton Street, Barry, Nr. Cardiff.
BIRMINGHAM—O. Golby, 748, Alum Rock Road, Ward End, Birmingham.
FRITTON—Clement Baldwin, 2, Angle Cottages, Fritton, Nr. Gt. Yarmouth.
LONDON, S.E.20—Mr. Fred E. Bolt, 131, Anerley Road, S.E.20.
SAXMUNDHAM—Mr. M. Tollemache, The Rookery, Snape, Nr. Saxmundham.
SWANSEA—L. G. Phillips, 12, Shelley Crescent, Swansea.
WISBECH—Russell H. Radcliffe, The Haven, Walsoken Road, Emneth, Wisbech.
WORCESTER—P. U. D. Vigors, The Cedars, Fernhill Heath, Worcester.

Marsh Street, Conway M.C.—The Leader, Mr. Gandy, has unfortunately been obliged to resign, and consequently the club is not making very good progress. New officials have been elected and the secretary is working very hard to keep the club up to standard. Any gentleman in the district who is willing to help the club should communicate with the secretary, who will be very pleased to give full details. *Secretary*: W. O. Knight, 22, Howard Road, Walthamstow, London, E.17.

Albert Village M.C.—Membership is rapidly increasing and good progress is reported. An outing to Alton Place was thoroughly enjoyed by a party of about 30, and this is to be followed by a visit to Matlock Bath. The club has been divided into four sections, which compete against each other in games. A Football Team is to be chosen shortly. Club roll: 22. *Secretary*: L. C. Adey, 239, Occupation Road, Woodville, Nr. Burton-on-Trent.

Middlesbrough M.C.—The Exhibition of Models proved a great success and was attended by about 1,000 people. It was opened by Mr. W. Birrell, captain of Middlesbrough Football Club, who gave a very spirited address and congratulated the boys on their work. Mr. Birrell was supported by Mr. G. H. Camsell, the famous centre forward, who last season scored 59 goals, which is a record for The Football League. Many interesting models were displayed, including an interesting model engine loaned by Mr. Fenner, a local gentleman. This model took seven years to build and is complete to the smallest detail. The club's first annual outing took place on 17th August, when members spent an enjoyable day at Whitby. Club roll: 47. *Secretary*: A. Bradley, 95, Deepdale Avenue, Marton Grove, Middlesbrough.

Weston M.C.—Members recently enjoyed a trip to Flat Holme, an island some distance from Weston. The party went by Motor Boat and visited the Lighthouse. The summer Camp was a great success. Fortunately the weather was good and many interesting events were arranged, including sports. Club roll: 22. *Secretary*: R. B. Nichols, Little Coombe, Tower Walk, The Shrubbery, Weston-Super-Mare.

Garstang M.C.—In preparation for the first winter session members organised a dance and realised quite a good sum to strengthen club funds. It is intended to introduce Fretwork as one of the new features for the session. *Secretary*: J. Gardner, Moss Lane, Garstang, Nr. Preston.

Victoria (Glasgow) M.C.—The club has suffered a loss on account of the departure of the secretary, W. P. Morrison for America, and all members are sorry to lose him. A new secretary has been appointed, however, so that the club work will not be interrupted. A visit was paid to the Albion Motor Works and members found the experience extremely interesting and instructive. A visit to a local shipyard has been arranged. The club is still without a Leader and the secretary is anxious to hear of a gentleman who is willing to take the position. *Secretary*: Henry C. Thompson, 4, Montgomerie Gardens, Scotstoun, Glasgow.

Willingham M.C.—The new Leader, Mr. Allen, has provided a workshop for members and also a good supply of tools, and it is hoped shortly to reproduce some really first-class models. Members are greatly indebted to the Rev. A. C. Hair, President, for permission to use the Parish Hall as a club room. Club roll: 13. *Secretary*: R. W. Huckell, Short Lane, Willingham.

Barrow-in-Furness M.C.—A visit to the local Fire Station proved a great success, members being conducted round by Superintendent Newsham. The secretary, W. E. Kelly, has been obliged to resign and this is very greatly regretted. The Leader is anxious to enlarge the club roll and new members will be made very welcome. Arrangements for the future include visits to Vickers Ltd., the local Paper Mills, the Town Hall and the Crown Printing Works. Leader: Mr. F. E. Fairclough, 5, Clifford Street, Barrow-in-Furness.

Upwey and Broadway M.C.—Two very successful Exhibitions have been held at which many excellent models were on view, including a Hammerhead Crane, Breakdown Crane, Big Wheel and Motor Chassis. The models attracted much attention and visitors heartily congratulated members on their good work. A visit was paid to the Weymouth Waterworks, where some interesting machinery was seen dating back to 1866. Club roll: 25. *Secretary*: W. Ravenscroft, Waterworks, Upwey, Dorset.

Southport M.C.—A cycle run organised by the Leader was greatly enjoyed. Members who had no bicycles played cricket on the shore. The two sections competed, the Bolts winning by five runs. Preparations are being made for the Winter Session. Club roll: 28. *Secretary*: W. E. Williamson, 18, Delamere Road, Ainsdale.

Napier (N.Z.) Meccano Club

The Napier (New Zealand) Meccano Club was inaugurated towards the middle of 1925 and was affiliated in April 1926 under the Leadership of Mr. Frank Drew. The club has been successful from the first and has won for itself a very high reputation in the district by means of well-organised exhibitions of models

Carlisle M.C.—Cricket has been a very popular feature of the syllabus during the summer and many enjoyable matches have been played in a field kindly loaned by Mr. Stewardson, the father of one of the members. Meetings have been temporarily suspended but will be resumed shortly. Club roll: 12. *Secretary*: D. L. Carey, 7, Strand Road, Carlisle.

Stotfold Pioneer M.C.—The club was represented in the local Hospital Procession and succeeded in obtaining a prize. A cricket match was played against the Stotfold Girls' Club, the boys playing left-handed and bowling underhand, and the result was a victory for the girls. Club roll: 14. *Secretary*: E. Ray, Stotfold House, Stotfold, Beds.

Hessle M.C.—It is hoped to organise another Exhibition and a large working model is to be loaned from Headquarters. Part of the money made at a recent Exhibition is to be given to Dr. Stephenson's Homes, the remainder going to club funds. Several outdoor meetings have been held. Club roll: 22. *Secretary*: T. A. Fillingham, "Red Lea," Marlbro' Avenue, Hessle.

Exeter M.C.—The club held its Annual Camp at Teignmouth, spending twelve days under the Leadership of Mr. M. C. Hodder. The Teignmouth M.C. paid several visits to the camp and two Cricket matches were played, both resulting in a win for the Teignmouth Club. Several places of interest were visited and these excursions were greatly enjoyed. Mat making is to be introduced in order to raise club funds, the mats being sold in the district. Club roll: 300. Sub-Leader and *Secretary*: Mr. W. A. Apsey, 74, Pinhoe Road, Exeter.

St. Saviour's (Tonbridge) M.C.—During the summer Cricket has been the most popular feature. The whole club camped out for August Bank Holiday and everyone had a really good time. It is hoped to organise a Fife and Drum Band. A Football Team is to be started for the winter, and Darts and Billiards are also to be introduced. Club roll: 28. *Secretary*: C. F. Copper, 91, Shipbourne Road, Tonbridge.

Preston Embee M.C.—Model-building continues to be very popular and the various competitions are entered into with great keenness. An Exhibition of models proved successful, prizes being awarded for both group and individual efforts. Members are discussing the possibility of a visit to the Meccano Factory in the near future. Other items of interest have been papers by the Leader on "*Meccano*," and by C. Thompson on "*Building a One Valve Wireless Set*," and a visit to the Trades Exhibition. Club Roll: 27. *Secretary*: J. R. Drysdale, c/o Merigold Bros., 127, Church Street, Preston.

St. Albans M.C.—Cricket has been a popular feature during the summer and in spite of very unfavourable weather several enjoyable cycle runs have been held, varying in distance from about seven miles for an evening to 25 for an afternoon run and picnic combined. The membership continues to increase and prospects for the winter session are good. Club roll: 22. *Secretary*: H. M. Upward, 19a, Worley Road, St. Albans.

Elm Road (Beckenham) M.C.—A Model-building night of unusual interest was held recently. Members brought their Meccano sets, and when all were ready a telegram was brought in from the "Austrian Government" ordering Aeroplanes, Ships, Tanks and Guns. The team leader then drew lots to decide which teams should build the different models. The aeroplane team finally gained the most points. Club roll: 17. *Secretary*: C. W. Price, 52, Queen's Road, Beckenham, Kent.

Sittingbourne Baptist M.C.—Model-building is a popular feature of the syllabus. In a "Blind Competition" held recently the Leader set a model that the competitors were allowed to look at for a few minutes before being blindfolded and told to build it. It is intended to divide the club into two sections, one for boys from 9 to 12 years of age and the other for those from 12 upward. Club roll: 14. *Secretary*: D. L. Thorn, "Anchorage," Addington Road, Sittingbourne.

Australia

Hampton M.C.—The club is now divided into two sections named respectively "Locos" and "Tenders," which compete with each other in model-building and games. First-Aid is to be a prominent feature of the syllabus in future. Several Lectures on various interesting topics have been promised by local gentlemen and are being looked forward to keenly. The President, Mr. Joseland, gave an interesting Lecture on "*Samoa*," which was greatly enjoyed. New members will be very welcome. Club roll: 17. *Secretary*: F. G. Wallis, 9, Kerford Street, Hampton, Australia.

South Africa

Malvern Wesleyan M.C.—A Concert recently held was thoroughly successful. The hall was packed and the audience greatly enjoyed the excellent programme provided by members, winding up with the Meccano play, "*Nonsense Nana*." The club continues to be run on sound and business-like lines and the membership is increasing. Football is a prominent feature and many interesting matches have been played. Members were invited by the Clifton M.C. to attend a concert given by the latter, and this was greatly enjoyed. The Leader and members have been asked to help in the formation of another Meccano Club in the neighbourhood and there is every prospect of a successful result. Leader: Mr. Sykes, c/o H. Garner, Esq., Box 54, Cleveland, Johannesburg, South Africa.

A NEW GRECIAN ISSUE

It is rarely that we have the pleasure of chronicling the appearance of so handsome a set of postage stamps as that issued this year by Greece to replace the famous mythological set that has so long been popular.

The new issue consists of 14 values, ranging from 5 lepta to 25 drachmae and includes nine striking designs, each of which depicts some famous link in Grecian history. The plates were engraved in London, the printing of the stamps themselves being carried out in Athens by Aspiotis Freres.

Our first illustration, that of a 40 lepta stamp, will be well-known to many of our older readers. It is the famous White Tower at Salonica. Built in the latter part of the 15th century, it was once surrounded by a tall wall that linked it up with the city fortifications. For a short period, after a massacre of Janissaries it was known as the Tower of Blood. At the present time it is used as a prison and is still a prominent feature of the sea front. The stamp is coloured blue-green and in common with the other stamps of the issue is perforated 12½–13½.

The Monastery of Simon Peter on Mount Athos, is the design used for the 25 lepta value. The present monastery is comparatively a modern building, but its history can be traced back through several destructive fires to the 14th century. The buildings are particularly handsome, despite their modern construction. Mount Athos, the site of the monastery, is revered with peculiar intensity in the Orthodox Church, for, according to a legend, the Virgin landed there in the 7th century. Its religious significance will be appreciated more fully when it is stated that nearly a score of monasteries of different orders have been built on the mountain. This stamp also is coloured blue-green.

Turning now to the 50 lepta stamp, we find a picture of the Corinth Canal. This also forms the subject of the 5 and 80 lepta values. The canal is one of the most remarkable engineering feats in Europe. Four miles in length, 69 ft. in breadth and 26 ft. in depth, it pierces the great peninsula of the Peloponnesus and connects the Gulf of Corinth with the Saronic Gulf. The journey between the Adriatic and Ægean Seas is thus shortened by over 200 miles, but only vessels drawing less than 23½ ft. can pass through. Sandstone cliffs rise sheer to a height of 170 ft. on each side of the canal. It is interesting to record that Julius Cæsar and other Roman emperors contemplated the creation of this canal in early days. The project did not come to fruition, however, until 1882, and the canal was opened to traffic in 1894. Its cost was £2,400,000. This stamp is coloured deep violet, while deep green, and black and indigo are the colours of the 5 and 80 lepta values respectively.

One of the most striking stamps of the whole series is the 3 drachmae value. Coloured black and violet, the design is a picture of the Greek battleship, "*Gheorghios Averoff.*" This ship is 462 ft. in length, has a beam of 69 ft. and draws 21¾ ft. of water. Propelled by engines developing 19,000 horse power, its speed is 24 knots. The ship served as the flagship of the Greek Navy during the Balkan Wars, and is named after George Averoff, a Greek millionaire who befriended his country to an extraordinary degree. Not only did he pay for the reconstruction of the Athens Stadium, but he also contributed very largely to the purchase price of the battleship that bears his name.

The 1 and 10 drachmae values illustrate the Theseion, which stands on a dusty, open space to the south-west of the Acropolis. Dating back to 420 B.C., probably it is the best preserved of the ancient Greek temples and despite its comparatively small dimensions, possesses a most impressive appearance. The columns are 19 ft. in height and the temple is built throughout of marble. Expert opinion is divided as to the origin of its name, but it is thought to have been dedicated to Theseus, a legendary King of Athens, who reigned about the year 1200 B.C. The colour of the 1 drachmae value is extremely effective in sepia and blue, while the 10 drachmae stamp illustrated is in black and claret.

The remaining illustration on our first page is of a 15 drachmae stamp which illustrates the Academy of Science, Athens. This was built in the 19th century and is the most handsome of the modern Athenian buildings. Like the Thesion, it is built throughout of marble from the Pentelicon quarries. The two large columns shown projecting above the building are statues representing Athena and Apollo. The same design is used for the 5 drachmae value, the colouring being black and yellow—green for the 15 drachmae value and black and orange for the 5 drachmae.

The 10 and 20 lepta values are of special interest to-day when the custom of wearing national costume is slowly dying out. The two stamps respectively illustrate the national costumes of the Dodecanese and Macedonia. The former stamp is coloured scarlet and the latter deep violet.

The Dodecanese is a group of 12 islands forming the Southern Sporades lying off the south-west coast of Asia Minor. The principal islands of the group are Rhodes, Patmos, Leros, Kalimnos, Cos and Misyros. Originally they belonged to the Byzantine Empire, and later to Turkey. During the Turko-Italian War of 1912, the Italians captured the islands, and were still in occupation when the Great War broke out. By the Treaty of London, Italy was promised the Dodecanese in return for her entry into the War, but in 1919 she agreed to hand over the islands, with the exception of Rhodes, to Greece. The promise was afterwards revoked and the islands now have been embodied in Italy.

The population of the Dodecanese is principally Greek. National costume is very much worn, Rhodes and Cos particularly being famous for their embroideries, in which the predominant colour is usually red on a white ground.

Although Macedonia lies in a part of the Balkans famous for its national costume, the particular Greek dress illustrated, probably the most striking of all Balkan costumes, is rarely seen nowadays. The long open jacket is of heavy blue serge, as is also the headdress, fastened at the top with a brown ribbon. The belt is of multi-coloured silk, fastened with a magnificent silver buckle.

(*Continued on page* 915)

For further stamp advertisements see also page 928.

Stamp Collecting—(*continued from page* 913)

Like most of the Balkan States, Macedonia has experienced a chequered history. Successive invasions, and consequent frequent admixtures of foreign populations, have left the country extremely cosmopolitan. Its population principally consists of Serbs, Bulgars, Greeks, Turks, Albanians, Rumano-Vlachs, Gipsies and Jews.

The last stamp with which we have to deal is the 2 drachmae. This shows the Athenian Acropolis, the view being that from the Ardettos Hill. The Acropolis, or "Upper City" of Athens, rises precipitously to a height of 500 ft. In early days it was the residence of the Athenian Kings and later the seat of Government. The many fine buildings, unfortunately, were destroyed by the Persians when they stormed the precipitous slopes to the right of the picture, early in the 5th century, B.C. However, during the period known as the Golden Age, many temples were erected on the site, which then was devoted exclusively to the worship of the gods. The Parthenon, to be seen in the picture, was used as a Christian church in the Middle Ages, but later was converted into a mosque by the Turks. It remained almost intact until the 17th century when, during a battle between the Venetians and the Turks, a powder magazine within the building was exploded by a chance shot. The remains are at present being reconstructed.

On the extreme left of the picture the ruins of the Roman theatre of Herodius Atticus can be seen, while in the bottom right-hand corner there are shown two columns of the Temple of the Olympian Zeus, built in A.D. 130 by the Emperor Hadrian.

This stamp is coloured black and blue-green. The same design is used for the 25 drachmae stamp, the colouring in this case being black and green.

We understand that Greece proposes to issue this month a special issue commemorating the Battle of Navarino that was fought in 1827 between the Egyptian and Turkish navies and a combined fleet of British, French and Russian ships. There will be five values, the designs showing portraits of the British, French and Russian commanders, and views of Navarino Bay.

We are indebted to Messrs. Stanley Gibbons' Monthly Journal for much of the information given in the foregoing article, and take this opportunity of acknowledging our indebtedness.

Stamp Gossip

AIR STAMPS REALISE £1,000

At a sale of Air Stamps, held recently in London, 120 stamps realised about £1,000, one of the most interesting being a Tunis 1919 official stamp, which brought £90. A German 1922 official air stamp for three marks, showing an error of colour, went for £85, and a Chile envelope and stamp Valparaiso to Santiago 1919 realised £80.

An interesting souvenir of the double flight of the R34 in July 1919 was a stamped envelope bearing full London postmarks, which was sold to an American for £30, whilst another interesting English stamp was one carried by the first official air mail from London to Windsor, on 9th September, 1911, which was sold for four guineas, and a special card printed in violet, which is one of the rarest of the series, brought ten guineas.

* * * *

BULGARIA : Sofia Bomb Outrage

At half past three on the afternoon of Friday, 16th April, 1925, the Cathedral of Sveta Nedelia in Sofia was filled with the leading people of Bulgaria attending the funeral of the Government Deputy General Georghieff, who had been assassinated on the Tuesday before. During the service a time bomb that had been placed at the foot of one of the pillars exploded, destroying the roof and the greater part of the building and killing one hundred and forty people, amongst whom were prominent politicians, members of the cabinet and other high government officials. This attempt to assassinate the whole government of the state at one stroke was but one event in the political troubles that Bulgaria has suffered during the last few years.

In order to preserve the memory of this event and of those who were killed, the Bulgarian Government issued the single stamp illustrated here, showing the remains of the Cathedral after the outrage. The face value of the stamp is 50 st., the colour deep olive-green—nearly black—and the perforation gauges 11½ holes per 20 mm.

* * * *

RARE AIR-MAIL STAMP

Stamp collectors will wage keen warfare to secure specimens of the special air post stamp used to frank the aerial mail carried by the Marquis De Pinedo on his recent trans-Atlantic flight. The stamp was issued by the Newfoundland Post Office and consists of the obsolete 60 cents stamp of the 1897 Cabot Commemoration series, overprinted in red, with the expression "Air Mail de Pinedo 1927." The design of the stamp bears a portrait of Henry VII who granted a charter to Cabot to discover new lands and appropriate them to the ownership of Great Britain. Only 200 copies of the stamp were issued for use on this flight.

Newfoundland has been well to the fore in historic air-post enterprises and in April, 1919, when the late Mr. H. G. Hawker made his attempt on the Atlantic crossing, 200 stamps of the 3c., 1919 issue, were inscribed appropriately. It will be remembered that Mr. Hawker was obliged to land in the sea. As much as £50 has been paid recently for a copy of this stamp.

* * * *

JAPAN

In our August issue we mentioned the introduction of a new set of stamps by Japan, to commemorate the 50th anniversary of the country's entry to the Universal Postal Union. The illustrations in this column depict the two designs. The upper, 1½ sen value, shows a portrait of Baron Mayeshima, the first Japanese PostmasterGeneral. The same design is used for the 3 sen. The lower illustration shows the 6 sen value. The design here is a map of the world, across which a dove, symbolic of the peace necessary for the successful functioning of the Postal Union, is carrying a letter. The same design is used for the 10 sen value.

* * * *

CATALOGUE PRICES

The prevailing tendency for catalogue prices to represent only the market value of a fair copy of a stamp was further exemplified when a superb used copy of the Ceylon 8d. brown, of the 1857-59 issue, was sold by auction in London recently for £51, £6 above the quoted price in current catalogues. The stamp had large margins, was imperforate, and bore the star watermark.

At the same auction there was some spirited bidding for Cobham flown covers. One of the only 10 Darwen post-marked covers of Sir Alan's 1926 England-Australia flight, fetched £10, a similar cover used on the return journey fetching the same amount.

Writing of catalogues reminds us that an advance announcement concerning Messrs. Whitfield King & Co.'s 1928 catalogue appears in our advertisement columns this month. This catalogue, which deals with the stamps of every country throughout the world, is ideal for the beginner or the general collector since it does not enumerate stamps other than principal varieties. It contains 800 pages and over 5,000 illustrations.

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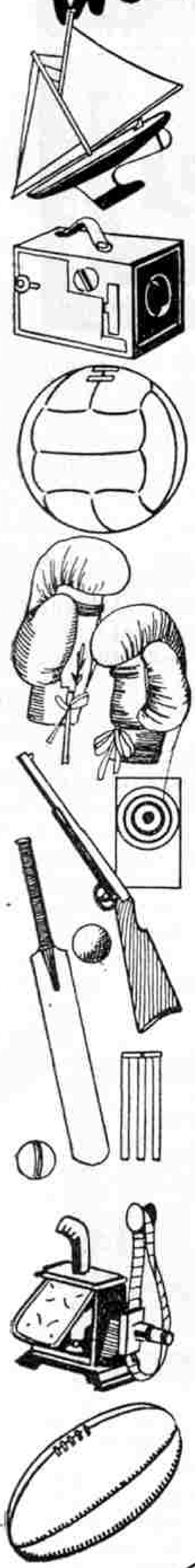
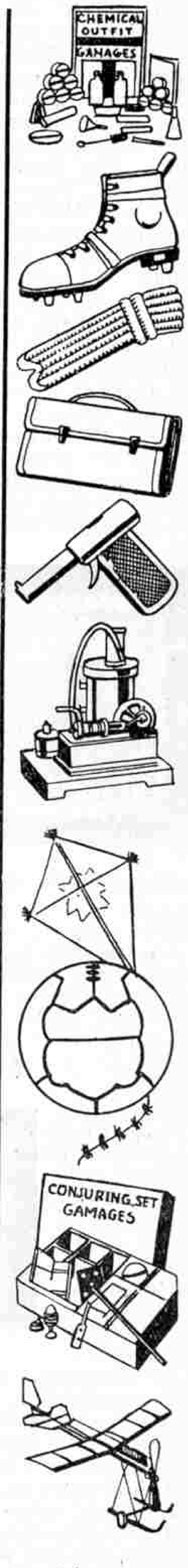
There is no House in the World that understands Boys and their needs as thoroughly as Gamages. Here we give just a few examples from a stock of Good Things as huge as it is varied. All "Meccano Magazine" readers should make their plans for a visit to Holborn, but if this is impossible simply write and tell us the subject in which you are interested, and we will send GRATIS and post free all the particulars you require.





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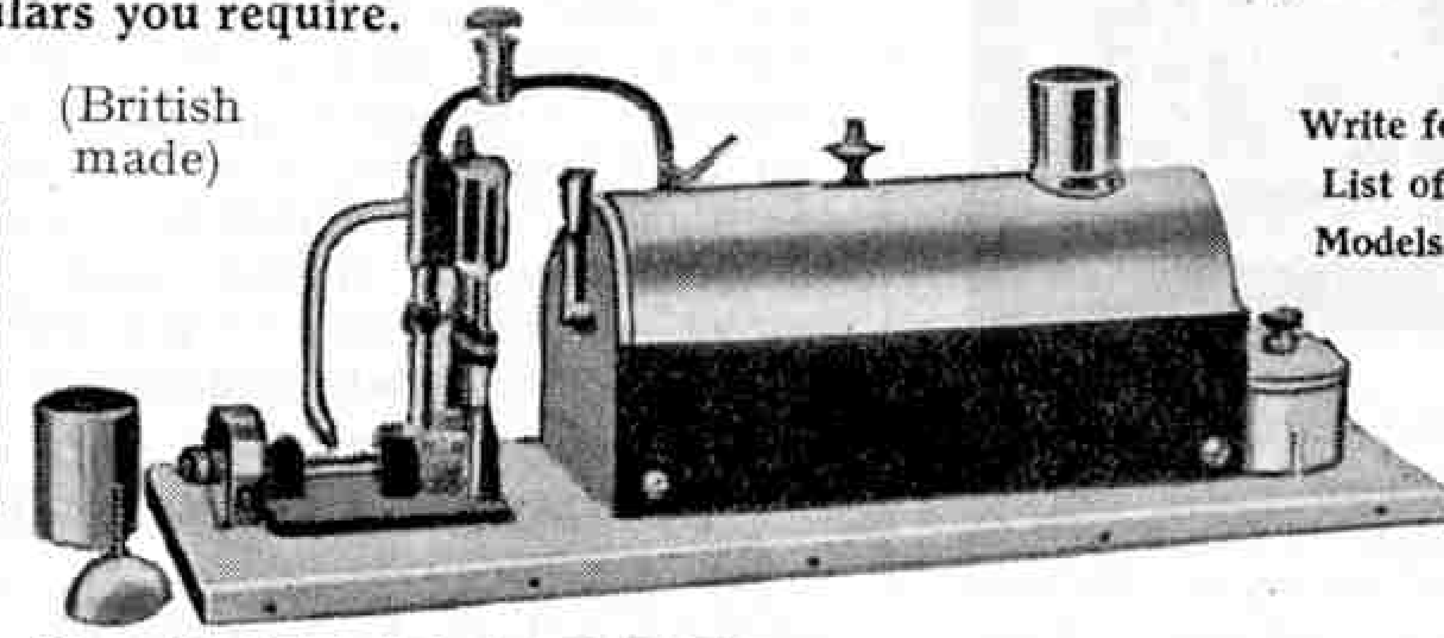
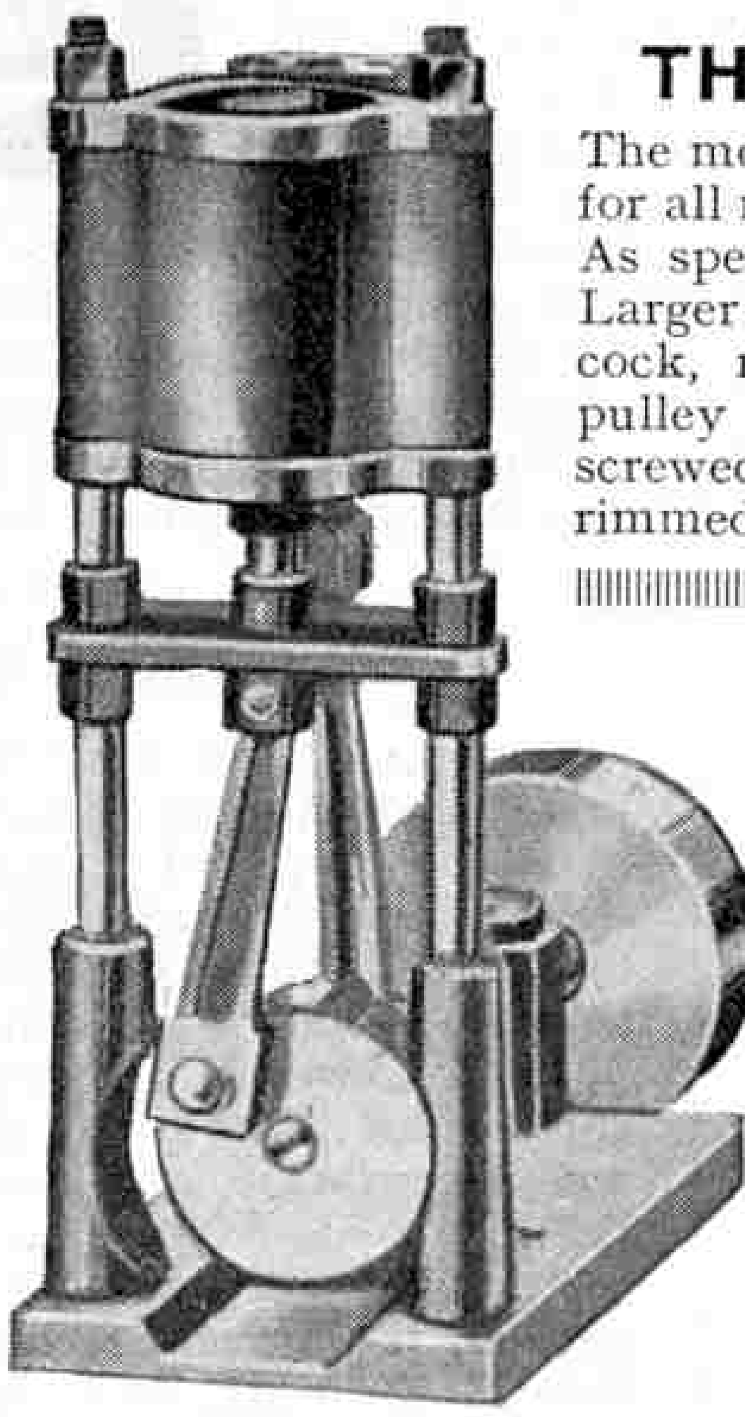


Write for List of Models

THE N.D.C. STEAM POWER PLANT No. 2

The most powerful and effective model set for its size on the market. Suited for all model driving purposes, specially effective for dynamo electric lighting. As specification under launch description, with improvements not shown. Larger lubricating cup, screw union at steam cock, no funnel, double-grooved pulley, large pulley for dynamo driving. The whole set screwed to heavy 3-ply base, metal covered and rimmed with pressed channel brass. Price **32/6**



THE N.D.C. MODEL STEAM ENGINE No. 1

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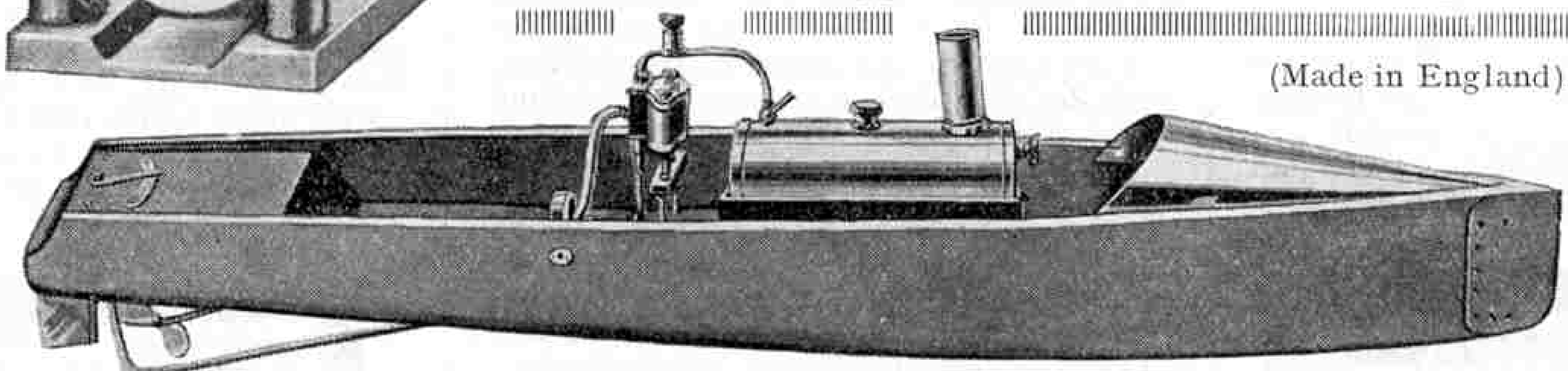
The most perfect piece of model engine design and workmanship ever placed on the market. All working parts steel-die cast to measurements far finer than can be produced by the most delicate engineering processes. Made from highest grade anti-friction metal—costing several times as much as pure copper—and of a permanent silver white polished finish, enamelled green and red. All parts interchangeable. Quality, finish, and value unapproachable. Price **16/-**

(Made in England).



THE N.D.C. MODEL STEAM LAUNCH No. 2

This is a beautifully-finished streamline racing model of finest material throughout, 36 in. long, enamelled white above and pale green below water line, unbreakable bows protected by pressed metal bow plate. The boiler is of a specially good steaming hollow form underneath, and has pressed formed heavy plate ends. The fittings include ground-in brass on brass safety valve, a beautifully-made solid brass water gauge, perfect model steam cock control, specially large automatic lubricator for piston valves, pistons, etc. Engine—double acting cylinder, $\frac{5}{8}''$ bore and stroke, of exceptional power and efficiency, effective 3-wick lamp, measure, and fluted filler—all of polished brass. Propeller scientifically formed of silver white metal casting, uncorrodible and highly polished. All tube connections are flanged and unions coupled. Wonderfully fast steamer, and the most beautiful model on the market. **59/6**

All Orders of 20/- and over Carriage Paid.

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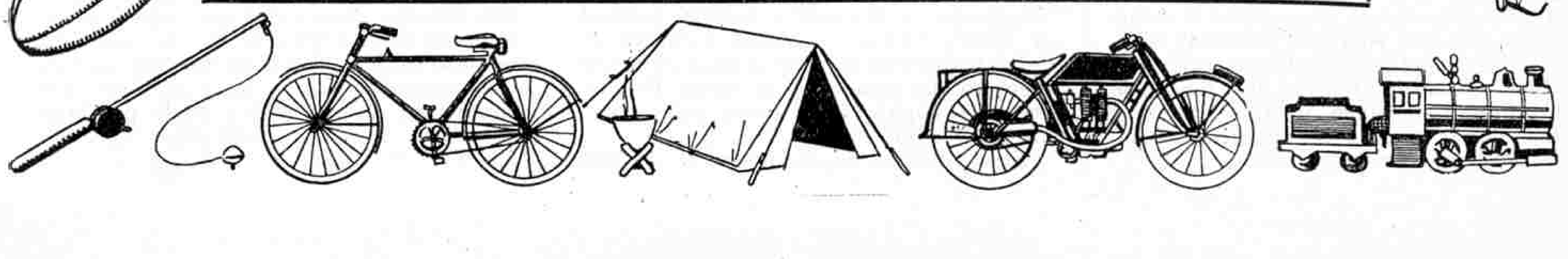
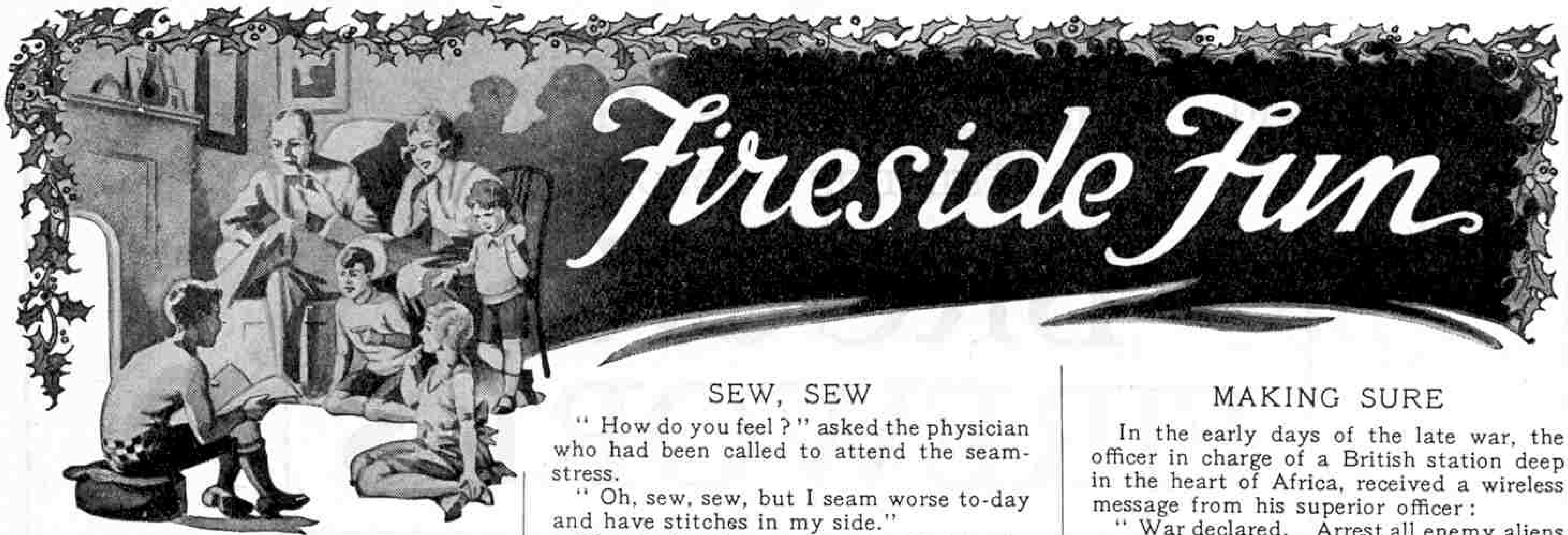




OH, CHRISTOPHER!

The host's small daughter, called upon to entertain the professor who was her father's guest, announced she would tell him a story. "There was once a man named Columbus," she began, "an' a queen sent him on a voyage, an' his ships were named Nina, the Pinta, and—and—"

"Santa Maria," prompted the professor.

"Yes, and the Queen's name was—was —"

"Isabella," suggested the professor.

"Professor," asked the child, with sudden suspicion, "have you heard this story before?"

* * * *

The recruit was grumbling about some dirt in his food—for he was still sufficiently raw to fail to appreciate when a little dirt is necessary to leave the proper savour.

"'Smatter!" bellowed the mess officer. "Stop whining. Don't you know you're here to serve your country?"

"Yes, Sir," was the humble reply, "but not to eat it!"

* * * *

LABOUR SAVING

New Servant (to Mistress): "Sure, Ma'am, 'tis very convenient to keep the water in them little bottles with squirts. I've washed the whole floor in next to no time and I've still some left!"

* * * *

Mrs. Murphy entered her lawyer's office, exclaiming, "I've had an accident. I slipped on a grating on the pavement and the doctor says I'm entitled to damages."

"But," said the lawyer, "this is the third accident you've had within a month!"

"Yes," replied Mrs. Murphy, "ain't I lucky?"

* * * *

Parson: "You love to go to the Sunday school, don't you, Robert?"

Bobby: "Yes, sir."

"What do you expect to learn to-day?"

"The date of the picnic."

SEW, SEW

"How do you feel?" asked the physician who had been called to attend the seamstress.

"Oh, sew, sew, but I seam worse to-day and have stitches in my side."

The doctor hemmed and told her she would mend soon.

* * * *

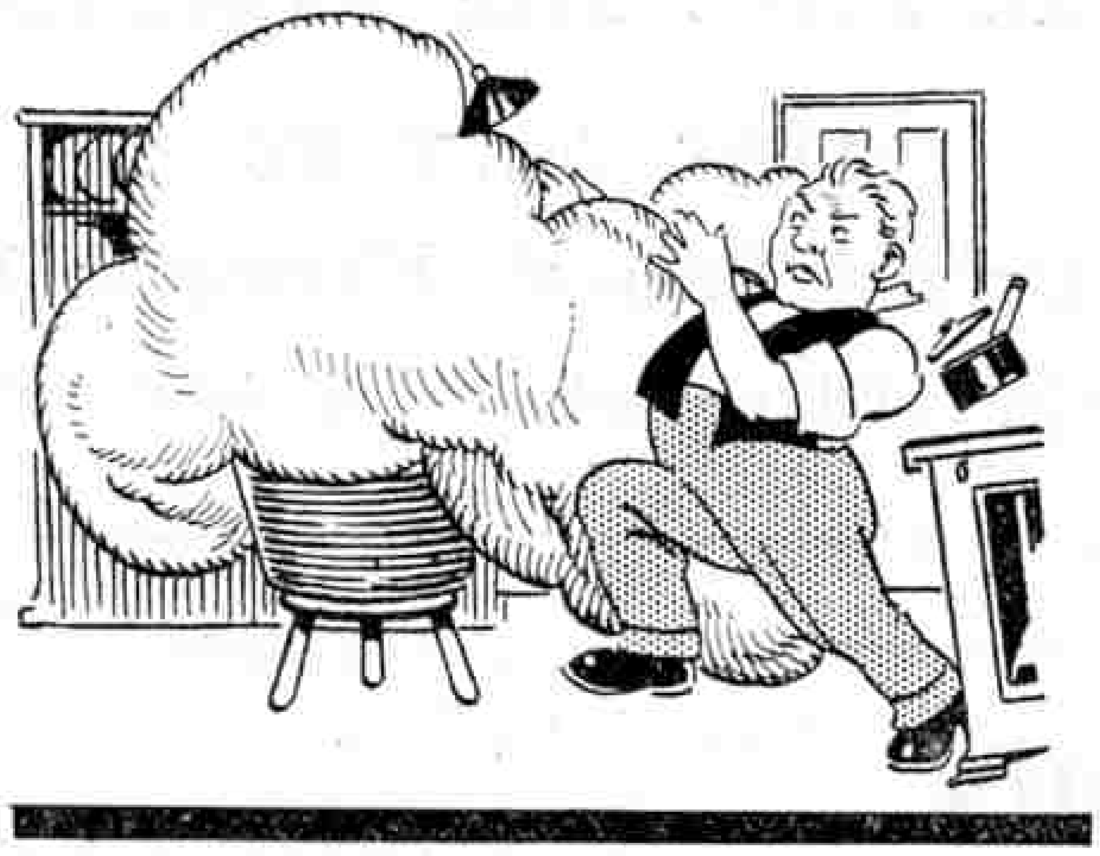
Battered Motorist (waking up): "Where am I? Where am I?"

Nurse: "This is No. 116."

B.M.: "Ward or cell?"

* * * *

A LITTLE GOES A LONG WAY



A gentleman who did not care for his wife's bread, decided to bake some himself, and came home one night with a bulky parcel in his arms.

"What's that?" asked his wife.

"It's yeast," replied the husband. "I am going to bake the bread myself to-night."

Whereupon his wife retired to bed. A few hours later the wife, a little anxious, called downstairs:

"Have you got the bread in the oven yet?"

"Got it in t'oven?" shouted the husband. "I can't keep it in t'kitchen, never mind in t'oven!"

* * * *

CAGED

Judge (to accused): "Why did you steal the saw?"

Accused: "Oh, just for a lark."

Judge: "Well, we keep cages for larks here, so you can have the use of one for the next ten days."

* * * *

"Well, my man," said the doctor, cheerily, to the new patient, "how do you feel?"

"He seems all right," said the nurse; "I've just taken his temperature."

"Good. Have you had anything to eat, my man?"

"I had a little, sir."

"What did they give you?"

"This lady gave me a piece of glass to suck, sir."

MAKING SURE

In the early days of the late war, the officer in charge of a British station deep in the heart of Africa, received a wireless message from his superior officer:

"War declared. Arrest all enemy aliens in your district."

With commendable promptness the superior received this reply:

"Have arrested seven Germans, three Belgians, two Frenchmen, two Italians, an Austrian and two Americans. Please say with whom we are at war."

* * * *

A teacher was giving a class of youngsters a lesson on kindness, and by way of pointing the moral she told the story of a shepherd who, having lost a lamb in a snowstorm, went out to seek it. When he found it, he took off his coat, wrapped it around the lamb, and brought it safely home. Then she asked if any of her pupils could tell her of a similar kind action like that.

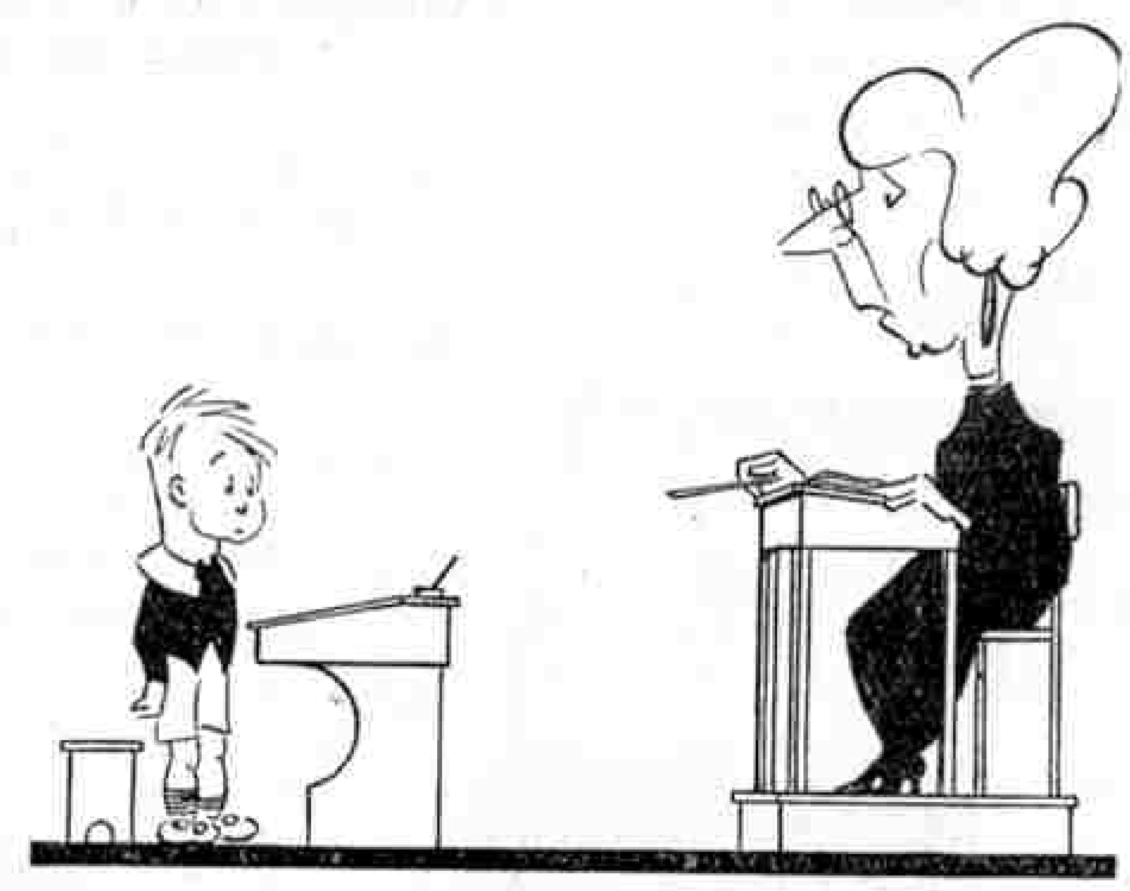
A bright youth held up his hand. "Please, miss," he said, "I heard father say that he once put his shirt on a horse."

* * * *

A Scotsman was asked by a friend whom he met in a tobacco shop if he would have a cigar. "Yes," said the Scotsman, and the other asked for two threepenny cigars, paid for them, and left the shop. Then the Scotsman inquired: "You sell those at five a shilling, don't you?" "Yes," replied the tobacconist. "Well," said the Scotsman, producing sixpence, "give me the other three!"

* * * *

BEYOND RECALL



Teacher (at grammar class): "'I am beautiful'; What tense is that, Tommie?"

Tommie: "Past, Miss!"

* * * *

A foreign paper contains the following advertisement:—

"Any person who can prove that my tapioca contains anything injurious to health will have three boxes of it sent to him free of charge."

Remember! Remember! The Fifth of November!

AND DON'T FORGET

BROCK'S FIREWORKS

The goods that have stood the test of public opinion for over

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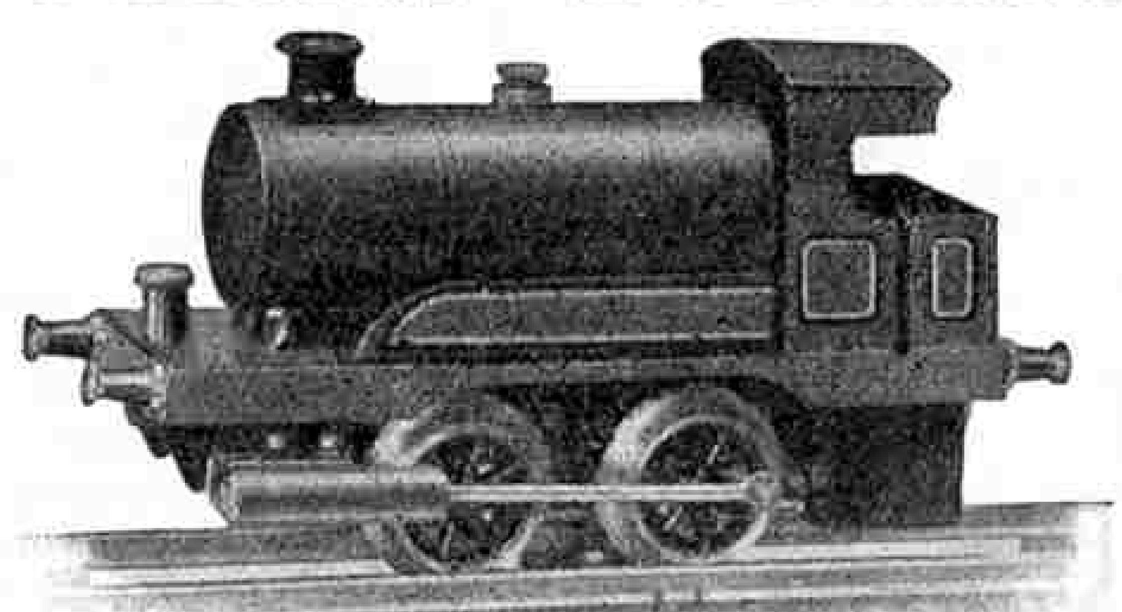

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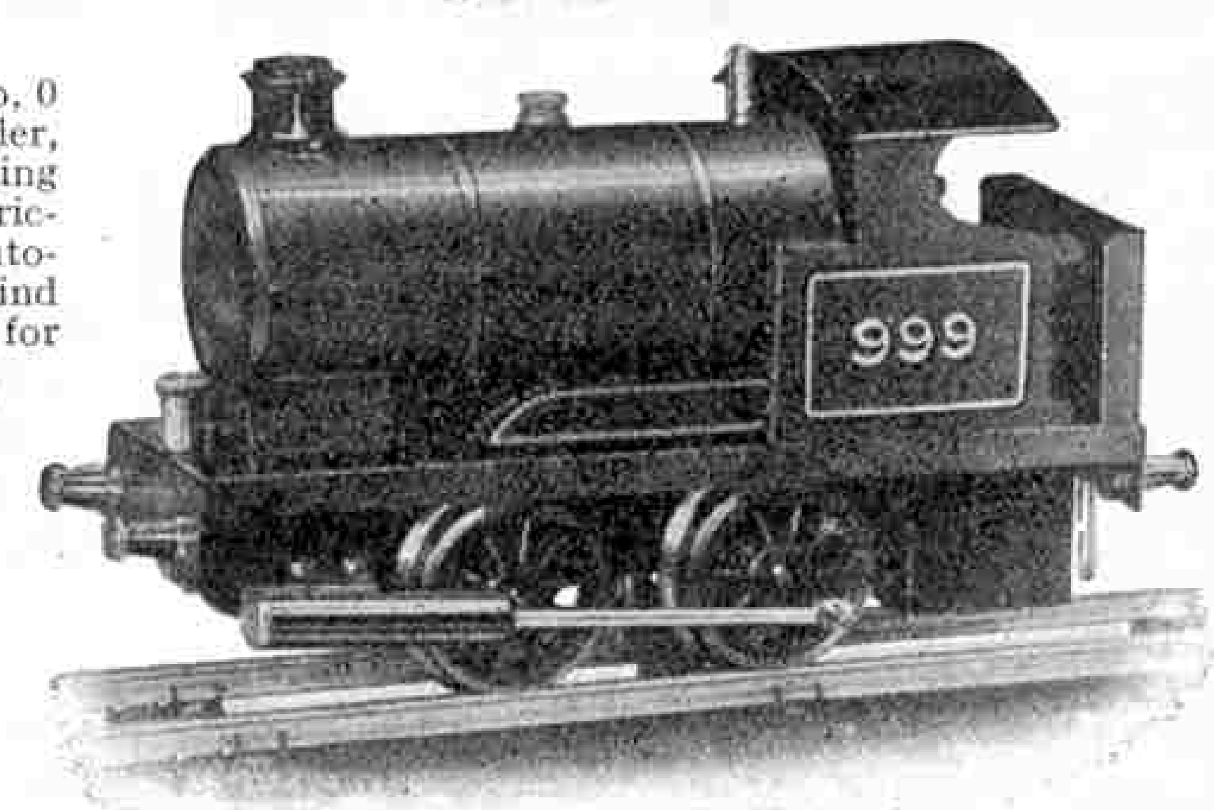

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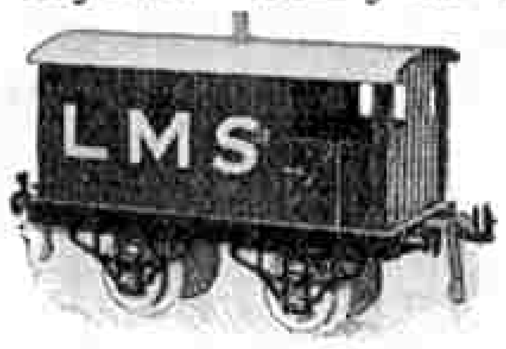

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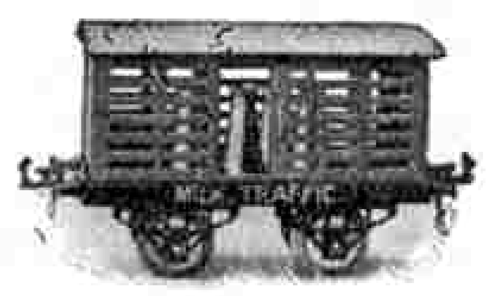

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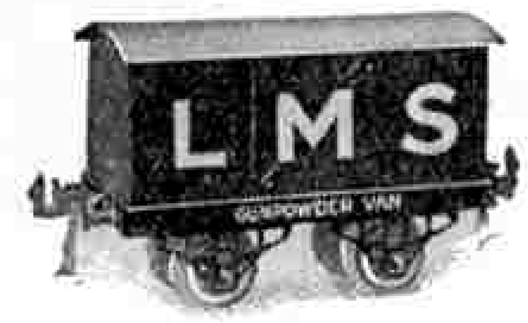

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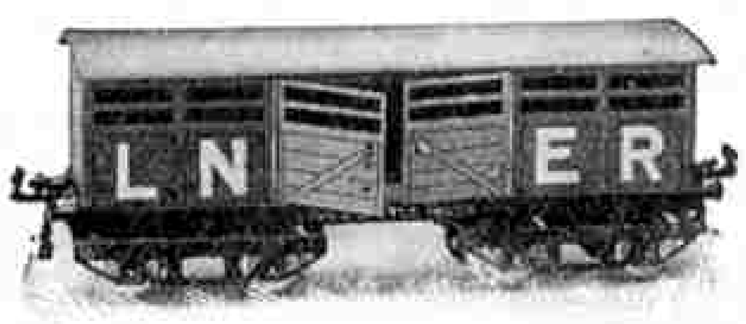

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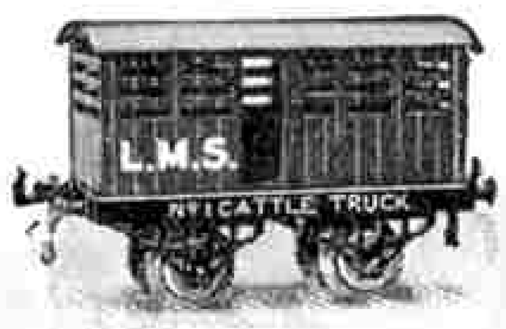

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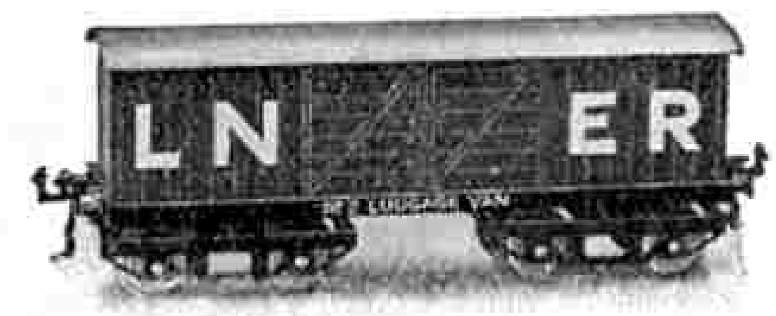

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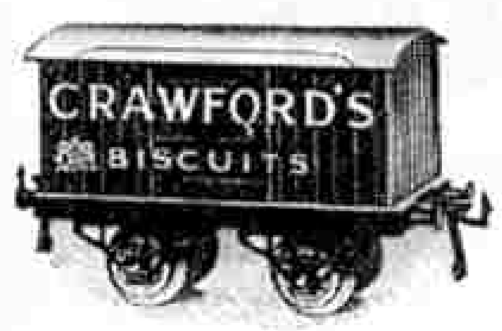

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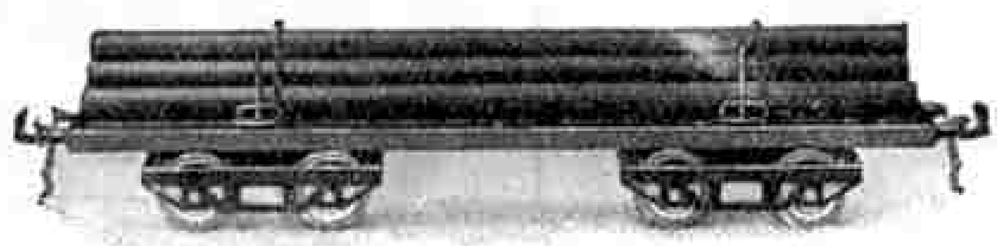

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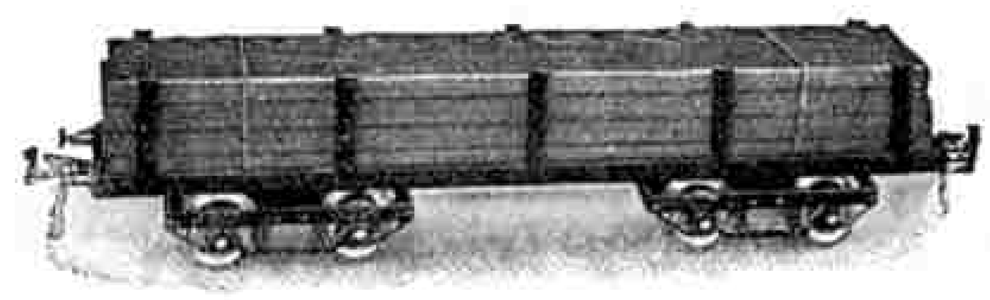

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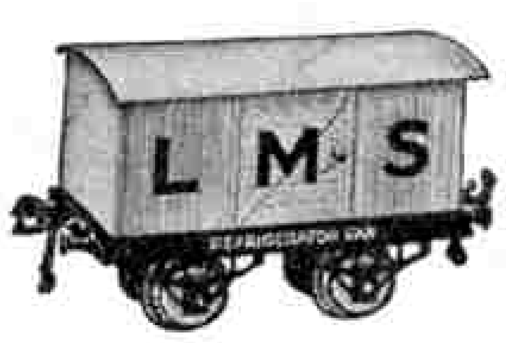

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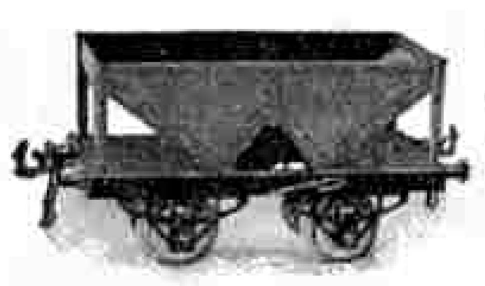

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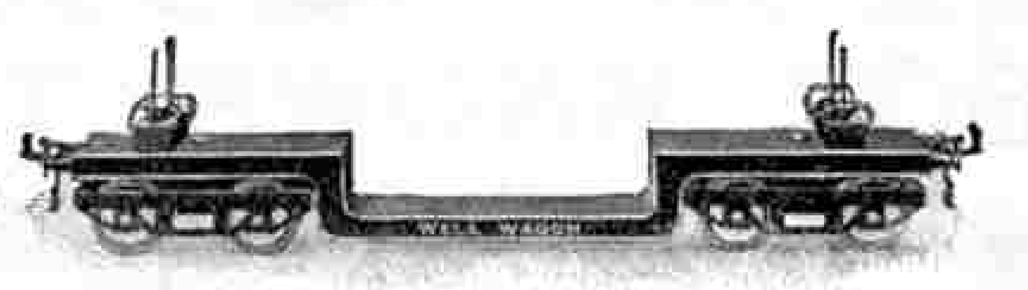

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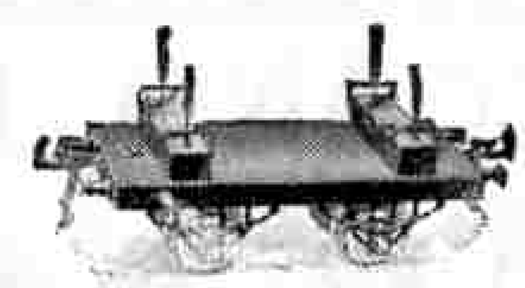

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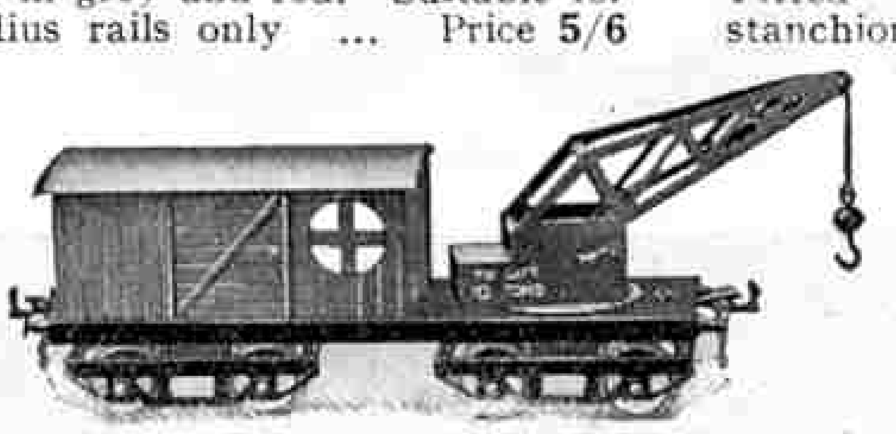

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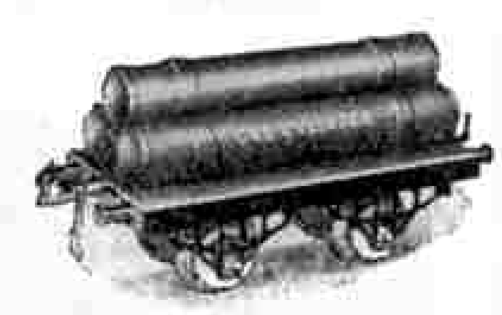

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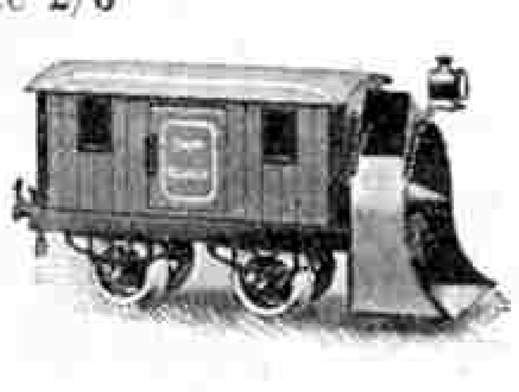

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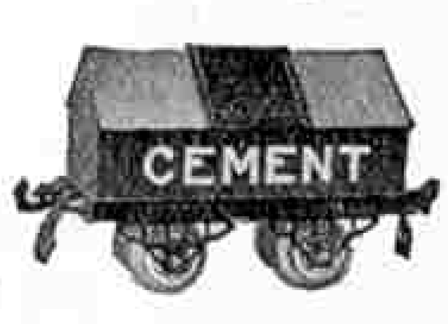

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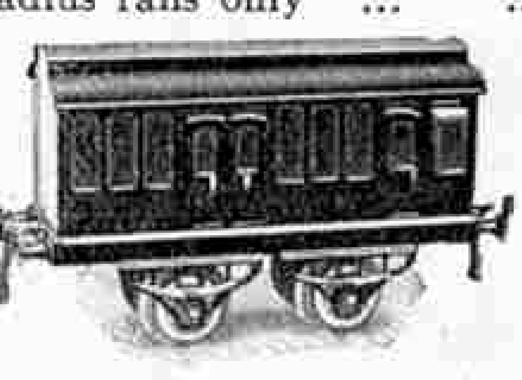

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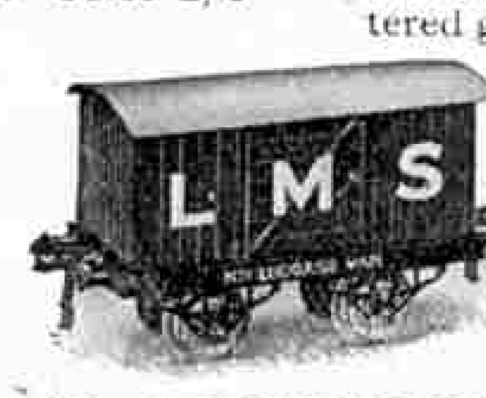

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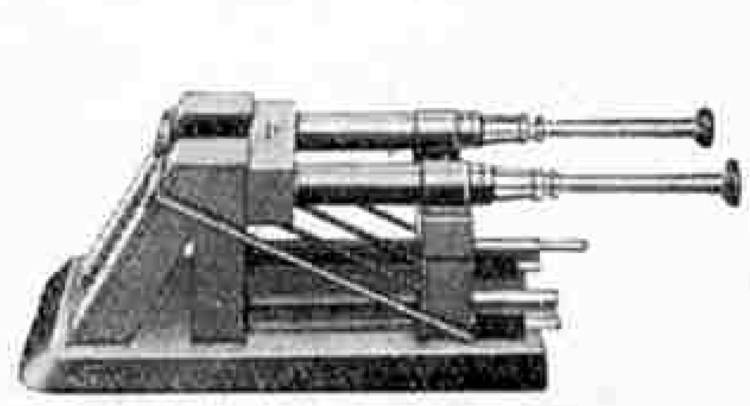

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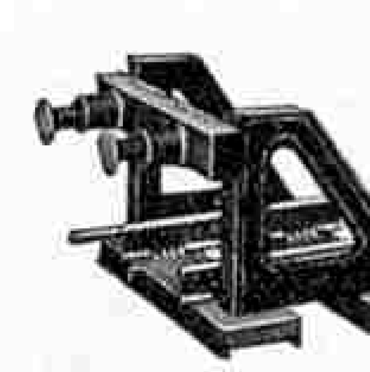

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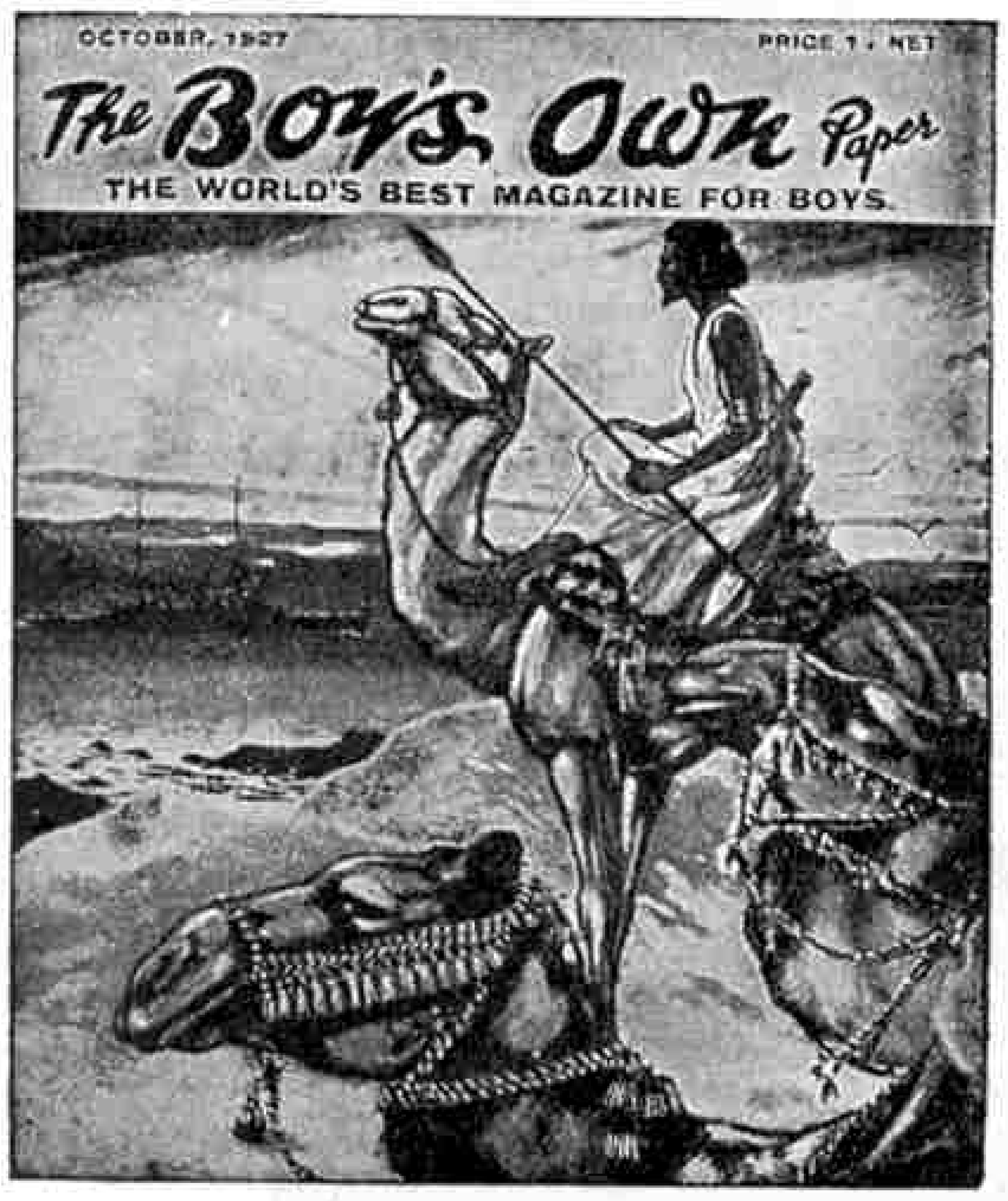

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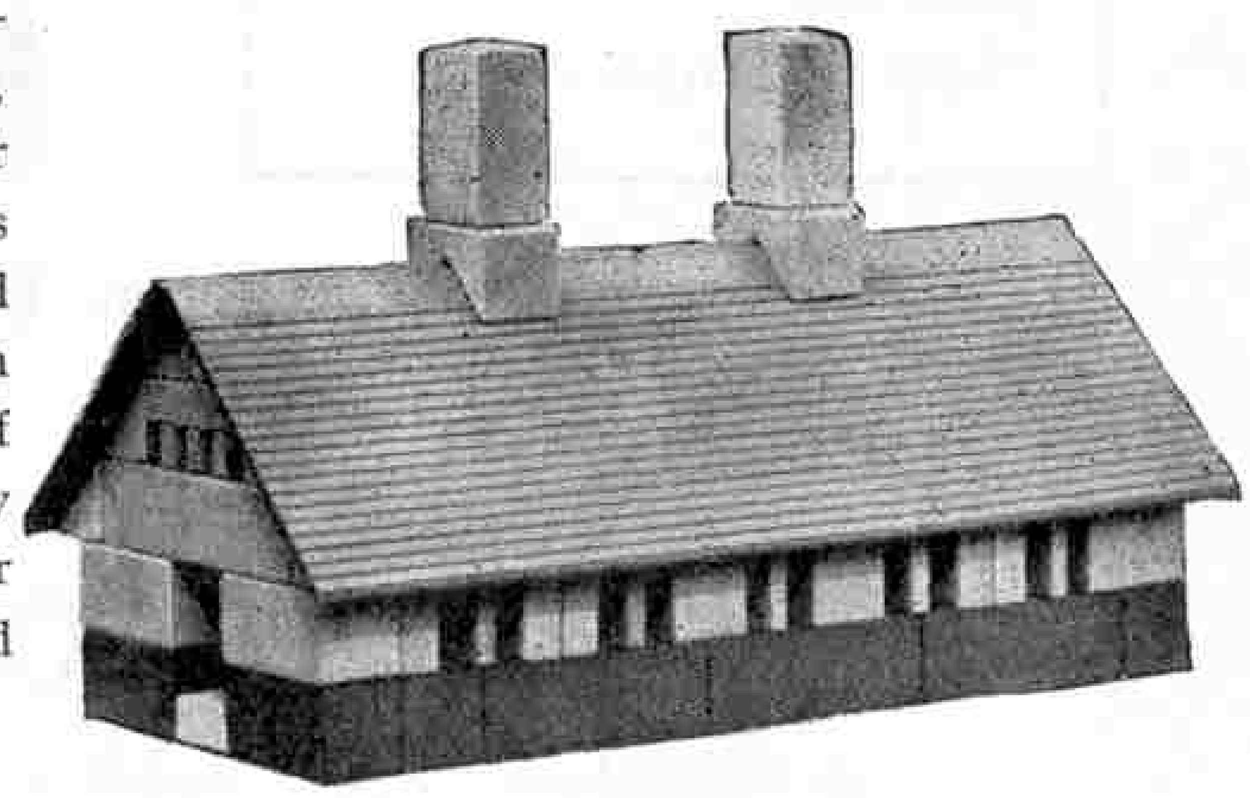

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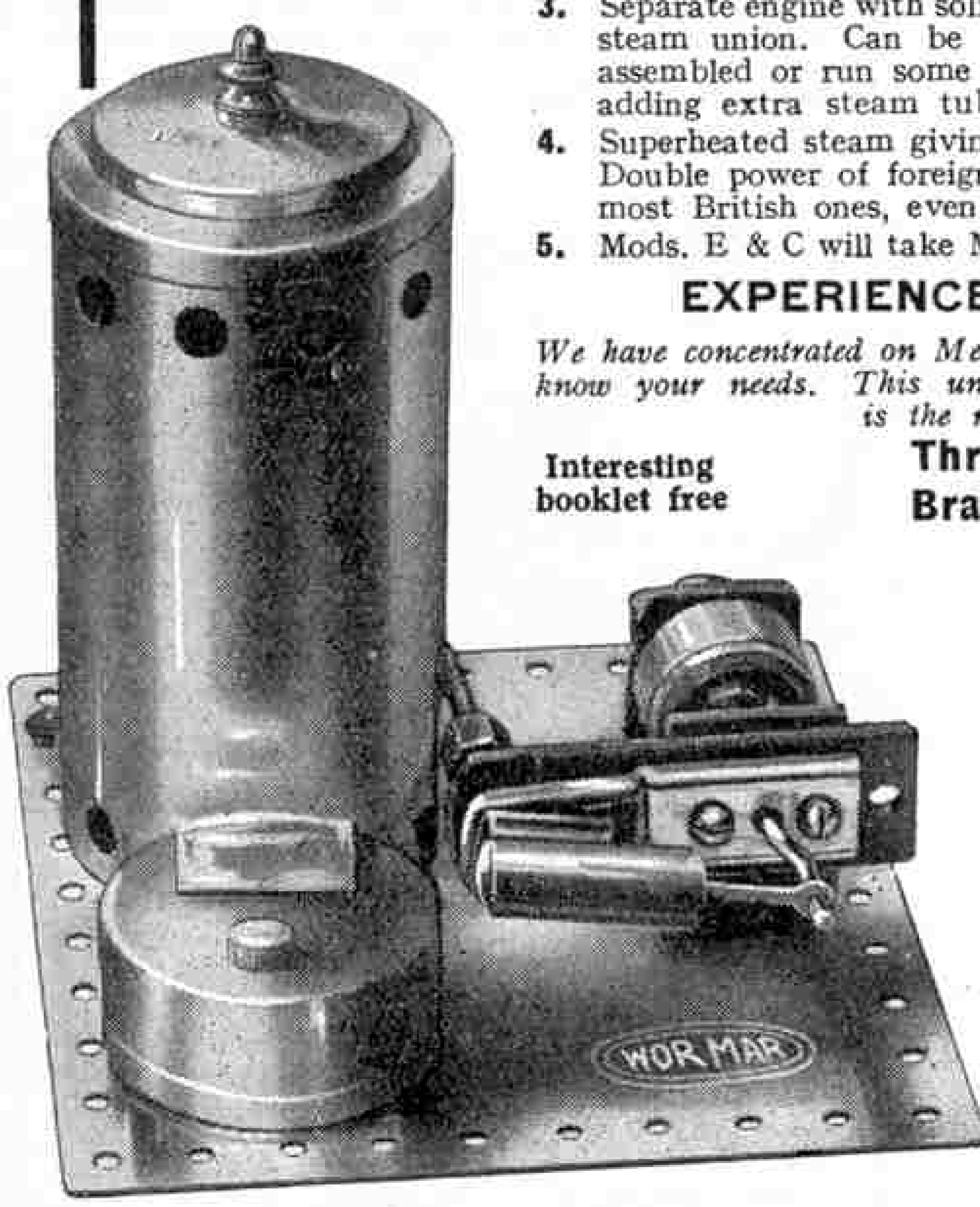

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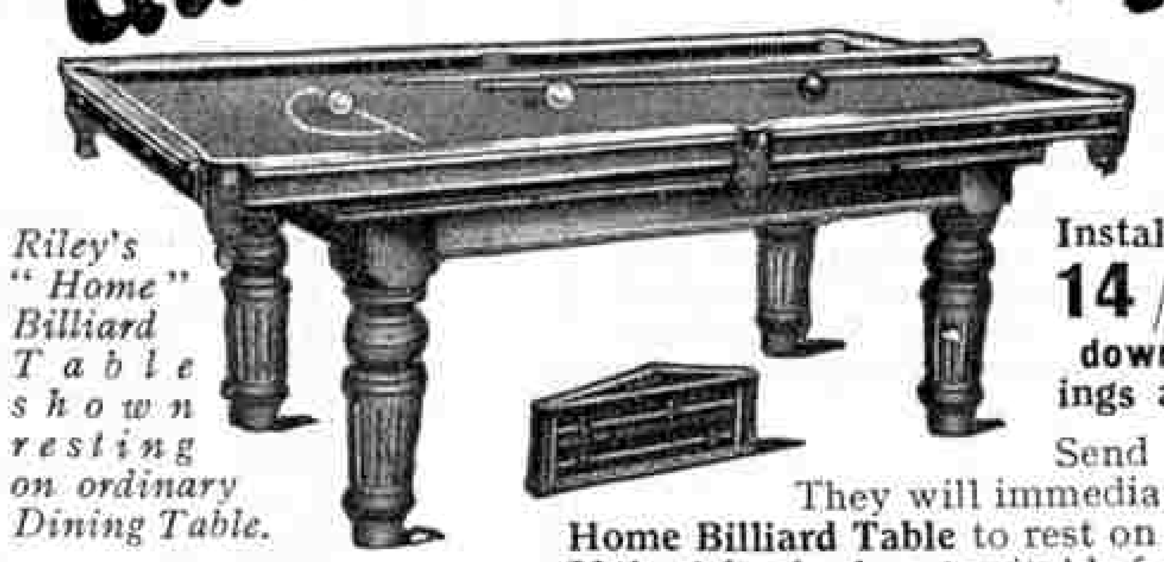

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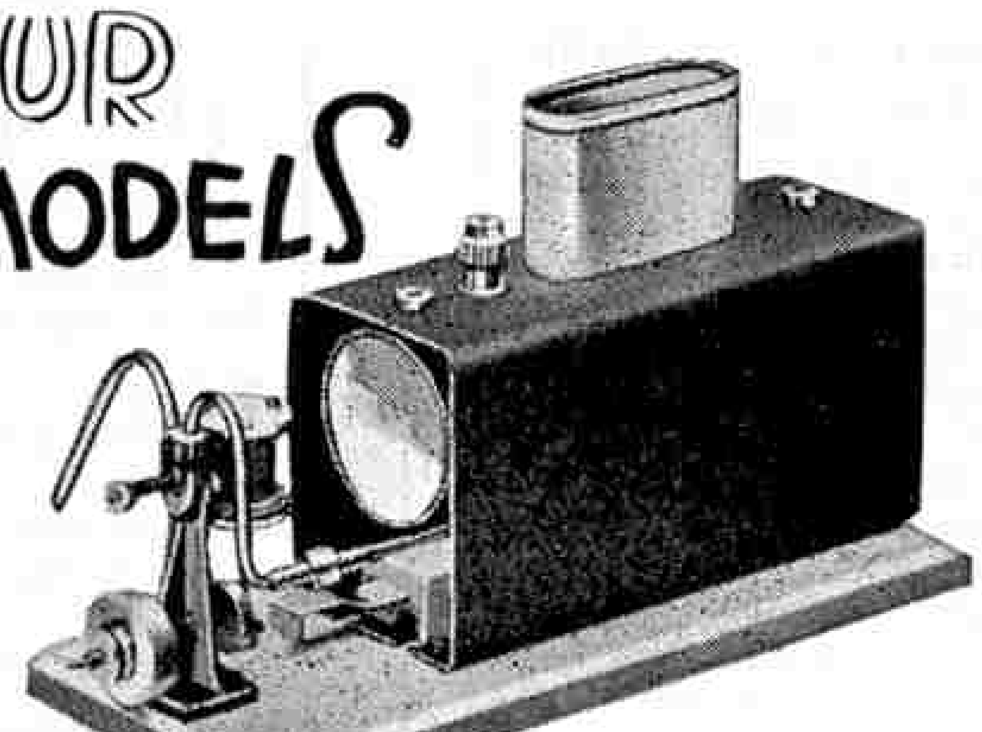

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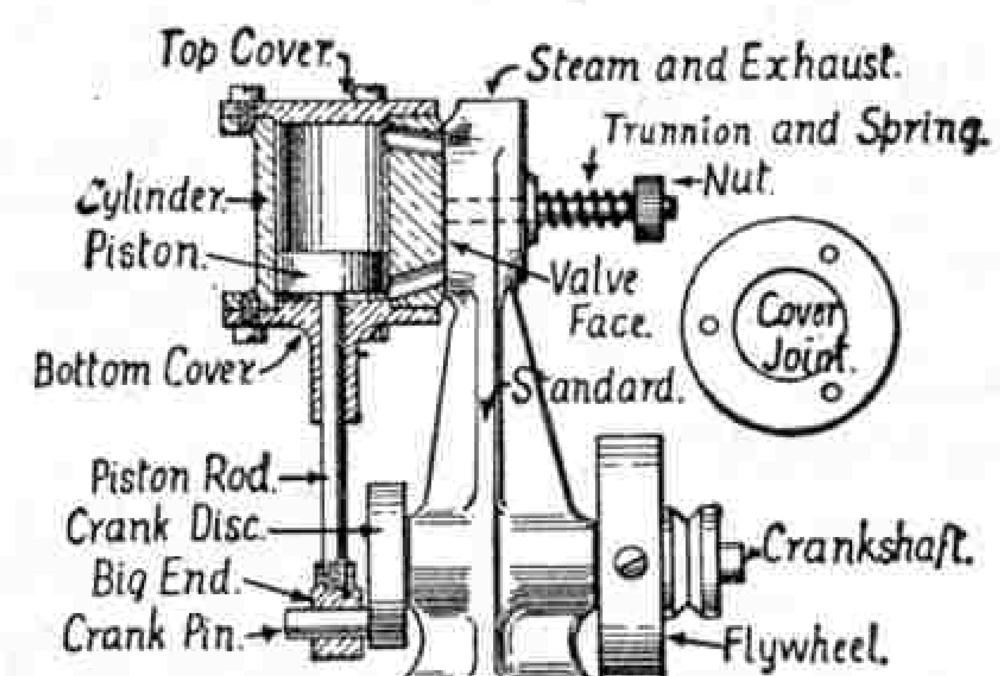

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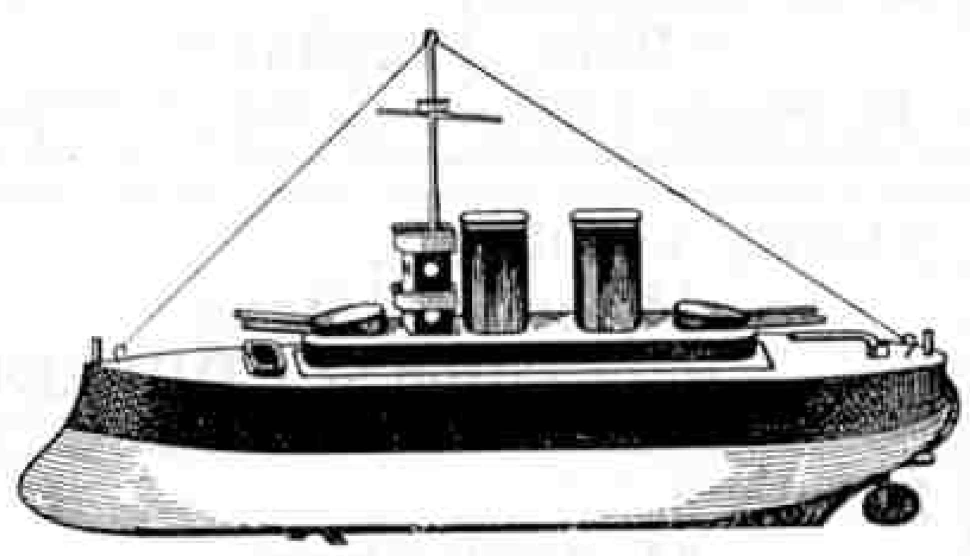
Carriage Paid. *Write for Free Lists.*

SUTCLIFFE'S

BRITISH MADE

MODEL WARSHIPS



A PRESS OPINION:

". . . the sort of toy which in a large family could be handed from one brother to another, and still be working when the last owner reached the stage when toys have no longer a fascination for him."

Meccano dealers should send for a sample of each size and for particulars of attractive window demonstration scheme for the Christmas season.

10/6 Two Sizes **15/-**

Sole Manufacturer: **J. W. SUTCLIFFE,**
ATLAS WORKS, HORSFORTH, near LEEDS.

CANARIES : GOLDFISH

A Beautiful Singing Cock Hartz Mountain Roller Canary in New Canary Cage. Carriage Paid to your house 17/6. A real genuine bargain.

GOLDFISH, all Colours, from 2d. each.

Fancy Fish also in stock.
Aquariums from 4/6 each.
Weed, Snails, Food, Instructional Books. All Accessories for most interesting hobby. Stamp for Illustrated Price List.

DE VON & CO.,
127, KING'S CROSS ROAD, LONDON, W.C.1.
'Phone: Museum 0767. Telegrams: "Oiseaux, London."

JENNERS

PRINCES STREET EDINBURGH
LIMITED

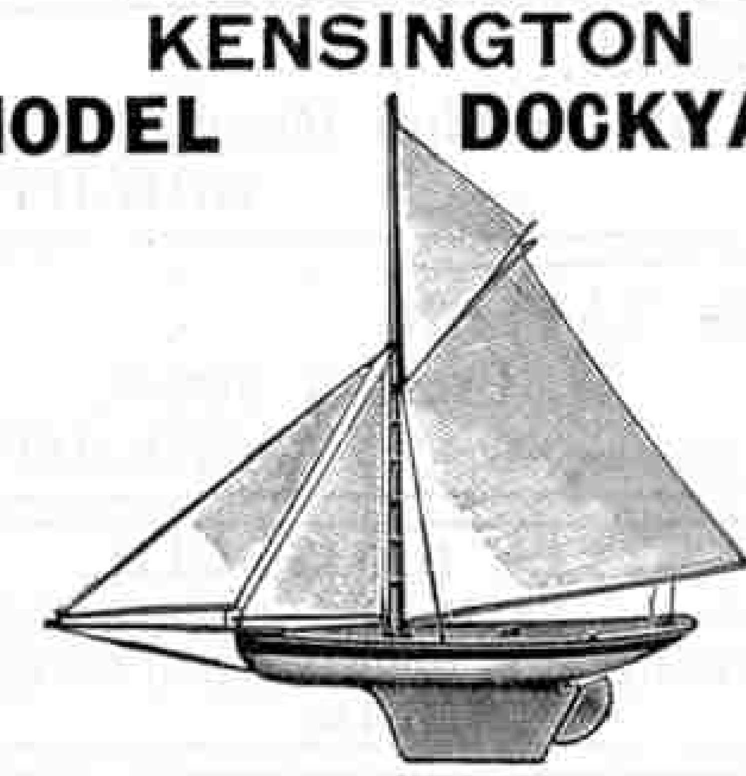
EDINBURGH AGENTS for MECCANO and Hornby Trains

A complete stock of all Hornby Train Accessories and Meccano Parts

JENNERS PAY CARRIAGE

STAMP PERFORATION GAUGE
Stamp collectors will find this card extremely useful in enabling them instantly to find the size of perforation of any stamp. Price 1d. (post free) from the Editor, "*M.M.*"

KENSINGTON MODEL DOCKYARD



Sailing Yachts & Fittings

HOBBIES STEAM LAUNCHES
MOTOR BOATS
HORNBY TRAINS
MECCANO OUTFITS AND PARTS
WORMAR STEAM ENGINES
Requisites for
FOOTBALL, HOCKEY, FISHING, PHOTOGRAPHY
AIR GUNS AEROPLANES
Electric Motors & Accumulators

Send 1½d. Stamp for List "M"

C. H. LORBERG

185, Kensington High St., London, W.8

Meccano & Hornby Train Supplies

All the dealers whose advertisements appear on this page carry full stocks of Meccano Outfits, Accessory Outfits and Meccano parts, Hornby Trains and Hornby Train Accessories all the year round. The names are arranged in alphabetical order of town.

HARRY BROWN,
1, Moss Lane,
ALTRINCHAM.

J. WOODHALL,
256, Grange Road,
'Phone: B'head 621 BIRKENHEAD.

HOBBIES,
9a, High Street,
BIRMINGHAM.

MERCER'S DOLLS' HOSPITAL,
68, Darwen Street,
BLACKBURN.

BATESON'S SPORTS DEPOT,
Abingdon Street,
BLACKPOOL.

SELLEN'S BAZAAR,
54, Waterloo Road,
BLACKPOOL, S.S.

J. MORRIS, F.C.O.,
70, Knowsley Street,
Tel. 1074 BOLTON.

BROWN, MUFF & CO. LTD.,
BRADFORD.

HOBBIES,
68, London Road,
BRIGHTON.

JOHN TAYLOR,
28, Preston Street,
Tel.: Brighton 957 BRIGHTON.

GYLES BROS. LTD.,
Tel. 2888 24, Bridge Street, BRISTOL.
188, Whiteladies Road, Clifton, BRISTOL.
Tel. 143

JOHN HALL (TOOLS) LTD.,
BRISTOL. NEWPORT.
CARDIFF. SWANSEA.

SALANSON LTD.,
20, High Street, BRISTOL.
4, High Street, CARDIFF.

SAM TAYLOR,
Silver Street,
Tel. 320 BURY.

HAROLD HUNT,
38, Spring Gardens,
Tel. 202 BUXTON.

HOBBIES,
$385\frac{1}{2}$, Yonge Street, Toronto 2,
CANADA.

H. W. GILL,
23 & 24, Pittville Street,
CHELTENHAM SPA.

R. H. JEPSON,
1, Cross Cheaping,
COVENTRY.

PURSEY & MOCKRIDGE,
The Sports Outfitters,
Tel. Dartford 173 DARTFORD.

HENRY WHALLEY,
195, Duckworth Street,
DARWEN.

RATCLIFFES TOYERIES,
19, Osmaston Road,
DERBY.

C. E. MELLER,
"Dolls' Hospital,"
41, Market Place, DONCASTER.

JAMES L. DIXON,
14, Suffolk Street,
(off Grafton St.), DUBLIN.

DIXON'S,
41, High Street,
DUNDEE.

DRAFFEN & JARVIE LTD.,
Nethergate,
DUNDEE.

BASSETT-LOWKE LTD.,
5, Frederick Street,
EDINBURGH.

WRIGHT'S DOLLS' HOSPITAL,
14, High Street,
ERDINGTON.

ROBERT BALLANTINE,
$103\frac{1}{2}$, St. Vincent Street,
GLASGOW.

C. BELL (The Children's House),
320, Byres Road, Hillhead,
GLASGOW, W.2.

CLYDE MODEL DOCKYARD,
22-23, Argyll Arcade, GLASGOW.
Model Makers to the Admiralty, the Railway Coys., etc.

HOBBIES,
326, Argyle Street,
GLASGOW.

The MARVEL MART (Wm. Ross & Co.)
110, West Nile Street,
GLASGOW.

FLETCHER'S TOYLAND,
77, Deardengate, HASLINGDEN.
Grand Building, RAWTENSTALL.

GAMLEYS,
The Hove Hornby Train Store,
78, Church Road, HOVE.

HAMMOND'S LTD.,
Paragon Square,
HULL.

W. J. S. CARPENTER,
13 & 15, Queen Victoria Street,
LEEDS.

HOBBIES,
89a, Woodhouse Lane,
LEEDS.

PEARSON & DENHAM (PHOTO)
LTD., 6, Bond Street,
LEEDS.

ROBOTHAM,
"Baby's Kingdom,"
Tel. 4809 LEICESTER.

BYCROFTS EMPORIUM,
366, High Street,
LINCOLN.

C. LUCAS, Hobbies Depôt,
35, Manchester Street,
LIVERPOOL.

Reliance Cycle & Motor Co.,
29/31, Manchester St., Liverpool.
Argyle & Conway Sts., Birkenhead.

The ARUNDEL CYCLE & SPORTS
STORE, 52, Church Road,
Upper Norwood, LONDON, S.E.19.

HOBBIES,
65, New Oxford Street,
Tel. Mus. 1656 LONDON, W.C.

HOBBIES,
147, Bishopsgate,
Tel. London Wall 7350 LONDON, E.C.

Meccano & Hornby Train Supplies

The twenty-seven dealers whose advertisements appear on this page carry full stocks of Meccano Outfits, Accessory Outfits and Meccano parts, Hornby Trains and Hornby Train Accessories all the year round. The names are arranged in alphabetical order of town.

HOBBIES,
79, Walworth Road,
Tel. Central 2457 LONDON, S.E.

LEDWITH BROS.,
42 & 44, Walworth Road,
Nr. ELEPHANT AND CASTLE, LONDON, S.E.17.

F. R. POTTER & SON,
43, Market Place,
LOUGHBOROUGH.

H. G. PARTRIDGE & CO.,
10, Chapel Street,
Tel. 234 LUTON.

A. FRANKS LTD.,
95 & 97, Deansgate, MANCHESTER.
90, Bradshawgate, BOLTON.

HENRY'S Toy & Game Stores,
22, King Street,
Tel. 3004 Central. MANCHESTER.

HOBBIES,
10a, Piccadilly,
MANCHESTER.

A. INMAN, MANCHESTER.
105, Lapwing Lane, Didsbury. Tel. 1518.
179, Dickenson Rd., Rusholme. Tel. 2241.

EDWARD LLOYD,
268, Upper Chorlton Road,
Tel. 613 Chorlton MANCHESTER, S.W.

JOHN NESBITT LTD.,
42, Market Street,
MANCHESTER

H. WILES LTD.,
124, Market Street,
MANCHESTER.

R. SCUPHAM & SONS,
35, Linthorpe Road,
MIDDLESBROUGH.

WILLIAM OLLIFF,
13, Grainger Street West,
NEWCASTLE-ON-TYNE.

JANES & ADAMS,
13, The Promenade,
And Branches. PALMERS GREEN.

DEAN & HOLT,
78, Yorkshire Street,
ROCHDALE.

ROCHESTER.
GERALD MORRIS,
24, High St., ROCHESTER.

HOBBIES,
214, West Street,
SHEFFIELD.

THE REDGATE CO.
(SHEFFIELD) LTD.,
Tel. 22806 Moorhead, SHEFFIELD.

SHEFFIELD PHOTO COMPANY,
6, Norfolk Row (Fargate),
'Phone 23891 SHEFFIELD.

WILSON, GUMPERT & CO. LTD.,
57, Fargate,
Tel. 489 SHEFFIELD.

BIRMINGHAM & COVENTRY CYCLE CO., 140 & 151, Above Bar,
SOUTHAMPTON.

HOBBIES,
25, Bernard Street,
SOUTHAMPTON.

OSBORN & CO.,
9, High Street,
SOUTHAMPTON.

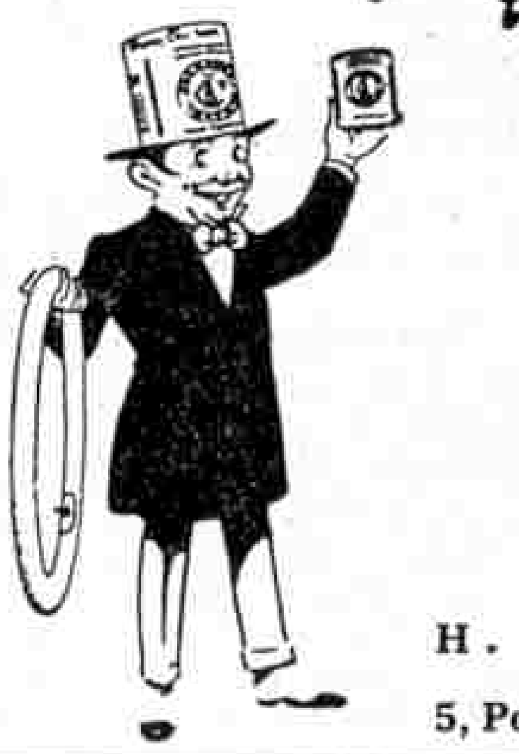
S. T. SIMPSON & SON,
589-595, Lord Street,
Tel. 999 SOUTHPORT.

H. W. GINN,
The London Motor, Cycle & Sports Co.,
Tel. 252 Staines 106, High St., STAINES.

SAXONS LTD.,
29/30, Holmeside,
SUNDERLAND.

SPORTS HOUSE
WOKING & WEYBRIDGE.

Mend your Punctures while you Ride



FORGET TYRE TROUBLE

and go care-free on your way. Tubes treated with our IMPERVO increase the joys of your Cycle.
"The Story of IMPERVO"
FREE
to Meccano Readers.
Write NOW for a Copy.
H. COLYER & CO.
(Dept. 31a),
5, Point Hill, Greenwich, S.E.10.

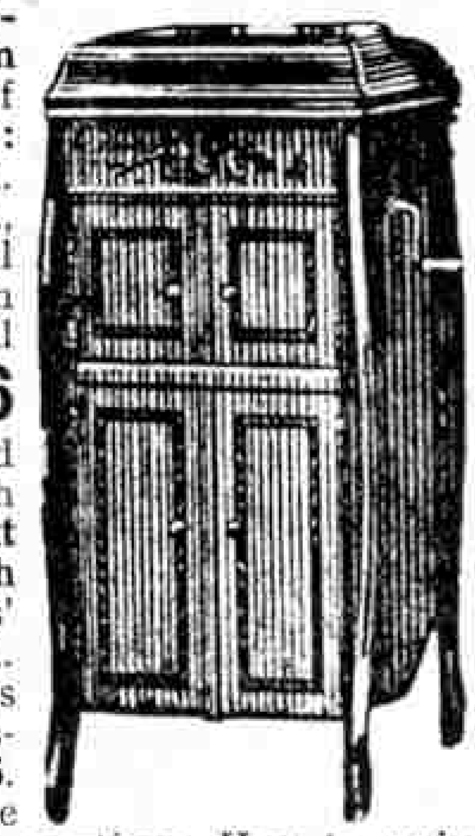
DISGUISE

Original and Instructive pocket OUTFIT. Price 3/- each complete. Post Free. Overseas 6d. extra.
Milton, 24, Station Parade, Norbury, London, S.W.16.

"MECCANO MAGAZINE" BINDERS
Your Magazines may be kept clean and tidy by enclosing them in one of the special binders we supply. Two sizes, price 3/- and 3/6 post free, from Meccano Ltd., Binns Rd., Liverpool.

A *Veeder*
CYCLOMETER FITTED TO YOUR BICYCLE TELLS YOU:
How far you have been.
Distance from one place to another.
Service your tyres give you.
Number of miles to destination.
Distance travelled, &c.

Make your riding doubly interesting. Its accuracy has been endorsed by all the best authorities and the experience of your fathers for 30 years.
Insist upon a genuine Veeder—see the name thereon.
Made in Two Models:
Regular 6/6, Trip 15/-.
F. E. DICKINSON, St. Andrew's House. Holborn Circus, LONDON, E.C. 1.



MAKE OR BUY A GRAMOPHONE 100% cheaper than others. Mechanical Parts of a 1st-class **RIFANCO-Phone:** Double Spring Motor, 12-in. Turntable, Swan Tonearm, Superior Sound Box, Internal Horn as fitted by other firms in £10, £20 Gramophones. All bar the wood. **£1 : 18 : 6 Nett Cash**
This set supplied with polished Oak or Mahogany 40 in. high Cabinet as shown, Pedestal **£4 : 15 Nett Cash**
Carriage paid in U.K. 7 Days' trial. Money back if dissatisfied. Other sets from 18/-. Machines 30 models, Sideboards, Pedestals, Portables, etc., from 19/6. Motors 9/-. 64-page Catalogue of all Accessories FREE. Instructions *How to make Gramophones 3d.* Est. 23 yrs. 1,000 Testimonials.
Regent Fittings Co., 73D, 120, Old St., London, E.C. 1.

MAKE YOUR OWN ELECTRIC LIGHT

These wonderful Dynamos light brilliantly 4-6v. lamps, and are very easy to work. 5/6, post 6d. Delivery by return of post.
GREENS (Dept. E.N.),
14, New Oxford Street, London.

5/6

READERS' SALES

(*Rate: 1d. per word, min. 1/-*).

"M.M.'s" Nov. 1921—Dec. 1923 in Binder. Perfect. On receipt Money Order £1/7/6.—V. Staker, Nairne, South Australia.

For Sale. Hobbies A1 Fretwork Outfit, 6/6. Post Free.—G. Johnson, 6, Norfolk Square, Great Yarmouth, Norfolk.

Sale. Number of Boys' Papers including "M.M.," also Photos of Footballers. List free. Wanted, Photos of Famous Cricketers.—Box 1002.

Cinematograph, Magic Lantern combined, Films, 60 slides, oil lamp. Cost 20/-. Take 15/-.—Cyril Beane, Ridgewell, Halstead, Essex.

Films :—"Skidding Thrones," comic, 700 ft., 8/6. "A Drastic Remedy," comic, 550 ft., 7/6. "The Right of Way," drama, 600 ft., 7/-. "A Mountain Tragedy," drama, 600 ft., 6/-. Send 1½d. for List. All complete and in good condition.—Hare, 30, Ellys Road, Coventry.

No. 4 Primus Engineering Set with extra parts. Cost 40/-. Accept 17/- or nearest.—Messenger, Whiteley Village, Walton-on-Thames.

For Sale. ¼-Plate Box Camera holding dozen Plates, 10/- ; also high grade Cinema, Mechanism and 3 1,000 ft. Films, £1. Write particulars.—Stevens, 68, Clipston Road, Alum Rock, Birmingham.

Stamps. Collection 340 British Empire, 12/6. Catalogued over £3.—Forth, 72, Beaconsfield Villas, Brighton.

For Sale. Gauge 0 Railway. Excellent condition. For particulars apply—Scrimgeour, Culter.

Wormar Steam Engine, cost 10/6. Take 6/6.—J. Summersell, 46, Abingdon Road, Oxford.

For Sale. 1927 Gibbons Catalogue of Stamps. Parts I and II. Good condition, 13/-. Wanted, Bar One Coupons, 5d. for 25, or 2/- 100.—Parr, 7, Second Street, Alexandria, Dumbartonshire.

Sale. A 1-Valve Set, Accumulator, Sterling Headphones and Valve. £2 or near offer.—Evelyn, 4, London Road, Kingston Cross, Portsmouth.

Sale. Pair of Adjustable Roller Skates, perfect condition, used once. Cost 15/-. What offers ?—Garner, Blackroot Road, Sutton Coldfield.

Sale. Wireless Spark Transmitting Set, 20 watt, 80 metres. Ex-Government. 15/-.—Simpson, Worksop College, Notts.

Some Erector and Primus for Sale. List and prices on application.—Owen, 7, Loudon Avenue, Radford, Coventry.

"Meccano Magazines," November 1925–September 1927. What offers ? Cigarette Cards, Sets 50, 6d., 25, 3d. Lists.—Box 1001.

1,225 Clean Cigarette Cards, 22 Sets, 1 Album, 12/6 the lot. Sell separate.—C. Billen, Beaconfield Street, Acomb, York.

Wanted. "M.M." 1923-1926. Perfect condition. State price. Exchange Parts 1-10 "Railways of World" for year's volume.—J. Woods, 4, Priory Terrace, Leamington Spa.

1,000 Cigarette Cards, 10/-. Album containing 300 in sets, 8/-. 2 Valve Set, £12 or offers. — J. E. Williams, 27, Shamrock Rd., Birkenhead.

Sale. Three complete volumes of "M.M."—1924, 1925, 1926, good condition. Offers ?—Souter, Station House, Monifieth, Forfarshire.

Sale or Exchange for B.D.V. Coupons, 1,750 Cigarette Cards. Stamp for list.—Callcott, 7, Ingram Road, East Finchley.

Hot Air Engine, bore 2", stroke 2¼", two 7" flywheels. Mounted on iron legs, £2.—"Doone," Carlton Av., Gillingham, Kent.

For Sale. Model Boat, 36 ins. long, real mahogany, driven by steam with two vertical cylinders. Very fast. Cost £45, will sell at £12.—J. Radice, Roseneath, Phillips Av., Exmouth.

Wanted. Part 42, and other loose parts of "Harmsworth's Home Doctor," clean copies only. Write and state cost to—BM/FAMW, London, W.C.1.

My Stamp and Coin Collections for Sale. Send for Lists stating wants.—Lord, 18, Park Grove, Levenshulme, Manchester.

Sale. Stationary Steam Engine, £3. Electric Rails, Accessories, Accumulators. Cheap. Apply—S. Simpson, Blinkbonny, Largs, Ayrshire.

This Month's Special Articles

STAMP ADVERTS.

(*Continued from page 914*)

For Sale. 3½ H.P 2 Stroke Engine, all controls. New. Carb. Mag. Guaranteed 6 months. All perfect. £10/10/-. Apply—J. A. Yetman, 38, Clifton Street, Brighton.

Cigarette Cards. Magnificent collection. 11,234 different, £15. Collections comprising complete sets only all different 4,000 70/- ; 1,650, 18/- ; 1,125 Wills and Players, only 10/- ; 600 Ditto, 5/-. Well assorted 500, 2/- ; 1000, 3/6. Cash with order.—Mitford Bagnall, Wayside, Laleham Road, Cliftonville, Margate.

Wanted. B.S.A. Air Gun. Good condition.—Powley, High Street, Sutton Coldfield, Birmingham.

Clean Cigarette Cards. Sets and odds. Lists free.—Thornton, 159, Grosvenor Road, Wavertree, Liverpool.

Miniature Table Railway, 21/-. Vertical Steam Engine, 7/6. Particulars on application.—Hill, 108, Stanmore Road, Edgbaston, Birmingham.

MECCANO MAGAZINE

Registered at G.P.O., London, for transmission by Canadian Magazine Post.

EDITORIAL AND ADVERTISING OFFICES :—

BINNS ROAD, LIVERPOOL.

Telegrams : "Meccano, Liverpool."

Publication Date. The "*M.M.*" is published on the 1st of each month and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price 6d. per copy. It will be mailed direct from this office, 4/- for six issues and 8/- for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

Advertisements

Readers' Sales and Wants. Private advertisements (*i.e.*, not trade) are charged 1d. per word, minimum 1/-. Cash with order. Editorial and Advertising matters should not be dealt with on the same sheet of paper (see important notice below).

Small Advertisements. 1/- per line (average seven words to the line), or 10/- per inch (average 12 lines to the inch). Cash with order (see important notice below).

Display. Quotations for space bookings, and latest circulation figures, will be sent on request.

Press Day, etc. Copy should be sent as early in the month as possible for insertion in following issue. We usually close for press on or before 10th of each month for following issue. Half-tone blocks up to 100 screen.

Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher copies. Sent free to advertisers booking two inches or over. Other advertisers desiring vouchers should add 8d. to their remittance and should order voucher copy at same time.

Remittances. Postal Orders and Cheques should be made payable to Meccano Ltd.

Stamp Advertisers Please Note :—

The Readers' Sales and Wants column is reserved for advertisements dealing only with collections of stamps as a whole. A collection that is being disposed of on approval sheets, or by packets or sets, should be advertised in the small advertisement column, the rate for which is 1/- per line, average seven words to the line. Although the advertiser may not be actually conducting a stamp business, such advertisements are not to be classified under Readers' Sales and Wants.

Advertisers are asked to note that private advertisements of goods manufactured by Meccano Limited cannot be accepted.

Obtaining the "*M.M.*" Overseas

Readers Overseas and in foreign countries may order the *Meccano Magazine* from regular Meccano dealers, or direct from this office. The price and subscription rates are as above, except in the case of Australia, where the price is 1/- per copy (postage extra), and the subscription rates 7/- for six months and 14/- for 12 months (post free).

IMPORTANT.

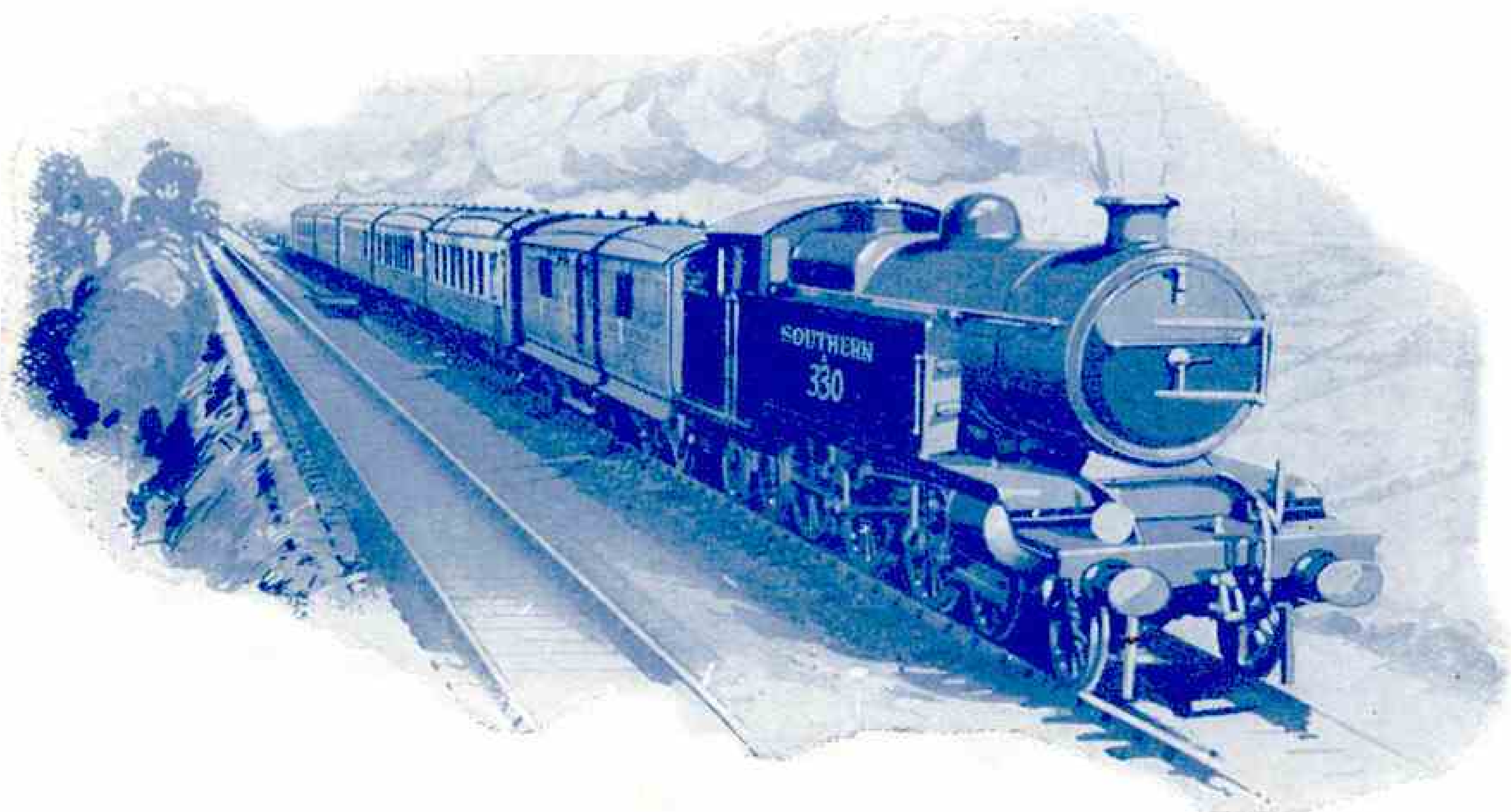
Overseas readers are reminded that the prices shown throughout the "*M.M.*" are those relating to the home market. Current Overseas Price Lists of Meccano Products will be mailed free on request to any of the undermentioned agencies. Prices of other goods advertised may be obtained direct from the firms concerned.

CANADA : Meccano Ltd., 45, Colborne Street, Toronto.
AUSTRALIA : Messrs. E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W.
NEW ZEALAND : Messrs. Browning, Ifwersen Ltd., P.O. Box 129, Auckland.
SOUTH AFRICA : Mr. A. E. Harris (P.O. Box 1199), 142, Market Street, Johannesburg.

FAMOUS TRAINS

The "Southern Belle"

The "Southern Belle" Express runs between London (Victoria) and Brighton. It consists entirely of Pullman cars and is claimed to be the most luxurious regular express in the world. It is generally hauled by large tank locos, and it covers the distance of 51 miles in exactly an hour.



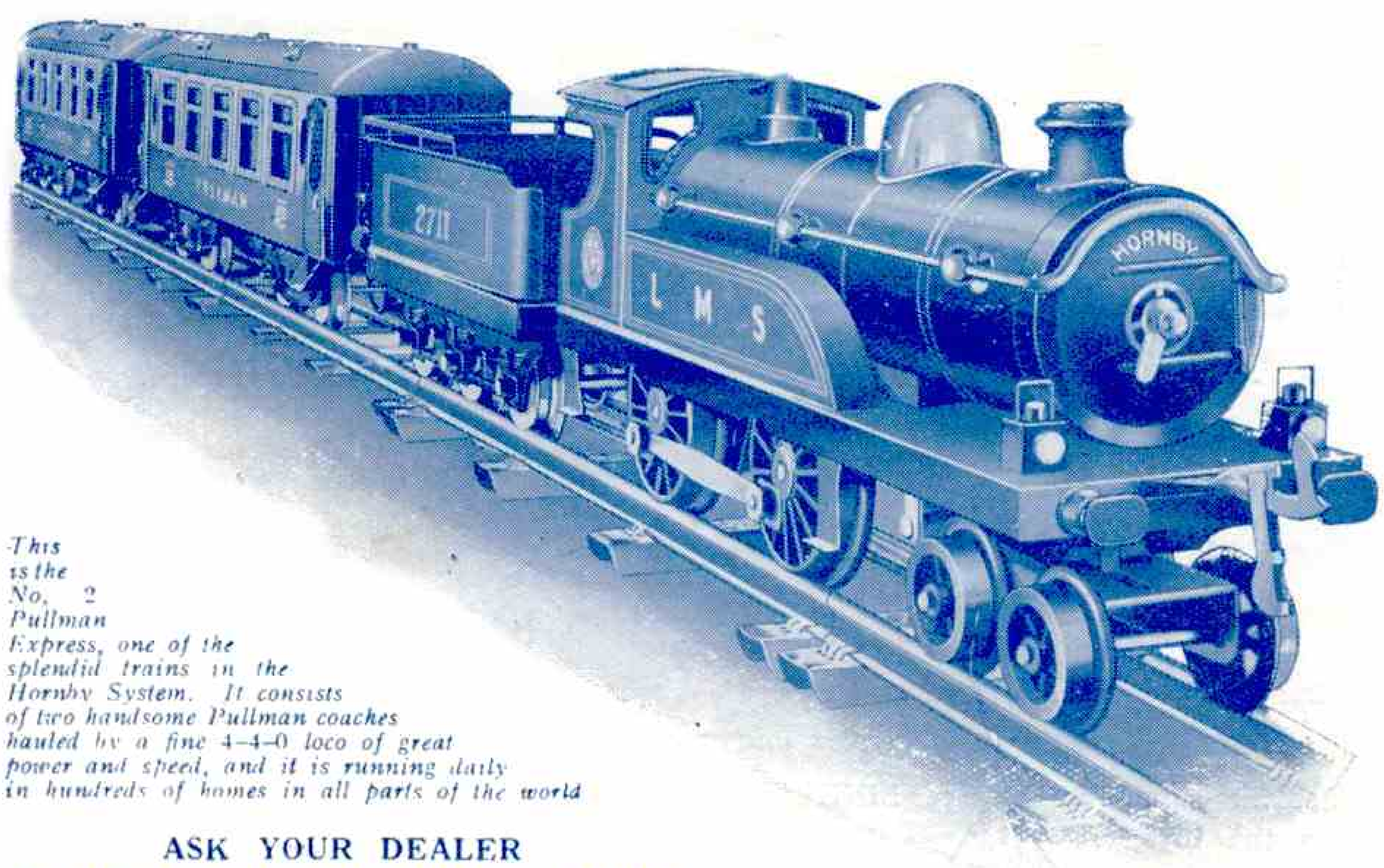
Run Your Own Railway!

ONLY when you've got a *real* train like the Hornby can you enjoy the fun of running your own railway system. It's the finest fun in the whole world, and you will find that even your Father will want to help you when you've fixed up a Hornby Railway !

See how long a Hornby loco runs without re-winding. See how it gets up speed with a heavy load behind it and how smoothly it rides over the points and crossings. You can't help being thrilled when you see it dashing along the track.

How fine and sturdily-built are Hornby Locos. How *real* they look. How beautifully they are enamelled in the correct colours ! Every part of a Hornby Railway is like that—strong and beautifully finished. Stations, Tunnels, Goods Wagons, Signals, Breakdown Vans, Snow Ploughs, Pullman Cars—all the real things in miniature.

HORNBY TRAINS
BRITISH AND GUARANTEED



This is the No. 2 Pullman Express, one of the splendid trains in the Hornby System. It consists of two handsome Pullman coaches hauled by a fine 4-4-0 loco of great power and speed, and it is running daily in hundreds of homes in all parts of the world

ASK YOUR DEALER
TO SHOW YOU THE HORNBY TRAINS

HORNBY TRAIN PRICES

No. 0 Passenger Set, complete	...	22/6
No. 0 Goods Set	,, ...	17/6
No. 1 Passenger Set	,, ...	25/-
No. 1 Goods Set	,, ...	20/-
No. 2 Pullman Set	,, ...	50/-
No. 2 Goods Set	,, ...	32/6
No. 1 Tank Goods Set	,, ...	22/6
No. 2 Tank Goods Set	,, ...	37/6
No. 2 Tank Passenger Set complete	...	40/-

Manufactured by
MECCANO LIMITED
BINNS ROAD
LIVERPOOL

P[illegible] BY MECCANO LTD., BINNS RD., LIVERPOOL.
[illegible] Stembridge & Co. Ltd., Albion Street, Leeds.