VOL. XII. Nº 11

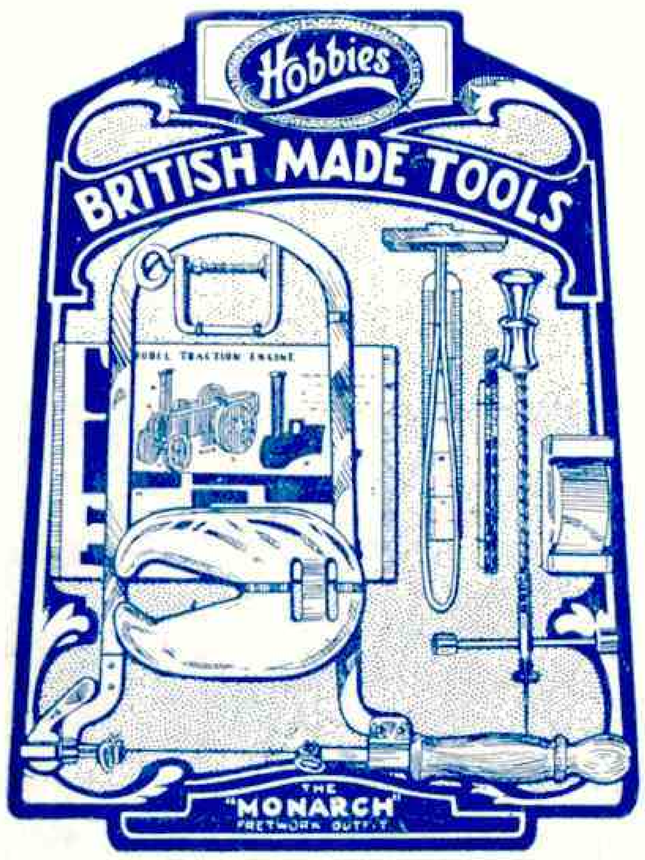
NOVEMBER 1927

MECCANO MAGAZINE

"THE FLYING SCOTSMAN"

(See page 980)

HOBBIES for happiness



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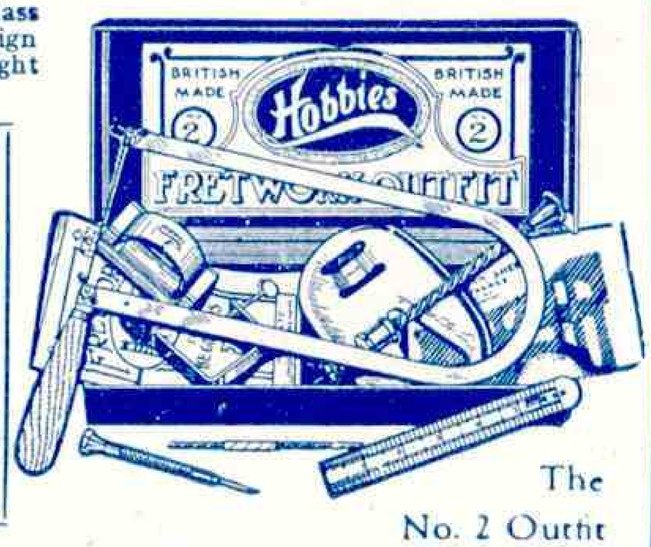

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MECCANO MAGAZINE

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November, 1927

With the Editor

How to Become an Inventor

By every mail I receive hundreds of letters from readers overseas. One such letter received this week from Australia, is from a young reader who wants me to tell him how to become an inventor. I am reminded of a similar question put by a young newspaper reporter to Alexander Graham Bell, who smiled as he puffed slowly at his pipe, and—weighing his words as a chemist weighs his drugs—said: "Young man, get an idea of your own. Be sure it is a good one. Then put every bit of energy you have into it, and stick to it!" That was all the reporter could get out of the genial inventor of the telephone—which has been described as the most valuable patent ever taken out! Bell's advice is good and applies not only to aspiring inventors but also to anyone in any walk of life.

As in the case of Mrs. Beeton's famous recipe for making jugged hare—in which she tells us to "first catch your hare"—the prime necessity for an inventor is to get an idea of his own. Ideas are not difficult to acquire—they are, in fact, as plentiful as fallen leaves in Vallombrosa, but unfortunately to most people they are worthless, although in practical hands every original idea possibly contains the germ of an invention. To "make good," an invention must be useful, it must have a practical application and it must satisfy some human need—in other words, it must make our lives easier or happier. If it does this, the demand for it will be great, no matter to what phase of human activity the idea relates.

There is plenty of scope for inventive genius to-day—for instance, every business man could employ a dictating machine that would turn out letters ready for mailing. Engineers want hundreds of things—for example, a practical machine that will utilise the energy of the sun's rays. Our mothers would welcome a regulator that would control instantly the temperature of the water in the hot water tap. Anyone can think of a dozen uses for window glass that can be seen through from the inside but not from the outside.

Every Inventor Meets with Opposition

Having once got an idea, the next thing is to put every bit of your energy into it, and to stick to it with your whole heart and soul. This takes courage, but courage is the quality that makes just the difference between success and failure. No one knew this better than Bell himself—for in his younger days he had to face the prejudice of the public against his telephone. All the business men whom he approached closed their minds to his proposition and refused to have anything to do with his "fool talking machine" as they called it. Other inventors have experienced the same prejudice, too. It took all the courage that George Westinghouse possessed to stick to his air-brake after experts had told him it was impracticable. It required all Edison's courage to bring his incandescent light to perfection, when scientists jeered both at him and his idea. It took a man of the courage of George Stephenson to bring his "*Locomotion No. 1*" to perfection, when engineers scoffed at him and when the public assembled at the opening of the Stockton and Darlington Railway, many in the hope, and most with the firm conviction, that they would see the engine "blow up"!

Almost every inventor has been confronted by sceptics, for there is a natural hostility to anything new or any new way of doing anything. It seems scarcely believable that it is less than a century ago that a committee of prominent—and presumably intelligent!—men opposed the use of locomotives on the Liverpool and Manchester Railway on the ground that a locomotive could not possibly work it as advantageously as if the carriages were drawn by horses! Even more recently—less than a quarter of a century ago—a Bill was before the Danish Parliament in connection with making laws for the regulation of motor-car traffic. One of the members expressed his opinion that Parliament need not concern itself about this matter as he was quite sure there would be no motor cars on the road a year or two later, for they could not possibly serve any useful purpose!

So we find that in almost every case inventors have had to face derision fearlessly and that they have had to show great courage in order to back up their inventions. The inventor of Meccano was no exception, and I hope soon to commence a new series of articles that will tell again the "Life Story of Meccano."

City Clerk's Struggle to Invent Artificial Silk

Last month we commenced the wonderful story of silk, so that it is not inopportune to mention that the inventor of artificial silk, the basis of one of our most prosperous industries, was a Liverpool bank clerk, who for many years struggled against continuous disappointments and lack of support, often with ruin staring him in the face. His name was Charles H. Stearn, and he commenced his experiments in a small house (at 3, Eldon Terrace, Rock Ferry), in an attempt to improve the material from which incandescent gas mantles was made. After he had invented an improved mantle known as the "Swan," he bought the house next door, which he used as a workshop for making these mantles. Resigning his position at the Bank, he moved to Newcastle-on-Tyne in 1880 and commenced what was to be a long series of experiments in an attempt to manufacture silk synthetically. For more than 20 years he worked unsuccessfully on the problem but at last, from the viscose used in the making of his mantles, he succeeded in preparing something that resembled silk.

He took out a patent and formed a syndicate, but the process turned out to be impossible on a commercial scale, and the syndicate threatened to withdraw its support. Stearn, who had put all his savings into his experiments and would have been ruined if the syndicate had taken this step, begged to be allowed to go on for another six months. The syndicate agreed, and before the end of the six months the process had been perfected. In 1905, Courtaulds, a well-known firm of silk manufacturers, took over the experimental plant, bought the patents and gave Stearn a position with the firm. At that time Courtaulds had a total capital of £700,000 but to-day, 22 years later, their capital exceeds the huge sum of £20,000,000 and the value of their shares has increased by leaps and bounds.

It is interesting to know that the Liverpool bank clerk, whose long and persistent efforts made possible its growth, remained with the famous firm until his death in 1919.

Our Christmas Issue: Important Notice

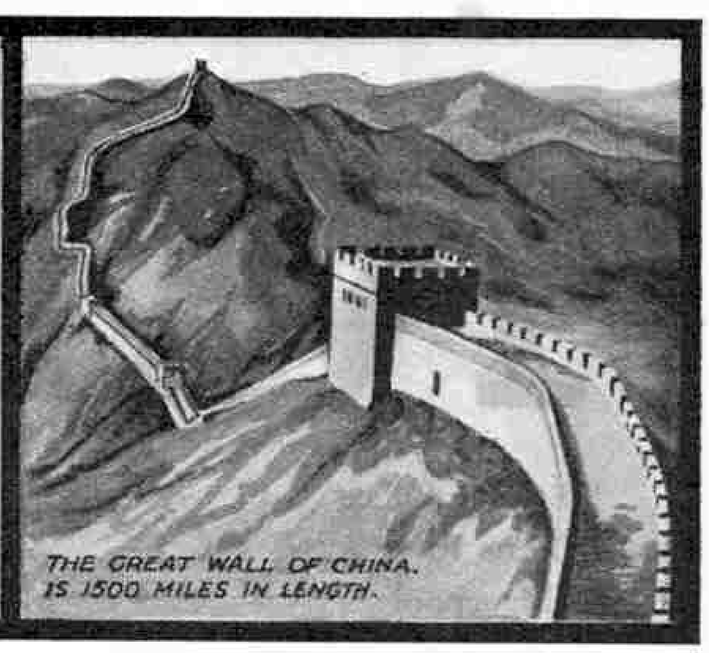
During the last few months many would-be readers have been disappointed in not being able to obtain copies of the "*M.M.*," the editions being "sold out." This note is just a reminder that there is always an extraordinarily heavy demand for our December issue and those readers who have not already done so should order it at once from their Meccano dealer or newsagent.

A TYPICAL CHINESE SHOP.
(NOTE FIRE BUCKET IN THE ROAD.)

MY TOUR ROUND THE WORLD

by

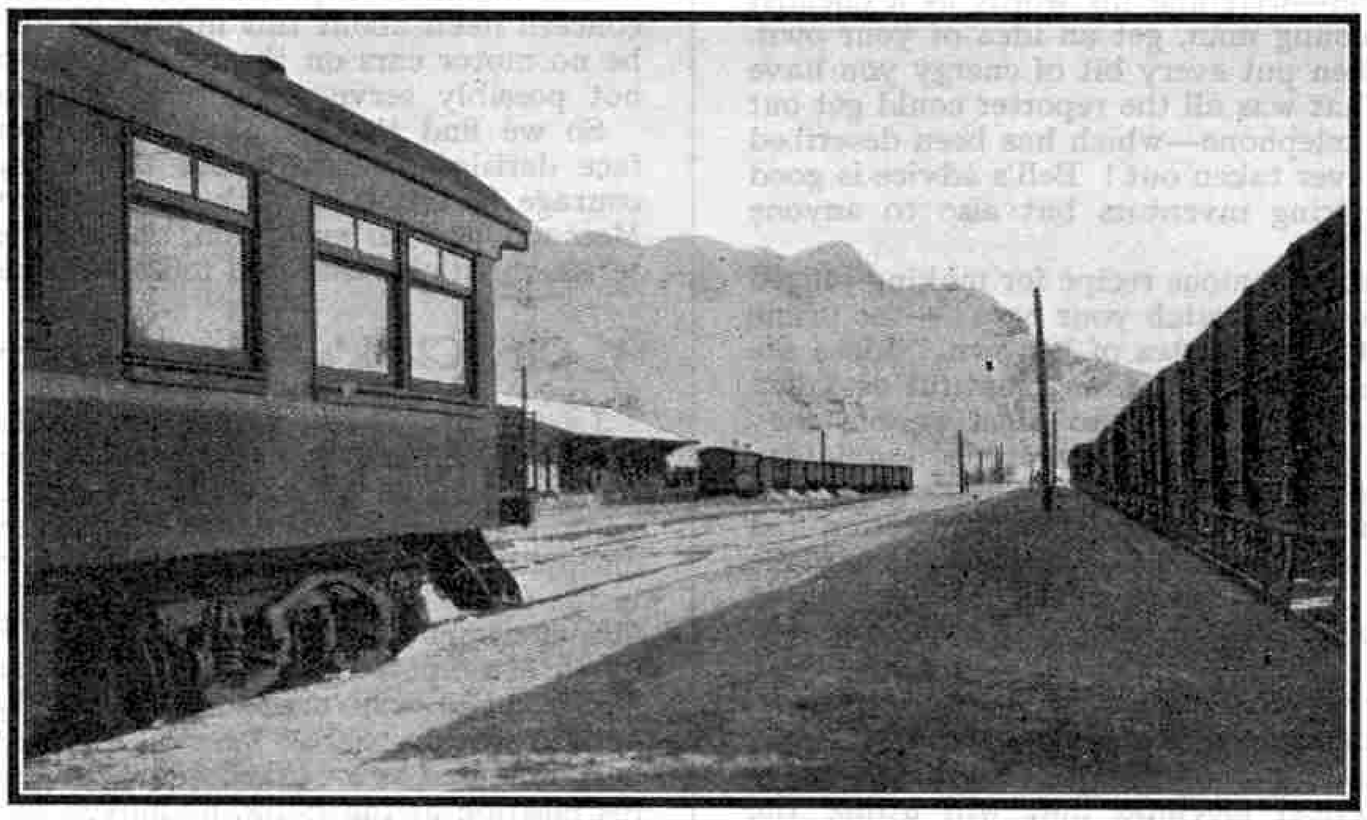
FRANK HORNBY


THE GREAT WALL OF CHINA.
IS 1500 MILES IN LENGTH.

IV. Travelling in a Troop Train. The Great Wall of China—the Greatest Wall in the World. A Visit to the Forbidden City. A Temple Ceremony.

THE long railway journey through Manchuria, of which I spoke last month, at length brought me to Mukden, the capital of the country. This is a large city surrounded by a wall pierced by eight gates, and the short time that I spent in it was sufficient for me to see that its streets are well laid out, with many well-stocked shops and markets. The city has been under the influence first of the Russians and then of the Japanese for many years, and in consequence of friendly co-operation between these powers at the end of the Russo-Japanese War it enjoys considerable prosperity, along with the rest of Manchuria.

The climate here is temperate. In the hilly country to the north of Mukden there are many vast forests that supply wood for shipbuilding, while in the portions over which I travelled, wheat, millet and the soya bean are cultivated. Millet is a grain that supplies the Chinese with meal for bread flour, its stalks being used for making baskets, matting and wide-brimmed hats.


On the way from Mukden to Pekin. A scene in the Manchurian hills

The soya bean, the other product unfamiliar to western people, deserves further notice. On its stout hairy stem the plant carries from 50 to 100 pods, each containing from two to five seeds, and it has proved a very productive and profitable crop. The first shipment of these beans came to England in 1908, and since then there has been an increasing demand as a result of the varied uses that have been found for them. They are now largely used in the making of margarine and even for cheap flour and meal. They are chiefly of value because of the oil contained in them, which amounts to about 18 per cent. It is pressed out of the beans and used for making soap and paint, and also in the manufacture of waterproof cloth. The crushed residue left after the oil has been extracted is used for cattle food.

When the value of the soya bean was recognised it was introduced into West Africa, where many oil-producing seeds are grown on a large scale for use in the soap industry. There it has proved wonderfully successful, some varieties from Sierra Leone containing as much as 23 per cent. of oil.

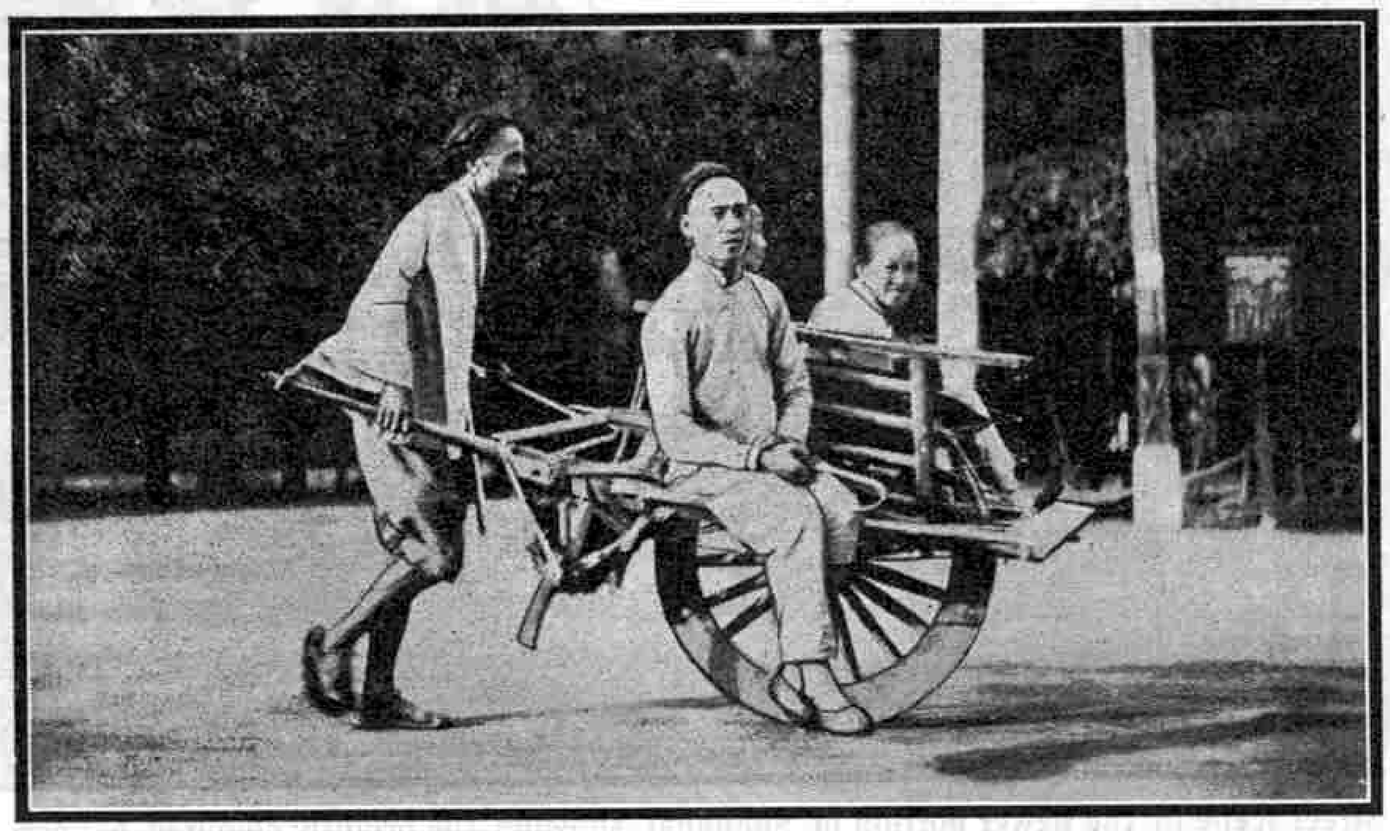
Manchuria is the most northerly of the provinces of China and has been more fortunate than the rest of the country during the recent troubles on account of having a strong army and an official Government. The Tuchun, or military Governor of the province, is Chang Tso Lin, who commenced his career as a bandit and has carried on warfare intermittently with almost every other Chinese leader since he became supreme in Manchuria. So far, however, that province has never been the scene of any fighting. If the present security continues there is no doubt that Manchuria will become even more prosperous than she is to-day, on account of her great mineral wealth and other natural resources that are as yet unexploited.

The disturbed condition of China was soon made evident to me when I wished to continue my journey to Pekin. There was some doubt as to whether it would be possible for me to travel by the train on which I wished to depart, on account of a big movement of Chinese troops that was in progress. I did at length succeed in getting a compartment, but the journey proved to be anything but comfortable, and I regretted the change from the well-appointed railways under Japanese control.

The coaches were in a most dilapidated condition, the better-class coaches having been commandeered for the use of the Chinese generals. The cold was very severe, representing about 20°–30° of frost, and the washing and heating arrangements were both out of order. Soldiers crowded every part of the train, and it was difficult to pass through the corridors in order to reach the dining car to obtain food. When I did succeed, room had to be made among the crowds who had assembled there. The soldiers generally were a very objectionable lot and wore a most nondescript dress. Most of them

had long robes lined with common fur, while some had fur caps or little tufts of light fur fastened to their ears. Altogether they looked far more like bandits than soldiers!

At Fengtien, two or three stations from Pekin, the train stopped and most of the soldiers got out, this place being a base where the military trains of the northern Chinese armies are made up and despatched to the various strategical positions. While there I noticed several military trains in the process of loading, open trucks being used for the soldiers and horses, as well as for guns, stores and other equipment. In one or two of the trucks were improvised structures resembling tents, which, I presume, were intended for cooking purposes. What struck me most, in view of the extreme cold, was the fact that so little protection was afforded the soldiers, and I was not at all surprised to read a few days later an account of the dreadful fate of 300 soldiers on the railway. These hapless coolies, who had been conscripted by the Fengtien soldiery in a place called Kalgan, not far from Pekin, and transported to Pingtichuan, were frozen to death to the last man in open railway cars. They were found dead when they arrived at their destination, whereupon orders were issued to have the bodies sent back to Kalgan!



Chinese wheelbarrow. Note the enormous size of the wheel

I was much tempted to take a photograph of the military trains at Fengtien, but in the end I decided to refrain as I was rather apprehensive that I might be taken for a spy and severely treated!

At length the train reached Pekin. This famous city is situated at the natural gateway between Manchuria and the hills of Mongolia and the rich fertile plains of China. Its history has been very eventful. From time to time throughout the ages barbarous hordes from the North have invaded the country and have held possession of the city, often for long periods. It was to prevent these invasions as far as possible that the Chinese built a huge wall to the north of Pekin more than 2,000 years ago. This was a most extraordinary engineering feat and I was greatly disappointed not to be able to examine it closely. This was impossible, however, as it would have involved a journey of some 40 miles partly by train and partly by motor-car, and at the time great masses of troops were crossing the line of the necessary journey.

Elaborately decorated coffin carried by coolies

The wall was solidly built of granite masonry and was 30 ft. in thickness at the base and from 25 to 30 ft. in height. A turret almost twice the height of the wall was built every 200 or 300 yards, projecting from the wall and overlooking its face in both directions. This enormous mass of masonry crossed the country westward from the sea over a distance of more than 1,500 miles!

This great wall resembles the walls built by the Romans across Great Britain to keep out the savage raiders from the north of Scotland in the fact that it scarcely deviates from its straight course, but climbs up the most rugged and precipitous mountain sides and plunges into deep ravines and gorges. It is remarkable to me that the Chinese ever managed to build it, for it must be remembered that it runs for the most part along bleak and inhospitable mountain ranges, far removed from any natural means of transport such as a great river, while its builders had only the crudest mechanical appliances with which to work. All the materials for the wall must have been carried on the backs and shoulders of coolies, and if it is true that it was built at the rate of 100 miles a year, many thousands of men must have been employed.

This Chinese barrier proved practically useless for its intended purpose, and many invaders broke through it to conquer the country to the south. The last conquerors of China came from Manchuria about 300 years ago. Since then the northern city has been known as the Manchu City, as the ruling race naturally took possession of the palaces and Imperial buildings. These are grouped together in a third walled city, enclosed within the Manchu City and known as the Imperial City. The traditions of the conquerors are still kept up in the Manchu City and to this day its gates are closed at a certain time every evening.

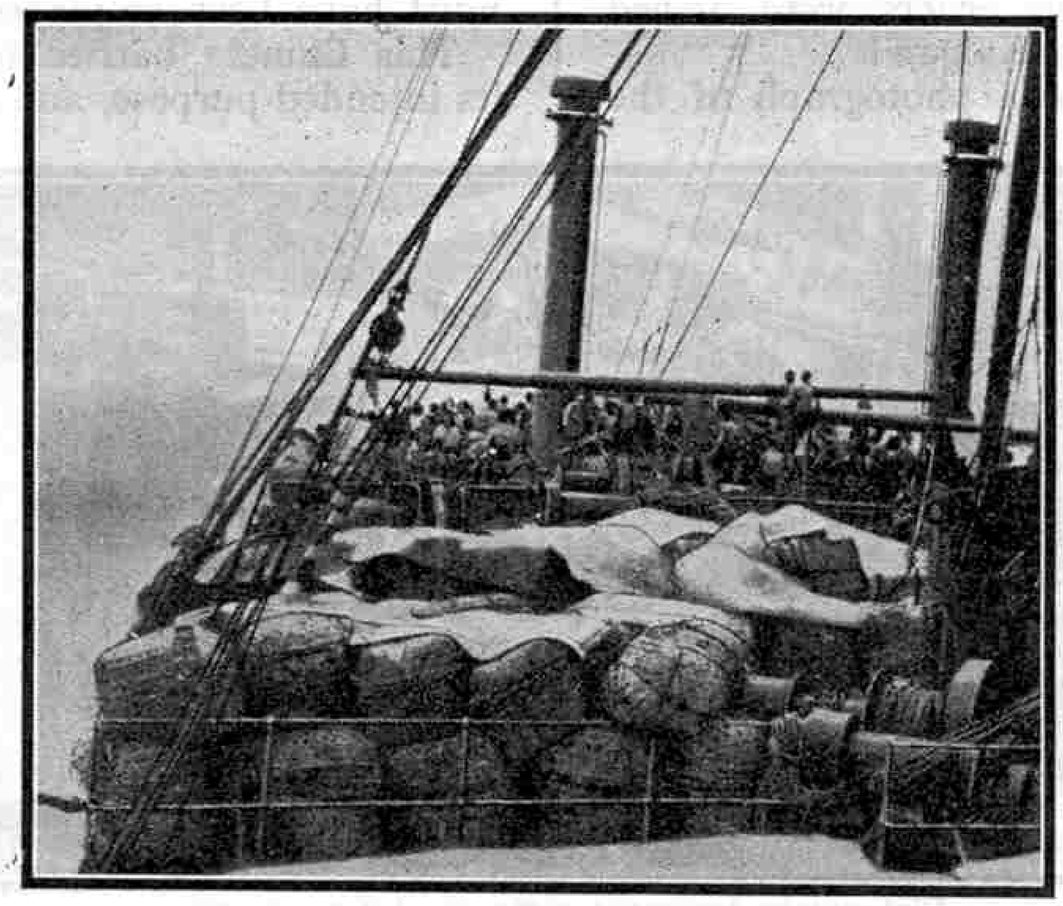
Both the Chinese and the Manchu Cities are roughly square in shape and the south wall of the latter runs along the north of the former. The area covered by the two cities is enormous, being about 25 square miles, and in comparison with other cities this is out of all proportion to the population. The reason for this soon became apparent when I saw the city from the walls.

It seemed to be a city of gardens. There are numerous large open spaces that are not built upon at all, and the picture of the blue, green and yellow tiles of the many temples and palaces glittering among the groves of trees was very pleasant. Buildings of more than one storey are not allowed in Pekin, and this restriction undoubtedly prevents the crowding of a large population into a small space. Another peculiarity of the city that I noticed at the same time is that there are no suburbs in the European sense. The city is entirely contained within the walls, which have always been kept in good repair, and it is difficult for those approaching the city across the surrounding sandy plain to realise that its interior is very busy indeed.

Street scene in the newer portion of Shanghai, showing the brightly coloured banners of Chinese merchants

While in Pekin I visited the Imperial City, which contains the Imperial Palace, the State Museum and the residence of the Emperor. The Emperor's Palace stands within a portion of the city that is known as the Purple Forbidden City, on account of the colour of its high walls. At one time any stranger who penetrated into this city was punishable by death, but now some parts are open to visitors and I took the opportunity of seeing all I could. The museum contains a unique collection of Chinese curios and works of art of all kinds. It is wonderful to think that many of these objects date back thousands of years!

The Chinese City includes most of the shops and restaurants and is the residential part of Pekin. Close by its southern gate is the Temple of Heaven, one of the most wonderful buildings in the world. This beautiful place is so large that the wall surrounding it is $3\frac{1}{2}$ miles in length! The grounds are filled with old fir and cypress trees and contain many altars, one of which was the scene of an annual ceremony in which the Emperor took a prominent part. This altar is a remarkable structure of marble and consists of three circular tiers, the lowest being 210 ft. and the highest 90 ft. in diameter. The highest terrace is paved with blocks of marble in such a manner that nine concentric circles are marked out by joints, while the central stone is perfectly circular.



Snapshot on the deck of a coasting steamer, showing the crowd of Coolies on the fore-deck

On this stone the Emperor knelt, surrounded first by the circles of the terraces and then by the circle of the horizon. The ceremony commenced with the Emperor fasting in the temple for 12 hours with closed eyes, a really remarkable feat of endurance. Afterwards he proceeded with his retinue to the sacred altar, where he remained while a bull was sacrificed as an offering, to the accompaniment of the fumes of burning incense from the nine huge braziers.

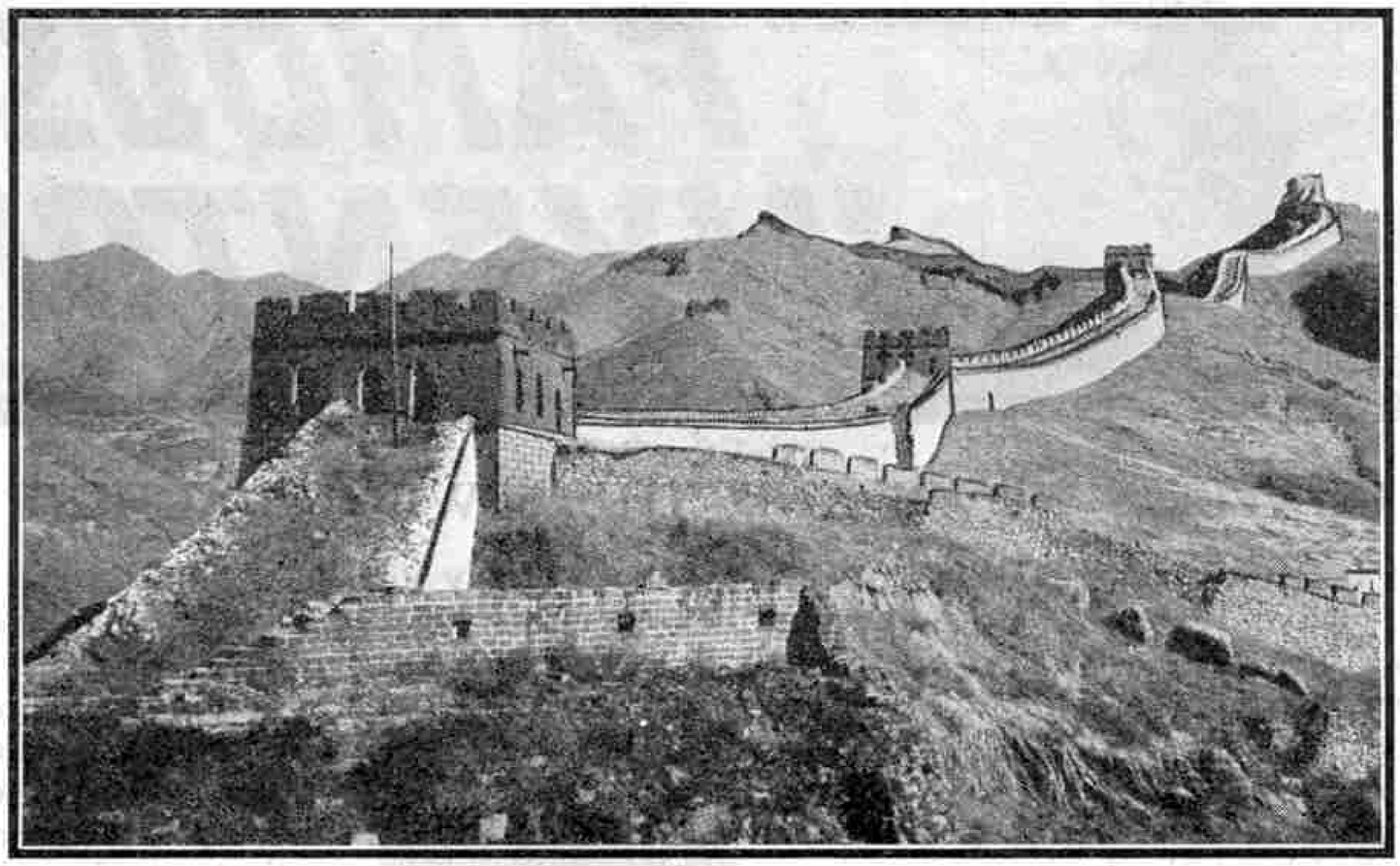
Another altar in the same temple is used for prayers for good harvests. This also is a circular structure surrounded by a triple roof of tiles of the most exquisite blue colour. Unfortunately some of the buildings have been used as billets for soldiers during the troubles of the last few years and during their occupation a considerable amount of vandalism has taken place and many precious relics have been stolen. A curious thing about the Temple of Heaven was that women were not permitted to enter under penalty of having their arms cut off!

Also in the Chinese City there is another wonderful temple known as the Temple of Agriculture. In the course of a religious ceremony held at one season of the year the Emperor himself ploughed three furrows in the sacred field attached to this temple and then watched the dukes and other dignitaries plough and sow in turn!

After leaving the sacred city, I visited the Lama Temple, which in effect is the embassy of the Grand Lama who rules Tibet. I was fortunate in witnessing a religious ceremony in one of the temples within the grounds. Only priests were present, some of whom sat cross-legged on the floor and others on meanly upholstered forms. The High Priest sat apart on a raised structure. They were being addressed by a young priest, but while my guide and I watched them through the door they appeared to me more interested in us than in the priest who was addressing them! They seem to be a poverty-stricken lot of people, and their temples are in a very neglected condition. I mentioned this fact to my guide, who explained to me that they had no money with which to renovate them. I suggested that, as they had so

much time at their disposal, some of them might do a little work themselves as the priests in the past have done in other countries, whereupon he informed me that they were far too lazy!

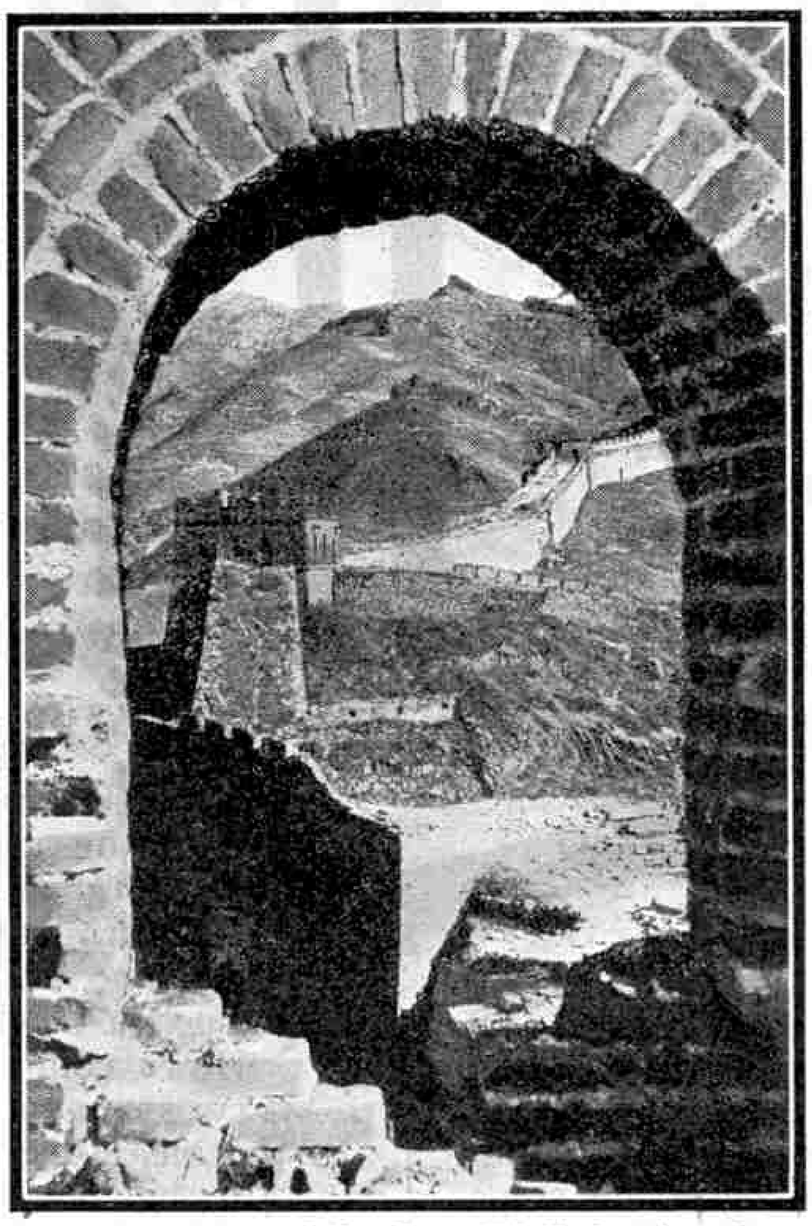
Leaving the temple I visited the native quarters of the city. The ordinary Chinese in Pekin live under very deplorable conditions as they have very little to spend on their welfare. The roads in this quarter are not paved and in wet weather become impassable, muddy pools. When they are dry the wind raises the fetid dust in such clouds as to make it most objectionable to pass through them. Bullock-carts and huge wheelbarrows are the chief vehicles to be seen in the street, while it is by no means uncommon to meet a train of camels laden with skins and other strange articles of commerce brought from the deserts of Mongolia along the caravan routes that have been used for thousands of years.



The Great Wall of China

From Pekin I took the train to Tientsin. This city is the port of Pekin and is situated on the River Peiho, at a distance of 58 miles from the mouth of the river. This seems to be a strange situation for a port, and I noticed that it was necessary to transfer goods from ocean-going vessels to junks and small vessels in order to bring them up to the port. Nevertheless, since Tientsin was opened to trade with foreigners it has prospered and grown until now its population is far greater than that of Pekin itself. The river is sealed by ice for three months in the year, the winter season in the north of China being severe but short.

At Tientsin I went on board the steamer that was to take me to Shanghai. This was not very large, as the river can be navigated only by small boats, and consequently we were severely tossed about when we reached the Yellow Sea. The pleasure of the trip was further somewhat marred by the knowledge that on the previous day another steamer belonging to the same company had been wrecked while making the same voyage!



Another view of the Great Wall showing the massive nature of the masonry

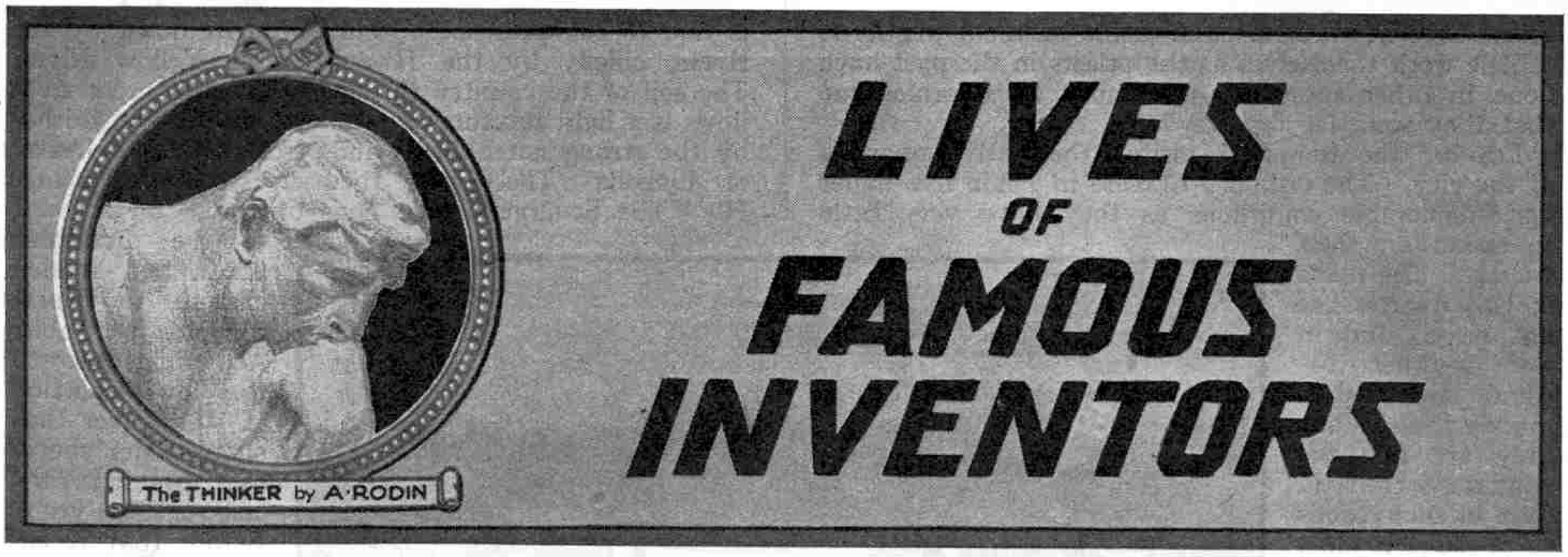
The appropriateness of the name Yellow Sea struck me very forcibly. The yellow colour of the water is due to the presence of mud brought down by the rivers, chiefly by the Hwang-Ho or Yellow River. The soil of the country through which this great river flows is a light mixture of sand and dust blown thither by the strong north-west winds from the Gobi Desert of Mongolia. The Chinese themselves call the Hwang-Ho "The Scourge of the Sons of Han," on account of the disastrous floods and sudden changes in course to which it is liable. According to records the lower portion of the river has changed its course nine times in the last 2,500 years. Before 1851 it entered the sea hundreds of miles to the south of its present position, but in that year it burst its restraining dykes and only settled down to a new course after causing wholesale devastation.

A glance at a map will show that there are few towns on the banks of this river and none at all near its mouth. It is not safe to live there, as the river is always liable to overflow in spite of the utmost care on the part of the Government. As it is not navigable, the Hwang-Ho does not at first sight appear to be of much use in spite of its great length and volume. It has been the chief agent in bringing down from the west the splendid light soil of Northern China, however, and in renewing its fertility. Thus it has played the same part in China as the Nile has played in Egypt.

The voyage from Tientsin to Shanghai is about 400 miles in length. The steamer first crosses the gulf of Pe-chi-li, a large sheet of water shut in by two peninsulas. The northernmost of these is the Liau-tung peninsula, and was better known twenty years ago than it is to-day. It was then the scene of a famous siege. At its southern extremity is Port Arthur, then a Russian fortress that offered prolonged and desperate resistance to the attack of the Japanese. Several fierce naval battles were fought in the sea around this peninsula, Japanese destroyers making repeated torpedo attacks on the Russian warships in the harbour of Port Arthur.

After passing between the two peninsulas the ship turned south and very soon arrived at Shanghai, the city that has become so well known to everybody in the present year.

(To be continued)



IX.—ELIAS HOWE AND THE SEWING MACHINE

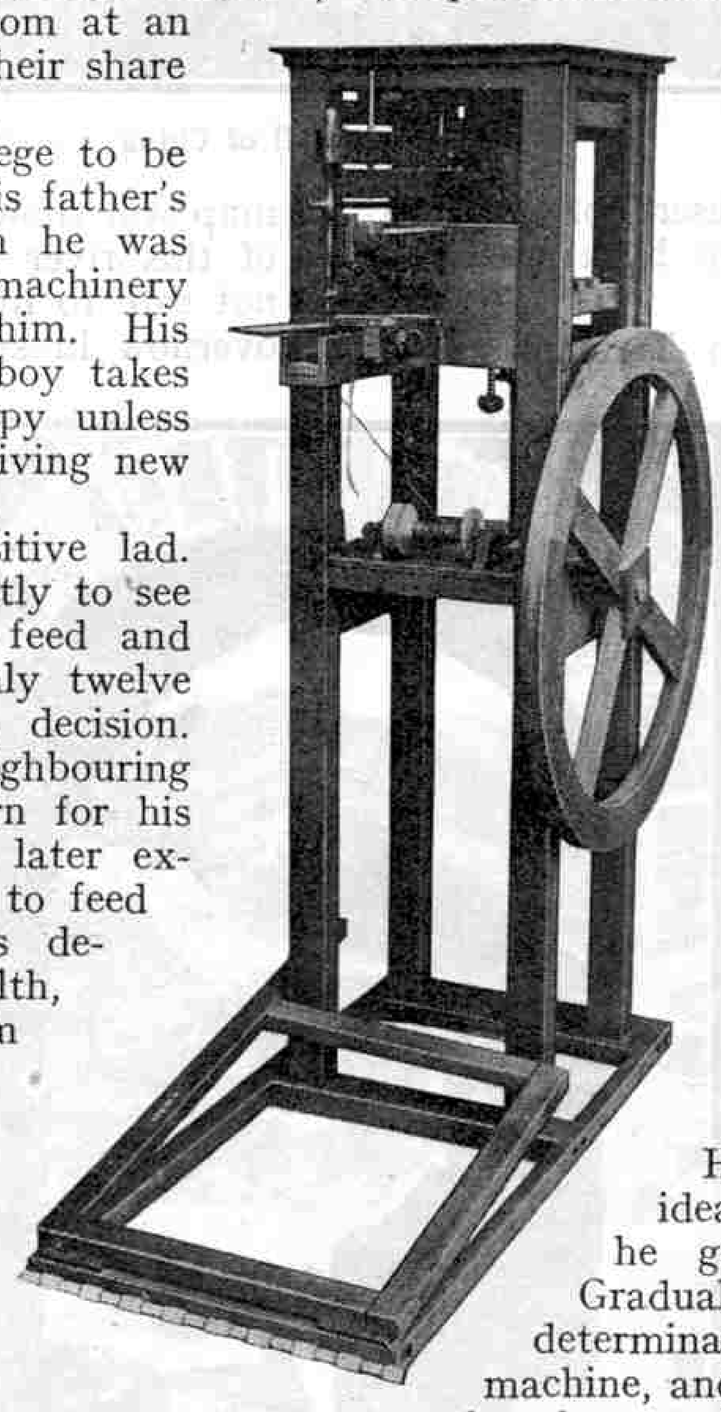
ELIAS HOWE was born at Spencer, Massachusetts, U.S.A., on 9th July, 1819. He was the son of a hardworking farmer who sought to increase his meagre income by sawing and planing timber and grinding meal for other farmers in the district. Elias was one of a family of eight, all of whom at an early age became accustomed to doing their share of the many minor tasks about the farm.

To Elias it was always a great privilege to be allowed to help in some small way in his father's sawing and planing mills, for although he was fond of the farm and its varied tasks, machinery had an overwhelming fascination for him. His father was wont to remark that "the boy takes after his uncles; they were never happy unless they were working with tools and contriving new ways of doing things."

He was a very observant and sensitive lad. Despite his youth it distressed him greatly to see how difficult it was in the home to feed and clothe so many of them, and when only twelve years old he came to a courageous decision. Leaving home one day, he visited a neighbouring farm and there secured a job in return for his "keep." In defence of his action he later explained that "there'll be one boy less to feed at home." His chivalrous effort was defeated, however, by his frailty of health, while a slight lameness prevented him from undertaking any heavy work. Somewhat disconsolate, therefore, he returned home and during the next four years contented himself with helping in his father's mills.

At 16 years of age Howe again left home and this time emigrated as far as the town of Lowell, where he secured an apprenticeship at a cotton machinery works. There he began to gain practical experience in the construction of power-looms and spinning machinery, but once more misfortune dogged his steps. Two years after he commenced work at Lowell a cotton panic broke out that resulted in all the cotton mills in the district closing down. Trade in Lowell was brought to a standstill, and Howe found his job almost crushed out of existence and with no prospect of early revival.

He therefore decided to seek work farther afield and accordingly journeyed to Boston. There he ultimately obtained work in the shop of a man named Davis, who made and repaired watches, clocks and scientific instruments. Howe found his new job very different from the previous one and extremely exacting. The strenuous days were often brightened, however, by interesting conversations that took place in the shop. Davis was well-known as a skilful craftsman, and would-be inventors and other instrument makers frequently called in to discuss with him their various difficulties and to ask his advice. One can imagine how eagerly the lad listened to these discussions.



Sewing Machine invented by Barthelemy Thimmonier

One day there came to the shop a man who had been trying to invent a knitting machine, but without success. He discussed the matter with Davis but failed to impress him with the proposed invention. Presently Davis said suddenly: "Why bother about that thing? Why don't you make a sewing machine?" Whether the caller ever tried to adopt this suggestion is unknown, but if he did so he appears to have failed for nothing further was heard of him.

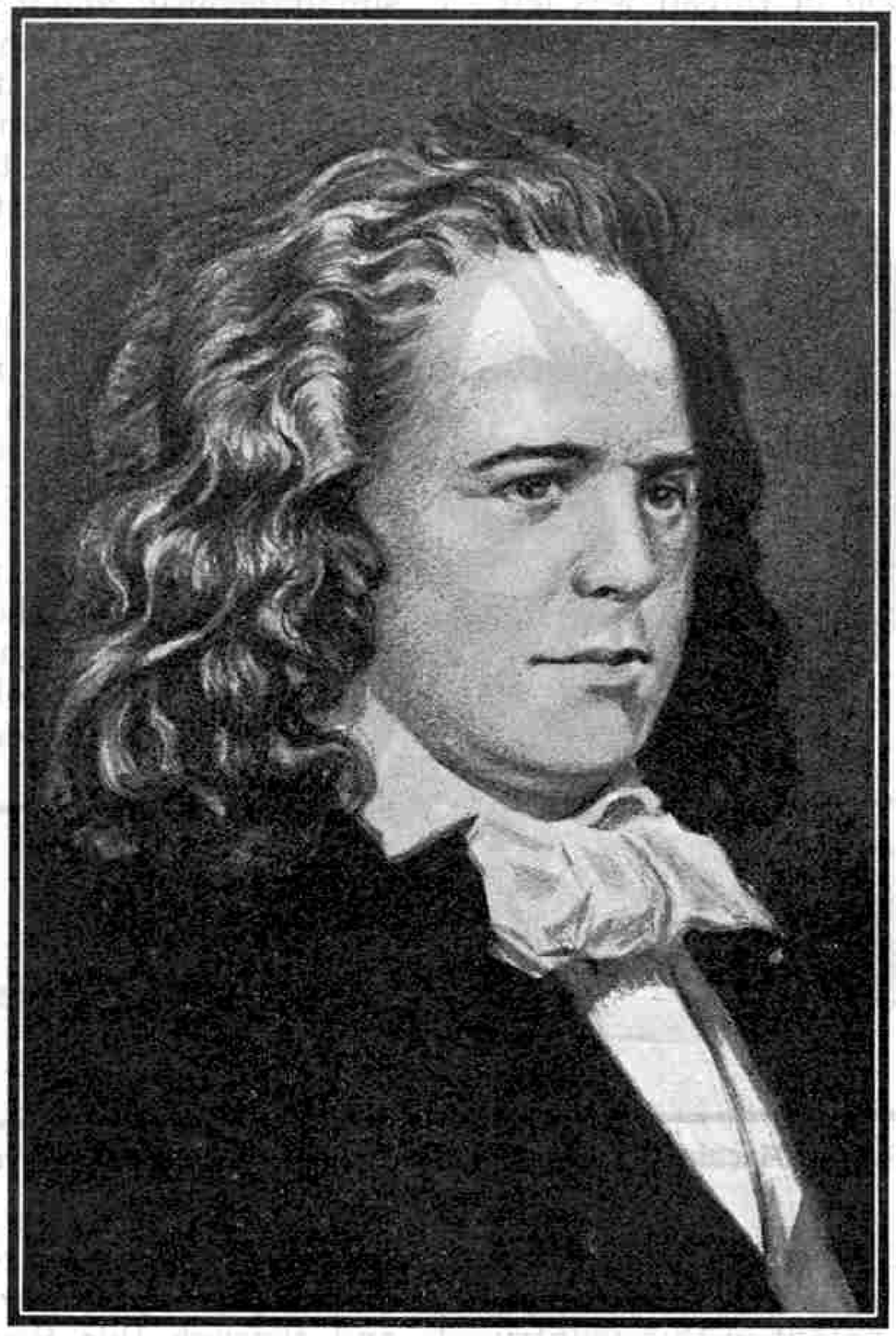
Howe was greatly attracted by this idea put forward by his employer and he gave it a great deal of thought. Gradually there grew up in his mind a determination to produce a practical sewing machine, and it was not long before the invention of such a machine became his whole object in life.

Howe commenced his experiments in 1841, but it was many years before he attained success. In the meantime his life was one of stern endeavour, for although he worked long hours in Davis's shop it was rarely that his week's wage amounted to more than nine dollars. Out of this small income he had to keep a wife who was always more or less ailing. Their home was in a very poor quarter and he utilised an empty garret for his work upon the sewing machine, often labouring far into the night.

At first Howe attempted to construct a machine that would operate by reproducing the movements made by the hand and needle of a person sewing, but after many months of fruitless labour he abandoned this idea as impracticable. Repeated failures did not discourage him, and night after night he retired to his garret and shut himself up with the problem.

The machine that Howe at length evolved was a very complicated and cumbersome affair and it resembled the abandoned model in having a needle with a hole at the heel, or blunt end. When this machine was tried out it did not work at all satisfactorily, and although the harassed inventor scrutinised the model over and over again in order to find the defect he was unable to do so. At the same time the health of his wife grew worse and worse and debts steadily accumulated. He began to grow absolutely desperate and he became more and more convinced that everything now depended upon making his machine a success.

From the first Howe's father had been one of the few people who believed in the possibilities of the invention, and when he learned how seriously his son was handicapped by adverse circumstances he invited him to remove with his family to his house. This invitation Howe accepted with gratitude, and conditions were immediately altered. He now had no worry about his wife, who was well cared for, and he was free to devote his whole time to perfecting his invention. Not long afterwards a disaster occurred in the shape of a fire that destroyed his father's workshops, but just as the outlook appeared to be once more hopeless a friend named George Fisher, who also believed in the invention, offered financial assistance, which was gratefully accepted. The two men became partners, Fisher subscribing immediately 500 dollars.



Elias Howe

Once more relieved of his immediate anxiety, Howe returned to work with renewed enthusiasm. The great problem of what was preventing the machine from functioning properly haunted him day and night and the solution is said to have come to him at last in a very sudden and dramatic manner. One night he dreamed that a savage king had commanded him, under penalty of death, to construct a workable sewing machine within 24 hours! At the end of the allotted time the machine was unworkable and Howe saw himself being led away for execution. As he walked along he noticed that the sturdy native warriors who composed his guard each carried a spear, the head or blade of which was pierced. In an instant he realised that he had found the solution to the problem of the unworkable sewing machine—the needle must have the eye near the point, instead of at the blunt end!

The dream ended abruptly and, with a feeling of exultation, Howe arose, dressed hurriedly, rushed to his workroom and quickly holed a needle near the point. It was the work of only a few minutes to adjust the needle in the machine, thread it and try out the model—and it worked!

This is a particularly interesting instance of re-invention. A machine with an eye-pointed needle and an oscillating shuttle had been constructed between 1832 and 1834, and the eye-pointed needle had actually been patented in England in 1841. There is not the slightest doubt, however, that Howe was quite unaware of this previous patent and that he arrived at his invention quite independently.

During the ensuing months many minor improvements were made to the machine and at last, in 1845, Howe considered his invention to be sufficiently perfect to justify him in patenting it. He therefore took his machine to the Patent Office at Washington and succeeding in taking out a patent for it. During his stay at Washington he took the opportunity of exhibiting his machine at a fair, but although it attracted a great deal of attention and was greatly admired, no one appeared to think of purchasing it. In July of the same year a practical demonstration of the machine's capabilities was given by the inventor at a clothing factory at Boston, where, in the presence of a large gathering of workpeople, a complete suit of clothes was stitched on the machine rapidly and with perfect success.

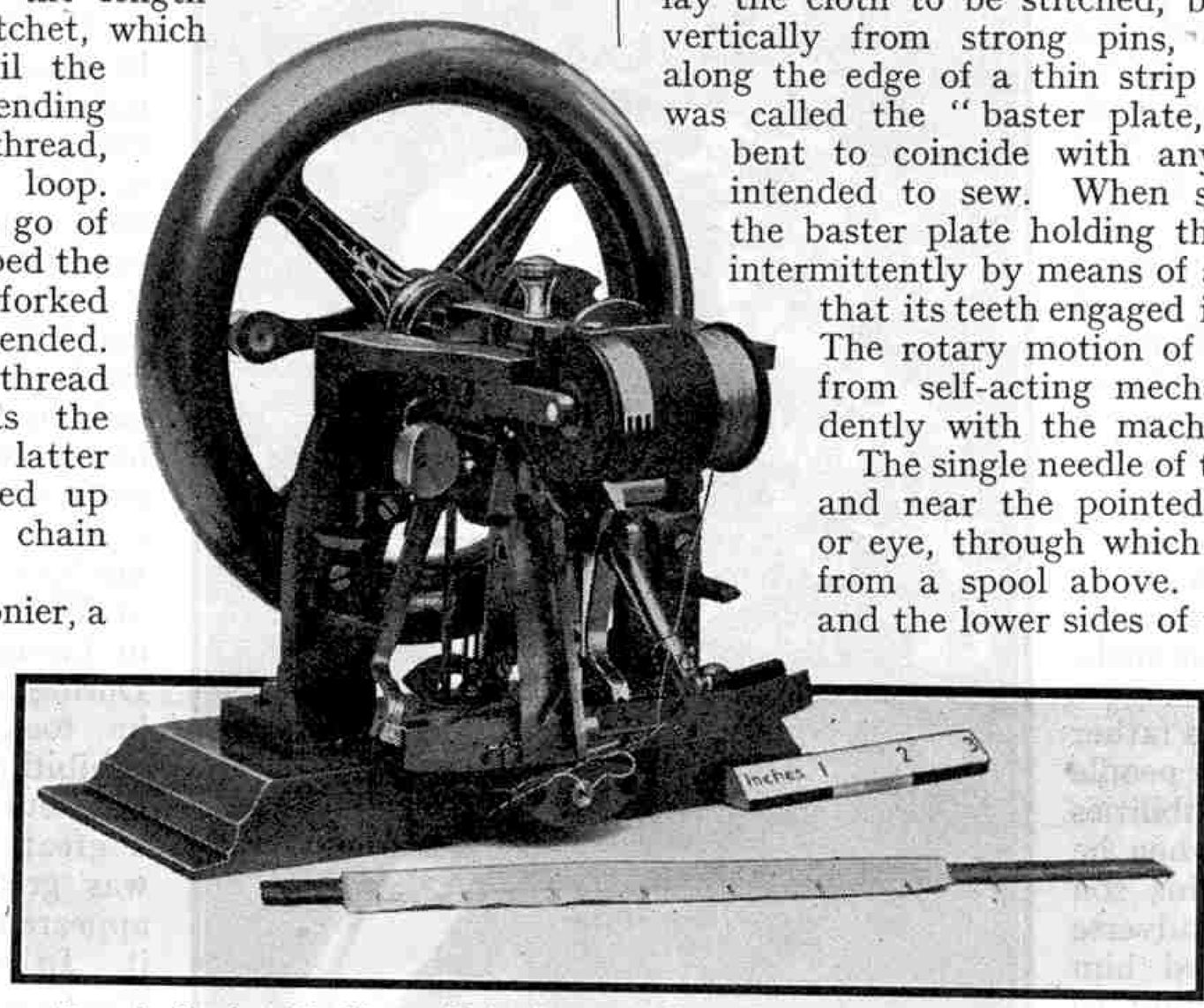
The sewing machine patented by Howe was not the first sewing mechanism to be invented, but it was the first of the type known to-day as "lock-stitch machines," in which the thread is so secured that it can only be undone one stitch at a time, and by cutting. The machines invented by Howe's predecessors, Saint and Thimmonier, offered no such security. The thread was guided through the material in such a manner as to form chain stitches, and the whole length of this stitching could be undone by pulling the exposed end of the thread.

Thomas Saint was a London cabinet maker who obtained a patent in 1790 for three boot and shoe machines he had designed, each having distinctive work to perform. The second only concerns us here, and this was a machine for "quilting, stitching and sewing," and like the other two machines it could be operated either by steam power or by hand. This machine was the first single thread chain-stitch sewing machine patented, but there is considerable doubt as to whether Saint ever actually constructed a machine from his design.

It is of interest to note that the frame of this original machine comprised a horizontal table and an overhanging arm as featured in machines of the present day.

A vertical needle bar contained two eyeless needles. The first needle functioned vertically as an awl and made a hole in the cloth. The thread was then led down from a reel mounted on the arm of the machine and mechanically laid across the hole. The second needle was forked at the lower end, and in descending it caught the thread and drew it down through the hole. When the forked needle withdrew, a loop of thread was left on the underside of the cloth and this was then grasped and carried along to the length of one stitch by a ratchet, which did not release it until the forked needle, descending with another length of thread, passed through the loop. The ratchet then let go of the first loop and grasped the new one made by the forked needle as it again ascended. As the new loop of thread was drawn along as the first had been, the latter automatically tightened up and formed a taut chain stitch.

Barthelemy Thimmonier, a tailor of St. Etienne, France, patented his first sewing machine in 1830. At first he appears to have had some success, but in 1841 a hostile mob destroyed all his machines then in use, numbering about 60. Thimmonier was not dismayed, however. He accepted this act as a challenge and promptly constructed new and better machines, in respect to which he took out a patent in this country in 1848. It was claimed for these improved machines that they could make as many as 200 stitches per minute, but nevertheless they did not bring the inventor either fame or fortune, for he died in poverty in 1857.



Howe's Sewing Machine. Note the curved needle and vibrating lever in the foreground

Thimmonier's machines were an improvement upon that devised by Saint. The "table" upon which the cloth to be sewn was spread comprised a hollow horizontal arm with a hole in the upper side. Within the arm was a hook, or "thread-carrier," which was fed with thread from a reel below. At each downstroke the pointed needle fitted in the overhead vertical needle-bar penetrated the cloth where it lay over the hole and passed partly down into the arm. The movement given to the needle was passed to the hook within the arm and, by means of a sliding rack and pinion, caused the hook to perform a partial turning movement as the lower part of the needle appeared below the cloth. By this means the thread held by the hook was looped once around the barbed needle, around the upper portion of which remained the loop brought up on the previous journey.

As the needle ascended, the thread wound round by the hook was drawn through the upper loop, which then tightened and, as in Saint's machine, formed a chain stitch. Saint's machine, however, formed the chain stitch on the underside of the cloth, whereas Thimmonier's machine formed it on the upper surface of the material.

The material being sewn was held down by a forked lever or pressed foot projecting downward adjacent to the needle, and was fed forward by hand after every double stroke.

The machine that Howe invented and patented was the first effective sewing machine to use two threads simultaneously, and it possessed several original features. There was no horizontal table or arm upon which to lay the cloth to be stitched, but the latter was hung vertically from strong pins, or pointed projections along the edge of a thin strip of metal forming what was called the "baster plate," and which could be bent to coincide with any curved seam it was intended to sew. When sewing was in progress the baster plate holding the cloth moved forward intermittently by means of a small pinion so geared that its teeth engaged in the holes in the plate. The rotary motion of the pinion was derived from self-acting mechanism operating coincidently with the machine needle and shuttle.

The single needle of the machine was curved, and near the pointed end had an aperture, or eye, through which passed a thread drawn from a spool above. Along both the upper and the lower sides of the needle was a groove for the thread to facilitate its passing along. The needle was fixed to a vibrating lever, and although swinging in a vertical plane, yet penetrated the cloth horizontally, passing through for some distance before the motion was reversed. As the needle began to thread through the cloth on its return journey a tiny loop of thread was left behind, and through this there immediately passed a shuttle drawing a thread and with which it was fed by a second reel. The shuttle travelled in a shallow horizontal trough, or "race," and was thrown the length of this race by blocks jerked by levers. The complete withdrawal of the needle pulled the looped thread taut, and also drew into the hole made by the needle the thread passed through the slack loop made by the shuttle. The various movements of the needle, shuttle and "baster plate feed" were actuated by arms and cams secured to a main shaft rotated by the turning of a large hand wheel.

When his invention had been patented Howe made every endeavour to sell his machines to clothing manufacturers. He found, however, that although they admired the result of his genius they were afraid to instal such machines in their factories, lest by doing the day's work more quickly fewer employees would be required. Such a state of affairs, they declared, would inevitably lead to riots by the workpeople, who might even destroy the factories. As day followed day without a machine being sold Howe became disheartened, and finally decided to take his invention to England in the hope that there he would find manufacturers with enough courage to give it a trial.

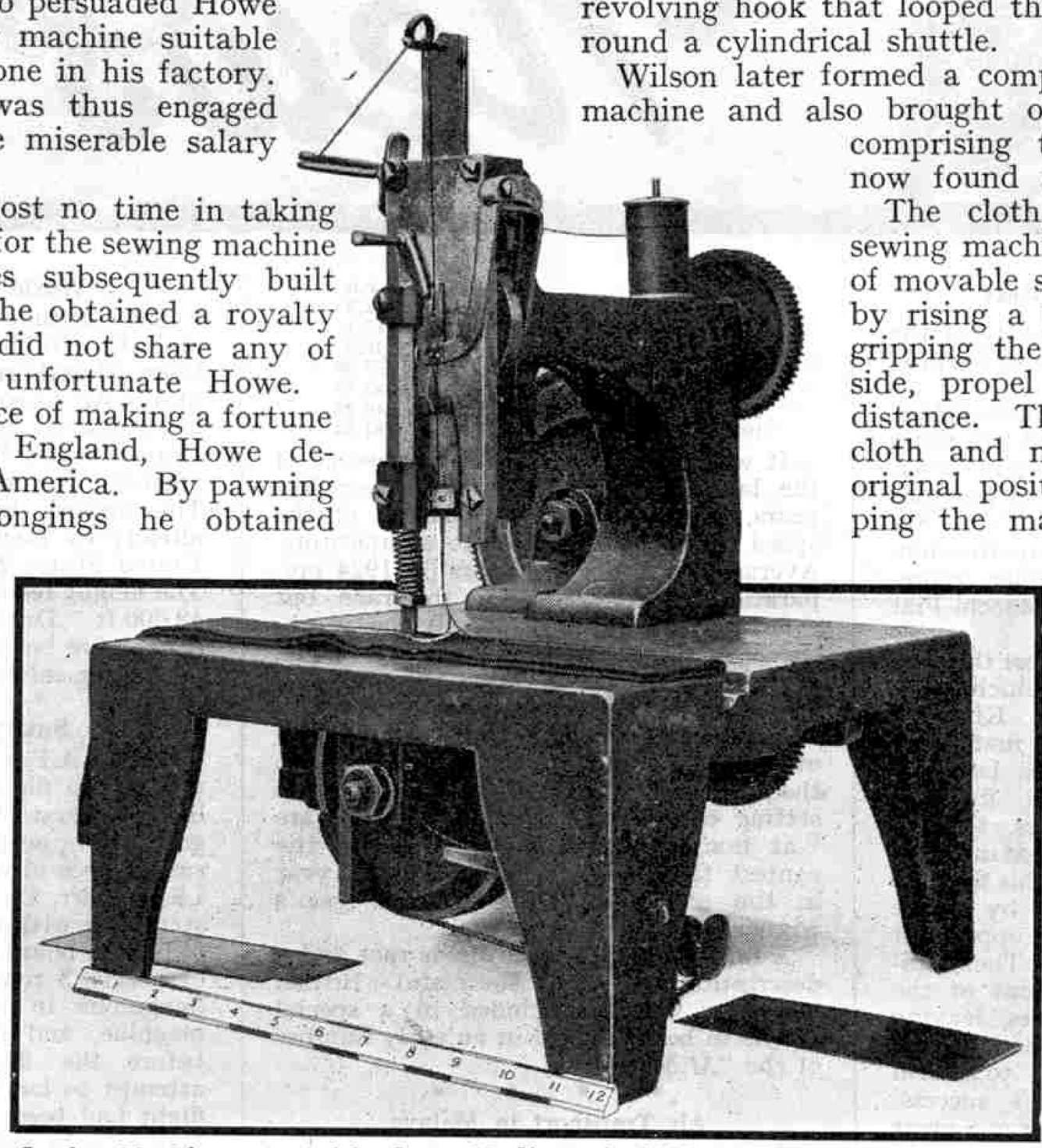
Howe took a steerage passage to England and eventually arrived in London practically penniless. After a long period of fruitless endeavour he made the

acquaintance of a mill owner named F. W. Thomas of Cheapside who, perceiving a means of making a handsome profit himself out of the invention, offered Howe £250 for a machine on condition that he might patent it in England, promising the inventor a royalty of three pounds on every machine sold under the British patent. Howe, in desperate need of money and thinking of the sick wife he had left in America, accepted the offer. Thomas also persuaded Howe to construct a similar machine suitable for the heavy work done in his factory. While the inventor was thus engaged Thomas paid him the miserable salary of £3 per week!

The factory owner lost no time in taking out an English patent for the sewing machine and on the machines subsequently built in accordance with it he obtained a royalty of £10 each, but he did not share any of this profit with the unfortunate Howe.

Having lost all chance of making a fortune by his invention in England, Howe determined to return to America. By pawning various personal belongings he obtained sufficient money to book a steerage passage and on the day of departure conveyed his baggage on a handcart to the quay.

Howe arrived home to find his wife seriously ill, and her death soon after his arrival was an even worse blow than the discovery that during his absence in England numerous rival inventors of sewing machines had sprung up in America. Forthwith he began a series of prosecutions for infringement of patent rights. The legal battle continued intermittently over several years and huge sums of money were spent by rivals in trying to oust Howe, but finally his claims were established by the courts and the validity of his patent guaranteed.



Sewing Machine patented by Isaac M. Singer in 1851, and the forerunner of the well known Singer Sewing Machines of to-day

When these legal disputes came to an end Howe's patent had still 13 years to run, and during that brief period he amassed a fortune at the remarkable rate of from £35,000 to £40,000 each year!

Howe did not live long to enjoy the great wealth he had accumulated, for he died on 3rd October, 1867, at Brooklyn, New York.

The sewing machines of some of the inventors against whom Howe took legal action were very effective, and the special features whereby their owners claimed them to be improvements upon Howe's invention were in many cases quite ingenious. One of the best of these contemporary machines was invented in 1849 by Allen B. Wilson, a journeyman cabinet-maker of Pittsfield, U.S.A. It is said of him that he was wholly unaware of the efforts of Howe and others to perfect an efficient sewing machine, and therefore that he did not produce his machine with any intention of trying to outwit Howe.

Wilson devoted all his spare time to constructing his machine and when the model was completed and worked to his satisfaction he took it to New York where steps were taken to procure a patent. This was obtained in the following year. His invention became known as the "rotary-hook lock-stitch" machine, and was claimed to be the first really practical sewing machine performing a lock-stitch. It embodied a revolving hook that looped the thread from the needle round a cylindrical shuttle.

Wilson later formed a company to manufacture his machine and also brought out an improved design, comprising the "four-motion feed," now found on all sewing machines.

The cloth table of this type of sewing machine has a limited number of movable surfaces that act as teeth by rising a fraction of an inch and, gripping the material on the underside, propel it forward a regulated distance. The teeth then release the cloth and move backward to their original position, prior to again gripping the material. There are thus four distinct motions of the feed, as the name given to this arrangement implies.

Mention must also be made of another inventor with whom Howe came into conflict. This was Isaac Merritt Singer, and an illustration of the sewing machine invented by him in 1851 is shown on this page. This machine was also of the lock-stitch type but differed from Howe's in several respects, one of which was the substitution of a straight needle for the curved one favoured by Howe. The needle was driven by a rotary shaft instead of the vibrating arm common to earlier inventions.

The manner in which Singer entered the sewing machine business is of interest. Unlike Wilson he knew all about the various sewing machines that had been invented and was well acquainted with Howe's patent. Lack of funds, however, prevented him from devoting himself to experimental work but at last his desire to make a sewing machine became so great that he approached two friends for assistance. From one of them he obtained a loan of 40 dollars and by the other, who was an engineer, he was granted the use of tools and a workshop.

Singer set to work and after many days of intense labour his machine began to take shape. Many of the parts were made by himself and, although crude, served their purpose. At last the machine was ready but for a considerable time could not be got to work. When all the employees of the workshop had long given the invention up in disgust Singer, still persevering, succeeded in getting it to operate, and eventually the machine was patented. To-day Singer is the most familiar name in the sewing machine industry.

The Schneider Trophy Race

For the third time in the history of the race Britain has won the Schneider Trophy, the blue riband of the air.

This year the great international seaplane race was flown over a course of 218 miles in the Gulf of Venice on 26th September, having been postponed from the previous day on account of bad weather. Six machines took part, two Supermarine-Napiers and one Gloster-Napier representing Britain, and three Macchi-Fiat machines representing Italy.

The race probably was the most thrilling in the history of the contest which dates back to 1913. Flight Lieut. Kinkead, flying the Gloster-Napier, was first away and was followed five minutes later by Col. the Marquis de Bernardi, flying a Macchi. The other competitors, alternatively British and Italian, set off at intervals of five minutes. At the end of his first lap Col. Bernardi was forced down by engine trouble, and Lieut. Kinkead dropped out at the end of the sixth lap. Then, unfortunately, came the retirement of the two remaining Italian machines, leaving Flight Lieuts. Webster and Worsley, each piloting Supermarine-Napiers, to finish the course to ensure Britain's success. The retirement of the Italians was a great blow to their compatriots and is genuinely to be regretted.

Lieut. Webster was the winner, and his time for the course, 46 minutes 20.28 seconds, showed an average speed of 281.54 m.p.h.! His fastest lap, the fourth, was flown at 284.11 m.p.h.! Lieut. Worsley's time was 47 mins. 46.75 secs., averaging 272.96 m.p.h. Flight Lieut. Webster's speed, in addition to being a record for the Schneider Contest, easily broke the world's record for any type of flying machine. The previous record, held by M. Bonnet, the French pilot, was 278.5 m.p.h.

The British engines and machines stood up to their work wonderfully. They were specially built for the race but their power has been kept a very close secret. It is believed, however, that they developed over 900 h.p.!

This is the first time that Britain has been represented in the race by a contingent organised by the Air Ministry and piloted by serving R.A.F. officers, and it is a significant pointer to the quality of British aircraft that, on the first occasion that our British manufacturers really have been able to let themselves go, so signal a triumph has been scored. The wonderful character of the victory is best illustrated by giving the record of the winners during the past six years and the average speed at which the Trophy has been won.

	M.P.H.
1920—Bologna (Italy)	102.5
1921—De Briganti (Italy) ...	117.4
1922—Biard (Britain)	146.5
1923—Rittenhouse (U.S.A.) ...	177.38
1925—Doolittle (U.S.A.) ...	232.57
1926—Bernardi (Italy)	246.49
1927—Webster (Britain) ...	281.54

It will be observed that the passage of the last four contests, spread over five years, has witnessed a doubling of the speed of the successful competitors. Averaged over the five years (in 1924 preparations were made for the race but eventually it was abandoned) the yearly speed increase has been 27 m.p.h. The British win this year raised the figure by 35 miles and if the average increase is maintained next year's race will be won at 310 m.p.h.!!! Britain's task will be the lightest next year, for our machines are setting the pace and in addition we are "at home." It is a regulation of the contest that the race is held each year in the country of the previous year's winner.

A fully detailed report of the race and a description of the successful British machines will be included in a special article to be published in an early number of the "*M.M.*"

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Air Transport in Malaya

The Air Survey Company has reported favourably on the project for an air service in Malaya, and two sets of designs for special aircraft for this service have been prepared. Both types are all-metal monoplanes. One will be propelled by three engines of 450 h.p., and will carry a crew of two, with accommodation for 18 passengers and one ton of freight. The other machine will have one engine of 450 h.p. and, also carrying a crew of two, will accommodate six passengers and 180 lbs. of freight. The range of the larger machine will be 275 miles and of the smaller 350 miles.

The main operating base of the service is to be at Singapore where a large hangar, slipway, offices and stores will be constructed. A similar airport with workshop is to be erected at Penang, where the manufacture of spare parts also will be undertaken. Port Swettenham is another proposed calling point and if satisfactory arrangements can be concluded, extensions to Belawan, in Sumatra, and Batavia, in Java, will be opened. Eventually the service will be linked up *via* Rangoon and India with England.

A company under the name of "Eastern Airways Ltd." is to be formed to work the scheme, which has received the approval of the Governments concerned as well as that of important shipping lines and commercial firms.

World's Altitude Record

The altitude record for all types of aircraft established with a balloon by Capt. Hawthorne C. Gray of the United States Air Corps, reported in our August "*Air News*," has been confirmed by the United States Bureau of Standards. The officially recorded height is 42,470 ft. This record, however, has been beaten already by Lieut. C. C. Champion, of the United States Navy, flying an aeroplane. The height recorded on his barograph was 48,000 ft. During the descent the machine caught fire but Lieut. Champion succeeded in landing safely.

* * * *

Smart Piloting Work

The R.A.F.'s second attempt to make a non-stop flight from England to India, like the first, was unsuccessful. But it gave the opportunity for an exceptionally smart piece of work on the part of Flight-Lieut. Carr, the pilot. The machine was started up with approximately 1,100 gallons of fuel on board, this representing a weight of nearly 3 tons. Such a load would be dangerous in an attempt to land the machine, and it was clearly understood before the flight commenced that to attempt to land before at least 10 hours' flight had been accomplished, would be a task fraught with considerable risk. The machine, a Hawker-Horsley Rolls-Royce, has a very high landing speed, yet, when the first hour of the flight disclosed a defect in an oil pipe, Lieut. Carr decided to make an attempt to save the machine rather than take to the parachutes and let the machine crash. When it was seen that the machine was making an attempt to come to earth, preparations were immediately made to deal with a nasty crash. The preparations fortunately were unnecessary, for the two occupants of the machine not only escaped hurt, but also succeeded in landing the machine without the slightest damage.

* * * *

Khartoum-Kenya Air Service

Experimental flights on the Khartoum-Kenya air route have been recommenced. Readers will remember that the original machine, the de Havilland-Short-Jupiter "*Pelican*" was wrecked when rising from the Nile for its first flight from Khartoum. The machine has been repaired at the Grecian factory laid down by the Blackburn Co., who are indirectly interested in the company operating the service.

On this route, by the way, there is a natural up-and-down line. At an altitude of 10,000 ft. and above, there is an almost permanent north wind blowing, while below this there is a continuous stream of air from the south.

Aviation Possibilities in South America

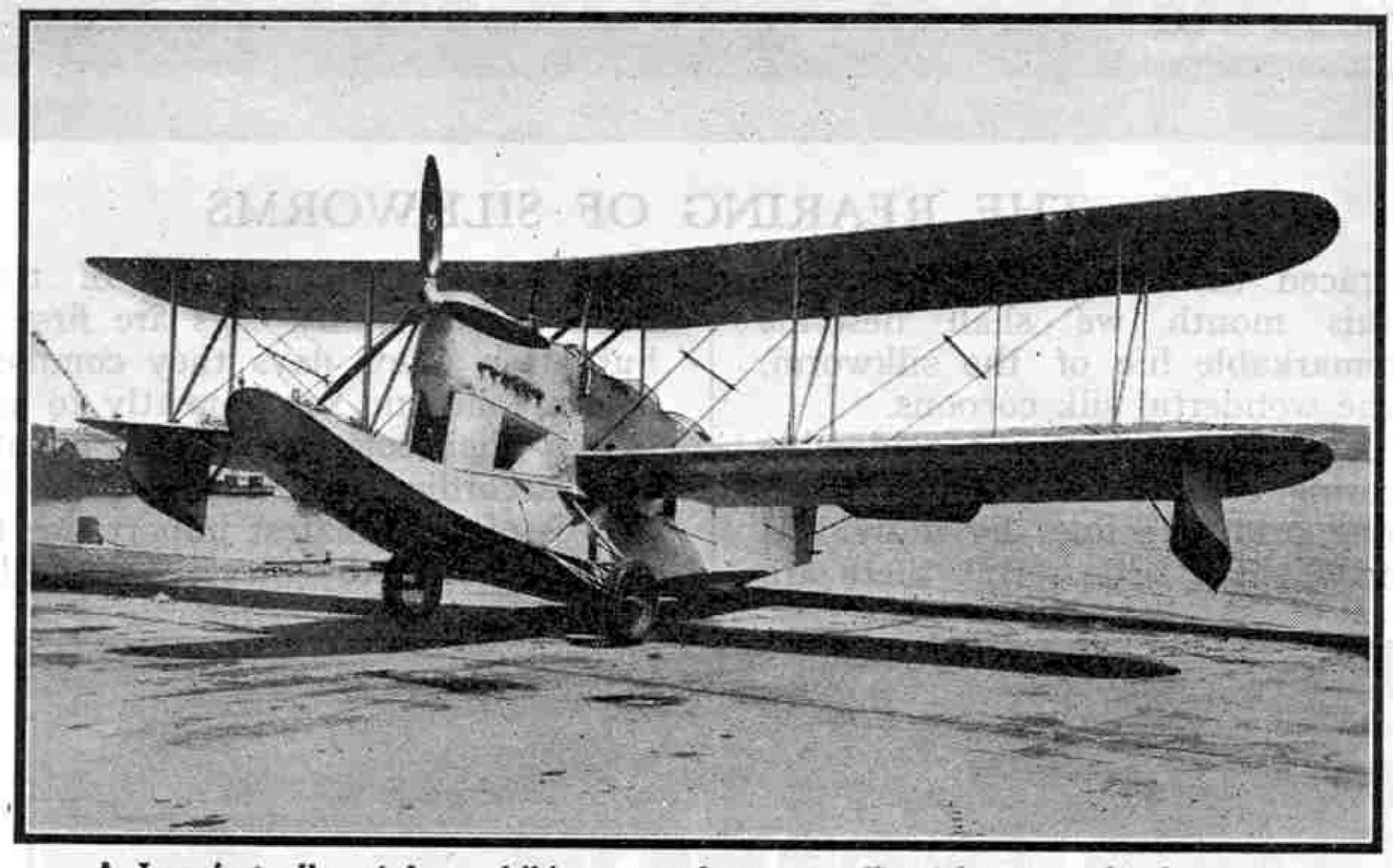
The Brazilian Government are watching with keen interest the development of the new commercial airway opened recently by the Peruvian Government between San Ramon and Iquitos. Probably nowhere in the world is there greater scope for aerial development than in South America. This great continent lies practically undeveloped save on the very edge of its coastlines. Its rail communications are poor and trans-continental communication is possible in many places only by steamer. Journeys that now require several weeks to accomplish might be reduced to a matter of days, or even hours, by aeroplane.

The new Peruvian undertaking is a twice-weekly service between San Ramon and Iquitos and forms a new link between the Peruvian hinterland and Lima, the capital, on the Pacific coastline. The more difficult crossing of the Andes between San Ramon and the coast will be carried out by fast motor and rail.

The service is being operated by the Peruvian Naval Air Service, and six machines, including four seaplanes, are in use. The seaplanes are intended for the section running almost parallel with the Ucayali and Pachitea Rivers, between Pueto, Bermudez and Iquitos. The total time to be occupied by the journey between Lima and Iquitos is two days, of which 15 hours will be spent in the train and on the road between Lima and San Ramon. The aerodrome at the latter place will be left on the morning following the departure from Lima, and allowing only for a descent at Masisea for refuelling, the flight to Iquitos will occupy from five to six hours. The same journey by river steam boat, canoe, and jungle trail would occupy from two to three weeks! No more striking example of the possibilities of air transport in South America could be desired.

The Brazilian Government's interest centres mainly on the possibility of extending this service completely across the continent to Para at the mouth of the River Amazon on the Atlantic. A service such as this would reduce the period of the trans-continental journey from four to eight weeks to four to five days. It would be necessary to extend the Peruvian line to Letecia on the Peruvian frontier to link up with the Brazilian service. A considerable time must elapse, of course, before such a service could be put into operation, for little is known of the Amazonian jungles, in fact, only three pilots have anything beyond a slight knowledge of the region. There would seem to be scope for the employment of seaplanes.

Used in Alaska for Aerial Survey



A Loening all-metal amphibian aeroplane, equally at home on land or water

The D.H. "Tiger Moth"

The new de Havilland "Tiger Moth" has quickly created a good impression and it is a matter of congratulation for all concerned that already it has established two air records that can definitely be claimed as British. Admittedly the records belong only to the world of light aeroplanes, but the performances serve as a demonstration of what the British aircraft manufacturer can do when he really sets out to produce record-breaking machines.

Captain Hubert Broad, flying the "Tiger Moth," not only set up a world's speed record of 186.47 miles per hour, but a few days later, without any alteration of the machine's equipment, attained an altitude of 20,000 ft.! This is ample evidence that the "Tiger Moth" is no freak machine.

In two important factors the "Tiger Moth" was handicapped during the climb. The carburetter setting was for speed, and the propeller used was the same as that fitted for the speed flight. The de Havilland Company may well be confident that, with necessary adjustments, the machine can increase its height record to something in the neighbourhood of 30,000 ft. The machine is equipped with a D.H. engine, specially designed for the "Tiger Moth," and developing approximately 113 h.p.

* * * *

Finding the Height of Clouds

Special apparatus is being tested at Croydon Aerodrome for finding the height of clouds for the guidance of night-flying airmen. It consists of a 500,000 c.p. searchlight throwing a beam vertically on to the clouds, and a theodolite through which to observe the point at which the beam strikes the clouds. The angle obtained and the distance of the theodolite from the searchlight are all the observer needs to ascertain the exact height of the clouds.

Civil Aviation Progress

In August last Imperial Airways celebrated their 8th birthday, or rather the 8th anniversary of their predecessors' first operations. Since that day British lines have carried over 100,000 passengers and a total of 7,000,000 miles has been covered. Unfortunately, Britain to-day takes almost a back seat in civil aviation matters despite the enormous superiority of its machines and operating conditions. For example, the great Deutsch Luft-Hansa combination between January and June of this year covered over 2,426,000 miles, this mileage comparing with 3,816,000 for the whole of 1926. In the same period 42,814 passengers, as compared with 56,268, were carried. It must be remembered, however, that Germany is in almost a unique position for the operation of air lines. It lies in the centre of the most important part of Europe and consequently its enterprise in pushing forward its natural advantages has reaped a vast reward. On the other hand, the aerialdevelopments in the German interior alone are enormous. Almost every town of any size possesses its own aerodrome, from which small feeder services connecting with the main international trunk lines are operated. It is not surprising, therefore, that such great figures can be shown.

The pessimists who decry the progress of British commercial aviation, and point to the great Continental organisations to illustrate their arguments, have overlooked the vital factor. In Britain there is not the big scope that exists in countries with vastly greater areas and less highly developed alternative means of transport. British aviation cannot extend indefinitely into other European countries, for they would not allow it. Our existing Continental services are worked on a reciprocal basis, lines from the countries into which we work running into Britain in return. The future of British aviation lies in the Colonies and the development of inter-Empire air routes. And progress in that direction is being made steadily.

In the meantime plans are being discussed for the operation of at least three internal air services in Great Britain. Proposals are on foot for a service down the East Coast of England between Aberdeen and London, calling at Dundee, Edinburgh, Newcastle, and other principal east coast towns. Another service is projected from Liverpool, calling at Manchester and Birmingham. A third service, that of the projected mail transfers at Queenstown for the Continent, was mentioned in the "*M.M.*" last month.

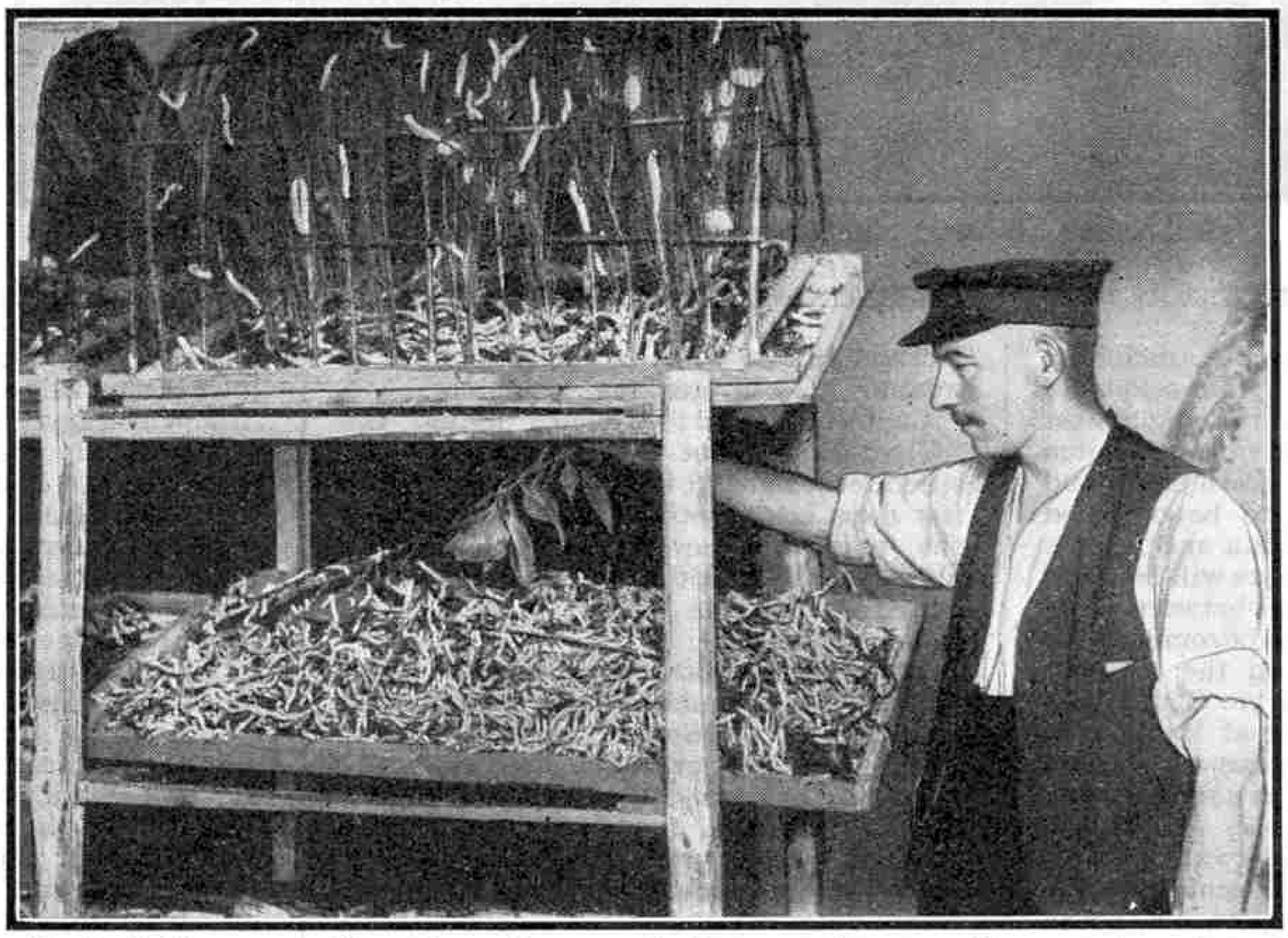
THE STORY OF SILK

II.—THE REARING OF SILKWORMS

LAST month we traced the early history of silk manufacture; this month we shall describe the brief but remarkable life of the silkworm, and the evolution of the wonderful silk cocoons.

In India and other Eastern countries a considerable amount of silkworm rearing, or *sericulture* as it is called, is still carried out along primitive lines by individual "farmers" working on a small scale. But there are nowadays also establishments known as "silk farms," which are devoted entirely to the rearing of silkworms in large quantities. These farms are to be found in India, China, Japan, and to a smaller extent in France and England.

There are many hundreds of varieties of silkworm moths, which may be divided broadly into two types—those that feed principally on oak leaves and to some extent on the leaves of other trees, and those that live almost entirely on the leaves of the mulberry tree. The silkworms reared in Europe are mostly of the mulberry feeding class and therefore it is this type of silkworm moth that we shall follow through the various phases of its short existence of six or seven weeks.



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

At a modern silk farm the female moths are induced to lay their eggs on sheets of paper or linen cloth which can be readily transferred from one place to another as required. There is little difficulty in persuading the moths to do this, for centuries of domestication have practically eliminated their ability to fly and so escape. The eggs, which number from 300 to 400, are laid in August. They are almost circular in shape and somewhat flat and their minute size may be gauged from the fact that 40,000 of them weigh only one ounce! These tiny eggs are first of a pinkish colour but after a few days they commence to deepen to a brown tone and subsequently to a reddish-grey. Ultimately their colour is either a greenish-grey or a slatey-grey according to the breed.

It is of the greatest importance that the eggs should not develop into caterpillars until there is an ample supply of freshly-grown mulberry leaves for them. At silk-farms, therefore, the trays of minute eggs are carefully placed into cold storage for the winter, as low temperature effectually retards their development. In China the old-fashioned method of achieving this purpose was to put the eggs into jars that were stood partially immersed in a current of ice-cold running water, and this method is still in common use by the small farmer.

With the return of the mulberry plants to leaf in the following May the silk farmer prepares for many busy weeks ahead, for the time has now arrived when the evolution of the season's silkworms must be resumed. The trays of eggs are withdrawn from cold storage and the eggs carefully placed on new mulberry leaves laid out on open shelves in a warm, but well-aired room. At the time the eggs are transferred to the shelves the temperature of the room is about 75°F. and during the following six or seven days it is increased by roughly 2°F. per day. Sometimes the hatching of the eggs is hastened by placing them in open packages in small incubators.

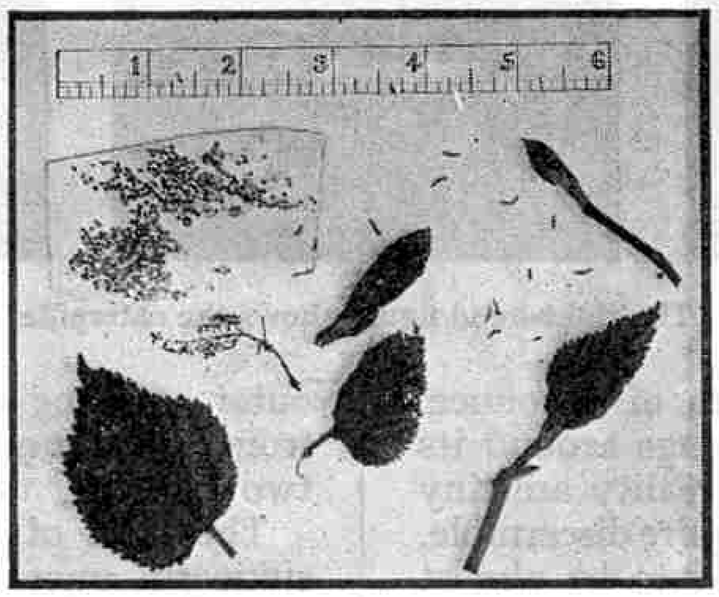
As the time for hatching approaches, the eggs change to a light colour. The protecting shells become so

nearly transparent that the outline of the caterpillar curled up within can be faintly discerned. A brownish curved mark on the shell denotes its position, while a tiny dark spot shows the position of the head.

The actual hatching of the silkworm egg is interesting, especially if watched through a good magnifying glass. In extricating itself from its shell the caterpillar always breaks through at the rounded side of the shell and never through the flat surfaces. This tiny creature that chews its way to freedom is barely 1/12th of an inch in length—too small for its various characteristics to be easily seen by the naked eye. The body of the caterpillar is largely covered with tufts of dark hair, which a magnifying glass shows to be growing from a number of minute warts arranged in rows. If these hairs were to be removed it would be seen that the tubular body of the insect is divided by dark rings into 12 annular segments. Where these dark markings occur the body is slightly constricted, as is also the case with caterpillars other than those of the silk moth.

Thousands of eggs clustered together

The three segments immediately behind the head are difficult to distinguish, as the protecting skin is usually considerably wrinkled, but from the underside of each of these portions there projects what appears to be a pair of hooks, but which actually are the caterpillar's real legs. Beneath segments six to nine are four pairs of "claspers."

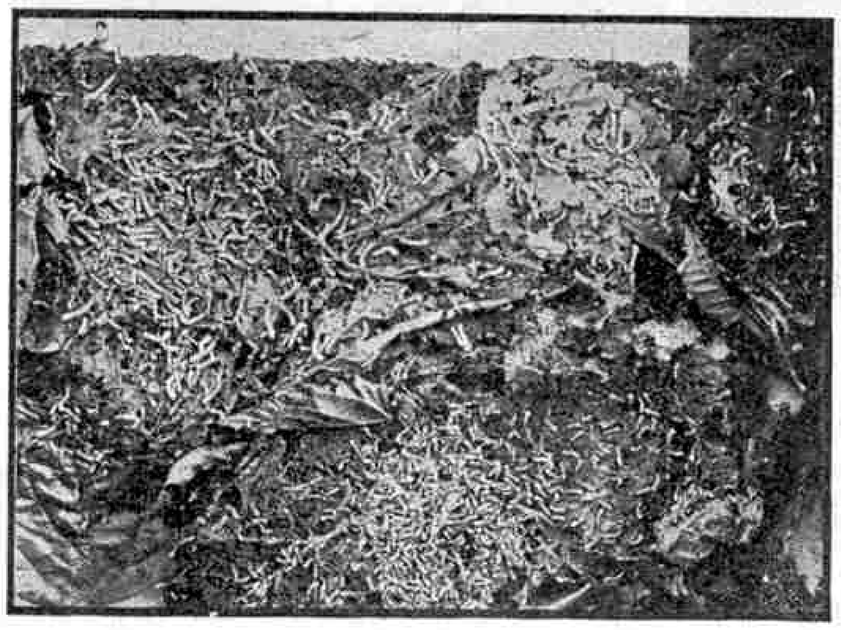


Photograph showing the comparative sizes of eggs, mulberry leaves and caterpillars newly-hatched

The baby caterpillar soon commences to eat ravenously, and in the course of the first few days of its life rapidly fills up its loose skin which, although very elastic, does not grow like the rest of the insect. About the fifth or sixth day this skin becomes uncomfortably tight and at last the silkworm loses its appetite and presently stops eating. This rest marks the end of what is known as the silkworm's "first age."

Despite its extreme youth the silkworm has been busy growing a second skin beneath the first, and the time has now arrived to cast off the latter. Having selected a favourable place amid the mulberry leaves the silkworm raises the fore part of its body, grasps the support it has chosen and runs a few silken threads across to just strengthen matters, meanwhile holding on tenaciously with its claspers to the leaf beneath it. On completion of these manœuvres it rests awhile, remaining so absolutely passive that the French regard it as the "sleep" of the silkworm.

Immediately the siesta is over the crucial task of skin-changing commences. The caterpillar thrusts forward its head, a swelling of the raised forepart of the body becomes noticeable and suddenly the old skin splits at the head. After wriggling its head free of the undesired covering, the silkworm slowly draws out the front half of its body. By muscular action it now pushes the old garment off backward and soon the entire silkworm becomes visible, resplendent in a new skin, and with the old skin left behind in a pathetic heap, the shell of the claspers still holding on to the leaf!



Young caterpillars (see next page)

The new skin, like the first one, is loose-fitting and as the silkworm frees itself from the latter it expands with relief, and when completely emerged is bigger than ever. There are noticeable changes in its appearance. This new skin is of a greyish colour and the head is now more prominent. When the moulting, as the casting-off process is called, has been safely accomplished, the silkworm loses no time in resuming its ravenous feeding, and the events of the "first age" are repeated.

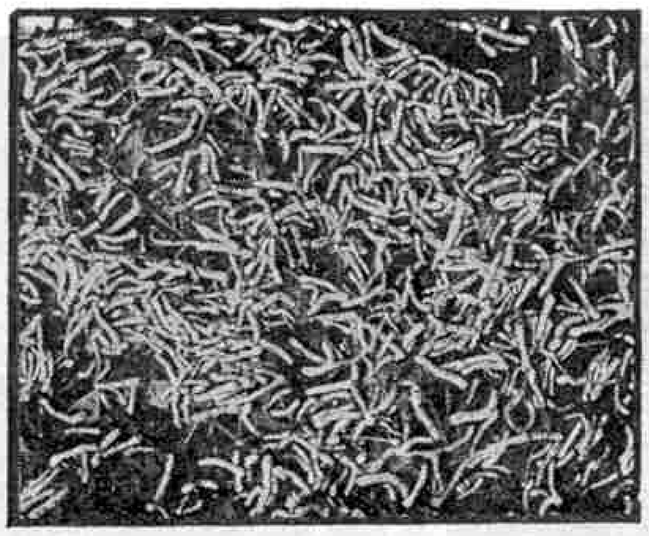
The mulberry leaves that form the staple food of the silkworm are not from the mulberry fruit tree but from the white mulberry tree. The latter tree produces only small berries that are of no value to the silk farmer, but its leaves are of great importance. Under normal conditions a healthy white mulberry tree will yield nearly 30 lb. of leaves in the course of a single season. Trees that are only three or four years old yield the richest quality of leaf, and reforestation of one part or another of the silk-farmer's plantation is therefore an important part of the season's routine. As many as 500 trees can be grown satisfactorily on one acre of land. Great care has to be taken that all leaves served to the silkworms are perfectly dry as a precaution against disease, and when rainy weather is anticipated sufficient leaves to last several days are collected while still dry.

The first meal of the day is served as early as five o'clock in the morning. Other meals follow at intervals of a few hours and the last one is given about ten o'clock at night. When feeding-time comes round new leaves are carefully laid on top of the caterpillars, care being taken to spread the food as evenly as possible. This is important, for if one caterpillar gets more food than the others it will attain the next moulting period earlier than they, and this must be avoided. The cleaning of the shelf upon which the caterpillars are being reared is done by placing over the creatures a net or a sheet of specially prepared perforated paper, on top of which fresh leaves are placed. In a short time the caterpillars find their way up through the mesh or perforations and the net or sheet can be gently lifted to another shelf while the first one is cleaned up.

The second moult occurs about four or five days after the first, the

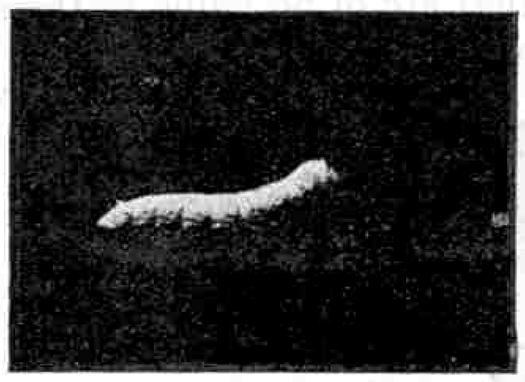
silkworms having in the meantime grown appreciably and also paled a good deal in colour. By the time it is about six weeks old the adaptable silkworm has outgrown four skins and has attained a length of almost three inches.

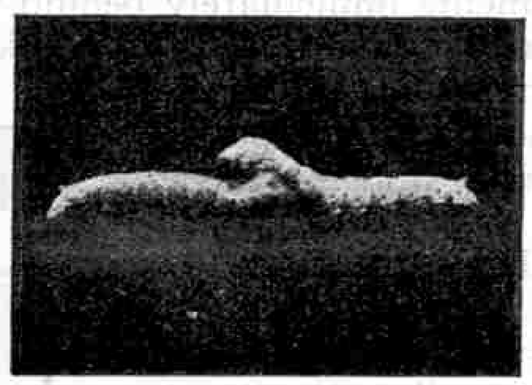
In this country the five phases of growth vary somewhat in duration, the first occupying about a week, the second, third and fourth about five days each and the fifth roughly 10 days. Each period is devoted to sheer gormandising, and as the silkworm approaches maturity its appetite becomes insatiable. At silk-farms where 50,000 or 60,000 caterpillars are bred each season the attendants are busy from morning to night in replenishing the supply of food. The amount of leaf consumed about this time is tremendous and during the first seven or eight days of its fifth age a silkworm eats more food than during the whole of its preceding existence. Extra care is taken during this period to ensure that the silkworms shall have only the richest of the leaves, as the nourishment in the food is now being expended more in building up within the silkworm the elements of silk than in continued growth of the creature itself.



The change after a few meals

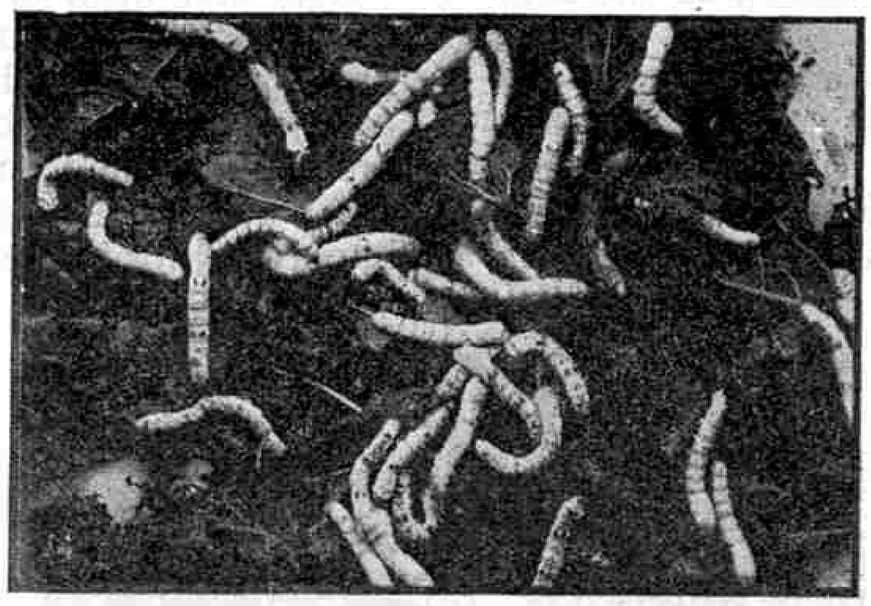
About the eighth day the silkworm begins to lose its appetite and a day or so later it ceases to eat. At this period it weighs about one-ninth of an ounce. It is now full-grown and on the dark rings around its body the various black spots, which in reality are tiny openings through which it breathes, are quite discernible. It is a pale yellow and so waxen-like as to be almost transparent.





Three stages in moulting. The right-hand figure shows the caterpillar alongside its cast-off skin

The silkworm now becomes very restless and, forsaking the mulberry leaves, crawls disconsolately about, endeavouring to climb any favourable object it encounters. Thin wisps of silk-like thread begin to issue from a "spinneret" in its lower lip. The sudden development of a desire to climb indicates the arrival of what is called the "ascension" period, and in conjunction with the intermittent action of the spinneret indicates plainly that the silkworm is seeking a place wherein to spin its cocoon.



Almost ready for spinning

The silk farmer is quickly to the rescue with sundry ingenious devices to aid the insect. Of these, one of the most adopted is a framework of twigs so arranged that their shoots intertwine, and this is carefully erected over the tray or shelf upon which the caterpillars are situated. They are not long in locating this welcome framework and, climbing up, they soon find a suitable place amid the twigs.

Now the silkworm commences the great work of its life. First of all it casts a few threads from one supporting twig to another to reduce the instability of the structure to the minimum. Then, beginning at the farthest points and gradually working towards its central situation until there is left only sufficient threadless space for the creature to turn around in, it spins an elaborate lattice work of delicate threads.

The material emitted from the spinneret is not pure silk but a composition of two substances called fibroin and serecin, each of which is composed of oxygen, hydrogen, nitrogen and carbon, though in different proportions. The name given to the thread is fibroin, as this substance forms the body of the thread, while serecin is merely the gummy substance with which the thread is wholly covered. Fibroin will not dissolve in water, even though this be at boiling point; but serecin, popularly known as "silk gum," is easily rendered soluble by boiling. It is also the means by which the thread hardens on exposure to the air.

The silkworm is occupied for several hours in spinning the elaborate foundation that is to support the cocoon, and when all preliminaries are finished it commences the spinning of what becomes the outer covering of the cocoon. The thread that issues from the spinneret of the caterpillar really consists of two threads, united into one by a kind of varnish.

The task of spinning engages the attention of the silkworm unceasingly for at least four days. At the end of the first day the loose outer covering, showing in the rough the ultimate oval shape of the cocoon, is completed. The thread thus spun is known as "floss," or "coarse silk," and it is now used commercially.

As the tireless silkworm continues spinning it gradually becomes lost to view in the maze of the thread that thickens around it. The cocoon is spun by a peculiar waving movement of the head and a slow turning of the body. Hour after hour this monotonous motion is maintained, the silk-like gummy thread winding itself, with never a break, backward and forward along the inner wall of the cocoon. The healthier and stronger the silkworm the greater is the store of fibroin it has to draw upon and a completed cocoon may contain as much as 1,300 yards of unbroken double thread! All cocoons are not of the same colour, different breeds having their own shade. Those of the best breeds are white, while others are golden or pale

yellow, or even a greenish tint.

Each cocoon is left untouched for about a week to ensure that the caterpillar hidden within shall have exhausted its supply of precious fibroin and completed spinning. The cocoon is then gently removed from its resting place and added to other withdrawals. A number of male and female cocoons are then carefully selected from the stock and affixed to a sloping board to await the transformation of the caterpillars into moths from which to obtain a supply of eggs to store until another season comes round.

The caterpillar within each cocoon soon undergoes its fifth transformation. This time, however, the moult is of a more drastic character and at the conclusion of it the caterpillar has become a chrysalis.

The sixth and last change takes place when the cocoon is from two to three weeks old. Within the closed silken chamber the chrysalis has been slowly developing into a moth. When the time arrives for it to make a bid for freedom it softens one end of the cocoon by means of a liquid that it emits from its mouth. The moistened silk then becomes loose and soon a small cream-coloured moth pushes its way out. Although the wings speedily dry and harden they are practically useless. The female moth cannot make use of its wings at all, and the wings of the male moth only serve to steady the creature when descending, upward flight being impossible. The moths are quite unable to eat, and they live only a few days. During that time the female lays her 300 to 400 eggs. Each egg is laid singly and the operation occupies about three days, after which the moth soon dies. The life of the male moth is even shorter, and it perishes a day or so after emerging from the cocoon.

The vast majority of cocoons on a silk farm are not allowed to remain undisturbed long enough for the moth to develop and ruin the fibroin thread by breaking a way through. They are removed from the shelves and "stifled," in order to kill the interned silkworm. This is effected by placing the cocoons on trays in an oven through which steam is allowed to pass upward and escape through outlets above the topmost tray. After about 20 minutes in the oven the cocoons are removed and placed in the sun to dry, after which they are stored away or despatched immediately to some silk factory.

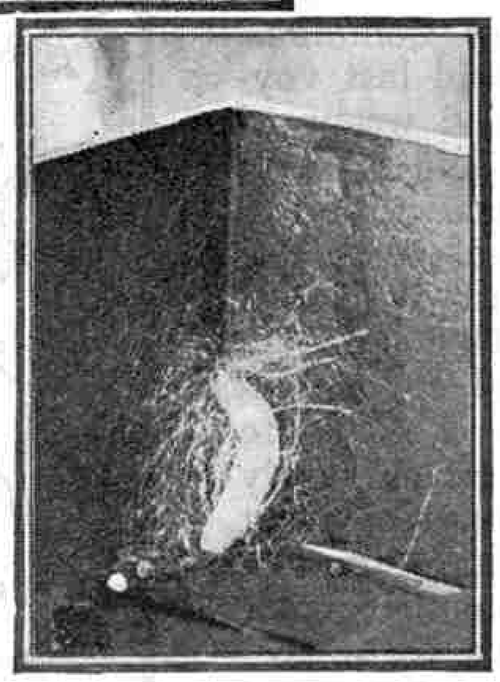
The unwinding or "reeling" of the cocoons is now largely done in factories, and this process and the weaving of the thread will be dealt with next month.

Mention was made in the early part of this article of the oak-feeding species of silkworm moths. Perhaps the best known and most valuable of these are the "*Antheraea Yama-Mai*" moths of Japan and the wild "*Tusser*" moths of India. The Japanese moth is of a bright yellow colour and measures from five to six inches across the wings. This beautiful insect is greatly valued by the Japanese, who devote considerable care to its breeding and rearing. The silk thread obtained from the cocoons—which are sometimes as large as a pigeon's egg—is of an exceptionally fine quality and has a beautiful lustre. Between 2,000 ft. and 3,000 ft. of thread may be obtained from a single cocoon.

The cocoons of the wild Tusser moth are the source of a very large proportion of the silk thread obtained and used in India. The methods employed in breeding and rearing the insects are crude, however, and this fact accounts to a great extent for the quality of the silk produced being inferior to that of the Japanese moth. Tusser silk also contains a high percentage of tannin.

A similar species of Tusser silkworm moth is the *Antheraea mylitta*, which is found also in China. The males are of a yellowish-brown colour and the females a pale yellow, while the fore wings of the male are slightly hooked at the tip. The cocoons of this moth are remarkable, for they are of such hardness that the Indians in certain localities are reputed to use them to extinguish the tinder they carry in bamboo tubes and use for lighting tobacco and other purposes.

Silkworm rearing is a fascinating hobby. Various dealers in naturalists' requisites sell silkworm eggs and the prospective amateur breeder should purchase about May. He should throughout follow the general principles outlined in this article. During hatching of the eggs care must be taken to keep them away from the direct rays of the sun, which are fatal to them. If black mulberry leaves—the staple food of silkworms in this country—are unobtainable, the silkworms should be fed on lettuce, blackcurrant or dandelion leaves, but preferably lettuce leaves.



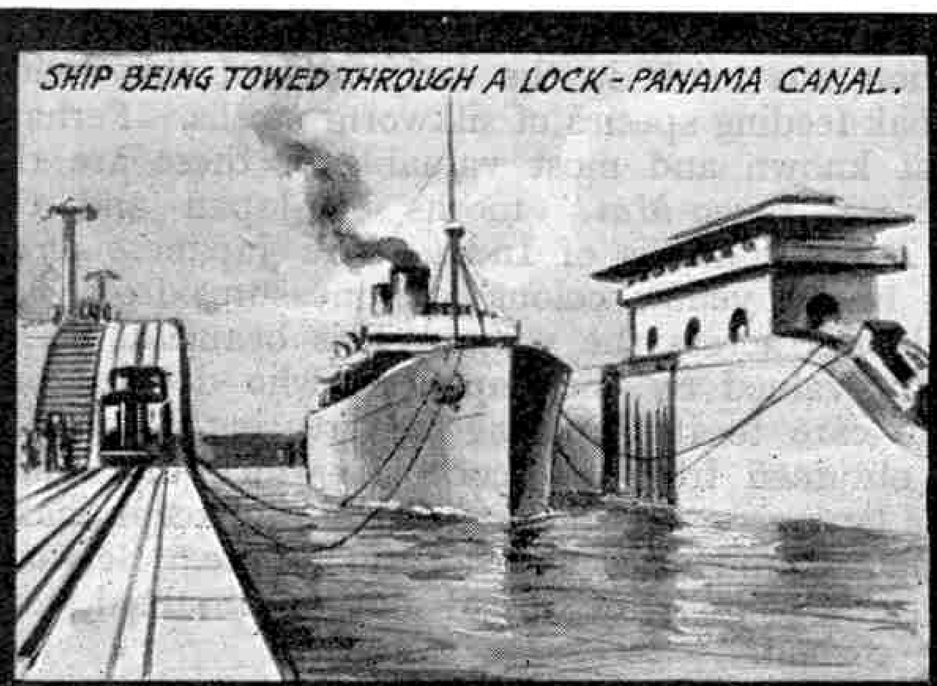
(Top) First stages of cocoon spinning. Note the preliminary supporting threads

(Centre) Fully grown silkworms. In the rear are cocoons in various phases of construction

(Right) Silkworms spinning outer cocoon

To unwind a cocoon, dip it in warm water and gently move it about. When the "varnish" has softened, locate the end of the thread, draw it up and attach to some simple winding arrangement that can be rotated until the whole thread is transferred.

(To be continued)



FAMOUS CANALS OF THE WORLD

V.—PANAMA CANAL

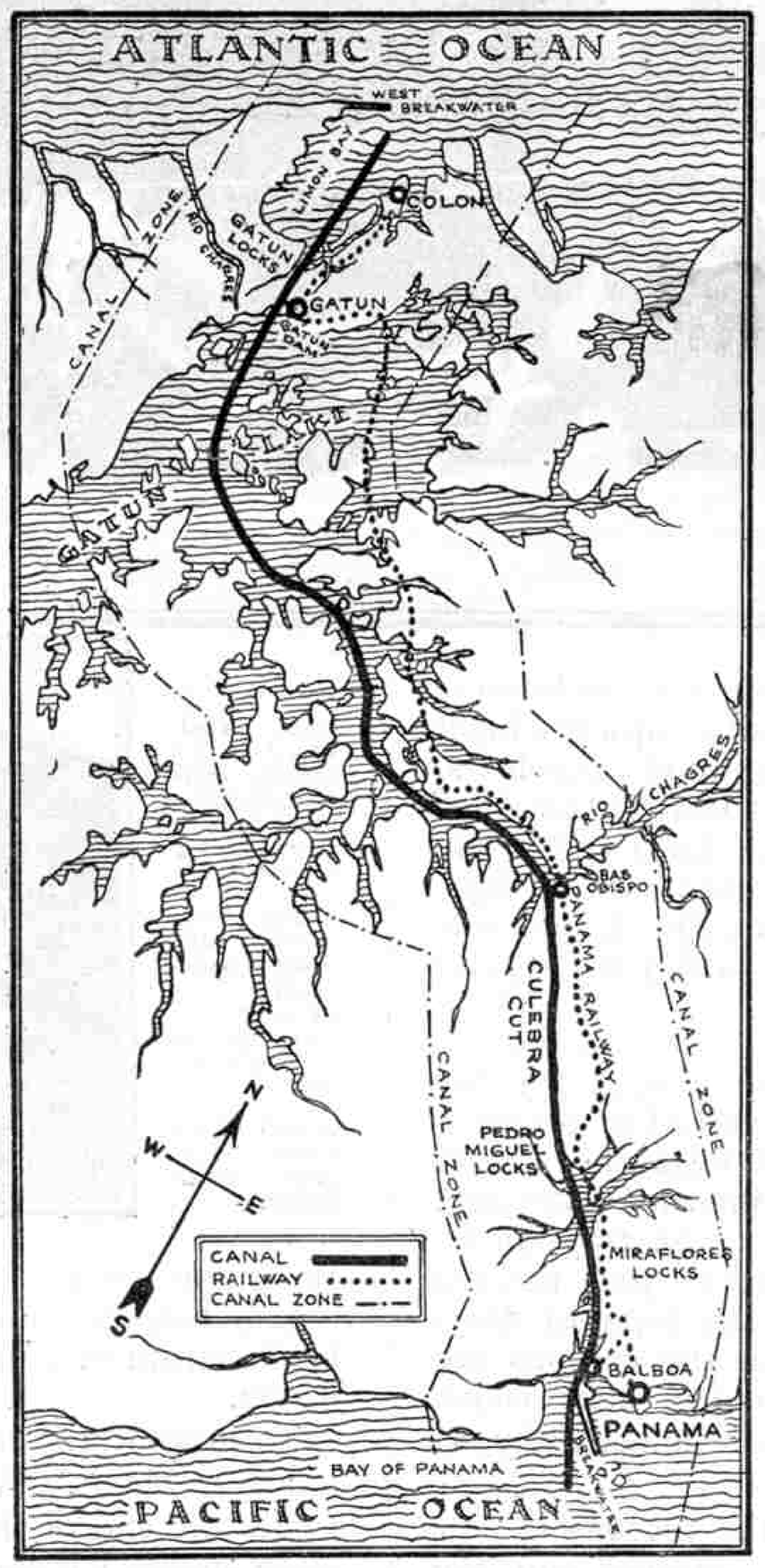
IT would be difficult to find two canal undertakings that present a greater contrast than those of Suez and Panama. The Suez Canal project, as we have seen in the last two issues of the "*M.M.*," involved the comparatively simple engineering task of cutting a channel across the low-lying Egyptian desert and, apart from the awkward incident of the Viceroy's opposition, the work was carried smoothly to a successful finish. The Central American Isthmus of Panama, on the other hand, presented difficulties of almost every conceivable nature, and the story of the Panama Canal scheme, that commences this month, is a thrilling record of a dogged and often desperate battle against dangers and difficulties.

Before the idea of constructing a canal across the Isthmus first came into being, several attempts had been made to locate a natural strait. One of the first to seek for a short cut to the Pacific Ocean was the famous explorer Christopher Columbus. During his fourth and last voyage, 1502-4, he sailed westward across the Atlantic and came to the coast of Central America. He explored the Gulf of Mexico but, failing to find a natural channel through which he could voyage to China and so inaugurate a shorter western sea route to that country, sailed slowly south along the coast of what is now known as the Isthmus of Panama. In the course of his scrutiny of the coast for a possible strait Columbus discovered and named the harbour of Porto Bello, and inspected what is now called Limon Bay and which to-day forms the Atlantic entrance to the Panama Canal. Failing to find any promising opening and convinced that the coastline continued south almost indefinitely—for he believed the land to be part of the continent of Asia—he finally gave up the search and returned to Spain.

Columbus did not make any organised efforts to explore the New World, by which name it became known, and it was not until 1513 that the Isthmus of Panama was first crossed by a white man. This distinction fell to a Spanish adventurer named Vasco Nunez de Balboa who, after a somewhat chequered career, had founded a small colony on the Isthmus. Learning from Indians that less than a week's march away was a great sea whose waters lapped the shores of rich Peru, Balboa set out on 6th September 1513, accompanied by nearly 200 volunteer soldiers, to find this mysterious ocean.

The journey proved much longer than had been estimated and it was not until 25 days later, after encounters with hostile tribes and long, fatiguing marches through dense tropical jungle, that the party sighted in the distance the gleaming waters of the "new" sea. Four days later, with his sword in one hand and the flag of Castile upheld in the other, Balboa trod the Pacific shore of the Panama Isthmus and claimed the land for Spain.

Balboa's company on this historic expedition included Alvaro de Saavedra Ceron, a cousin of Hernando Cortes, the Spanish explorer who later conquered Mexico. During the remaining years of his residence on the Isthmus Ceron devoted considerable time to exploration in the hope of finding a natural strait linking the two oceans, but he failed to discover such a passage. He concluded finally that one did not exist, and is said to have drawn up plans in 1529 for a canal across the Isthmus at Panama. Ceron died before his scheme could mature,



Map showing the Panama Canal

however and his proposals were forgotten.

A natural sea strait linking up the two oceans was discovered near the southern extremity of South America on 21st October, 1520, by the famous explorer Ferdinand Magellan, in the course of his search for a new trade route to the wealthy Moluccas Spice Islands. Magellan gave his name to this narrow sea passage, which was really a succession of inlets. After a 22 days' voyage through the strait his ships entered the "Great South Sea," to which he subsequently gave the name of "Pacific" in recognition of the four months of calm weather with which he was favoured.

The newly-discovered sea strait was much too far south of the Panama Isthmus to be of practical benefit, however, and in 1543 King Charles V of Spain ordered the Governor of the Panama District to carry out a survey of the River Chagres, presumably with a view to converting it into a canal.

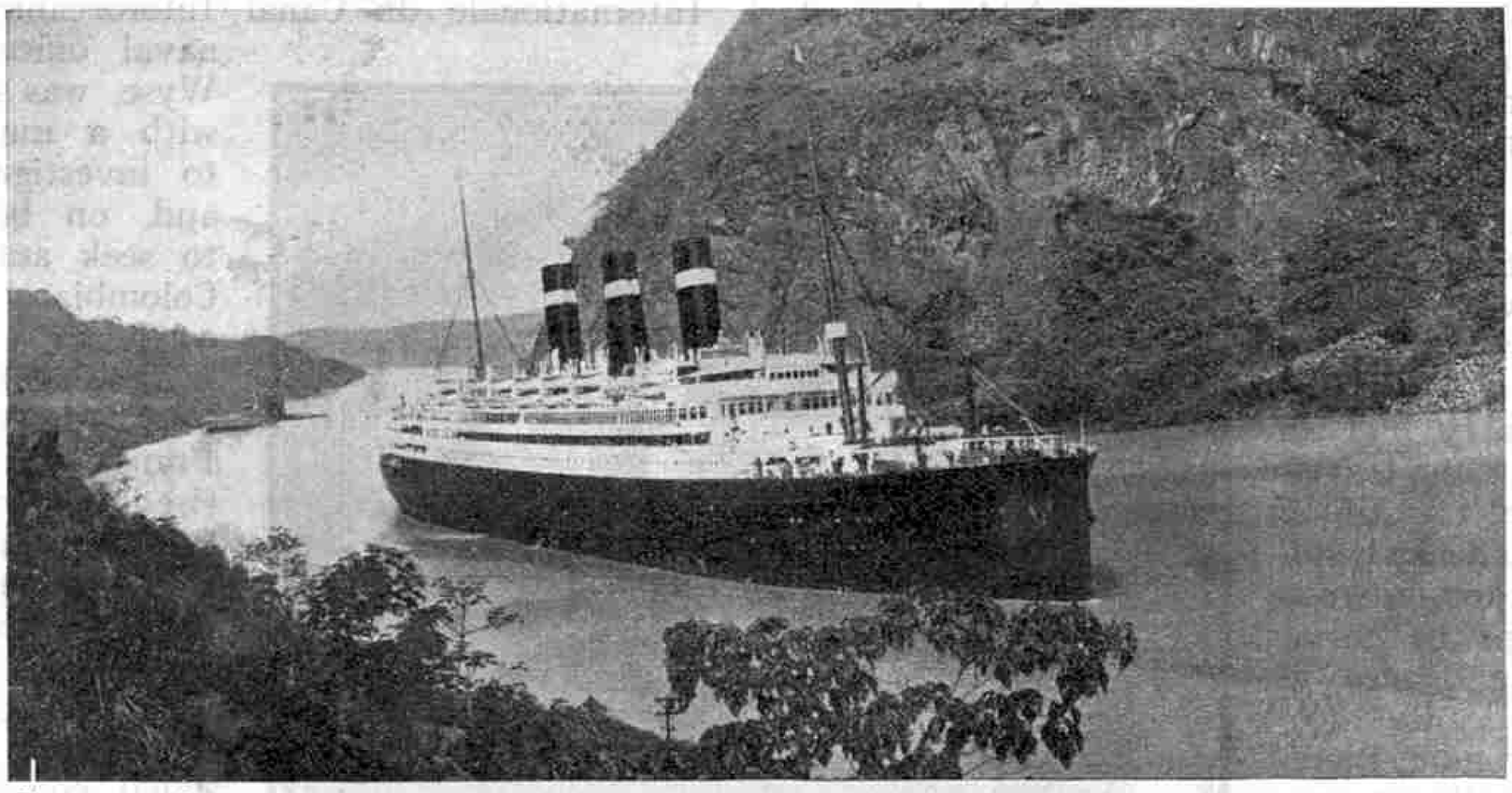


Photo courtesy] ["*White Star Magazine*"

The Red Star Liner "*Belgenland*" on her world cruise, passing through the Panama Canal

By that time Spain had conquered Mexico and Peru and other South American countries and had been systematically looting the defeated cities and exploiting the vast mineral wealth of the continent. The plunder obtained in Peru and Chili was shipped to Panama from where it was transported overland, along a road constructed by the Spaniards specially to facilitate this traffic, to Porto Bello on the Atlantic Coast of the Isthmus. From there it was once more loaded into vessels and conveyed to Spain.

Many of the Spanish treasure ships bound for Panama fell victims to buccaneers, and matters became so serious that it was decided not to risk the valuable cargoes on this route but to send them south to Magellan Strait and from there direct to Spain. It was not long before this route also became dangerous, for in 1578 Sir Francis Drake handled the traffic very severely as he voyaged through the strait and northward along the Pacific coast of South America.

The Spanish historian Gomara in his history of the West Indies written in 1551 declared that a canal across the Isthmus was a practical idea. In his book which was dedicated to Charles V he pointedly remarked:—"There are mountains, but there are also hands. If determination is not lacking, means will not fail; the Indies, to which way is to be made, will furnish them. To a King of Spain, seeking the wealth of Indian commerce, that which is possible is also easy."

With no safe route available for the convoy of its ill-gotten treasure, it is very probable that Spain would have given serious consideration to the construction of a canal across the Panama Isthmus but for the fears of Philip II who succeeded Charles V. Philip was afraid that if the canal were constructed an English fleet would promptly come along and take possession of it. He appears to have been greatly in awe of the growing British supremacy at sea, and it is said that he forbade, under penalty of death, any attempts to construct a canal linking the two oceans.

During the 300 years of Spanish dominion in Central and South America the subject of a canal was revived periodically, but although various surveys were made of different routes, no progress was made in actual construction. In 1814 the Spanish Government ordered the Viceroy of "New Spain"—the name given to the Spanish American possessions as a whole—to have a canal made by what was known as the Tehuantepec route across Colombia. Before this scheme could be commenced however, Colombia revolted against Spanish rule and won her independence.

With the overthrow of Spanish government the prospects of a canal being constructed again faded away and 17 years elapsed before the people of Colombia took up the matter. Advice was then sought by Bolivar, the President, from a London firm of engineers, who after investigation declared themselves in favour of a railway rather than a canal. Apparently Boliver was disappointed by their verdict for the proposal was dropped.

During the early part of the 19th century the route across Nicaragua appears to have been most favoured for a canal. It was specifically named in a United States order of 1825 for an official survey to be made, while four years later the Nicaraguan Government granted the request of the King of Holland for a concession to build a canal across their territory. The proposed Dutch enterprise had to be postponed owing to revolutionary troubles arising in the Netherlands, and was never carried out.

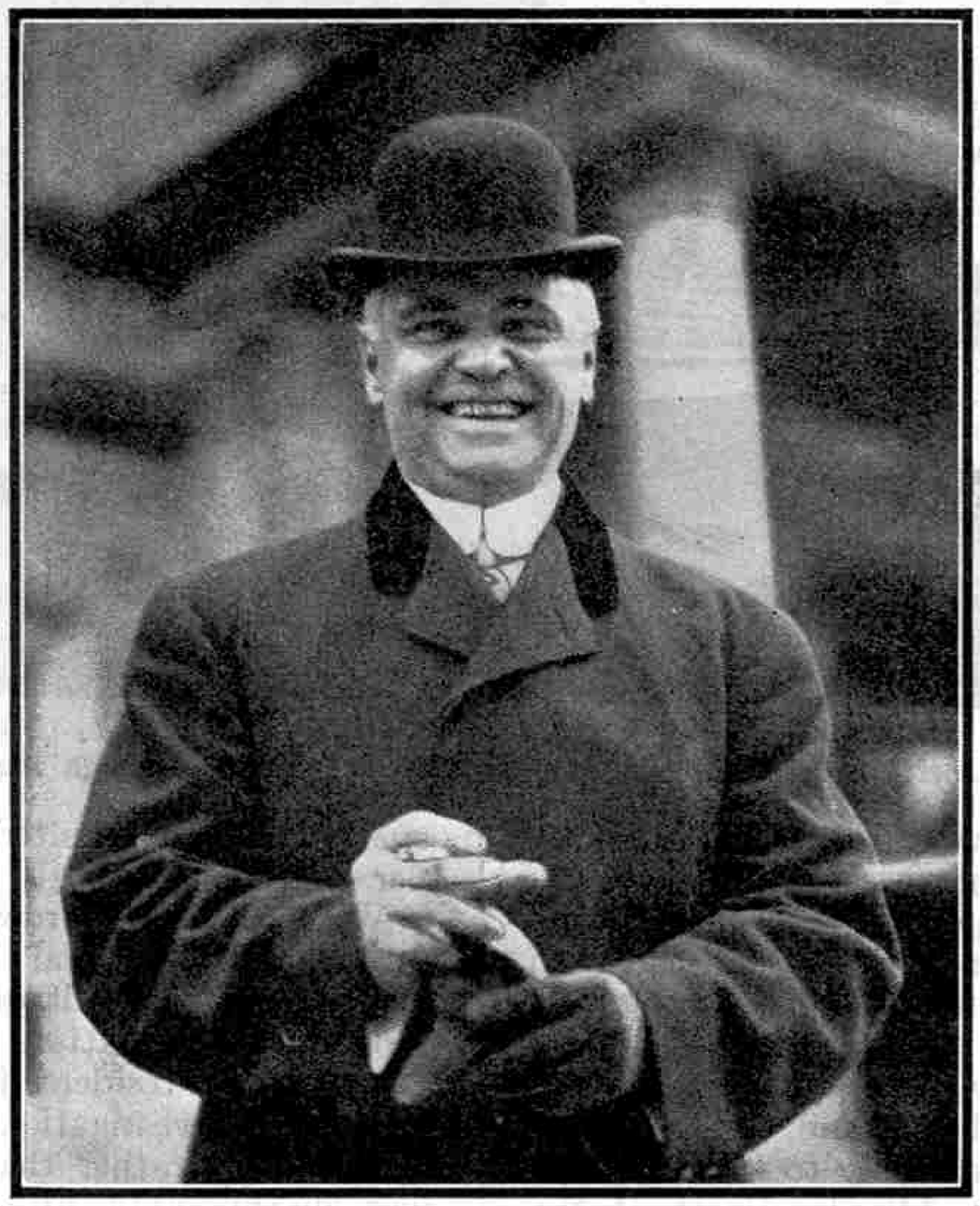
The U.S. Survey of 1825 was followed by prolonged discussions and investigations of numerous schemes. In 1846 the matter was taken a step further by the signing of a treaty between the two republics, by which the United States obtained the right of transit across the Isthmus by any existent or proposed means of communication. A guarantee that the United States would recognise the sovereignty of the Nicaraguan Republic over their own territory was embodied in the treaty.

Another survey of the Isthmus had been made in 1843 by a Frenchman named Napoleon Garella, who was sent to the Panama Isthmus by the French Government. On his return Garella expressed himself in

favour of a sluice canal, but nothing came of his report.

The sensational gold rush to California in 1848 created an unprecedented amount of traffic along both the Atlantic and the Pacific coasts of the American continent. Thousands of prospectors sailed from New York to Colon, crossed the densely wooded Isthmus as best they could, and at Panama took steamer over the Pacific to San Francisco. A group of American engineers and financiers were quick to realise how profitable would be a railway to cater for this traffic across the Isthmus. Backed up by the United States—Nicaraguan treaty, a company was quickly formed and construction of a single railway track across the Isthmus was commenced in 1849.

The task of building the railway gave some indication of the difficulties that would be met with by anyone who attempted to cut a canal through that district. The country had an evil reputation among travellers on account of the stifling atmosphere of its dense tropical forests, and the numerous unhealthy swamps that formed the breeding places of vast hordes of deadly mosquitoes. Small wonder, therefore, that the railway promoters found it difficult to persuade men to remain on the Isthmus long enough to complete the task of clearing a road and laying the requisite 46 miles of track. Progress was inevitably slow and it was not until January 1855—almost six years after the commencement of operations—that the railway was completed. The cost of the project was £2,500,000.



General Goethals, the American engineer who completed the Panama Canal

The new means of transport across the Isthmus proved a great success and was the means of developing the locality, especially at Colon. But the railway could not confer upon shipping the great advantages of an oceanic canal or a natural strait.

The idea of a canal across the Isthmus came to the front again in 1850 when, on 5th July, an important document was drawn up and signed by England and the United States. This agreement, known as the Bulwer-Clayton Treaty, was a guarantee by these powers that any canal made across the "Isthmus between North and South America" would be an open sea passage to the ships of every country in the world. The treaty solemnly stipulated that neither country should "obtain or maintain for itself any exclusive control over the said canal."

When the treaty was signed it was felt that the time had arrived to encourage proposals for an Atlantic-Pacific canal, but it was not until 1869 that substantial signs of progress in that direction became noticeable. The successful completion in that year of the Suez Canal undertaking, and the great saving in time it made possible to ships, gave a decided fillip to schemes for oceanic canals. The idea of cutting a vast continent at some place where it narrowed, thereby saving several days of voyaging, became distinctly attractive, and sensational schemes for sea-to-sea canals were put forward in various countries. De Lesseps, the engineer of the Suez Canal, found himself feted and honoured on every hand and France, immensely proud of his achievements and fame, began to hint at the Isthmus of Panama as a likely scene for further triumphs.

A progressive step was taken in 1876 when a company was formed with the title of "La Societe Civil Internationale du Canal Interoceanique." A French naval officer named Lieut. Wyse, was sent to Colombia with a number of experts to investigate the Isthmus and, on behalf of France, to seek authority from the Colombian Government to construct a sea-to-sea canal.

The negotiations proceeded slowly, but three years later France was granted the desired concession on various conditions, one of which was that any canal decided upon must be completed within 12 years of a company being formed to construct it. The concession granted to the canal company "all public lands required for the construction and service of the canal, of a belt of land 219 yards wide on each side of its banks throughout the entire length, and 1¼ million acres in localities to be chosen by the company." After a period of 99 years, dating from the time of the opening, the canal was to become Government property.

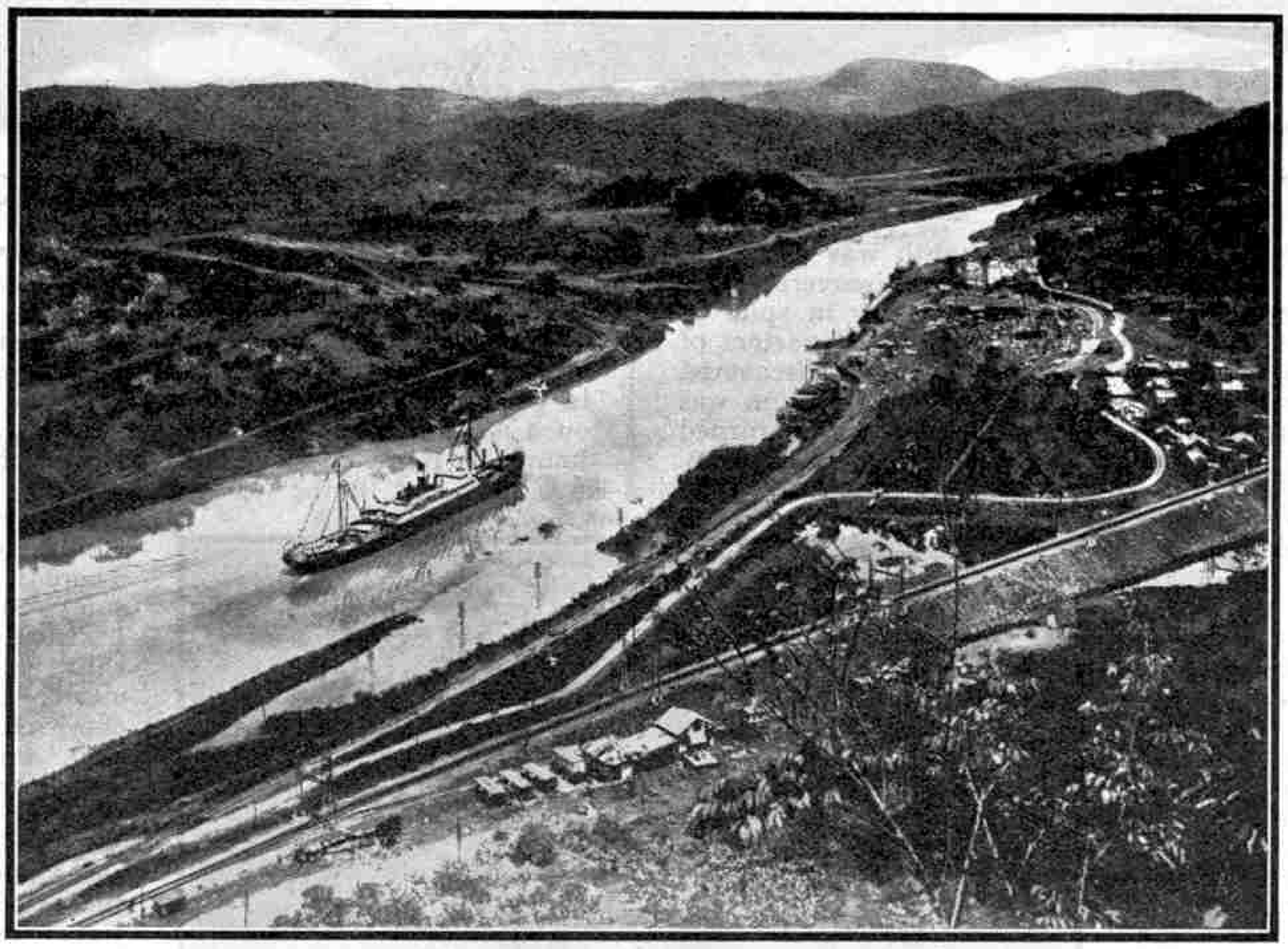
In due course the experts returned to Paris, where a committee was formed with de Lesseps as chairman. The famous engineer immediately called together an international conference, and on 15th May 1880, 137 delegates, representative of many different nations, met in Paris to decide as to the best type of canal to construct at the Isthmus. Opinions were divided. A number of engineers strongly advocated a canal equipped with a series of locks and constructed along the Nicaraguan route, as on this course excavation would be confined almost entirely to joining up extensive lakes and enlarging rivers. De Lesseps, on the other hand, was wholly in favour of a sea-level canal by the shorter but more difficult Panama route. The problem was debated for a fortnight, and de Lesseps finally won his case.

Efforts were now made to raise the necessary funds, but the French public urged that de Lesseps should visit the Isthmus before committing himself to any definite scheme. This he accordingly did in company with several engineers, who had assisted him at Suez, and in due course he returned to France still completely in favour of a sea-level canal. Encouraged by the knowledge that the famous engineer had studied the

problem on the spot, and stimulated by his confidence and enthusiasm, rich and poor alike among the people now gave liberally of their savings to provide the needed funds for the great Panama enterprise.

De Lesseps estimated that the entire cost of constructing the sea-level canal would be 843 million francs (normally £34,000,000). Those engineers who had recommended a canal with locks shook their heads, however, and declared gravely that the sea-level scheme would end in disaster for all connected with it.

A corporation was now registered under the name of "Compagnie Universel du Canal Interoceanique de Panama," and the making of a canal across the Isthmus began in earnest. One of the most important initial steps was the engaging of large numbers of French labourers and the conveying of them to the Isthmus. Little was known of conditions on the Isthmus, and those who believed they were voyaging to some El Dorado found themselves, on arrival, confronted by a sadly different state of affairs from that existing in their own country. At Colon and Panama the advent of the railway had resulted in the development of those neighbourhoods, but in the interior of the Isthmus primeval tropic conditions reigned supreme.



A picturesque view of the Culebra Cut

The route chosen for the Panama Canal was adjacent to the railway and, in order to be able to use the latter freely for the quick conveyance of men and materials from one part of the canal zone to another, de Lesseps purchased the concern for £5,100,000.

The first batch of employees, who reached Colon in February, 1881, were soon busy erecting hutments, hospitals, etc., and in assisting to complete a detailed survey of the route. As successive squads of workmen arrived at Colon a start was made upon the arduous task of clearing a way through the dense forest areas in preparation for the actual excavation of the channel. Camps were established at various points on the canal route and were made the starting points of operation for the clearing parties there quartered. The task of cutting the requisite pathway through the forest proved slow and expensive, but sufficient progress was at length made to enable excavation work to be begun in earnest. The scale of operations steadily increased, and by 1883 there were about 11,000 workmen engaged on the Isthmus.

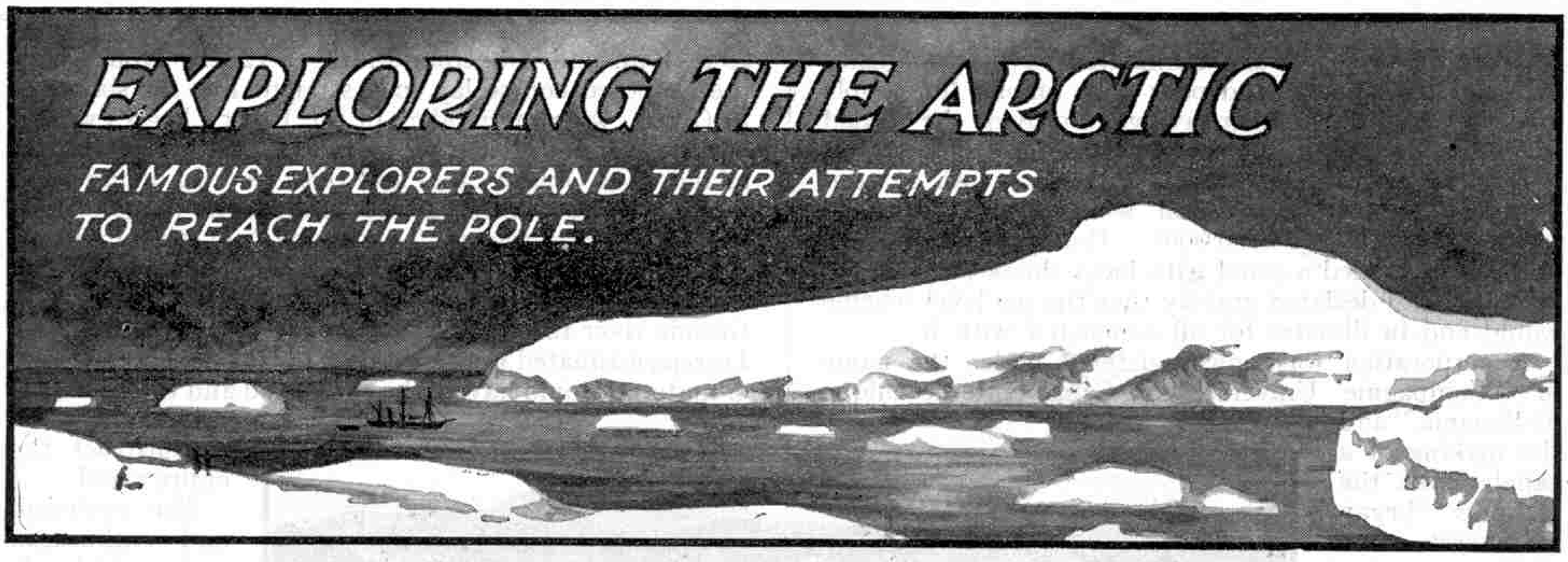
As planned by de Lesseps the canal was to be approximately 47 miles in length, to have an average depth of 29 ft. 6 in. and a bottom width of 72 ft. From Colon the proposed course lay in a straight line for six miles to Gatun, where the valley of the River Chagres was to be entered and followed to Obispo, 21 miles farther inland. At Obispo canal and river were to diverge, the former thence cleaving a way through the range of hills that form the rugged "backbone" of the Isthmus. This range was to be penetrated at Culebra Hill, the canal thereafter passing down the valley of the Rio Grande river to Panama Bay in the Pacific Ocean. De Lesseps estimated that a total of 157,000,000 cubic yards of material would have to be excavated and that it would take eight years to construct the entire canal.

The optimism and enthusiasm with which de Lesseps and his men began their difficult task on the Isthmus soon became severely taxed. Difficulties and disasters occurred with distressing frequency and the discontent that in time grew rife among the workpeople was not diminished by de Lesseps' periodical discoveries that he had sadly under-estimated the extent of the work involved in constructing the canal. So greatly had he miscalculated the amount of excavation required to cut a channel through Culebra Hill that, in a revised estimate he gave a year or so after work had been commenced on the Isthmus, his original figure of 100,000,000 cubic yards was increased to 176,500,000 yards!

In the Chagres valley the route of the canal intersected the course of the river almost 30 times, and all efforts of the French engineers to restrict the river to the dimensions of the canal proved unavailing. Every tropical rainstorm converted the wide Chagres into a tremendous torrent, the volume of the river's flow increasing with incredible swiftness from about 350 cu. ft. per second to more than 100,000 cu. ft. per second, and carrying all before it. Rising with visible rapidity the river soon overflowed its banks and ruthlessly swept away the barrages and embankments erected by the company.

After repeated and costly delays on this account de Lesseps finally constructed a special outlet for these sudden and heavy floods by building a 150 ft. dam across the river at Gamboa, near Obispo, and thence providing the water with a special diversion channel to Colon Bay. These various additional labours proved a heavy drain upon the company's funds, and it became evident that the estimated cost of the canal would be greatly exceeded.

(*To be continued*)

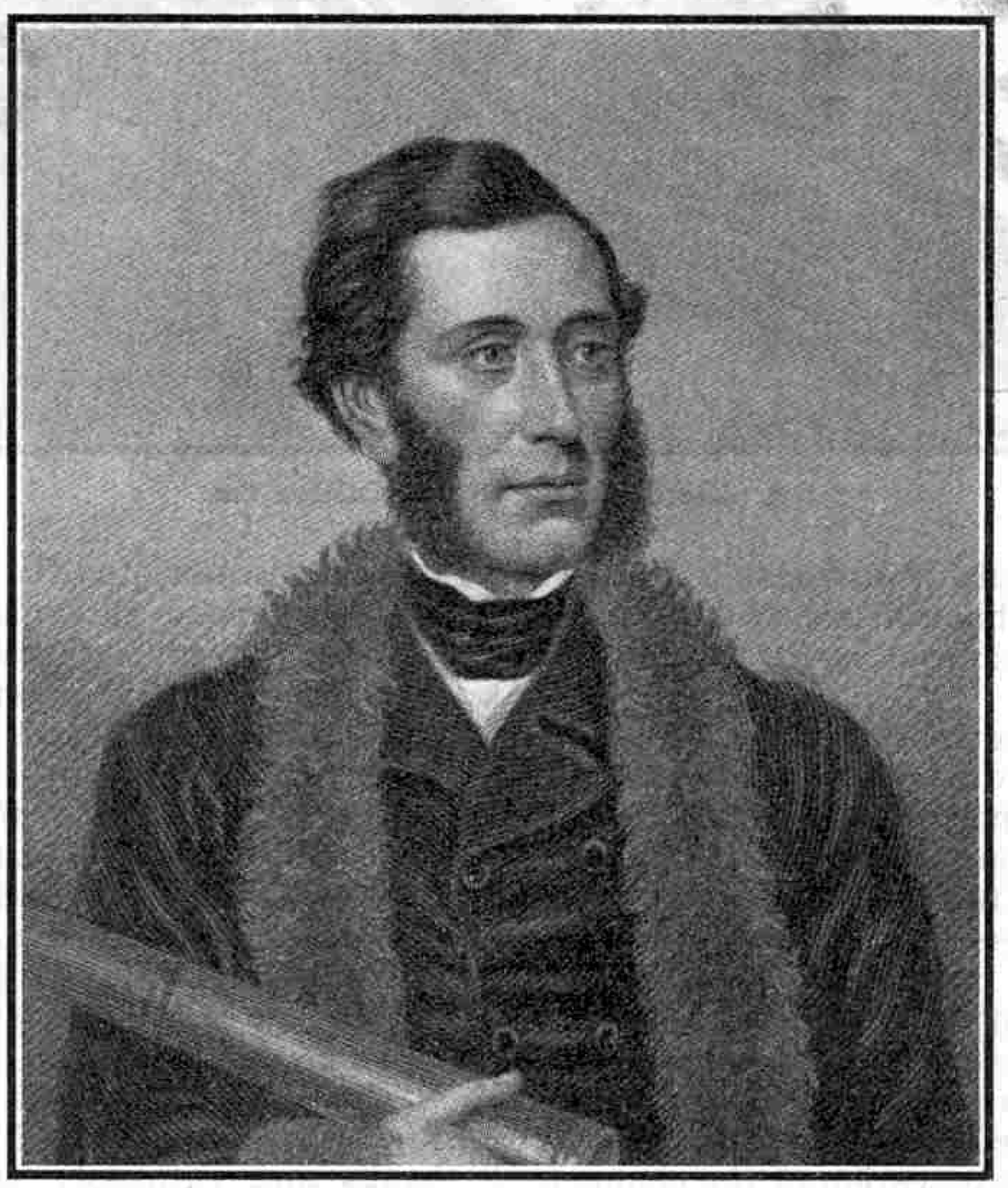


XV.—M'CLINTOCK TAKES UP THE FRANKLIN SEARCH

M'CLURE'S expedition described last month was no more successful than previous expeditions in discovering the fate of Franklin, which remained a mystery in spite of all efforts. It will be remembered that the winter quarters of the ill-fated explorers on Beechey Island had been discovered by Captain Ommaney in 1851, but no further information was obtained for almost three years. Then in 1854 Rae returned from a journey to the Arctic coast of Canada with definite news. He had learned from Eskimos that a party of about 40 white men had been seen on the coast of King William Land and that they travelled from there towards the mouth of the Great Fish River, where they all perished of starvation. Rae obtained certain relics from the Eskimos who gave him this information and these proved to have belonged to Sir John Franklin and some of his companions.

The necessity for following up Rae's work by further search in the same district was urged upon the Government by Lady Franklin and the ill-fated explorer's colleagues, but the conclusion had been formed that further exposure of the lives of officers and men to the risks of such an enterprise was not justified, as there was practically no hope of finding any of the crew of the "*Erebus*" and the "*Terror*" alive. In April 1857 the final decision of the Government to proceed no further was announced, and Lady Franklin immediately decided to send an expedition on her own account, as she was determined to learn the full story of the fate of Sir John and his men.

The "*Fox*," a steam-yacht of 177 tons, was purchased and refitted to adapt her to polar work. Everything ornamental was removed and the vessel was sheathed with thick planking and fortified by cross beams. A stout iron propeller was fitted and the sharp stem was so heavily cased in iron that it resembled the blade of a giant chisel. Finally the quarters of the officers and men were cut down to the minimum, for in Arctic exploration everything else must give way to the necessity for carrying as much food as possible.


Captain F. L. M'Clintock

The command of the vessel was entrusted to Captain F. L. M'Clintock. A more capable leader could hardly have been found. He was an Irish naval officer like M'Clure, and had already distinguished himself in three of the expeditions devoted to the search for Franklin, particularly by making long and arduous sledge journeys of great geographical value. He selected as second in command Lieutenant Hobson, an officer also distinguished in Arctic service.

Another noteworthy member of his staff was Carl Petersen, the interpreter. Petersen had lived 18 years at a whaling station in Greenland and had accompanied Kane, the American explorer, on a memorable voyage through Smith Sound into what is now known as Kane Basin. The ship in which this was accomplished was held fast in the ice and it became necessary to return to civilisation in small boats under the most miserable conditions. There is little doubt that the safe return of the Kane expedition after abandoning their ship was largely due to this sturdy Dane, who saved his companions from absolute starvation, when within reach of a settlement in Greenland, by shooting a seal as coolly and accurately as if he were on a casual hunting expedition. At the time of M'Clintock's projected expedition Petersen was paying a visit to his home in Copenhagen, but six days after his arrival there he responded to a telegram by appearing at Aberdeen, where the "*Fox*" was being fitted out.

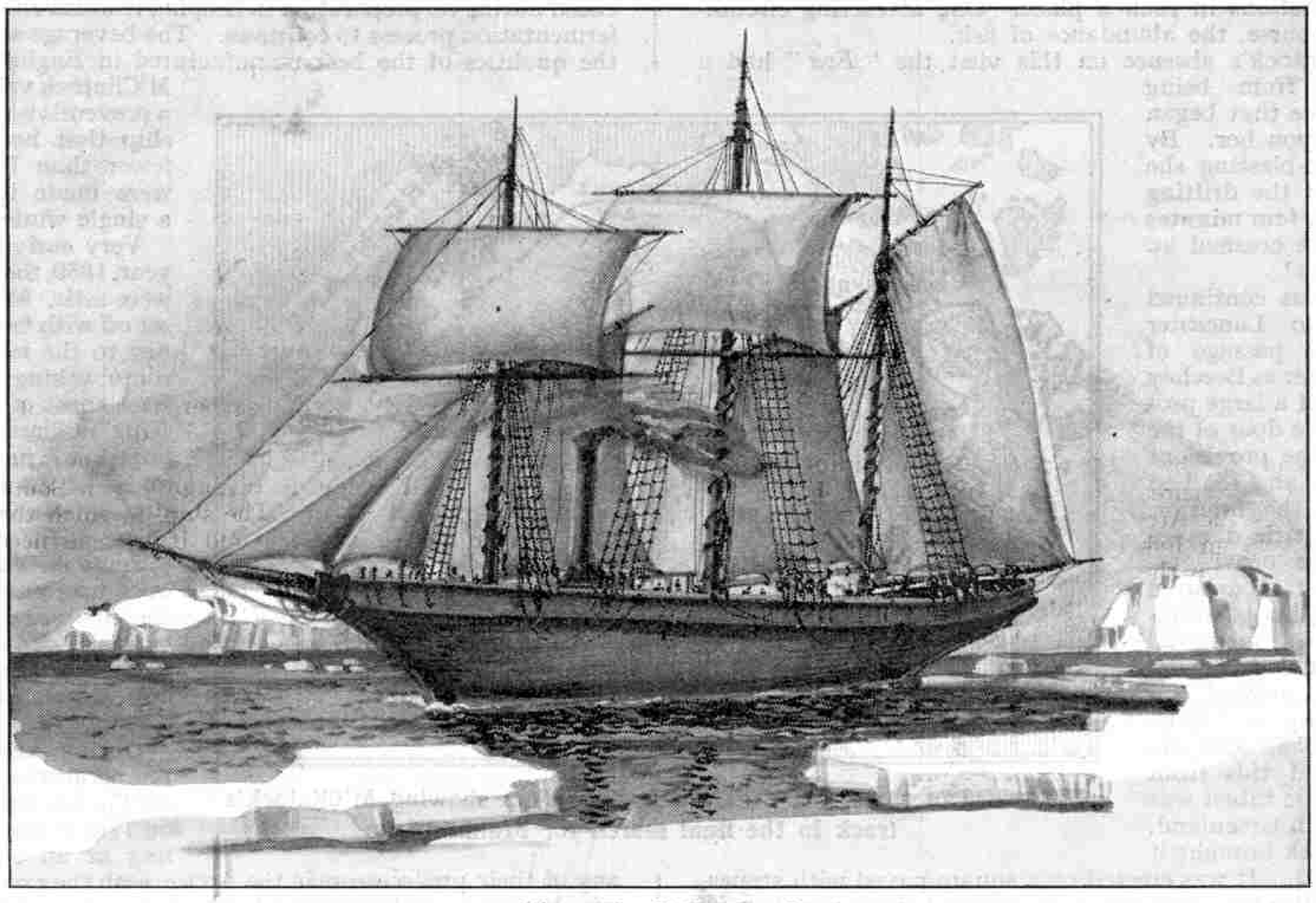
Although the Government had decided not to send out an official expedition, they acted generously in contributing ice gear, charts, clothing and nautical instruments, in addition to three tons of pemmican. The work of preparation was pushed on rapidly and finally, on 30th June, the vessel set sail. Unfortunately she ran aground upon the bar and remained there until next day. At high tide she floated off and commenced her long and lonely voyage.

The earlier part of the voyage was by no means auspicious. Calling at several Danish settlements on the west coast of Greenland in order to obtain stores and dogs, the ship reached Melville Bay in the middle of August and attempted to pass through the ice of Baffin Bay in the track pursued by Franklin towards Lancaster Sound. The ice in this bay breaks up in spring and drifts to the south in a mass, usually described as the "middle ice." There are three possible routes through it from Greenland to the west, known respectively as the northern, middle and southern passages. The first and the last of these may be found more or less unobstructed owing to the drift of the ice, but the middle passage is accomplished by pushing through the pack.

The practicability of these routes varies very greatly, but

usually the northern passage is chosen. It was M'Clintock's intention to pursue this route, but to his disappointment the "*Fox*" was beset in the ice a few days later and was unable to proceed. The lookout-man in the "crow's-nest" scanned the horizon in vain for "leads" or open lanes of water through which to sail or steam. The ship was helpless in the ice and drifted very slowly with it in a westward direction, until at length M'Clintock became convinced that she would not be released in time to reach Lancaster Sound that season. All efforts to warp her through the ice pack proved unavailing, and even blasting the ice was useless, as the removal of the surface ice by explosion only brought up huge masses of ice previously submerged.

Ultimately, when it was too late, the ice broke up, leaving open lanes of water in all directions. Unfortunately the nearest of these was half a mile away and the new ice in process of formation prevented the ship from reaching it. Towards the end of October the drift assumed a southerly direction and the "*Fox*" was not released from the ice until the spring of the following year, by which time she had covered 1,385 miles and had almost reached the Atlantic Ocean once more. The passage through the loose ice on the edge of the pack was very dangerous, but the stout little vessel withstood her severe buffeting splendidly.



The "*Fox*" becalmed

During the tedious drift to the south the only interest and excitement was that afforded by the appearance of bears and seals which were immediately pursued as the meat obtained from them was valuable. The hunting was carried on chiefly by Petersen and Christian, an Eskimo dog driver who had joined the expedition in Greenland. Petersen proved a great acquisition in this respect, his long life in Greenland having made him familiar with all the tricks used in stalking these creatures. He was full of stories of hairbreadth escapes. One of these concerned an Eskimo who, on visiting his nets, found a seal entangled in them. While kneeling down to disentangle it he received a blow on the back, but he ignored this in the belief that it was given him by his companion. A second blow caused him to look round, however, when he was astounded to find a grim old bear looking at him. The Eskimo fled and Bruin calmly extricated the seal and commenced his supper!

Another story regarding dogs was somewhat "tall." Petersen had acquired the Greenlanders' habit of thrashing dogs unmercifully. When remonstrated with on one occasion he told the astonished Englishmen that a friend of his had discovered that he could beat his dogs with a heavy hammer until they were unconscious, and that on laying them with their mouths open to the wind they soon revived and ran about all right! The dogs certainly needed a strong hand, as they were almost wild. Their appetites were amazing and they would eat anything, even leather harness and slippers! An amusing incident occurred when Hobson attempted to administer a slight kick to one of them. Unfortunately his slipper flew off and was immediately seized by the lucky dog, who ran away to enjoy his triumph in secret. Needless to say the slipper was seen no more!

Sharks and whales were occasionally encountered. It was customary to soak salt meat for seven days before using and it was usually lowered in a net through a hole in the ice for the purpose. One morning only a fragment remained and it was generally agreed that a shark had swallowed the rest. The Eskimos believe that sharks are insensible to pain, and M'Clintock found that bullets could be fired through them without having any apparent effect. Petersen assured his leader that he had even plunged a long knife several times into the head of one while it continued to feed upon a white whale entangled in his net! This insensibility may be due to the fact that the brain of a shark is proportionally very small.

On one occasion eight or ten grampus or "killers" were seen. These are smaller than the huge animal hunted by the whalers, but are so ferocious that they attack the whale in spite of the disparity in size. The sight of their fins upon the surface of the water causes the Eskimo in his frail kayak to scurry off to safer quarters.

The spring of 1858 found the "*Fox*" once more on the west coast of Greenland with the season completely wasted. M'Clintock was determined to make his way through to Lancaster Sound without loss of time, and after refitting as well as possible at the various settlements he set off once more to the north. Several whalers were met with, their captains proving very generous with provisions, coal and ship's stores, and at length Cape York, near Smith Sound, was reached.

The "*Fox*" grounded on a reef off Cape York and narrowly escaped disaster. Fortunately she floated again with the rising of the tide before the ice-floes exerted any pressure on her. The hours of waiting for high water seemed like an eternity to the anxious commander, for the ship heeled over at an angle of 35°, and the slightest shake would have caused her to fall over upon her side and become a complete wreck.

The passage across Melville Bay is always dangerous. Only two or three years previously the captain of one of the whalers met with by M'Clintock lost his ship, "*Princess Charlotte*," in an extraordinary manner in these waters. The steward had just reported that breakfast was ready when the captain, seeing that the floes were closing together ahead of the ship, decided to remain on deck a few minutes to see her pass safely between them. The vessel was almost through when the closing points caught her sides amidship, passing through them, and only held up the ship for a few minutes while the crew scrambled into their boats and escaped. Within ten minutes the captain's breakfast and the ship were both at the bottom of the sea!

M'Clintock sailed as far to the north as the ice would allow him and then turned west once more in a second attempt to push through the pack. The ship met with better fortune than in the previous summer and reached Lancaster Sound by the middle of July. On the way a few Eskimos were met with on the coast of North Devon. They had come from their home in the south across the ice of Lancaster Sound and it was noted that one of them, named Kal-lek, was distinguished by the possession of a bald head, a rarity amongst those people!

M'Clintock now made for Ponds Bay, a rendezvous of the whalers a little to the south of Lancaster Sound. He landed and interviewed two Eskimos who were living there in order to trade with the whalers. They gave unsatisfactory answers to all inquiries regarding wrecks and castaways, and M'Clintock determined to visit the Eskimo village from which they came. This was known

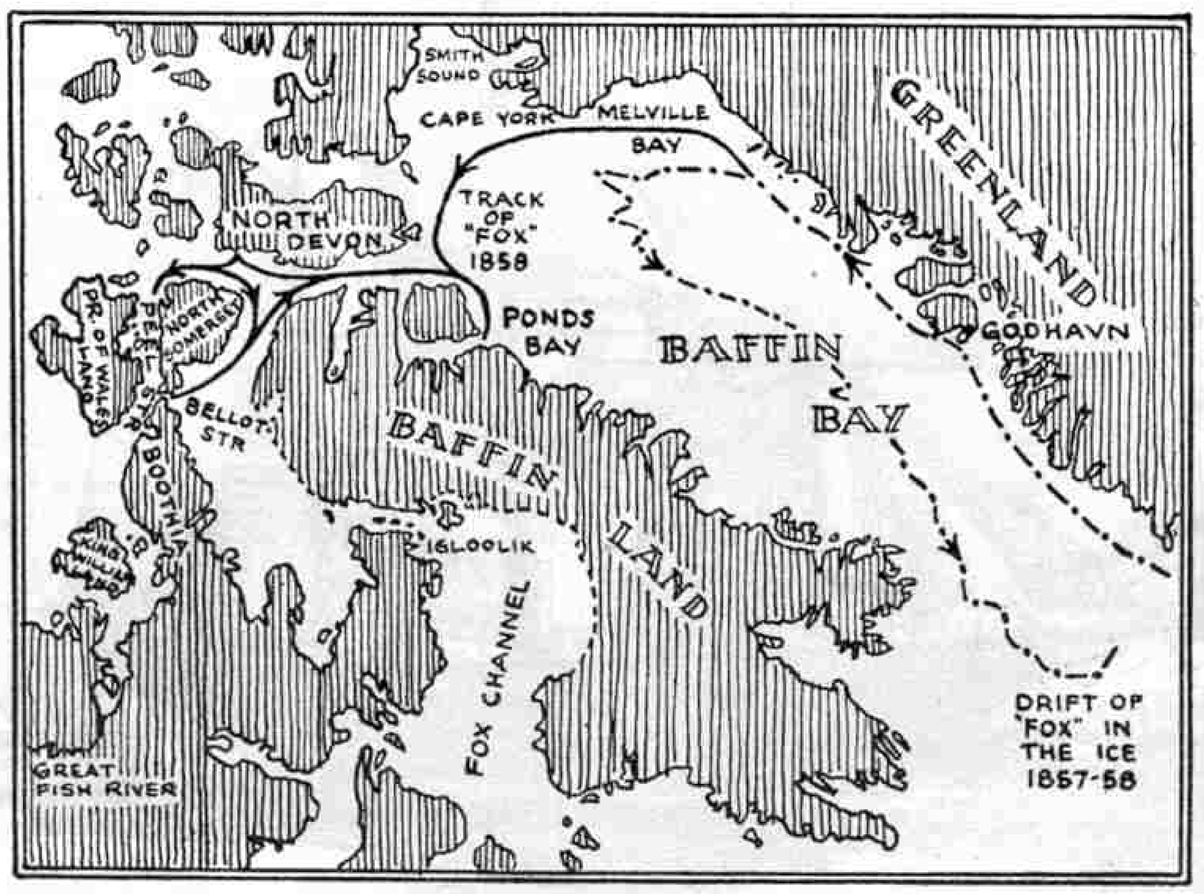
by the name of Kaparoktolik, and was reached after a tiring journey. It proved to consist of a few huts on a narrow strip of beach with a glacier behind and towering cliffs on either hand. The inhabitants numbered 25, of whom nine were men.

The visit proved interesting. No information regarding Franklin was obtained, although the visit of Rae to the west coast of Baffin Land two years earlier was known to the Eskimos. Many of them had been to Igloolik, a village on the western coast of Baffin Land visited many years earlier by Parry, and the chief drew a map showing the route and the coastline in return for a present of two knives. The region in which these people lived was inhospitable in the extreme and it seems difficult to account for their having fixed their habitations in such a place. One attracting circumstance was, of course, the abundance of fish.

During M'Clintock's absence on this visit the "*Fox*" had a narrow escape from being crushed in the ice that began to drift down upon her. By warping and ice-blasting she was got clear of the drifting masses of ice only four minutes before these were crushed up against the rocks!

The voyage was continued by a return to Lancaster Sound and the passage of Barrow Strait as far as Beechey Island, the site of a large provision depot. The door of the hut containing the provisions had blown open and ice had accumulated in the interior, but fortunately little damage was done to the provisions.

A melancholy task awaited M'Clintock here. Lady Franklin had caused a memorial tablet to be made which was to have been erected on Beechey Island by an American explorer in 1858. Circumstances prevented this from being done and the tablet was left at Godhavn in Greenland, whence M'Clintock brought it to Beechey Island. It was erected on a square paved with stones, on which stood also the cenotaph in memory of those members of Belcher's expedition who died in the Arctic, and a small tablet in memory of Lieutenant Bellot, whose discovery of the strait bearing his name proved of great value to the present expedition.



The cruise of the "*Fox*" in the Arctic. Map showing M'Clintock's track in the final search for Franklin

The course from this point to the land to be searched most minutely was southward down Peel Sound. At first all went well, but suddenly a line of ice was encountered stretching across the Sound from coast to coast. As the strait became narrower for many miles towards the south there was little hope of its being navigable, and it became necessary to find another route to King William Land. Accordingly the vessel rounded North Somerset in order to traverse, if possible, Bellot Strait. There was still some doubt as to whether this really was a strait or only a bay. If the former, then it would be possible to sail or steam through it and thus shorten the sledge journeys that were to be undertaken subsequently. Every mile sailed towards an unexplored region in the Arctic saved two miles of laborious sledge dragging, one mile out and one mile home again.

The first attempts to penetrate the strait were frustrated by the strong tide and adverse ice conditions. It thus became necessary to winter in a small bay at the eastern end, and the men christened this "Fox's Hole." The "*Fox*" did subsequently navigate the strait, and its existence was demonstrated beyond all doubt.

The remaining part of the season was spent in laying down depots for provisions along the west coast of Boothia in preparation for the journeys to be undertaken in the following spring. The winter passed slowly, and was marred by an unfortunate event—the death of Brand, the engineer of the expedition. In the previous year Scott, the assistant engineer, had died as the result of a fall, and now only two stokers were left to look after the ship's machinery.

The health of the men remained satisfactory throughout the long winter, only one man showing signs of scurvy. It was discovered, when too late, that he had lived on salt meat since leaving England, as he disliked preserved meat, and this undoubtedly accounted for his condition. The fact that he was not seriously affected until 19 months had elapsed was a good testimony to the quality of the provisions supplied and the general cleanliness of the ship.

The diet of the members of the expedition is of interest. To each man ¾ lb. of biscuit or bread was allowed daily. The meat ration was issued on a three-day basis. On the first day ¾ lb. of salt beef and ¼ lb. of preserved vegetable was issued, along with ¾ lb. of flour and suet for a pudding. On the next day this was replaced by ¾ lb. of salt pork and pea-soup, while the third day's ration included ¾ lb. of preserved meat and ¼ lb. of preserved potatoes. A few "luxuries" and antiscorbutics were also distributed. Among these were cranberries and preserved apples and sugar, while there was a daily allowance of an ounce of lemon juice and an eighth of a pint of rum, with tea and chocolate also. It will be seen that members of Arctic expeditions were by no means pampered!

A curious item of the diet was an allowance of beer. This was made on board from sugar and hops, and great trouble was experienced during its preparation in keeping it warm enough to allow the fermentation process to continue. The beverage scarcely possessed the qualities of the beer manufactured in English breweries, but M'Clintock valued it greatly as a preventive of scurvy. On one ship that he commanded no fewer than 700 gallons of it were made in the course of a single winter.

Very early in the following year, 1859, the sledge travellers were astir. M'Clintock himself set off with two men on a journey to the magnetic pole, his route taking him round the west coast of Boothia toward King William Land, where he hoped to find sufficient remains of the Franklin expedition to enable him to reconstruct their adventures. His purpose in this journey was to open up communications with the inhabitants of Boothia and to make enquiries from them before commencing a systematic search in King William Land.

During this journey the temperature fell as low as 40°F., for the party set out on 17th February, thus travelling at an earlier date than any of their predecessors in the Arctic, with the exception of a single trip during specially favourable weather made some years earlier by Kennedy. The ground was frozen so hard that most of the dogs fell lame, while even the rum was thick and syrupy and required thawing before it was drinkable. The snow was hardened by the low temperature until it resembled grains of sand, and in consequence the work of the dogs was rendered much more difficult by the increased friction between the sledge runners and the ground.

At the end of the day's hard march it was necessary to spend about two hours in building a snow hut. This was the most disagreeable part of the work, for the men became thoroughly chilled standing about in the intense cold. Putting on frozen moccasins in the morning was also a troublesome business, and the only really comfortable time throughout the 24 hours was shortly after the commencement of a day's march, when the brisk exercise had warmed the travellers and they had not yet become tired and hungry.

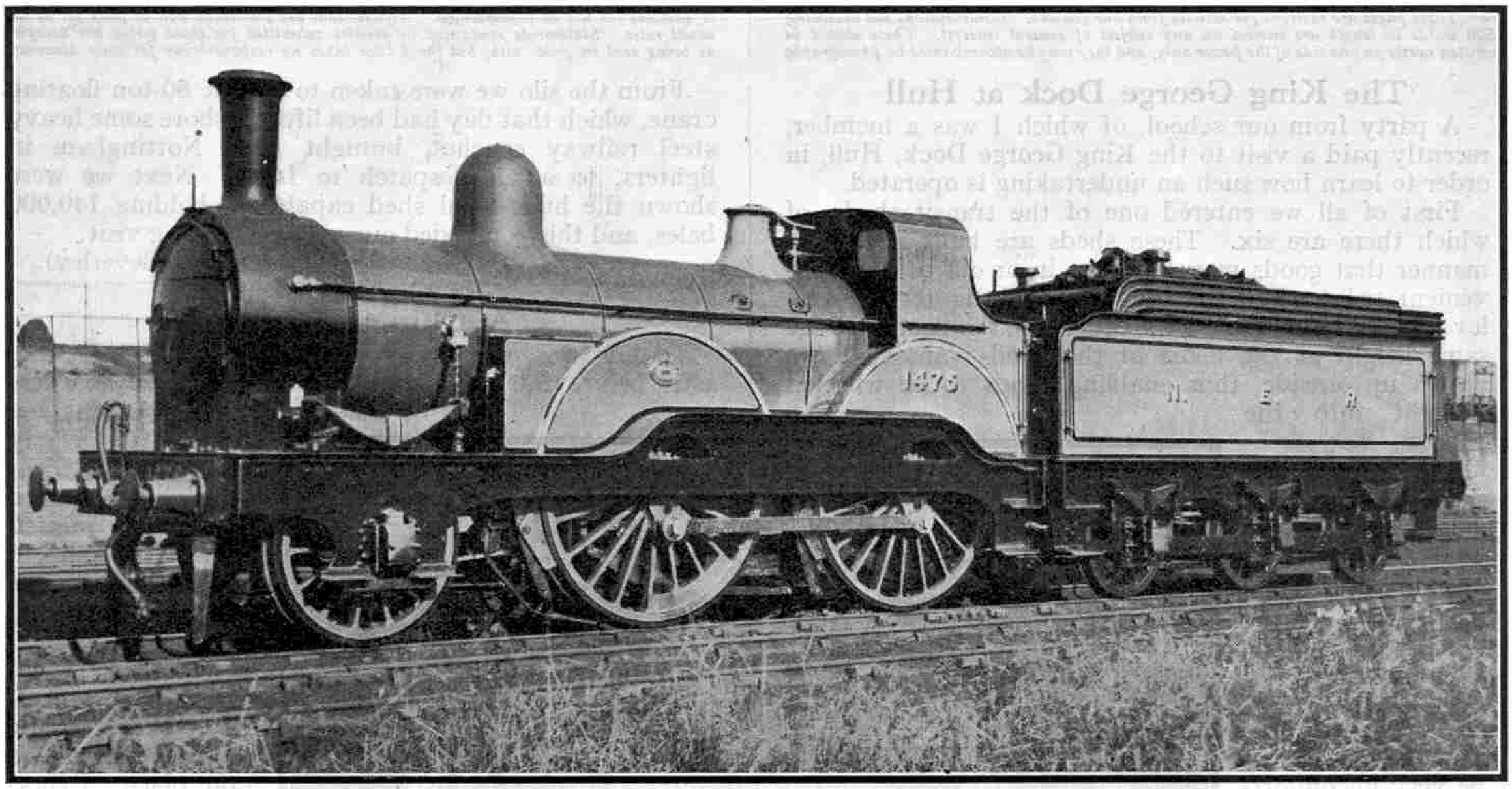
At the magnetic pole they fell in with Eskimos, some of whom built them a large snow hut for a reward of one needle each! Cautious inquiries made by Petersen under the guise of attempts at trading elicited the information that a ship with three masts had been crushed by the ice in the sea to the west and that all the people in her landed safely. None of these Eskimos had actually seen the white men, but one of them said that he had seen their bones upon the island, and it was plain that the lost explorers had never landed upon the Boothian shore. Many of the belongings of the crews of Franklin's ships were found in the possession of these Eskimos, however. According to the Eskimos' story these could not have come out of the ship they saw, but no information was obtained with regard to a second ship, so that the fate of this was yet unknown.

On returning to the ship preparations were immediately completed for the main journeys, three of which were planned. The first was to explore the as yet unknown shores of Prince of Wales Island; the remaining two parties were more closely concerned with the chief object of the expedition. M'Clintock himself purposed travelling to the mouth of the Great Fish River and examining the shores of King William Land on the way, while Hobson was to explore the west coast of King William Land and cross the ice to Victoria Land.

The two latter parties carried with them provisions for 84 days. Each had a sledge drawn by four men, (*Continued on page* 983)

Locomotives that have Made History

By R. S. McNaught



A veteran of 1885 that covered 80½ miles in 78 mins. with a load of 100½ tons

IT does not always follow that an old class of locomotives still at work has earned its long career through sheer merit, but there are several outstanding examples of this. The well-known "Precedents" (or "Jumbos" as they have always been termed by railwaymen) are probably unique in this respect. They were old when the many classes of compound express types were introduced on the former London and North Western Railway, yet all the latter, with the possible exception of one or two rebuilds, have long since gone to the scrap heap. While a large proportion of the "Precedents" also have gone to their doom, the survivors are to be seen to this day working light expresses or more frequently piloting a giant "Claughton" or a "Prince of Wales" on the heaviest and fastest trains on the L.M.S.

The "Tennants" and the "Race to Scotland"

Another famous class of veterans, somewhat resembling the "Precedents" in general appearance and dimensions, was the "Tennant" class of 2–4–0 express engines of the old North Eastern Railway. This class was built in 1885, at a period when the company was without the services of a locomotive superintendent. More powerful locomotives being urgently required to work the increasingly heavy East Coast expresses between York, Newcastle, and Edinburgh, Mr. Henry Tennant, then General Manager, who had undertaken the temporary charge of the locomotive department, suggested the building of a new type of engine along the general lines of the existing "901" class, but with larger cylinders and several improvements. A design was prepared and approved, and the first of the set of twenty, No. 1463, was ready for duty in February, 1885. The four coupled wheels had a diameter of 7 ft., while the two inside cylinders were 18 in. in diameter with a stroke of 24 in.

The "Tennants" proved remarkably fine engines and for many years they worked the Anglo-Scottish trains with great success. During the "Race to Scotland" in 1888, the fastest run between York and Newcastle was performed by No. 1475 of this class, which was officially stated to have covered the 80½ miles in 78 minutes with a load of 100½ tons. On two other occasions during the "Races" the same engine covered the distance in 81 and 82 mins. respectively.

On the last day of August, 1888, the East Coast drivers were given a free hand by way of a finale to a series of brilliant runs, and they made a special effort to establish a record for that route. The 188-mile run from King's Cross to York (Gt. Northern) was performed in 3 hrs. 22 mins., and from York to Edinburgh (North Eastern), the 204¾ miles in 3 hrs. 37 mins., averaging 57.6 and 57.7 miles per hour respectively.

In general appearance the "Tennants" were unusually handsome engines, their colour scheme of light green with dark brown and red frames and green wheels, brass safety valve covers and splasher beading, being very attractive. Possibly a defect from the point of view of their drivers and firemen was the meagre cab shelter, but this detail followed the (Continued on page 985)

FROM OUR READERS

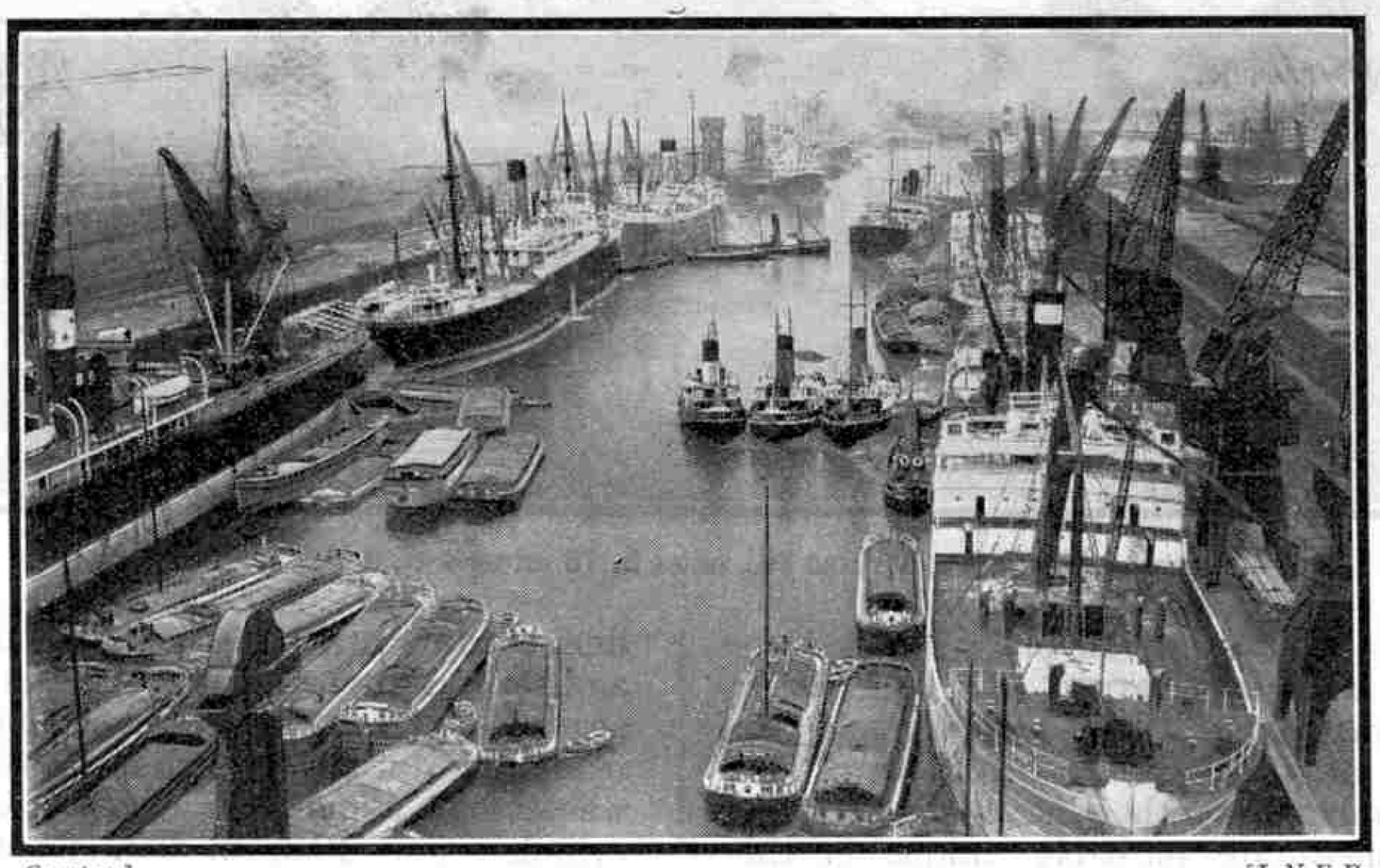
These pages are reserved for articles from our readers. Contributions not exceeding 500 words in length are invited on any subject of general interest. These should be written neatly on one side of the paper only, and they may be accompanied by photographs or sketches for use as illustrations. Articles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

The King George Dock at Hull

A party from our school, of which I was a member, recently paid a visit to the King George Dock, Hull, in order to learn how such an undertaking is operated.

First of all we entered one of the transit sheds, of which there are six. These sheds are built in such a manner that goods may be taken in or out at any convenient point at either side. One side is at the same level as the quay, and at the other side the floor is at the same height as the floors of the goods vans that are drawn up outside, thus enabling goods to be wheeled straight into the vans.

On leaving the shed we came to a grain elevator that was lifting wheat from a ship's hold at the rate of 140 tons per hour. The air around was full of chaff and dust and it seemed to us that the work must be very uncomfortable for those engaged in it. Close by were two more elevators each working at the rate of 60 tons per hour and they were unloading maize from another ship. Several other ships were being unloaded at the quay, including a Japanese steamer that was discharging soya oil into a tank barge. In contrast to this smart-looking vessel was a dirty collier moored under the movable coal hoist. This hoist may be moved from hatch to hatch, and is therefore specially useful for loading colliers. It is capable of handling 800 tons of coal per hour and the same quantity can be dealt with by each of the three fixed hoists near it.



Courtesy] [L.N.E.R.

King George Dock, Hull

We then passed on to the two large graving docks. Each of these is about 500 ft. in length, 70 ft. in breadth and 30 ft. in depth, and huge pumps are installed that are capable of pumping dry either dock in less than two hours.

Retracing our steps we went to the grain silo where there is in operation an elaborate system of conveyors by means of which any ship on the quayside can discharge into any bin. The silo is six storeys high, and is fully equipped with weighing and loading apparatus so that any required quantities of grain may be delivered into lighters at the quayside. From the top a magnificent view of the dock and the surrounding country is obtained.

From the silo we were taken to see the 80-ton floating crane, which that day had been lifting ashore some heavy steel railway coaches, brought from Nottingham in lighters, to await despatch to India. Next we were shown the huge wool shed capable of holding 140,000 bales, and this concluded our very interesting visit.

D. Armstrong (Beverley).

A Chinese Festival

To-day was the occasion of a festival. All were astir before the cock crew and the firing of crackers announced the beginning of a gay day, which was somewhat marred by heavy rainfall overnight and in the morning. The weather improved in the afternoon, however, thus enabling the procession characteristic of such festivals to take place. Everybody in the village turned out, either to take part in the procession itself or to watch it.

In every household innumerable tasty dishes had been prepared, which in the first place were offered to the gods. When all the invited guests had assembled, they sat down to a sumptuous meal before witnessing the procession. This started at about one o'clock with a Chinese band leading, playing for all it was worth and trying its best to drown all other noises. Next came banners bearing gold-lettered inscriptions, following which were young folks of both sexes dressed in splendid clothes. Another band with foreign instruments played an extraordinary medley of airs—this minute "Auld Lang Syne," the next "Tipperary," "Johnny Get Your Gun," etc. These tunes and others are played on all occasions, including marriages and funerals!

Splendidly draped youngsters followed, sitting in a sampan. They were powdered beyond recognition, and wore gorgeous headwear. The idols had been taken out of their joss-houses for the procession and were carried through every street. Then came another Chinese band making an awful din with drums, cymbals and cornets, the singing of the people directly behind adding to the racket. Next followed burlesque figures, walking in stately composure, and it was a wonderful

sight to see them catch up to the others. More banners and bands succeeded these and the procession ended with sedan chairs and rickshaws occupied by important personages. These chairs are supported by two long poles strapped to the sides and are carried by two coolies.

Everyone was clad in his best and the whole village was resplendent in white, red, and a host of colours. Colour and noise are the chief characteristics of a Chinese festival, and none is complete without the firing of crackers, which is a symbol of rejoicing.

L. E. BROADBRIDGE (Formosa).

Testing a 6-Wheel Motor Chassis

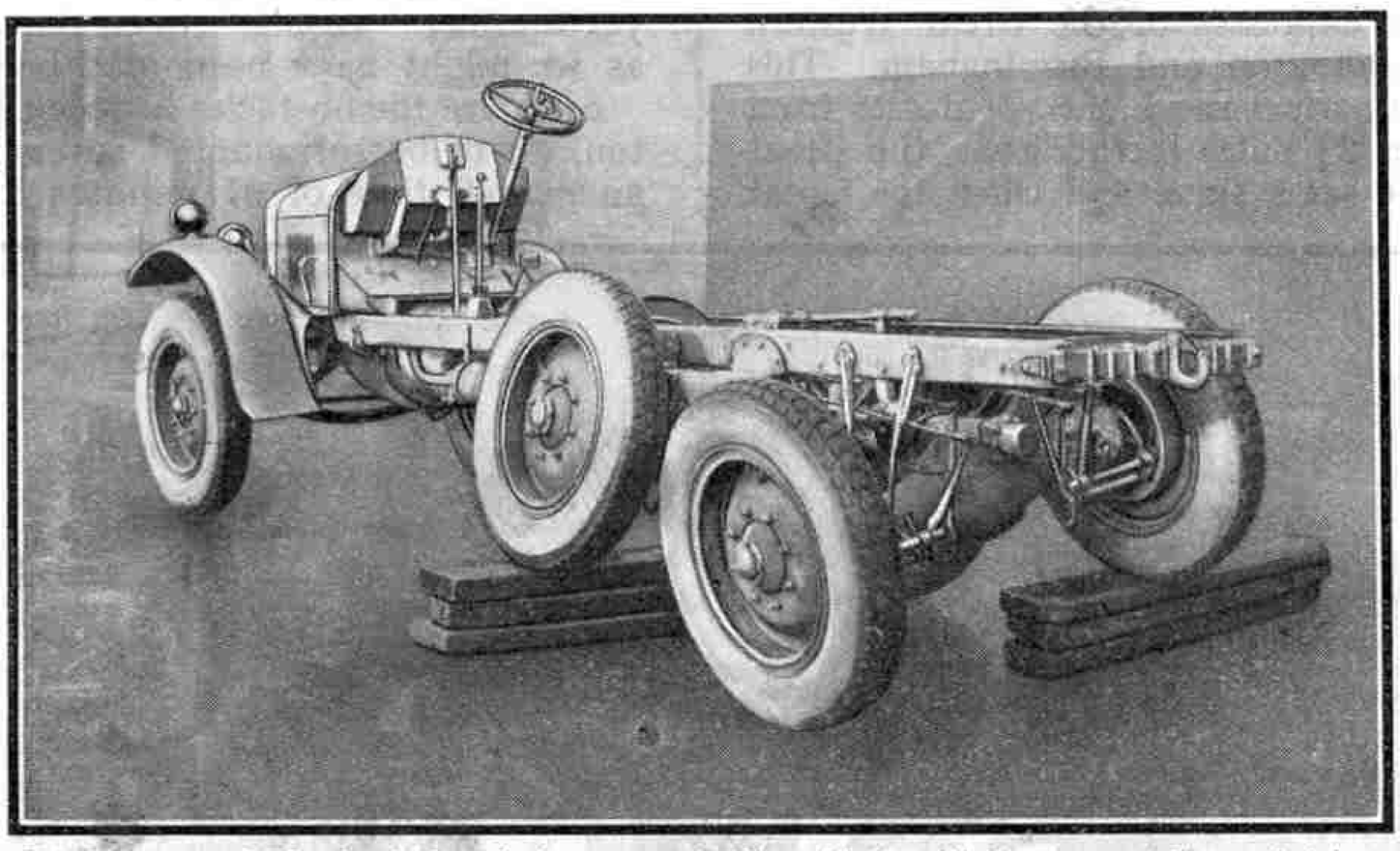
I was specially invited recently to attend a test for the War Dept. of a Thornycroft type A3 rigid 6-wheel chassis. This chassis differs from ordinary ones in the fact that the two driving wheels are replaced by four wheels on the bogie plan, but rigidly attached to the chassis springs, which are semi-elliptic, pivoted in the centre, and four in number. All four wheels both drive and brake, and the bogie is so flexible that a difference in levels of the wheels of 18 in. is permitted.

On the day of the test I travelled with officers in a luxurious Thornycroft bus to Adel Moors, north of Leeds, the six-wheeler following. On arriving the chassis went forward and was directed at a boulder-strewn path leading to Adel Crag. With its wheels lifting over rocks projecting a foot or so it climbed steadily upwards. It was then turned on to the moors themselves, travelling over uneven ground, hillocks, pits, boulders, and gorse bushes. An excellent idea of the rough state of the ground may be obtained from the photograph on this page. The driver steered deliberately at formidable obstacles, crushing gorse-bushes and topping boulders everywhere, demonstrating the flexibility of the machine.

Next the chassis climbed up the steep bank behind the crag, gradient 1 in 3, its four rear wheels slipping at times, for heavy rain had been pouring down all night. Having topped this, it descended the opposite side, showing the efficiency of the four rear wheel brakes during its descent.

An even more formidable test followed. The chassis, on which was mounted a weighted box as load, ran full speed over rough fields, bumping like a taxi-ing aeroplane, and entered a quarry by a pathway. The quarry workers had left blocks of stone about 3 ft. by 1 ft. by 1 ft. over the path, and the "A3" ran over these until it arrived at the centre of the quarry.

Curving downward stretched a trackway a yard or so wide, flanked by the rising sides of the quarry. The clayey, sandy surface, with a gradient in parts of 1 in 2, combined with heavy rain, made the test very strenuous. The chassis turned the hairpin at the top—itself a difficult task, as rocks prevented "cutting" the corner—and descended the track calmly. Having reached the bottom it was turned on the grass, facing up hill, and engaging gear the chassis accelerated sharply. On a steep part, with four wheels revolving, it stopped, but the driver merely backed, found a new grip for the wheels, and without chains rushed up the hill without further check.



The Thornycroft 6-wheel chassis is a remarkable vehicle with two rear axles and drives and brakes on four wheels. Our photograph shows how it is able to surmount large obstacles while maintaining an even keel

The final test consisted of a speed run over a sloping field, running downward, turning about, and rushing uphill back again. On the return trip the driver topped a hillock about 3 ft. in height with one side of the chassis almost tipping up, showing the advantages of the six wheels.

The frame is specially designed to withstand the driving and braking stress transmitted to it through the springs, which form the sole connection between the wheels and the frame. Rubber buffers attached to the frame, and slings from the latter passing beneath the axles, prevent the permissible 18 in. difference in the level of the wheels from being exceeded.

The height of the frame from the ground is 2 ft. 10½ in., under load. The chassis is capable of carrying a useful load of 50 cwt. on reasonably good roads and of 30 cwt. over rough country highways.

S. G. ROBINSON (Leeds).

Vegetable Ivory

I was very much interested to see the photograph of Colonel Kelsall in the August "*M.M.*" as I had the pleasure of travelling home with him from Panama after having lived there for four years. In addition I went aboard the "*St. George*" when it called at Panama and was shown round by the captain.

The ship on which we came home was carrying a cargo of ivory nuts. These are the seeds of a palm-like tree that grows in South America, each plant having six to eight large heads of fruit. A very strange thing about the tree is that it grows in groves apart from all others and the ground under it is so free from plants that it appears to have been swept. The nut is often called vegetable ivory on account of its resemblance to that well-known material, and is used for making small articles of turnery.

Colonel Kelsall procured a few odd nuts and with just an ordinary jack-knife made some wonderful carvings such as lockets and rings from them. He was a very lively companion and at a fancy dress ball we had on board he dressed up as an ancient Briton, the costume suiting him perfectly.

T. ROYDEN DARLINGTON (Upton Heath, Chester).

FAMOUS TRAINS XI.

The "*Birkenhead Diner*," G.W.R.

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

IT is probably correct to claim that the highest regular railway speeds in the whole world are run by the famous two-hour expresses of the Great Western Railway between Paddington and Birmingham. This may seem paradoxical, when the L.M.S. expresses from Euston have to cover 2½ miles further than the Great Western trains in the same time, and when the Great Western itself runs express trains in other directions from Paddington at higher overall average speeds. The explanation lies, of course, in the relative difficulty of these various routes from the locomotive point of view.

In the first place, only two of the two-hour trains between Paddington and Birmingham actually make a non-stop run over the 110½ miles; they are the 11.10 a.m. and 2.10 p.m. down. Of the other expresses, the 9.10 a.m. down calls at High Wycombe. All the remaining trains in both directions call at Leamington and for the stop there of three minutes, costing at least five minutes in the actual running, no additional time is allowed. This brings the "net" average speed of the trains calling at Leamington up from 55.3 to 57.7 miles an hour; but as certain of the L.M.S. trains call in the same manner at Willesden or Coventry, this does not altogether explain the necessity for exceptional speeds.

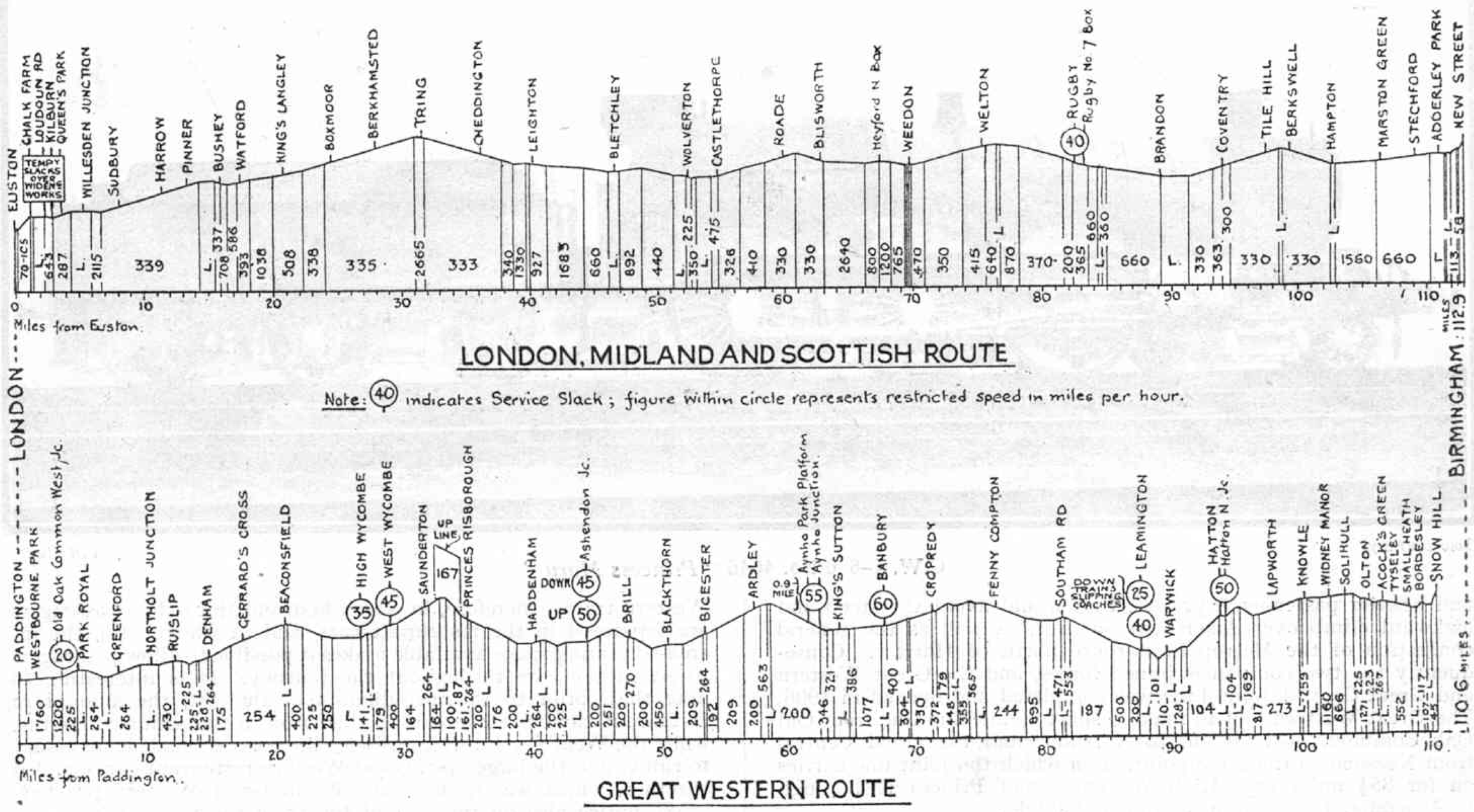
The reason is to be found in the difficulty of the grading and the number and severity of the enforced reductions of speed for curves. At no more than three miles out of Paddington the speed of a down two-hour Birmingham express, already travelling, probably, at 50 miles an hour, must be brought down to 15 for the negotiation of the junctions at Old Oak Common West. Then, after the train has climbed from Denham to Beaconsfield and is hurrying down to High Wycombe at 70 miles an hour or so, comes a reduction to 35 miles an hour over the sinuous length of line through the town just mentioned. After more climbing, to the crest of the Chilterns, and a dash at very high speed down past Princes Risborough to the level marches of Buckinghamshire, comes a third reduction, to 50 miles an hour, as we take the facing junction at Ashendon. More ups-and-downs and a long climb past Bicester to Ardley precede yet another "easing," over the Aynho junction, just as we might have been reaching a high speed again.

Such are the obstacles between London and Leamington, all to be surmounted within the brief compass of an overall time of 91 minutes for the 87¼ miles, entailing an average speed of all but 58 miles an hour. To maintain such a time, when the losses arising out of all these speed reductions and gradients have been taken into account, must obviously involve very high speeds over those sections of the line that favour their attainment. From Leamington to Birmingham only 26 minutes are allowed for the 23¼ miles, start-to-stop, and yet as soon as we are through Warwick, no more than two miles from the re-start, the engine is faced with a four-mile ascent, of which three miles are as steep as 1 in 104! As compared with such handicaps as these, the rival route has no steeper gradient than 1 in 330—save only the first 1¼ miles out of Euston at 1 in 70-105, up which most of the trains receive the assistance of a "banker" in rear—and no intermediate slack other than the 40 miles per hour reduction through Rugby.

Photo] "Getting hold of them" [*F. E. Mackay*

The G.W. 2-hour Birmingham express accelerating past West London Junction. The engine is a 4-cylinder 4-6-0 "Princess Elizabeth"

In such conditions as these it is hardly surprising that the working of the two-hour Birmingham expresses over the Great Western route calls for brilliant locomotive work. It probably could be said of no other train service in any part of the world that the ordinary timings practically *demand* top speeds in excess of 80 miles an hour if schedule is to be maintained. Yet such is the case on the way to Birmingham by Great Western, where on practically every down trip you may clock an "eighty" in the descent from Princes Risborough to Ashendon, with another, if you are lucky, on the way from Southam Road down to Leamington. On the up journey you may anticipate just the same high maxima past Bicester and again in the final dash from Beaconsfield down to Denham, with perhaps a third "eighty" thrown in, so to speak, on the steep



Gradient profiles of the Great Western and the London Midland and Scottish routes, London to Birmingham

descent from Hatton to Warwick. As a matter of fact, in the course of constant travelling by these amazing "fliers," I have noted maxima of 80 an hour and over at no less than four entirely different points on the down journey and five on the up.

The highest speed records that I have ever recorded in 20 years of careful train-timing were made over this route on the very train that is the subject of our study this month—the 6.10 p.m. express from Paddington to Birkenhead—Driver J. Williams, of Wolverhampton, succeeding in getting 90 miles an hour out of his engine on the former descent, and no less than 91.8 miles an hour down the latter, ere we slowed for the Leamington stop! No such speeds are ever needed to maintain the faster and perhaps more famous schedules of the Great Western West of England lines, such as 175 minutes from London to Exeter, the 75-minute run from Swindon to Paddington, or the 105-minute journey from London to Bath, even though these are end-to-end bookings at 60 miles an hour, or even more. The reason is that they are maintained over level or comparatively level lines and, so far as the Swindon and Bath runs are concerned, with no restrictions on speed at any point in the journey.

It is within the knowledge of most "*M.M.*" readers, no doubt, that the present Great Western route to Birmingham is—over its first 60 miles at any rate—a comparatively new one. We have already seen how that famous early engineer of the Great Western—Brunel—preserved the evenness of grade of his main lines by utilising river valleys, but so much at the expense of distance as later on to earn for the letters "G.W.R." the humorous explanation of "Great Way Round!" So the Great Western Birmingham expresses of years gone by followed the course of the Thames up to Reading and Oxford, and had barely a grade or a slack worth mentioning in the first 100 miles of their journey.

Birmingham was 129¼ miles away from Paddington, however, as compared with 113 miles from Euston, and the handicap in distance was too great to admit of any equalising in time of the two routes. When the late London and North Western Railway had at last got its time between London and Birmingham down to the even two hours, early in the present century, the best that the Great Western could manage, without any intermediate stop, was two hours, 20 minutes. Even to-day, if the Leamington stop were made, it is doubtful whether the Great Western could have maintained any less timing over their old route than 2¼ hours between Paddington and Birmingham, which would entail an average of practically 60 miles an hour throughout. It was therefore decided, as it already had been decided and carried out in regard to the South Wales and West of England routes, to "cut off the corner."

The Great Central Railway which, as we saw in the September "*M.M.*," had in 1899 reached London from the North, was at the same time anxious to find an alternative route out of London for its freight trains

Leading Dimensions of 4-cylinder 4-6-0 "Princess" Class Engines, Great Western Railway

Cylinders (four) Diameter	15 in.
" " Stroke	26 in.
Driving Wheels, Diameter ...	6 ft. 8½ in.
Heating Surface, Firebox	283 sq. ft.
" " Tubes	1,687 "
" " Superheater ...	155 "
" " Total	2,125 "
Firegrate Area	27 "
Working Pressure	225 lb. per sq. in.
Tractive Effort (at 85 per cent. working pressure)	27,800 lb.
Adhesion weight	55½ tons
Weight of Engine (in working order)	75½ "
Total Weight of Engine and Tender	115½ "
Length of Engine and Tender overall	64 ft. 2 in.
Water Capacity of Tender	3,500 gals.
Coal " "	5 tons

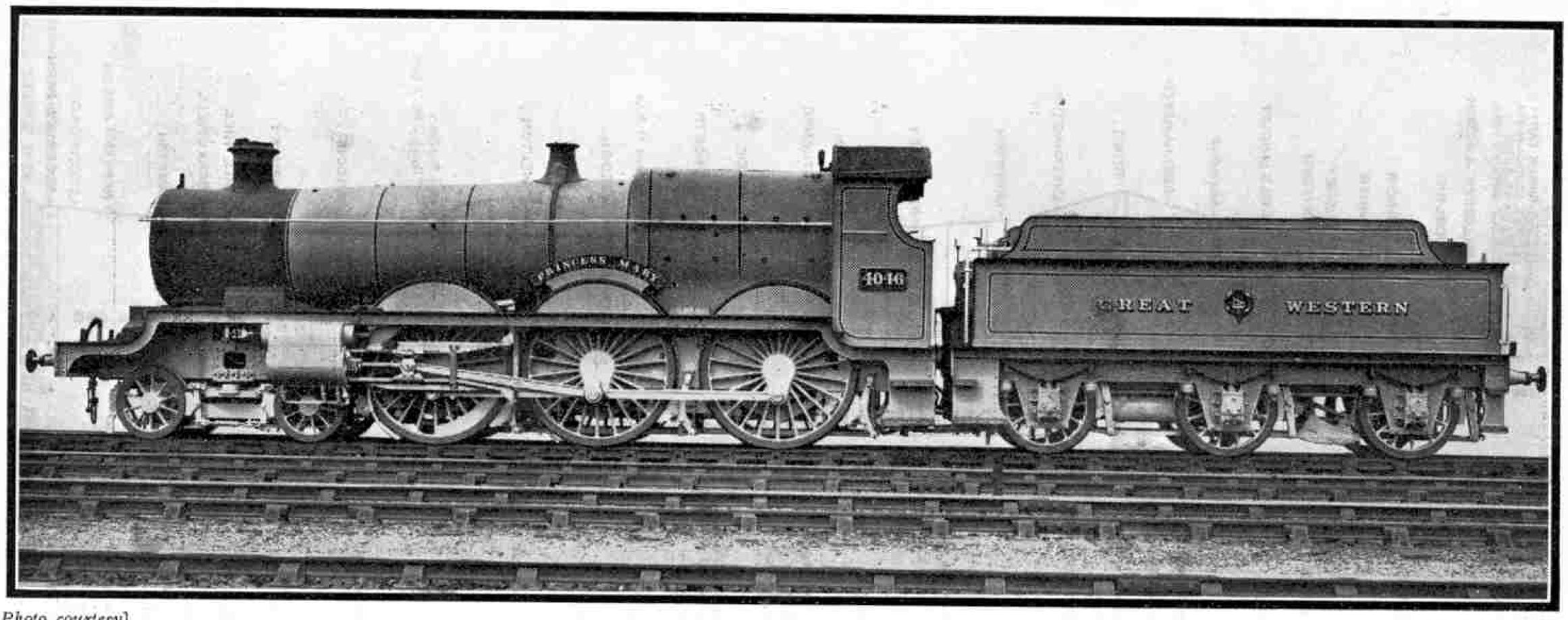


Photo courtesy] [*G.W. Railway*

G.W. 4–6–0 No. 4046 "*Princess Mary*"

and heavier passenger expresses, that would avoid the steep and awkward climb over Amersham Summit, as well as the general congestion of the Metropolitan route north of Harrow. Consequently the two companies joined forces, and the Great Western and Great Central Joint Line was completed and opened in 1906. The Great Western had to make a short connecting line from Old Oak Common, near Acton, to Northolt, and the Great Central from Neasden to the same point, from which the joint line carries on for 35½ miles past High Wycombe and Princes Risborough to Ashendon Junction, in the north of Bucks.

From there the Great Western had another connecting spur to make, running forward to a junction with the old Birmingham main line at Aynho, five miles south of Banbury. This was opened in July, 1910, when, for the first time, two-hour expresses began to run between Paddington and Birmingham. Our 6.10 p.m. down "*Birkenhead Diner*," then starting at 6.5 p.m., and non-stop to Birmingham, was one of them. It has been altered recently to 6.10 p.m., in conformity with the sensible arrangement of "systematic" departure times, whereby all the Birmingham expresses leave Paddington uniformly at 10 minutes past the hour.

Why do I choose this express as the particular one for description? Because it is, in my judgment, the most difficult of the all-the-year-round locomotive propositions on the Birmingham service, which is saying a good deal. It is, of course, the matter of load that makes the difficulty exceptional. The absolute minimum of train formation usually consists first of a 70 ft. composite corridor coach and a "triplet" articulated restaurant car set of three vehicles, weighing empty 118 tons (these are attached next the engine and come off at Wolverhampton); a bogie brake, a 70 ft. corridor third, two 60 ft. corridor thirds and a third-class brake, weighing usually 152 tare tons, for Birkenhead; a slip portion of two 60 ft. coaches (55 tons) for Banbury and another 35-ton 70 ft. composite slip coach for Bicester.

These together make up a 12-coach train to haul out of Paddington, and over the first 53½ miles of the journey, weighing empty some 360 tons. The full weights behind the tender may be taken as a minimum, roughly, of 380 tons to Bicester, 343 tons to Banbury, and 285 tons on to Wolverhampton. It is but seldom that the two-hour expresses of the rival route so much as reach the last figure in total weight, and this is yet another handicap to the locomotives in the maintenance of the Great Western two-hour schedules. It arises out of the fact that the Great Western expresses have to serve a considerably larger area of country than the Birmingham and Wolverhampton districts alone.

We have already reviewed the rolling stock on the train, and little more need be said under this head, except, perhaps, to call attention to the articulated restaurant cars. These are built on the same lines as the familiar Gresley articulated coaches of the London and North Eastern, with central bogies supporting the adjacent ends of the kitchen car, in the centre, and the first and third-class saloons flanking the former on either side. This is one of the few Great Western trains, therefore, in which first and third-class passengers are separated in the restaurant cars, and in which, also, the increased seating space available makes it possible to allow passengers to sit in the cars throughout the journey. It is interesting to note that, prior to the introduction of this set, the amount of restaurant car business done on this train in the summer months, while the Wembley Exhibitions were in progress, made it necessary to run two of the large open Great Western restaurant cars coupled together, which was quite a novelty in Great Western practice.

We notice also on the rear of the train the two slip portions, each carrying its distinctive array of tail signals. In the earlier days, when the train did not stop at Leamington, there were three—one for Banbury, one for Leamington, and one for Knowle, the last-mentioned being designed for residents in the outlying suburbs of Birmingham. The latter did not appreciate doing without their dinners for the sake of a slightly earlier arrival home, however, and they are now set down at Leamington, and taken on from there by a connecting train that follows the "Diner."

The engine may, and quite probably will be a "Castle" type four-cylinder 4–6–0, but as all my best records on the Birmingham service have been made by the earlier four-cylinder "Star" class engines (which include, of course, the "Monarchs," "Queens," "Princes," "Princesses," "Abbeys" and "Knights") which often still haul this express, and as the "Castles" received ample attention when we travelled on the "*Cornish Riviera Limited*," we will suppose ourselves to be headed to-night by one of the "Princess" batch of four-cylinder 4–6–0's, with four cylinders of 15 in. diameter and 26 in. stroke, and 225 lb. per sq. in. steam pressure. Steam is blowing off from the safety-valves when the signal is given to start, but we need not expect any more noise of this kind throughout the journey, as the schedule, the load and the road will between them demand as much of the precious element as can reasonably be generated.

As the extensive rearrangement of lines, which has been proceeding for a long time past between Paddington and Old Oak, is probably still incomplete, we may expect cautious running at first. We shall be reminded of the work already carried out by passing through Westbourne Park Station on what is apparently the wrong side of the platform. Then, just as our driver is nicely "getting hold of them," there comes the reduction of speed over Old Oak Common West Junction, generally involving the cross-over from "Main" to "Relief" lines, as well as the sharp divergence proper on to the Greenford line.

There is now a rise to Park Royal and a drop to Greenford, where we may expect first to reach the "sixty" line. Despite 2½ miles up at 1 in 264 from there to Northolt Junction—where the L.N.E.R. line from Marylebone joins us, the down line burrowing under and coming up on our left—we shall fall but little below the mile-a-minute rate, and on the subsequent level stretch to Denham we may get up to 65 an hour. Just beyond Ruislip Station our fireman sees to it that the tender tank is well filled from the "G.W. & L.N.E. Joint"

To New Readers

Previous articles in this series of "Famous Trains" have appeared in recent issues as under :—

1. "Flying Scotsman" ... ... Jan.
2. "Cornish Riviera Express" ... ... Feb.
3. "West Coast Postal"... ... ... Mar.
4. "Atlantic Coast Express" ... ... Apr.
5. "The Golden Arrow" ... ... May
6. "Hook of Holland Boat Express" ... June
7. "Dover Pullman Boat Express" ... July
8. "The Fishguard Express" ... ... Aug.
9. "The 3.20 Down Manchester" ... Sept.
10. "The Midland Scotsman" ... ... Oct.

Photo courtesy] [*G.W.Railway*

An articulated express passenger train, first and third-class dining car set

track-troughs that have been laid there.

In my judgment this is the most beautiful of all the exits from London, and all the best of the scenery is concentrated in the next 20 miles or so as we thread our way through the abrupt slopes of the Chiltern Hills. From between Ruislip and Denham we rise, first at 1 in 225, then at 1 in 175 and 1 in 264, for 7½ miles unbrokenly, until beyond the golf course at Seer Green, where we breast the summit, just before reaching Beaconsfield Station. Notwithstanding 380 tons of trainload, we need not expect to fall below 50 miles an hour on the climb, and it is quite possible that our "minimum" will be higher than this. But such feats are of so common occurrence on the Great Western Birmingham service that one scarcely takes any notice of them!

After threading the extremely deep cutting north of Beaconsfield Station we hurry down the modest descent to High Wycombe, getting a very fine view on the left—if it is still light, of course—when we emerge high up on the east side of the High Wycombe Valley. Brakes go on just before the station for the curves already mentioned, the worst of which are in the next mile beyond. We are now 26½ miles from Paddington, and with a clear road have probably taken 32 or 33 minutes.

After Wycombe we traverse a deep valley, bearing round to the right through West Wycombe—where a singular station lay-out may be seen owing to space having been taken for a four-track station with centre fast roads and outside platform roads, whereas the platform roads, with a wide space between them, have alone been laid in—and up to the summit of the Chilterns. This is roughly 33 miles out of Paddington, approached by six miles of ascent from High Wycombe, mostly at 1 in 164. The summit we may expect to surmount at between 40 and 45 miles an hour. Between High Wycombe and Princes Risborough a number of traces may still be seen of the old Great Western branch that ran from Maidenhead to Aylesbury. The new joint line replaced this, but the steep gradients and sharp curves necessitated an entire regrading and re-alignment in order to allow of express speeds over the route. From the Chiltern Summit down to Princes Risborough the down line follows the old route, falling steeply at 1 in 100 and 1 in 87. In order to ease this grade for up trains, however, an independent up line has been constructed, in parts half-a-mile away from the down, with no steeper gradient than 1 in 167.

Our enormously rapid acceleration down the steep grade to Princes Risborough will prove one of the most thrilling experiences of the journey, and when we have dashed through that station at over 70 miles an hour—attained from 45 or less in no more than two miles of distance—we shall still continue to accelerate as we leave behind us the imposing rampart of the Chiltern Hills, until we are probably up to 83, 84 or even 85 miles an hour at Haddenham. We passed Princes Risborough a minute late, owing to our heavy load, but although the 9.4 miles from there to Ashendon Junction are only allowed eight minutes, we can reckon on picking up the lost minute on this length. On the previously mentioned occasion of our touching 90 miles an hour at Haddenham we completed this 9.4 miles in six minutes 45 seconds, at an *average* speed of 83.6 miles an hour over the whole distance.

Photo courtesy] [*G.W.Railway*

Snow Hill Station, Birmingham

The slack over the diverging line to Ashendon brings us down to 50 miles an hour again. The up line, we notice, flies over the L.N.E.R. main line, which here leaves us for Grendon Underwood Junction, where it rejoins the main line over which we travelled recently to Manchester. Two miles up at 1 in 200-251 to Brill are now followed by three miles down at 1 in 200 to Blackthorn, on which we shall once again exceed 70 miles an hour, and possibly touch 75. Beyond Blackthorn comes the six mile rise at 1 in 200 to Ardley, in the middle of which, at Bicester, the first relief comes to our hard-worked engine by the dropping of our first slip-coach off the tail of the train. Once through Ardley Tunnel we have another fall to

(*Continued on page* 1009)

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.

"The Fourth of the '*Fernandina*'"

By George F. Knox
(Philpot. 7/6)

If any boy interested in engineering imagines for one moment that life as a marine engineer means a bed of roses with holidays at all the ports of call, he had better read this book and be disillusioned! The book deals with the author's life as Fourth Engineer on the "*Fernandina.*" After serving his apprenticeship Mr. Knox was a "full-blown engineer" ready to get afloat as soon as possible. Unfortunately, instead of being appointed to a well equipped ocean-going liner with the latest and best of engines, he found himself aboard the rickety old "*Fernandina.*"—a tramp steamer whose engines were in a dangerous state, since to get up any speed much air had to be fanned in and the use of too much air was liable to burst the boilers.

With such a vessel it is no wonder that the engineers' nerves were worn and their tempers frayed, so that they were not always too polite to each other! Many were the accidents they had in the engine-room, and many an ingenious repair was effected. More than once the case seemed hopeless and they were in fear of the ship blowing up any minute, but fortunately the ship did not blow up, although there was a serious accident.

Aroused from his sleep one night, the Fourth went below to the stokehold and saw "the Chief, attired in his pyjamas, and standing upon a heap of ashes and clinker, endeavouring to make his voice heard amidst the thunderous roar. Around the island of clinker upon which he was standing seethed a turbulent sea of boiling water, while at the furthermost end of the stokehold still more could be seen gushing from out of one of the furnaces. The Third was reaching out, endeavouring to drag one of the firemen to a place of safety. Apparently the man was disabled, and occasionally he would give a moan of agony. Near the ladder which led to the deck I could see the figure of another fireman, also disabled, trying to ascend the ladder, apparently making a frantic effort to escape from this hell of fire and boiling water." The Fourth was ordered to shut off the steam on the port boiler, and he managed this although the heat of the handrails seared his flesh off his hands and the frightful hiss of steam almost unnerved him. He could feel the heat from the boilers burning his lungs and shrivelling his face—but it was a matter of life and death—there was no turning back if the men were to be saved—and exerting the last of his strength he closed the stop valve and shut off the steam.

Then there are adventures of another kind—one night, tired with the monotony of the ship, two friends set out for an evening in port, saying they would be back by sundown. They arrived back on the pier about 6-0 p.m. as it was getting dark. Unfortunately the ship's boat was not there to meet them, and despite repeated hails, and diligent searching, no boat came to light. Instead, they heard stealthy footsteps and soon they were surrounded by figures wearing sombrero hats and it was only a matter of a moment before the two were prostrate on the road. What would have happened next is a matter for conjecture, had not the one and only policeman of the district appeared on the scene and scared off the attackers. Even then their adventures were far from finished on this particular night, and it is with a decided sigh of relief that the reader learns of their safe—though belated—return to the ship!

Apart from being an interesting yarn, the book gives an insight into the work of engine-room staffs on tramp steamers, and helps one to appreciate the dangers they run, and the hours of anxiety and hard work many of them put in on each voyage. It is an enjoyable story and one to be read by any boy who contemplates adopting Mr. Knox's profession. We only hope that any such will be more fortunate in their first ship than was Mr. Knox!

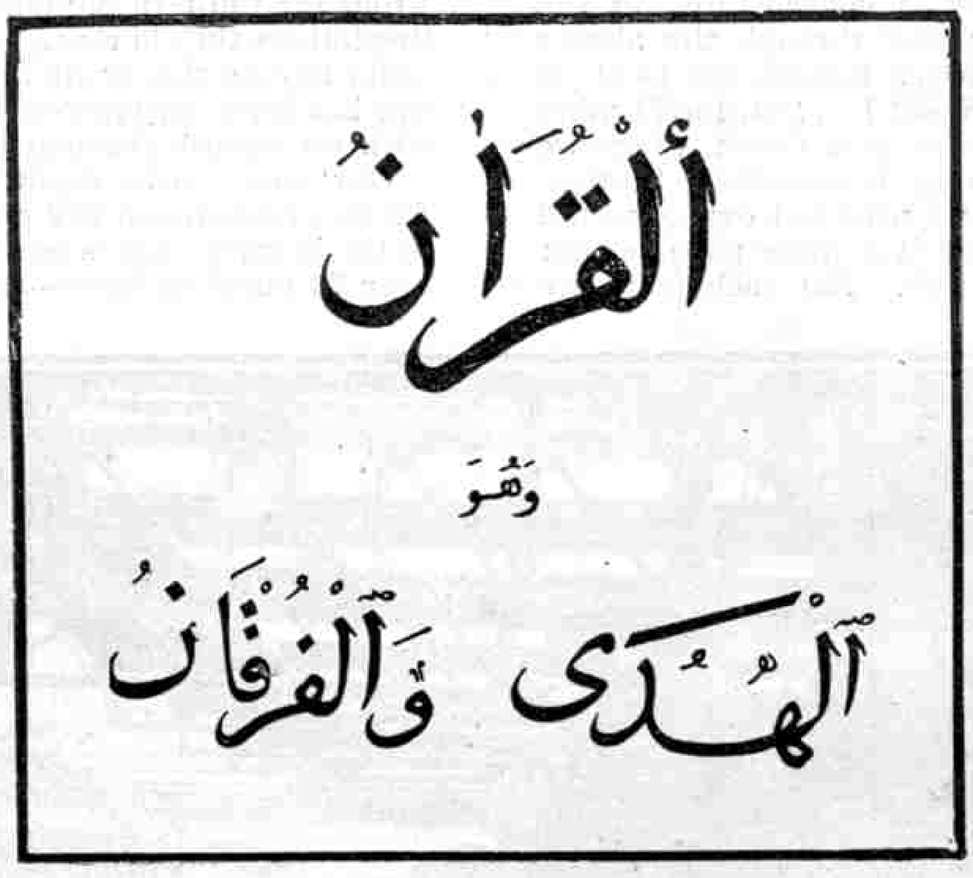
* * * *

The Koran

Chandos Classics
(Frederick Warne & Co. Ltd. 2/6 net)

One of the most interesting recent additions to the excellent series known as the "Chandos Classics" is a translation of the Koran, the sacred book of Islam. The Koran is often regarded as occupying the same place among Mohammedans as the Bible does among Christians, but as a matter of fact it not only provides the text book of the ritual of the Mohammedans but also contains the principles of their civil law.

A book that is sacred to so many million people, including nearly a quarter of the population of India, must inevitably be worthy of study, and this re-issue brings it in a handy and well-printed form within reach of everybody.



The inscription of the Qu'rân, which means "The Guide and the Discriminator." The book is reviewed on this page

* * * *

"Successful Crystal and One-Valve Circuits"

By J. H. Watkins
(Sir Isaac Pitman & Sons Ltd. 3/6 net).

This little book commences with a simple explanation of the crystal and the various circuits in which crystals are used, including an account of the so-called loud speaker crystal circuits. The subsequent chapters introduce the valve as a detector and amplifier, and finally there are accounts of reflex and "super" circuits involving the use of one valve only.

The author gives 60 circuits that can be constructed within the limits of the crystal and one valve, and points out how the expense involved in their construction may be kept low. The book can be recommended as a guide to experimenters in this branch of wireless.

* * * *

"Accumulator Charging, Maintenance and Repair"

By W. S. Ibbetson (Pitman, 3/6)

Intended for the use of all interested in the charging and upkeep of accumulators, this book is essentially one of general interest in view of the fact that accumulators are now so generally in use for wireless work, motor-car lighting and starting equipment, and country house lighting plant. The accumulator has always been surrounded by a considerable amount of mystery and the author attempts to disperse the secrecy surrounding this electrical device. It is his hope that the knowledge placed at the disposal of readers will bring about a more fair and efficient treatment of one of the most useful means of producing electricity.

The book is essentially of a practical nature and gives in detail all the information necessary for keeping an accumulator fully charged and in good condition. If this is not considered sufficient for those who wish to thoroughly understand their batteries, just that amount of theory has been included to enable the reader to understand the principles underlying the action of the accumulator and its treatment.

The book is well illustrated and will be found a most useful hand-book to accumulator users and to those in charge of service stations.

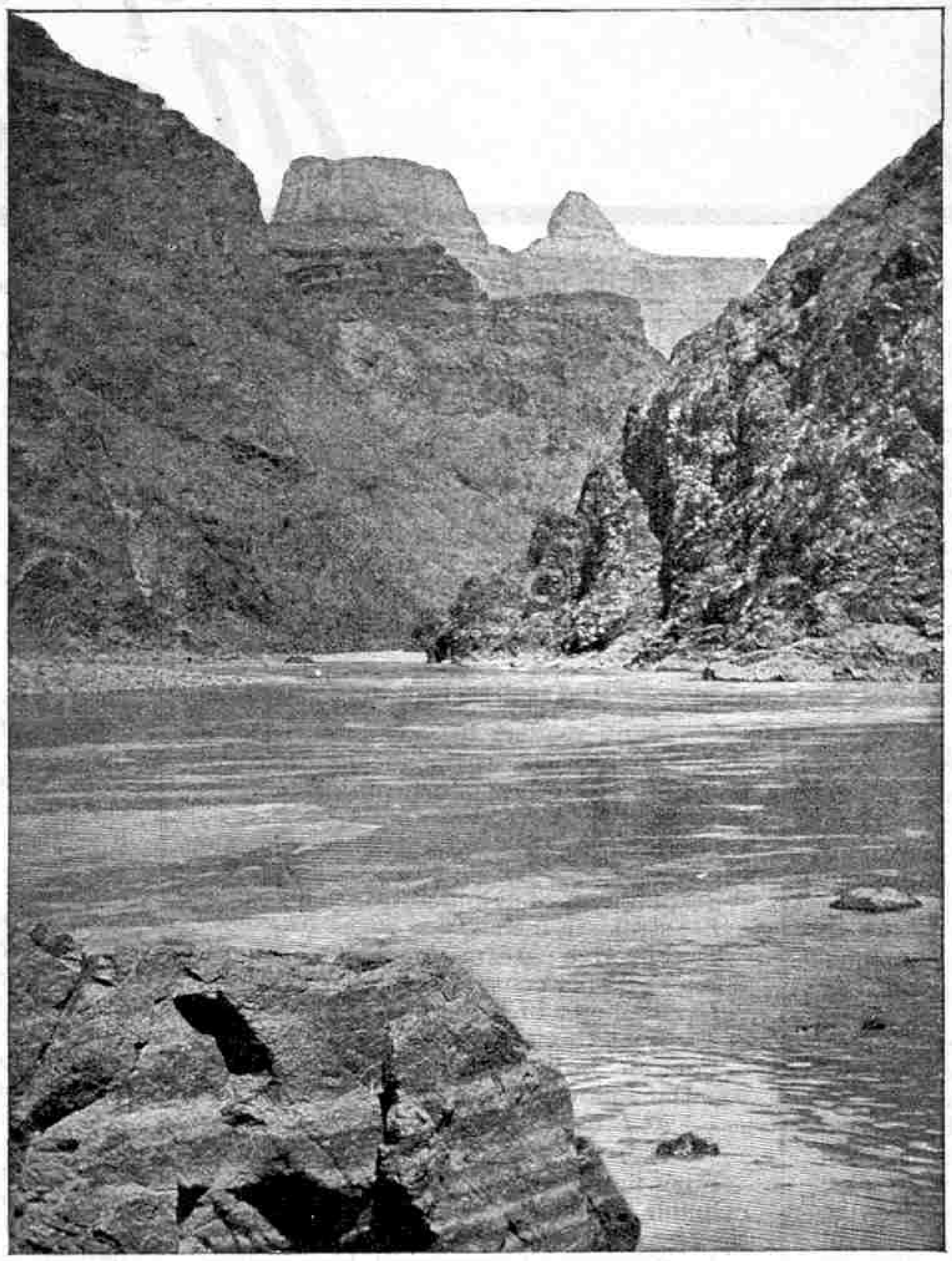
"Last Memories of a Tenderfoot"

By R. B. Townshend
(The Bodley Head. 12/6)

Life in Colorado in 1870 was not lacking in excitement and danger, as this book shows, and next to their splendid courage, it must surely have been their sense of humour with which many of the pioneers were blessed that helped them to win through. In the first chapter we are introduced to an old General who owned two mules, Fanny and Jenny, who consistently refused to be parted. Unfortunately for our tenderfoot, when he tied the General's mules up for the night he used the wrong knot, and by morning the mules had vanished. Sent out to search for them he returned crestfallen to report his failure to the General. "Half-a-day lost already" squeaked the General (who had a cracked voice, as well as a sense of humour!) "D'you know that my time's worth five dollars a day? All because a tenderfoot can't picket a mule right or follow a drag-rope trail." So off the General sallied, on horseback, to look for the wandering mules, while the tenderfoot returned to camp, where the first thing he saw was Fanny and Jenny with their noses busy in a heap of corn. The rogues had come home of their own accord, dragged the corn sack out of the back of the buggy, and were going into it like pigs into porridge!

On a lonely cattle-ranch on the plains of Colorado, a cowboy friend rides in to discuss the latest news, which is that Pat Higgins is dead. Pat has had an adventurous life. "He was never really right, after the Cheyennes scalped him the second time last year. The Sioux had scalped him once away up on the Union Pacific . . . the second time was on Little Sand Creek . . . Well, here was poor Patrick on the bare prairie and the Cheyennes just acoming for him like blazes, and him afoot and nothing to shoot with. So what does he do but just sit down on the ground and peel off one of his boots, as they danced up close, for he felt awful mad thinking he'd have to be scalped again—you bet he hadn't forgotten that first time! As soon as they rode on to him, dashed if he didn't take the boot in his hand and up with it as a club and fight the Indians with that. Of course that didn't last long. How could it? A boot ain't no weapon to fight with against half a dozen redskins." So poor Patrick was scalped again, although the Indians must have had a shock when they saw that he had already been scalped more than once! After all his adventures and daring, it is sad to relate that Pat fell down a well after a drinking bout and met an undignified death by drowning!

During his wanderings, the author witnessed the Indian Snake Dances, where the Indians are wonderfully streaked with paint and bedecked with rattles of tortoise-shell and dried deers' feet. They move in groups of three, after the first solemn parade, one holding a whip of feathers, and with his arm around the shoulders of his companion, who carries a live snake in his mouth. Sometimes the snakes are so big that they cannot be grasped properly in the teeth and are supported by the hands as well. The first man plays with the snake's head with his feather whip, and so they prance round, followed by the "gatherer" who picks up the snakes when they are dropped from the mouth of the dancer. These gatherers think nothing of handling a handful of writhing snakes, and the strange thing is that none of the dancers seem to be bitten although many of the snakes are of the most poisonous kind and they are not treated in any way, or their fangs drawn.



At the foot of Bright Angel (one of the illustrations from "The Last Memories of a Tenderfoot," reviewed on this page)

There are dozens of interesting experiences and impressions in this book, and so many States, and people and customs are dealt with that there seems to be an inexhaustible fund of information within its covers. It is a book that can be read many times and one that holds the reader enthralled from start to finish. The photographs that illustrate it are as excellent as they are unusual.

* * * *

"Sandy and Co."

By Ruth Ellison (Australian Book Co. London), 3/6

Written principally for young Meccano boys, this story centres round a jolly sea-Captain and a little Meccano boy "Sandy." The latter lost a leg in an accident through trying to save his terrier, who is his devoted and constant companion and forms the "& Co." The Captain tells many exciting little stories to his nephews and to "Sandy & Co.," and it goes without saying that Sandy is a brave little sport and makes the best of his troubles, being a typical Meccano boy.

Unfortunately, although the ambition of his life is to own a huge and shining Meccano Outfit that adorns the centre of the local toyshop window, Sandy has not sufficient money to buy it, although he is saving up and is only a small amount short of the price. Every time he passes the window he gazes at the treasure that he is working for, until a tragedy happens—he hears another little boy talking excitedly to his mother as they enter the shop, and his heart jumps as he thinks they may be going to buy the Outfit—his Outfit! "He had not long to wait. A few minutes later, with hurrying steps and a voice full of excitement, the little boy, accompanied by his mother reappeared; and under his arm, as he hugged it tight was a big brown paper parcel. So Sandy's dream was over! At last his beloved Meccano had gone." And so our little hero, with his dog, went home heavy-hearted.

Things are not always black for Sandy, however, and good friends are sometimes found in jolly young captains, as readers of the book will discover.

* * *

"My Travel Book"

By G. G. Jackson
(Frederick Warne & Co. Ltd. 3/-)

This book tells in an interesting manner the story of the growth of travel by land, sea and air. We read how the railways started and how they work, how the early steamboats have grown into giant liners and how the petrol engine has made possible the development of the motor-car and the aeroplane into the marvellously efficient machines of to-day.

The section on railways is particularly good, and although its length appears too great in proportion to the space devoted to ships and aircraft, these latter sections have an enormous amount of interesting information crowded into relatively small space.

The book is well illustrated by a large number of drawings and in addition there are several very attractive full-page plates in colour.

Interesting New Books

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

"Yachting—How to Sail and Manage a Small Modern Yacht" (Brown Son & Ferguson), 7/6

"Adventures in Science" edited by Arthur Malle, M.A. (Collins), 1/9

"Models of Buildings" by Wm. Harvey (Architectural Press), 7/6

The Ljungström Turbine Engine

The Beyer-Peacock Ljungström type turbine engine at present operating on the L.M.S. Railway has been showing a satisfactory capacity of speed within recent months. On one occasion it hauled eight corridor-coaches from Nottingham to St. Pancras, a distance of 123½ miles, in 135 mins., an average speed of 54.8 miles per hour. An interesting feature of the locomotive is that it can be operated successfully at high speeds with its tender leading, and on the occasion mentioned its return trip from St. Pancras to Nottingham was made with the tender in this position.

* * * *

New 4-6-0 S.R. Goods Engines

A new class of goods engines to be known as "S.15" has been introduced on the Western Section of the Southern Railway. The engines will be numbered 823E to 832E and their design generally follows the lines of the "King Arthur" 4-6-0 express passenger engines; in fact the boilers and a large number of the other parts of the new engines are interchangeable with the "King Arthurs."

The engines have been designed by Mr. Maunsell, Chief Mechanical Engineer to the Southern Railway, and have two cylinders, placed outside the frames, each with a diameter of 20½ in. by 28 in. stroke. The valve gear is of the Walschaerts type, the drive being off the middle pair of coupled wheels, which are 5 ft. 7 in. in diameter. The total wheelbase for the engine is 26 ft. 7½ in. The boiler carries a working pressure of 200 lb. per sq. in. and has a total heating surface of 2,215 sq. ft. of which the superheating accounts for 237 sq. ft. The total weight of the engine in working order is 80 tons 14 cwt. and at 85 per cent. of the boiler pressure the tractive effort is 29,860 lb.

The tender is mounted on two bogies and provides capacity for five tons of coal and 5,000 gallons of water. Its weight in working order is 56 tons 8 cwt. making a total for the engine and tender of 137 tons 2 cwt. The engines will be painted in the standard black adopted by the S.R. for its goods engines.

* * * *

The World's Most Powerful Engine

Subsequent to our recent note on the most powerful British locomotive, we have received several inquiries as to the most powerful locomotive in the world.

The world's most powerful locomotive is the Virginia 2-10-10-2 Mallet, which was built at the American Locomotive Coy's shops in 1919. This weighs 307 tons 5 cwt. and with its tender 401 tons. It can be worked as a simple engine or as a compound; its tractive force when working as a simple engine being 176,000 lb. and when working compound 147,200 lb. Among "compounds" the Erie 2-8-8-2 triplex Mallet compound articulated freight locomotive, built in 1914 by the Baldwin Locomotive Works, is the most powerful, having a tractive effort of 160,000 lb. This is also the heaviest engine, its weight being 380 tons 16 cwt.

* * * *

Tractive Effort

So many readers have inquired within recent months as to the means of calculating the tractive effort of locomotives that we give below the formula.

Customarily the following letters are used:—

d = diameter of cylinder in inches.
L = stroke in inches.
P = effective steam pressure, usually taken as 85 per cent. of the boiler pressure.
D = diameter of driving wheel in inches.
T = tractive effort in lbs.

For an ordinary two-cylinder engine use the following formula:—

$$T = \frac{d^2\ L.P.}{D}$$

For non-compound three and four cylinder locomotives multiply this result by 1½ and 2 respectively.

In the case of compound locomotives, the calculation must necessarily be somewhat approximate in the absence of indicator diagrams. Without these the mean effective pressure (M.E.P.) cannot be estimated exactly. However, the approximate tractive effort can be obtained as follows:—

Take the M.E.P. for the high pressure cylinder at 65 per cent. of the initial boiler pressure, and that for the low pressure cylinders at 25 per cent. Assume that all the work is being done in the low pressure cylinders and refer the M.E.P. for the H.P. cylinder to the L.P. cylinder. Divide the M.E.P. of the H.P. cylinder by the ratio of the L.P. cylinders to the volume of the H.P. cylinder. Add to this figure the total M.E.P. of the L.P. cylinder, or cylinders, and using this result as the value for P proceed as for a simple engine. The formula is the same but L equals the length of the L.P. stroke in inches, d equals the diameter of L.P. cylinder in inches. The remaining symbols are as before. With these formulæ readers will find little difficulty in calculating for themselves the tractive effort of two, three and four-cylinder compounds.

Orange-Light Distant Signals

The Great Western Railway, after prolonged experiment, have decided to substitute orange lights for red in all distant signals on the main lines to the West and North of England. The L.N.E.R. came to the same decision some time ago, and over most of their lines in England the substitution is now complete. At the same time the distant signal arms are painted yellow instead of red. R.S.M.

* * * *

G.W.R. Name Changes

In addition to the alterations in the names of the locomotives of the old "King" group of "Star" class engines to facilitate the naming of the new "King" class, various other G.W. engines are to lose their names entirely. These are as follows:—

3382—"*Cardiff*," 3384—"*Swindon*," 3385—"*Newport*," 3386—"*Paddington*," 3387—"*Reading*," 3388—"*Swansea*," 3389—"*Taunton*," 3390—"*Wolverhampton*," 4412—"*Oxford*," 4415—"*Shrewsbury*."

It will be observed that each of these engines bears the name of a town and the change is being made because instances have occurred where passengers have been led to believe that certain trains were going to the towns indicated on the engines' nameplates!

No. 3353—"*Plymouth*," has been renamed "*Pershore Plum*" at the request of the Worcestershire branch of the National Farmers' Union.

* * * *

Giant Voices Direct Passengers

A very recent innovation at York Station is the fitting of three gigantic amplifiers, controlled from the central signal box, through which an announcer gives information as to the platforms and times of arriving and departing trains. A special microphone is installed in the signal box, designed to exclude all sound, thus differing from the ordinary broadcasting microphone, which picks up all sounds and would consequently be useless in a busy signal box. The announcer is provided with a schedule of trains, and as they arrive and depart the signalmen supply him with information, which is broadcast on the following lines:—

"The train now standing at No. 4 South stops at Selby, Doncaster, and London only."

"Over the bridge for Malton and Scarborough. Please hurry up."

The announcements are plainly heard in every part of the great station. R.S.M.

"*King George V*" Tried Out

The new G.W.R. locomotive No. 6000 "*King George V*" completed a notable performance on its first run with the "Cornish Riviera Express." The train weighing 410 tons for the major portion of the journey, and 338 tons after the Weymouth portion was slipped at Westbury, was started prompt to time. Despite checks at Westbourne Park and Acton, resulting in 4½ mins. lost time before Slough was reached, the arrival at North Road, Plymouth, was five minutes ahead of schedule.

Over the South Devon section, the most difficult portion of the whole run, the load was probably as much as 350 tons, including passengers and baggage. This is the heaviest passenger load ever hauled by one engine over this section, the "Castle" engines never being called upon to take more than 300 tons unpiloted. Throughout the trip "*King George V*" was running well within itself and the 157 miles between Slough and Exeter were covered at an average speed of slightly more than 61 m.p.h.

Another 19 engines of the "King" class are being built at Swindon, the names and numbers of the complete series being as follows:—

6000—"*King George V*"; 6001—"*King Edward VII*"; 6002—"*King William IV*"; 6003—"*King George IV*"; 6004—"*King George III*"; 6005—"*King George II*"; 6006—"*King George I*"; 6007—"*King William III*"; 6008—"*King James II*"; 6009—"*King Charles II*"; 6010—"*King Charles I*"; 6011—"*King James I*"; 6012—"*King Edward VI*"; 6013—"*King Henry VIII*"; 6014—"*King Henry VII*"; 6015—"*King Richard III*"; 6016—"*King Edward V*"; 6017—"*King Edward IV*"; 6018—"*King Henry VI*"; 6019—"*King Henry V.*"

* * * *

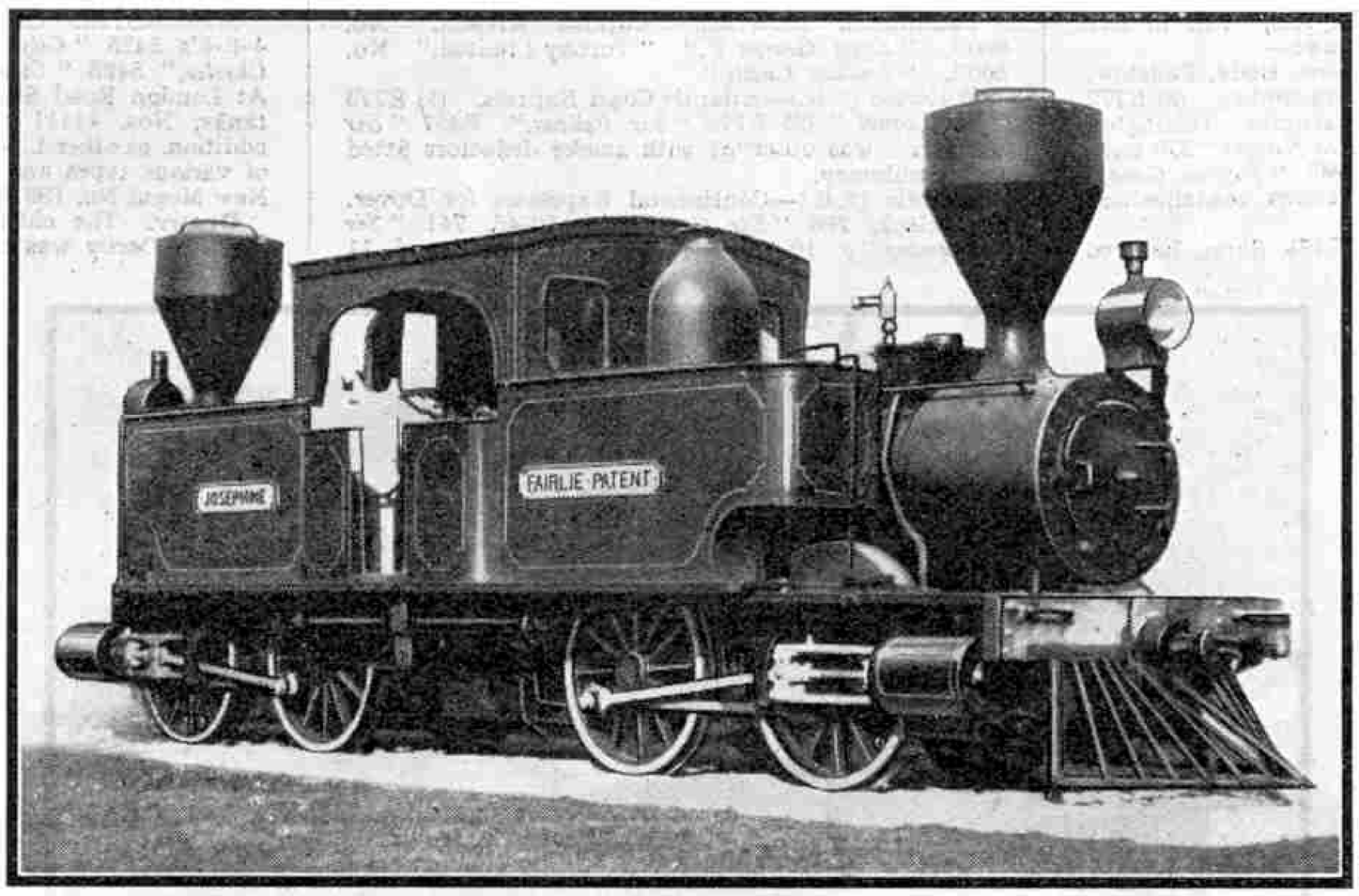
New Metropolitan Electric Stock

The new type of electric trains, consisting of seven-coach units, now being introduced on the Metropolitan Railway, are expected to make possible a big speeding-up of services. The driving cars in these units are the most powerful type yet introduced in this country and they can attain a speed of 30 m.p.h. in less than 30 secs. from starting. The engine is rated at 2,500 h.p. and the maximum speed is 65 m.p.h. The carriages are of the compartment type, each train providing accommodation for 482 passengers, as compared with 318 in the old type of train.

The New L.M.S. Engines

Many readers have written within the last few weeks enquiring whether we are able to give a list of the names allocated to the new L.M.S. 4–6–0 engines. As far as can be ascertained at the moment of writing, only two of these have been named, Nos. 6100, "*Royal Scot*," and 6101, "*Highland Chieftain*."

An Overseas Veteran



Photo] [*T. Maclachlan, Dunedin*

The New Zealand State Railway locomotive "*Josephine*," which was on exhibition recently at Dunedin, N.Z. This locomotive is of the early Fairlie articulated type, and was designed to burn wood. It hauled the first train into Dunedin at the opening of the Port Chalmers line on 1st January, 1873

New Belgian "Decapods"

To avoid the necessity for "double-heading" and "banking" in operating mineral trains on the heavily-graded Luxembourg line between Brussels and Arlon, the Belgian State Railways have introduced a new goods locomotive to be known as "Type 36." This locomotive, a 2–10–0 with four cylinders each 19⅝ in. in diameter by 26 in. stroke, is the most powerful freight locomotive ever used on these lines. In full working order it weighs 104½ tons and on a 65 per cent. boiler pressure basis has a tractive effort of 45,600 lb. The tenders weigh, in running order, 54 tons, and provide a water capacity of 5,286 gallons and accommodation for seven tons of coal. The working pressure of the boiler is 199 lb. per square inch and the diameter of the coupled wheels is 4 ft. 9 in.

* * * *

A Unique Locomotive Record

The L.N.E.R. "Pacific" locomotive 4474, "*Victor Wild*," holds a most interesting record. It has worked non-stop from King's Cross to Newcastle, 268 miles to the north, and from Paddington to Plymouth, 225½ miles to the west. "*Victor Wild*" was one of the locomotives that participated in the G.W.R.—L.N.E.R. exchange two years ago.

1926 Railway Statistics

The annual summary of railway returns for Great Britain recently published by the Ministry of Transport gives a clear indication of the bad effect of the industrial disputes during the past year. The total amount of general traffic carried was 215,500,000 tons, which shows a decrease of 100,000,000 tons as compared with 1925. Passenger traffic also showed a slight decline, the number of passenger journeys made during the year (excluding the underground electric system) being 1,541,000,000.

The Underground Electric Railways also show a slight decline, the number of passengers carried during the year being 1,842,000,000. It is interesting to note that in 1908 the corresponding number was 206,000,000. The total car mileage run during the year was 242,000,000 as compared with 40,000,000 in 1908.

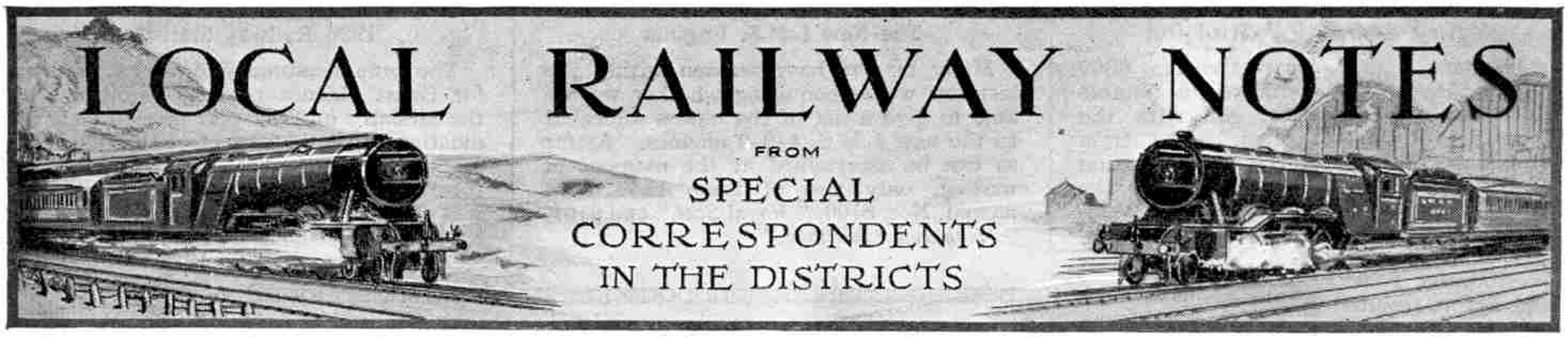
The report gives some interesting figures regarding railway maintenance for the year, and shows that altogether there were 52,332 miles of single track in operation, including sidings. The electrified track in operation was 527 miles. For maintenance purposes 1¼ million cu. ft. of ballast; 3½ million tons of sleepers, 180,000 tons of rails and 370 miles of fencing were used.

The total number of passenger vehicles in operation was 51,210. Nearly all the new carriages introduced during the year were fitted for electric light. Locomotives employed numbered 24,132, including steam, electric and petrol engines; and 720,860 goods wagons were in use, providing capacity for 7,665,856 lb. of merchandise. It is from the train mileage figure that the effect of the railway stoppage in May is most clearly traceable. The train miles run were 346,000,000, as compared with 402,000,000 in 1925. The total number of persons directly employed on the railways was 689,264.

* * * *

A Curiosity of Grouping

Many interesting points have arisen as a consequence of the grouping system, but probably Addison Road, Kensington, possesses an unexampled claim to fame. This station is the joint property of the L.M.S. and G.W. Railways but, in addition, the Southern, Metropolitan and District Railways have running powers through the station. On very few stations throughout this country can the passenger stock of five distinct railways be seen in one station.



LONDON

A recent "Atlantic Coast Express," run in five portions, was operated as follows:—

(1) E780 "*Sir Persant*," 400 tons, Bude, Padstow, etc.; (2) E476 Urie, 320 tons, Ilfracombe; (3) E772 "*Sir Percivale*," 420 tons, Ilfracombe, Torrington and Plymouth; (4) E755 "*The Red Knight*," 370 tons, Seaton, Exmouth, etc.; (5) E742 "*Joyous Gard*," 370 tons, Sidmouth. All the trains contained at least one restaurant car.

Western Section 4–4–0 No. E431 (large boilered Drummond Class) has been noted on the 11-10 a.m. express to Eastbourne (non-stop). She is fitted with a Urie funnel and a six-wheeled tender for working short runs. This class of engine is now largely used for excursion traffic on the Central and Eastern Sections.

Atlantic No. 423B, "*The Needles*," has been seen working the "*Sunny South Special*" (15 vehicles). This is exceptional, for Atlantics are rarely allowed to work over the West London line. A.H. (Kensington)

* * *

GLASGOW

L.M.S.—"The Royal Scot" arrived recently with 4-4-0's 909/5, ten minutes early. These engines came on at Carnforth, bringing the 15-coach train to Aymington where a Carstairs engine (14350 on the first time of running) takes six coaches to Edinburgh, leaving the 4-4-0's with nine for Glasgow.

In St. Enoch, the "Continental Express via Tilbury" coaches had 14376 piloting 914 on nearly 500 tons.

L.N.E.R.—Recent Sunday excursions to Fort William have been handled by (1) 9495 "*Glen Mallie*" and 9256 "*Glen Douglas*"; (2) 9495 and 9408 "*Glen Sloy*"; (3) 9298 "*Glen Sheil*" (unaided with eight coaches, a fine achievement) with a second train, 9496 "*Glen Moidart*" piloting 9495. The most recent Sunday trip was made by Mogul 4693 with nine (unassisted) followed by 9221 "*Glen Orchy*" and 9408 with eight coaches and two steel diners (355 tons). This brings 9408 an easy first on these runs, having made the trip seven Sundays out of a possible 11. 9493 "*Glen Luss*" comes next with five—one of these being a train from Edinburgh, 9493 with another "Glen," coming on at Cowlairs, East.

On a recent Sunday, eight Glens left running on excursions—9298, 9496/5 Fort William, 9242 pilot to 9408 on 13 coaches and diner to Newcastle (over 460 tons), 9490 "*Glen Dessary*" eight coaches to Elie, with 9493 and 9407 "*Glen Bleasdale*" 11 coaches for Crail. 9498 "*Father Ambrose*" brought up the rear with five coaches (unbanked) for Edinburgh.

The Sunday excursion to Crianlarich is usually entrusted to a superheated 2–6–0 and "J37" 9033/98 have been seen.

9092 "P" tank is scrapped. 9599 "N," contrary to expectations, was not scrapped, but left again fully repainted. Lining of buffer beams has again stopped and Directors 6384/99, after coming into the shops with lined beams, left unlined. 6385 was one of the last to leave with lined beams.

Another interesting scrapping is 10180, one of two Wheatley 0-6-0's that were fitted with "Scott" funnels owing to bridge restrictions at Kipps, where these engines were in use.

G.N.R. "N2" 0–6–2T, 4721/2/3/4/6/7, have been transferred from the London area to Glasgow and are being replaced in London by the new "N7" tanks 2642/61 (inclusive), built by Beardmore.

To suit "Director" class engines two minutes have been added to the time of every train between Edinburgh and Glasgow and vice versa. The fastest trains now take 62 minutes in each direction. J. M. C.

SEEN IN LONDON

Paddington (G.W.R.)—"Cornish Riviera." No. 6000. "*King George V*." "Torbay Limited." No. 5002. "*Ludlow Castle*."

Waterloo (S.R.)—Atlantic Coast Express. (1) E773 "*Sir Lionel*" (2) E778 "*Sir Pelleas*." E457 "*Sir Bevidere*" was observed with smoke deflectors fitted to her chimney.

Victoria (S.R.)—Continental Expresses for Dover. 10 o'clock, 766 "*Sir Geraint*"; 10-45, 741 "*Sir Sagramore*"; 10-50, 764 "*Sir Garvain*" and 11 o'clock, 850 "*Lord Nelson*." For Newhaven, 10 o'clock, Atlantic B40, "*St. Catherine's Point*." "Southern Belle" (10 Pullmans), E798, "*Sir Hectimere*."

Euston (L.M.S.R.)—"Royal Scot," 15 bogies. "Claughton" 5985 with 4–4–0 5327 pilot, both engines still painted black. 10-5 for Scotland, 5932, "*Sir Thomas Williams*." The only engine seen painted in L.M.S. livery was 4–4–0 5273 "*Jason*." On a run with the night sleeper from Glasgow, 4-4-0's 903/2 ran to Carnforth, where 4–4–0, 5295 "*Scorpion*," with "Claughton" 6009, came on and, calling only at Crewe, finished the run.

Liverpool Street (L.N.E.R.)—Flushing Continental Express. 4–6–0, 8568. "Super Clauds" 8813 & 56 were observed.

King's Cross (L.N.E.R.)—9-50 (Newcastle first stop), 2562, "*Gladiateur*" (Gateshead); 10 o'clock, "Flying Scotsman," 4471, "*Sir Frederick Banbury*"; 10-10, Leeds, 4470, "*Great Northern*"; 11-10, West Riding Pullman, Atlantic 4442 (G.N.R. badge on rear splasher); 11-20, Edinburgh Pullman, Director 5507, "*Gerard Powys Dewhurst*"; 11-50, "Scarboro' Flier" (first stop York), 2555 "*Centenary*" (also seen with 4471); In "Flying Scotsman," 2546, "*Donovan*"; 10-25 sleeper, Glasgow, etc., 2556, "*Ormonde*"; 10-35 Edinburgh sleeper, 2546, "*Donovan*"; 1-50 ex Edinburgh, arrived with 4475, "*Flying Fox*."

The following were also seen:—2558, "*Tracery*"; Moguls 4649/74; G.E.R. 4–4–0 8812 for Cambridge; G.C. 4–6–0 5475; 4419 (the Booster 4–4–2) and N7 0–6–2T, 2644/5/7. J. M. C.

A RECENT TOUR

MANCHESTER. On a visit to Manchester, L.N.E.R. 4–6–0's 5425 "*City of Manchester*," 5426 "*City of Chester*," 5428 "*City of Liverpool*," were observed. At London Road Station two of the L. & Y. Baltic tanks, Nos. 11111 and 11113, were on view. In addition, at other L.M.S. stations quite a large number of various types and sizes of tanks were to be seen. New Mogul No. 13014 was seen at Victoria.

DERBY. The chief item of interest in a recent visit to Derby was a view of the three new L.M.S. 2–6–0—0–6–2 Garratts, Nos. 4997/9. These are now at work hauling goods trains between Toton and Brent, each performing the work of two Class 4 0–6–0's. Other engines seen there were ten new 4–4–2 Tanks for the L.M.S. Tilbury service. These are Nos. 2125 to 2134, and are similar to the locomotives already operating on this line. The Derby Works have also in hand 30 Class 4 0–6–0's.

YORK. The outstanding engines seen here were Gresley Pacifics and one of the Raven Pacifics. The engines particularly noted were 4470 "*Great Northern*," 4477 "*Gay Crusader*," 4481 "*St. Simon*," 2573 "*Harvester*," 2577 "*Night Hawk*," 2578 "*Bayardo*," 2579 "*Dick Turpin*." The Raven Pacific was No 2404 "*City of Ripon*." Whilst returning from the visit to York, the old L.M.S. 2–4–0 "Kirtley" was seen piloting a goods train near Chesterfield. A North Stafford 0–6 0, No. 2356, was spotted in the same district, a most unusual place to find a N.S.R. engine.

BIRMINGHAM. Among G.W.R. engines recently seen at Birmingham are 4003 "*Lode Star*," 4050 "*Princess Charlotte*," 5010 "*Restormel Castle*," 4108 "*Hotspur*," 3381 "*Birkenhead*," 4027 "*The Norwegian Monarch*" (formerly "*King Henry*,") 5006 "*Tregenna Castle*," 4046 "*Princess Mary*," 4100 "*Badminton*," 4063 "*Bath Abbey*," 3816 "*County of Leicester*," 3317 "*Somerset*," 4093 "*Dunster Castle*," 4002 "*Evening Star*," 4004 "*Morning Star*," 3828 "*County of Hereford*," 4156 "*Gardenia*," 5001 "*Llandovery Castle*," 4033 "*Queen Victoria*," 3315 "*Quantock*," 3353 "*Pershore Plum*" (formerly "*Plymouth*"), 2951 "*Tavistock Court*," 3418 "*Sir Arthur Yorke*," 4015 "*Knight of St. John*," 3314 "*Mersey*," 4048 "*Princess Victoria*," 3401 "*Vancouver*," 4082 "*Windsor Castle*," 3365 "*Charles Grey Mott*."

It is a matter of regret to have to report that three more of the remaining Midland Singles mentioned in the September magazine have gone to the scrap heap. These are Nos. 633, 640 and 669. Two more of the famous "Jumbos" also have passed on. These are "Precedent" type No 2176 "*Robert Benson*" and "Waterloo" type No. 817 "*Constance*."

G. F. F. (Hinckley).

* * * *

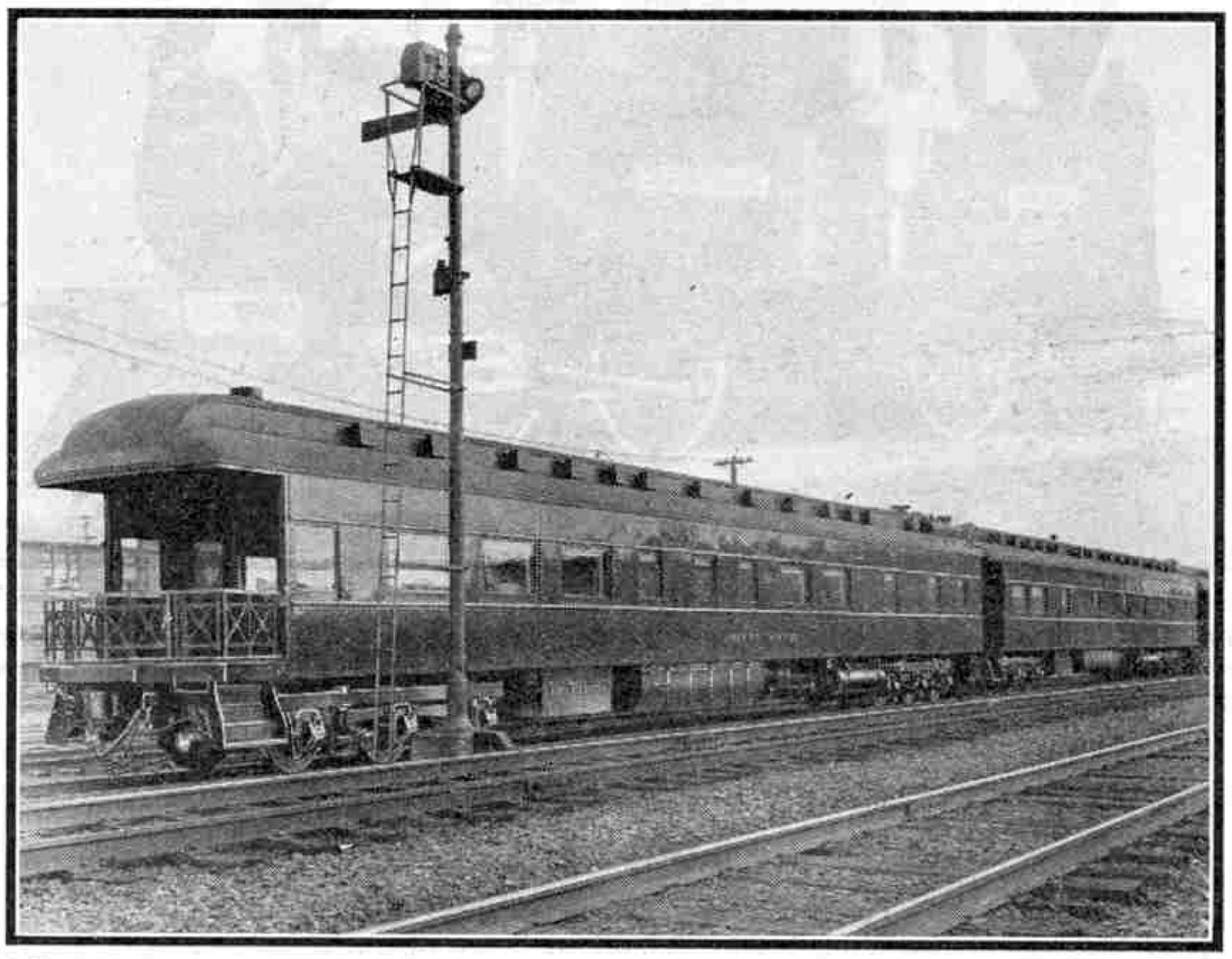
The 5.41 L.M.S. Preston-Fleetwood train was recently hauled by an old Midland Compound, No. 1126, running tender first, a most unusual occurrence.

W. L. H. (Preston).

* * * *

The name of Clifton Station, near Penrith, has been altered to Clifton Moor, the change taking effect on 1st September. The new name is intended to create a link with a famous point of local history. In 1745 Prince Charles Stuart and the Duke of Cumberland fought a pitched battle at a point only a short distance removed from the site of the L.N.E.R. station buildings.

R. S. H. (Carlisle).



The two cars, "*Mount Stephen*" and "*Strathcona*" of the Canadian Pacific Railway Royal Train that carried H.R.H. Prince of Wales and H.R.H. Prince George from Montreal to Banff. The Prime Minister and Mrs. Baldwin accompanied them on their trip across Canada

Swinging the Compass

Importance of Testing New Instruments

By "Airman"

THE compass is just as important to the pilot of an aeroplane as it is to the navigating officer of a ship.

No reliance can be placed upon a compass until it has been thoroughly tested, and new aeroplanes must have their compasses checked before being used for regular flights. In order that the airman may be assured that he can rely on a new instrument, the operation of "compass swinging" is performed.

At most aerodromes there is a circular cement slab with eight lines radiating from the centre, marking the four magnetic cardinal and four quadrantal points of the compass. These points—N., S., E., W., and N.W., S.W., N.E., S.E.—have been accurately determined by an expert.

Pupils receiving instruction in Compass-Swinging

The first step is to trestle the machine up in the flying or level position, its fore-and-aft line being laid along the north and south lines in the circle on the ground. This is done accurately by dropping a plumb line from the centre of the propeller and sighting along it to another plumb line dropped from the centre of the fuselage near the tail. It is important for the aeroplane to be dead level across the wings as well as from nose to tail.

When these adjustments have been made satisfactorily the compass reading is noted. The card of the compass itself is so pivoted that it is free to revolve in a horizontal plane. In order that vibration may be prevented from causing a false reading to be made, it is immersed in a mixture of alcohol and distilled water contained in a bowl of non-magnetic material.

On the outside of the bowl, and in the fore-and-aft line of the compass and aeroplane, a mark is made, to which the name "lubbers' line" has been given. As the compass card is pivoted, it remains stationary when the aeroplane turns or alters its course, and the "lubbers' line," being set in the fore-and-aft line of the machine, then registers the change of direction on the compass card.

The compass card, which is circular, is divided into 360 degrees, which are read in a clockwise direction. For example, N. = 0 degrees or 360 degrees, E. = 90 degrees, S. = 180 degrees, W. = 270 degrees, and N. by W. = 350 degrees.

The reading of the compass in this first position should be exactly north. The process is then repeated for every cardinal and quadrantal point and the readings obtained in these positions have then to be considered.

Owing, perhaps, to the influence of metal in the machine, the compass reading may be inaccurate. For example, when the aeroplane is on the north and south line, the compass needle may point to four degrees east of north. The amount of such deviation must be reduced to the minimum. In order to do this a small field magnet is inserted in a slot near the compass to drive the needle back to north. On the principle in magnetism that similar poles repel one another, the red or north end of the field magnet is brought close to the red or north end of the compass needle. If it is found that the compass needle is driven back too far a smaller magnet is used, or the field magnet may be placed farther away from the needle.

When the error on the cardinal points has been reduced to a minimum, a deviation table giving the readings and error for each point is prepared and pinned up in the machine, so that the pilot may allow for the error in calculating his compass course.

Such a deviation table would take a form similar to that given on this page.

Magnetic Course	Deviation	Steer by Compass
N. = 0 degrees	2 degrees E.	358 degrees
N.E. = 45 ,,	1 ,, W.	46 ,,
E. = 90 ,,	2 ,, W.	92 ,,
S.E. = 135 ,,	Nil.	135 ,,
S. = 180 ,,	2 degrees W.	182 ,,
S.W. = 225 ,,	Nil.	225 ,,
W. = 270 ,,	3 degrees E.	267 ,,
N.W. = 315 ,,	3 ,, W.	318 ,,

The rule made use of is that, to convert magnetic course to compass, westerly deviation is added, and easterly subtracted. If the pilot finds that his course lies between two of these points, he calculates his compass course with due regard to the error on each of these points.

After the foregoing operations have been carried out for a machine, the pilot has to take care that there are no tools or other metal implements near the compass to cause it to give false readings and thus render of no account all the work entailed in the delicate and important operation of "compass swinging."

It will be seen that the process is somewhat similar to that used for testing the compass of a ship. In this latter case the ship is taken to a place where the bearings of easily visible landmarks are known accurately and there the magnets are inserted in the positions necessary to counterbalance the deviations of the needle from the correct reading.

Engineering News of the month.

A Triumph for British Engineering

Egyptian engineering circles have recently experienced an excellent illustration of the maxim that the best is always the cheapest. A 10-span railway bridge had to be built at Dessouk, and the work to be carried out involved the demolition of an old bridge, the erection of a new one 660 yards in length, and the re-capping of three piers. 36,000 tons of steel work were to be put into position. The authorities placing the contract asked for the work to be completed in 12 months, a task that was regarded as a sheer impossibility by every firm that tendered. Among firms from various countries, Messrs. Dorman Long, the famous British engineers, tendered for the contract. The lowest Continental offer asked for a three-year period in which to complete the work. Dorman Long's tender was higher in price but called for a shorter period in which to carry out the contract, which eventually came to them.

In spite of the British labour troubles of 1926 and extensive damage caused to a pier by a boat in collision, Dorman Long's actually succeeded in completing the contract in 13 months.

* * * *

A Canadian Hydro-Electric Scheme

Probably for the first time in the history of the world and certainly in the history of Canada, a complete river has been scheduled for the purpose of a hydro-electric undertaking. This scheme is the project of the Gatineau Power Company, operating on the Gatineau River in Quebec.

Estimated to cost approximately £10,000,000, a total horse power of between 700,000 and 800,000 will be available when the three plants now under construction on the river at Chelsea and Farmers Rapids (2) are completed. 200,000 h.p. will be available for transmission to Toronto 200 miles away.

One of the most interesting features of the enterprise was the work entailed in creating a regulated water flow by the erection of a great storage dam at the head of the river. This has an estimated capacity of 95,000,000,000 cu. ft., and ranks in size only a little smaller than the Assouan Dam in Egypt. Additional storage dams have been provided at the Farmers Rapids and Chelsea plants, that at Chelsea being the larger. Here the dam is 1,600 ft. in length and 100 ft. in height. Its size is such that it backs the river up for a distance of 26 miles to the tail-race at Paugan Falls, and impounds approximately 440,000,000 cu. ft. of water. A further dam being built below the Paugan Falls will back the river up for a further distance of 30 miles, and will completely submerge nine waterfalls and rapids.

To make way for the increased flow of the river it has been necessary to flood 150 farms, move a railway a considerable distance back from the river to avoid the possible flooding of the line, and to move various roadways to facilitate the making of the new river channel.

* * * *

Dock Traffic at Southampton

The progressive policy of the Southern Railway in connection with its Southampton Docks continues to produce exceptionally good results. During the year 1926, over 1½ million tons of traffic more than that dealt with in 1925 was handled, the actual gross tonnage of the vessels cleared being 14 millions. 99,459 passengers landed in the first six months of 1927, this comparing with 88,414 for the corresponding period of 1926.

* * * *

Kent Colliery Rope-Way Scheme

The Tilmanstone Colliery in Kent has now received the approval of the Railway and Canal Commission for its scheme of conveying coal from the collieries to Dover by aerial rope-way. The original application was made in March last, but was rejected on the ground that the plans were inaccurate and the scheme incomplete in its inception. Permission was given in May to submit amended plans and now that that has been done the scheme has been passed. It was stated that prior to the coal stoppage last year the output was 1,000 tons a day, but the heavy cost of transport to Dover for shipment made so big a difference in price that the colliery could not develop successfully. The establishment of the rope-way would cheapen the transport charge to the extent of a shilling a ton as compared with the existing railway charges for the same journey, and it would be possible to develop until the output reached 4,000 tons a day.

The scheme provides for the erection of bunkers at Dover with a capacity of 5,000 tons each. Two towers, by which the rope-way would run, would be erected at Dover on the eastern arm of the harbour, and 700,000 tons of coal a year could be sent to the coast by this means.

The Post Office Tube Railway

A new tube railway is shortly to be opened for service in London. But no ordinary member of the public will ever see the trains for the line is to carry mails only. Indeed, the tunnel is far too small to accommodate carriages in which a passenger could comfortably be carried! And the trains will run without drivers! This is accomplished by controlling the trains, which are electrically driven, from the stations through which they pass.

Six miles in length, the line runs from Paddington in the west to Whitechapel in the east and there are stations under all the large post offices on the route. The mails will be loaded and unloaded almost automatically, and at least 25% of the mail vans now working on the London streets will disappear from service when the line comes into full operation. Thus does the G.P.O. do its bit to solve the problem of London's congested streets.

* * * *

British Firms in South Africa

It is authoritatively stated that Messrs. Beyer, Peacock & Co., the well-known engine builders of Manchester, are to open up a large works at Bloemfontein, South Africa. Negotiations for the purchase of a large farm, that is to be the site of the works, are already in progress.

It is intended to manufacture railway materials from rails to locomotives and even guns, telephone parts and motor-cars. There is an excellent supply of steel available at Pretoria and considerable speculation is on foot as to the reason for the choice of Bloemfontein for the new works. At Pretoria practically no transport costs would be incurred, and in addition an abundant coal supply is to hand. Possibly Bloemfontein provides some inducement over and above any natural advantages that the town possesses.

* * * *

Italian Motor Roads

The success of the experimental motor road running from Milan having proved beyond all doubt the utility of such highways, a further road running from Rome to Ostia on the sea coast has been commenced. The new road will be 14 miles in length, with a width varying between 66 ft. and 78 ft. The establishment of advertising signs along the roadside is to be prohibited.

The Round Island Wireless Beacon

The first of the new wireless beacons now being constructed around the English Coast by Trinity House has been put into operation on Round Island in the Scillys. The object of this beacon is to assist navigation by sending out distinctive radio signals at regular intervals in order to enable vessels fitted with wireless direction finders to take bearings from the signals and thus ascertain their exact position.

The Round Island station is to operate on the wavelength of 1,000 metres specified for all wireless beacon stations, and its installation has a power of 500 watts. Each wireless beacon will have a special call sign, that for Round Island being *GGG* transmitted in Morse.

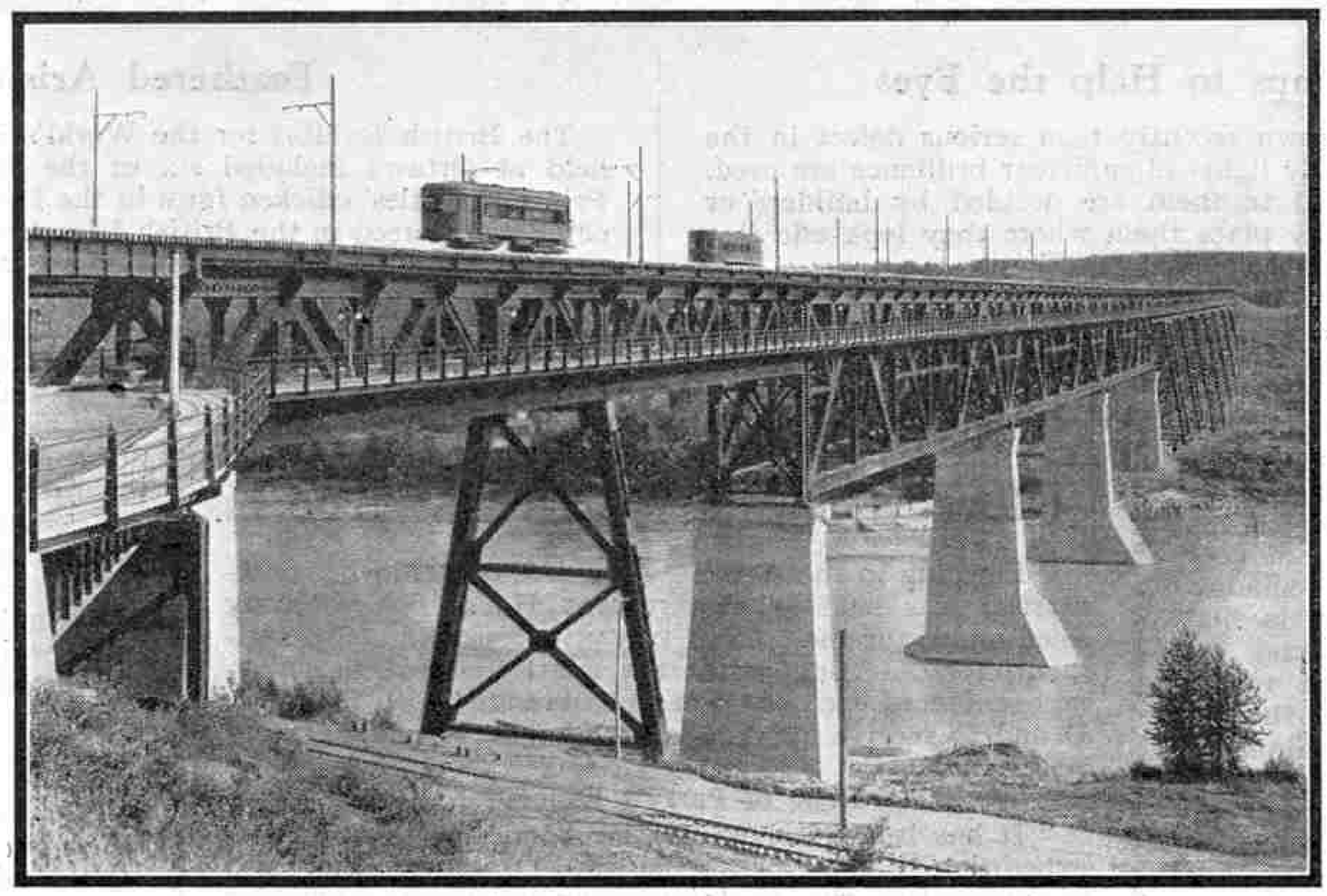
In good weather the signal will consist of the call sign repeated at the rate of 15 words per minute for 47 seconds, followed by a prolonged dash of 10 seconds duration, and terminating with one repetition of the call sign. This combination will take exactly 60 seconds to transmit, and will be followed by a silent period of three minutes. Then the combination will be transmitted again for a minute, followed again by the silence. The call sign combination then is repeated and followed by silence for 21 complete minutes. Thus in good weather the station will transmit signals over a period of nine minutes each half-hour. The signals are transmitted from a cage multi-wire aerial of the L type slung between a lattice tower mast 60 ft. in height and the lighthouse gallery at a point 50 ft. above the ground.

The signalling apparatus consists of two principal parts; a master control clock that determines the periods at which the beacon transmits, and what is called the "character wheel," which actually transmits the call sign. Duplicate control clocks are mounted on a switchboard that incorporates a relay operated by the master clock, which starts up the motor driving the character wheel. Immediately before the beginning of the transmission contacts on the clock start up the main alternator, which provides the whole of the power required for the transmitter. A small pair of contacts then energises the motor of the character wheel. At the end of the third transmission the clock contact opens and the circuit of the main alternator is broken until the commencement of the next 30-minute period.

In foggy weather a hand-operated switch is turned to short circuit the alternator contacts, and the complete combination of signals consisting of the one-minute transmission and the three-minute silence is then repeated continuously until the weather clears.

The station is capable of giving accurate bearings on a normal ship's direction finding apparatus up to a range of 100 miles, but under favourable conditions this distance can be increased considerably.

A Famous Canadian Bridge



The High Level, Double-track Bridge across the North Saskatchewan River, on the C.P.R.

The New Manchester Reservoir

Manchester's great new reservoir at Heaton Park is now nearing completion. All that remains to be done is to surmount the surrounding bank with a parapet walk of concrete, but this part of the work will not be carried out until the reservoir has been filled and its completely watertight condition proved. The reservoir, which was started nearly 20 years ago, covers an area of 77½ acres and has an average depth of 26 ft. Its greatest depth is 55 ft. and it will hold 560,000,000 gallons. It will be brought into commission very shortly together with the fourth line of pipes from Thirlmere.

* * * *

Singapore Naval Dock

Work on the 50,000-ton floating dock that is being built for the Admiralty for use at the new naval base at Singapore is rapidly being pushed forward. Three of the seven sections have already been launched and at the time of writing the remaining four, all of which must be completed by the end of January next, are well in hand.

In the complete dock there will be approximately 20,000 tons of steel and 3½ million rivets. As they are completed the sections of the dock will be fitted together and tested preparatory to the voyage to Singapore. The dock probably will be divided into two sections for the voyage.

The Smallest Electric Motor

A motor so small that its rotor could be wrapped in a postage stamp has been made by the Westinghouse Electric and Manufacturing Company. "*The Engineer*" states that this is the smallest synchronous motor ever manufactured for practical use. Four million of these motors, together with their reduction gears, would be required to balance a large 8,000 h.p. motor recently built in the Westinghouse shops. The diameter of their shafts are in the ratio of 512 to one, and 37,000,000 of the small rotors would be required to equal the weight of the large one. While two men, one on the other's shoulders, could stand upright in the circular opening for the rotor in the 8,000 h.p. motor, the rotor of the miniature motor could be worn set in a ring to fit a man's little finger!

* * *

A New Nile Barrage

A new barrage is to be constructed across the Nile at Nag Hamadi. This project is a further step toward the complete irrigation of the Nile Valley, and follows the building of the Assouan Dam in 1899, the Esna Barrage in 1908 and the Sennar Dam, concerning which we wrote in our issues of July and August last year.

The new barrage will be placed some 367 miles south of Cairo between the existing barrages at Assiut and Esna, and it will be approximately 900 yards in length. It will raise the level of the river above it sufficiently to control an irrigation canal leading from the river just above the barrage, and an area of approximately 500 acres is to be served by this canal. The new scheme will enable two crops to be grown each year instead of one as at present, and will overcome the risks of crop failure due to incomplete irrigation caused by low water levels.

* * * *

A Pile Sinking Dodge

A smart method of sinking wooden transmission poles into soft soils was recently reported from America. First a length of 1½ in. pipe is sunk into the ground and the soil forced out from the bottom of the pipe. The displaced soil is replaced by explosives. Then the pipe is withdrawn and the pole is placed over the spot and held in position by guy ropes. The charge is exploded and before the soil has time to subside the pole drops into the hole. It is reported that poles 110 ft. in height have been sunk from 14 to 16 ft. into the ground in this manner.

Of General Interest

Electric Lamps to Help the Eyes

Attention has been drawn recently to a serious defect in the lighting of rooms. Usually lights of sufficient brilliance are used, but the positions allotted to them are decided by builders or decorators, who frequently place them where they look effective instead of where they enable users to see best.

The lesson of daylight has not yet been learnt thoroughly. Compare for a moment a football match played by daylight with one played by artificial light. In the former the light is uniform on all sides and the flight of the ball can be followed easily, whereas even with the most powerful artificial lights irritating and deceiving shadows are formed, which result in poor judgment. The only shadow possible in daylight play is that cast by the sun itself and the effect of this is by no means overwhelming because of the all-round excellence of the illumination.

For indoor work we have advanced a long way, but a scientific study of the whole subject is still desirable with a view to the introduction of a lighting system that will abolish glare and produce an illumination comparable to daylight. The ordinary type of electric lamp with an open filament gives an intense light that dazzles the eyes. New lamps are now being introduced, however, with globes covered by a thin layer of translucent china clay that absorbs very little light and at the same time softens and diffuses the remainder. "Frosting" the glass by etching its surface with hydrofluoric acid is another method for eliminating glare. Formerly this was done on the outside of the glass only, as it was found that etching on the inside made a globe too fragile. This trouble has now been overcome with excellent results, including increased light transmission.

The effect of colour on the eyes must also be studied more carefully. It is now possible to obtain electric lamp bulbs covered with china clay coloured in several tints and they are decorative in appearance as well as being less glaring. Further experiments will result in the almost complete elimination of the headaches and irritation that are now ascribed to poor lighting. Glasses that transmit the rays necessary for visibility, and yet do not stop the outward passage of health-giving light such as some of the ultra-violet rays, are becoming possible, and there is no doubt that the use of these in a scientifically-designed lighting system will be found not merely valuable, but practically essential in fighting diseases of all kinds.

Lamps are also made of special glass having a tint carefully adjusted to give a light closely approximating to daylight. These lamps are now extensively used in shops for the matching of coloured fabrics and also for painting classes at night schools.

Over a Hundred Years Ago!

"Flogging in the Army. A general detachment court-martial was held at Government House on yesterday se'en-night, for the trial of two privates of the 43rd regiment, for desertion, when the court found them guilty, and sentenced each of them to be branded with the letter D and to receive 500 lashes."—"LIVERPOOL MERCURY," 5th Jan., 1827.

Relic of Parry's Expedition

"It has been resolved by the Admiralty that another expedition to the North Pole shall be undertaken; and in consequence the '*Hecla*' has been undergoing repairs for the last six months in the Dockyard at Deptford preparatory to setting out a third time, under the command of Captain Parry."—"HANTS ADVERTISER," 26th Feb., 1827.

An Early Motor Car

"An extraordinary sensation was excited in Regent's Park on Thursday by the appearance of Gurney's steam carriage which coursed through the streets at the back of the Diorama at the rate of ten miles an hour, carrying several persons—inside and behind. It moved with perfect ease."—"SUNDAY TIMES," 29th April, 1827.

Whiskers for Sale!

"The following curious notice appears in the shop windows of a hairdresser in the neighbourhood of Dean-street, Soho:—'Notice. If the gentleman who left his mustachios here for alteration, about two years ago, does not call in a few days and redeem them, they will be sold by public auction to defray the expenses of warehouse room, etc.!'"—"THE TIMES," 26th Feb., 1827.

Feathered Aristocrats

The British Exhibit for the World's Poultry Congress recently held at Ottawa included six of the finest specimens from the Prince of Wales' chicken farm in the Duchy of Cornwall. Practically every breed in the British Isles, from the diminutive Bantam to the heavy dignified Orpingtons, was represented in the exhibit, which consisted of 360 hens, roosters and ducks, including a number of old English and Cornish game cocks, and two pairs of homing pigeons from the King's loft at Sandringham.

Special care was taken of the birds on their long journey, one of the foremost judges of poultry in Great Britain being in charge of them from the time they left England until their return. The Canadian National Railways had a special car waiting on the siding at Montreal in which to rush them at once by fast passenger train to the Congress Buildings in Ottawa.

This exhibit was twice the size of the British display at the Poultry Congress held three years ago in Spain. The Prince's birds were White Wyandottes and Buff Rocks, and among other interesting exhibits were three crates of Indian Aseels from Lucknow. These had been sent to England and went forward to Canada by the same boat as the British birds.

Earliest Steamship in the Pacific

The first steamship to ply on the waters of the Pacific Ocean was the "*Beaver*," a small paddle vessel of 110 tons, which in various capacities had a successful career lasting more than 50 years. This famous vessel was launched at the yard of Messrs. Green, Wigram & Green, Blackwall, England, in the presence of King William IV and a very large concourse of people. She left Gravesend under sail on 27th August, 1835, flying the flag of the Hudson Bay Company, and reached Fort Vancouver on the Columbia River, via Cape Horn, in the following March. Her engines, made by Boulton & Watt, were then installed. The lower reaches of the Columbia River are now in the United States, but at that time settlers were only just beginning to cross the Rocky Mountains into Oregon, and the territory was a matter of dispute between Great Britain and the United States. The Hudson Bay Company had several posts in it, including Fort Vancouver, and carried on an active fur trade there.

The "*Beaver*" was engaged in the coasting passenger and freight trade, Imperial Hydrographic survey, etc., and often appeared in Victoria Harbour. In 1874 she was sold by the company and from that time was employed as a tug. Her end came in 1888, when she was wrecked off Prospect Point near Vancouver.

Caribou in Yukon Territory

For the past three years the great Arctic Caribou herd has been seen along the shores of the Yukon River during every summer, ranging from near Dawson to about 150 miles up the river towards White Horse. The total herd in this territory is immense and, covering, as it does, hundreds of square miles, it is difficult to even estimate the number.

The accompanying picture shows part of a herd that was encountered during the past summer and there are several hundreds in these groups. Practically every boat on the Dawson run, during the summer, saw some caribou and many vessels saw herds like these.—Canadian Pacific Railway "*Bulletin.*"

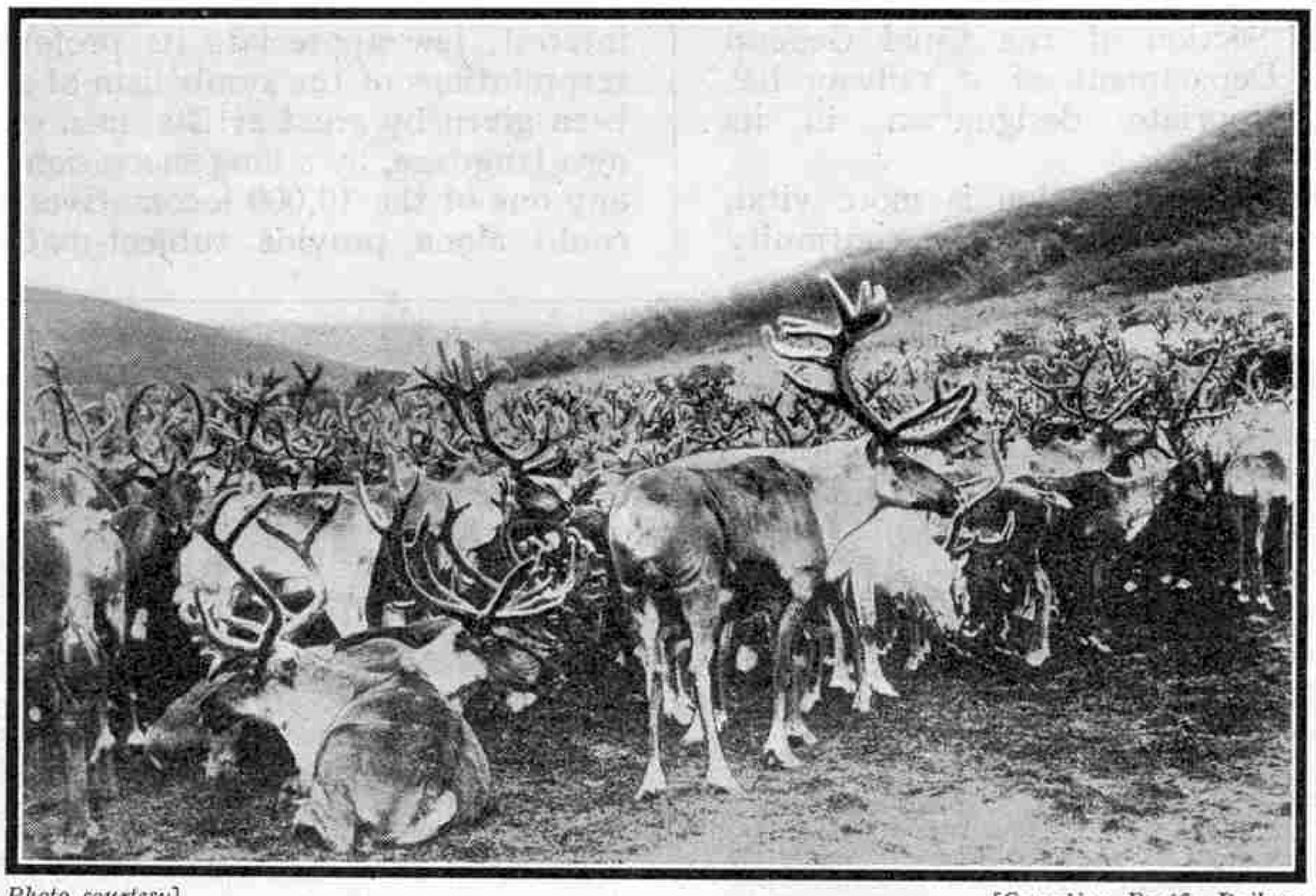


Photo courtesy] [*Canadian Pacific Railway*

A herd of Caribou in the Yukon River district

Steam Bought Like Gas

No less than seven thousand million pounds weight of steam are sold yearly in New York. The steam is produced in a centrally situated plant and is distributed through pipes to the users, who buy it exactly as they buy electric current or gas.

Provision of steam in this way is economical for the small user who is saved the trouble and expense of installing a small steam raising plant for himself. It is, therefore, particularly useful for house and office heating, and it also finds application in driving the machinery of small electric light plants and of the lifts in many New York apartment houses and hotels. Great improvements recently made in the heat-retaining properties of the distributing pipes have made it possible to carry the steam over much greater distances, and there are now 45 miles of pipes carrying steam for sale in New York. Last year 350,000 lbs. of cheap anthracite and powdered bituminous coal were used to raise the steam supplied to regular users.

Removing Obstructions from Oil Wells

In drilling oil wells it may happen that the tools used are broken or that the drill itself may become unscrewed and fall off, and before any further work can be done in the bore the obstruction thus formed must be removed.

Various kinds of fishing tools have been devised and drilling crews have become very skilful in their use, but when the width of the hole is taken into account it is not surprising to find that the recovery of a lost part from a depth of 6,000 ft. in 33 hours is regarded as a remarkable record. Other fishing jobs have lasted for months, for it is usually better to keep on with the hope of success than to recommence drilling. To add to the difficulties the borings are often zigzag in character. In one case on record the crew drilled into the casing of another bore that had been sunk 40 ft. away, while even greater deviations have been recorded with very deep wells.

The most remarkable method ever used for removing an obstacle was employed during the sinking of a well in Texas. The drilling bit fell off and became wedged in the bottom of the hole, which was 18 in. square and had reached a depth of 110 ft. at the time. After days of effort the drillers were about to desist and commence another bore when one of them was seized with a brilliant idea. He offered 25 dollars to a negro boy standing by if he would go down the narrow hole and fasten a rope to the broken bit!

The boy was strapped into a hastily rigged harness and was lowered head foremost with a cable in his hands. Two journeys were necessary before he succeeded in fastening the cable to the bit and altogether he was down several minutes. The episode reminds one of the tale of the negro who was shot out of a gun at the siege of Vicksburg during the American Civil War, and is almost too good to be true. It is well authenticated, however, and the only misgiving expressed by the boy was that there might be snakes in the hole!

How the Bank of England Protects its Gold

The Bank of England is in process of rebuilding and remarkably elaborate defences are being constructed for the vaults in which its gold and securities are stored. Reinforced concrete blocks 6 ft. in length, 2 ft. in width and 2 ft. in thickness are being used for the walls, the reinforcement consisting of old steel ship's cables separated into single strands and interlaced in an intricate manner. The blocks are keyed on to each other in position and circular grooves are left between them, through which electric wires pass. These are connected to special alarms so that any attempt to move a block will result in a breakage of the wire and the sounding of the alarm.

A further defence available in case of emergencies is the flooding of the vaults. The process of flooding is capable of control from three points, one at the Bank, one elsewhere in London, and a third 10 miles away from the city.

460,000 Miles Rug Quest

Mr. J. F. Ballard, a 75-years-old retired druggist of St. Louis, U.S.A., reputed to be the world's greatest collector of rugs, has just completed his third voyage round the world. He has travelled 460,000 miles in search of rugs and has visited London 46 times. Once he travelled 41,000 miles to secure an Indo-Persian carpet which had been woven in the tenth century. A Syrian prayer rug which he secured is valued at £3,000.

The Ancient Oar Mace of Hastings

The Prince of Wales was recently presented with a replica of the ancient oar mace when he visited Hastings. The oar mace was the badge of office of the water bailiff, its possession giving him the right to board vessels and to make arrests on the high seas. The office was abolished more than 150 years ago and at a later date the original mace disappeared. Its discovery after being lost for more than 100 years was due to the late Mr. Charles Dawson, of Lewes, the discoverer of the famous Piltdown skull that is the English claimant to the title of the "Missing Link."

The mace is now in the Brassey Museum, Hastings, and consists of an ivory handle with a silver oar at one end. At the other end is a silver crown, which when unscrewed reveals the receptacle in which the bailiff carried his parchment warrant. The replica presented to the Prince is of the same material and size as the original.

Changing the Guard at the Palace

The original mansion that occupied the site of the present Buckingham Palace was built in 1703 by a Dutch architect for the Duke of Buckingham—hence the name. In 1761 it was purchased by George III and about fifty years later reconstructed by George IV from designs by Nash. Latterly its appearance has been improved greatly by the opening up of The Mall and the erection of the splendid Victoria Memorial, which is surrounded by fountains and gates of gilded ironwork, and the whole of the eastern facade of the Palace has been encased with Portland stone. Here King Edward VII was born on 9th November, 1841. The interesting ceremony of changing the guard may be seen daily about 10.30 a.m., when Their Majesties are in residence.

If all the intentions of George III had been carried out there would also have been another royal residence in the grounds that constitute the present Regent's Park. The latter park was to have been connected with the grounds of Buckingham Palace by a magnificent highway. This part of the scheme was partly carried out, but instead of a tree-lined avenue the famous shopping centre, Regent Street, has resulted!

Motive Power on the L.M.S.

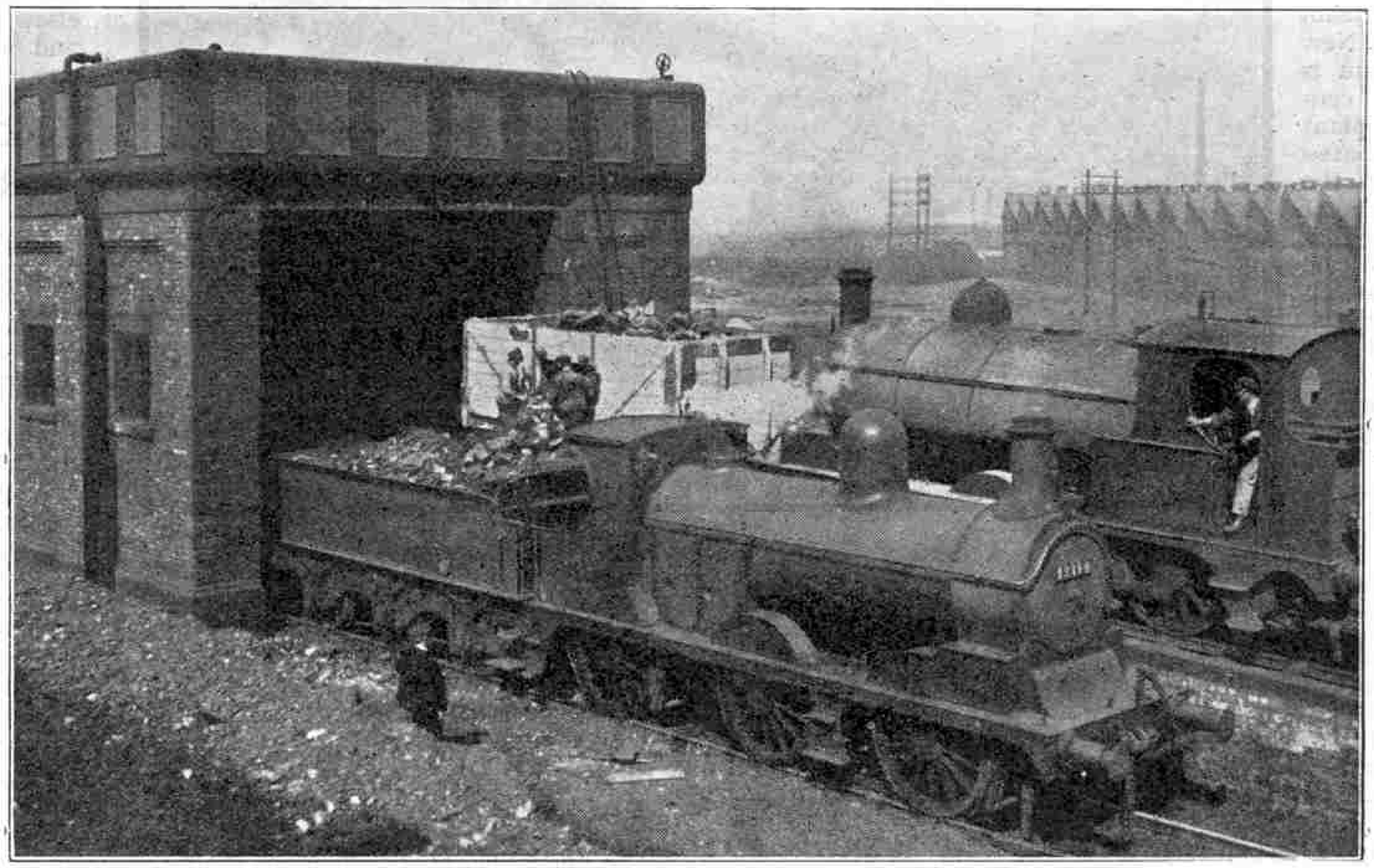
Maintaining and Running Locomotives

By Walter Paterson

THE Motive Power Section of the Chief General Superintendent's Department of a railway has a peculiarly appropriate designation in its dynamic suggesting title.

No part of any railway organisation is more vital, nor can any boast finer traditions, or greater continuity than that which, since the dawn of the Railway Era, has maintained, manned and run the locomotives.

Outside the Motive Power Section, remarkable opinions are held and frequently expressed as to its scope and functions. Occasionally, comments based upon weird conceptions of these are made, and, together with criticisms of similar value, contribute to the confirmed cheerfulness which thrives in the section.



Courtesy] [L.M.S. Rly.

Coal Stage

There can be no monopoly of happiness, but there is no lack of it in the Motive Power Section, because it is difficult to conceive of a more congenial and inspiring vocation. Those whose lives are spent in it will agree that it provides inexhaustible interest, fascinating variety, and a constant incentive to the highest endeavour.

Fascination of the Work

Such a claim could probably be made for other phases of railway work, but it is especially and demonstrably true of the Motive Power Section.

As its name implies, its business is to provide power for movement—the valuable commodity by which the railway lives. Yet this fundamentally important section is practically unknown to, and unheard of by, the travelling public. It is unknown even to thousands of railway employees, who have consequently very vague ideas about it.

Although a locomotive at work unfailingly rouses interest, few appreciate its profound significance. Interpretations of the symbolism of such power-units have been given by great artists, men of letters, and, in their own language, by a long succession of engineers. Whilst any one of the 10,000 locomotives owned by the L.M.S. could alone provide subject-matter for a good-sized volume, it will be recognised that in a brief article such as the present, it is impossible to deal adequately with the work of the department to whose care so mighty an aggregation of power-units is entrusted.

Suffice it to say that the personnel under the immediate supervision of the Superintendent of Motive Power embraces, in addition to the specially-trained officials and supervisors, a comprehensive repair staff, including craftsmen of several different "trades"; a shed staff comprising boilerwashers, tubesweepers, steamraisers, coalmen, ashfillers, etc.; it also includes a footplate staff of engine-drivers and firemen, all of whom are recruited from the engine-cleaners, each of the latter being in "the line of promotion."

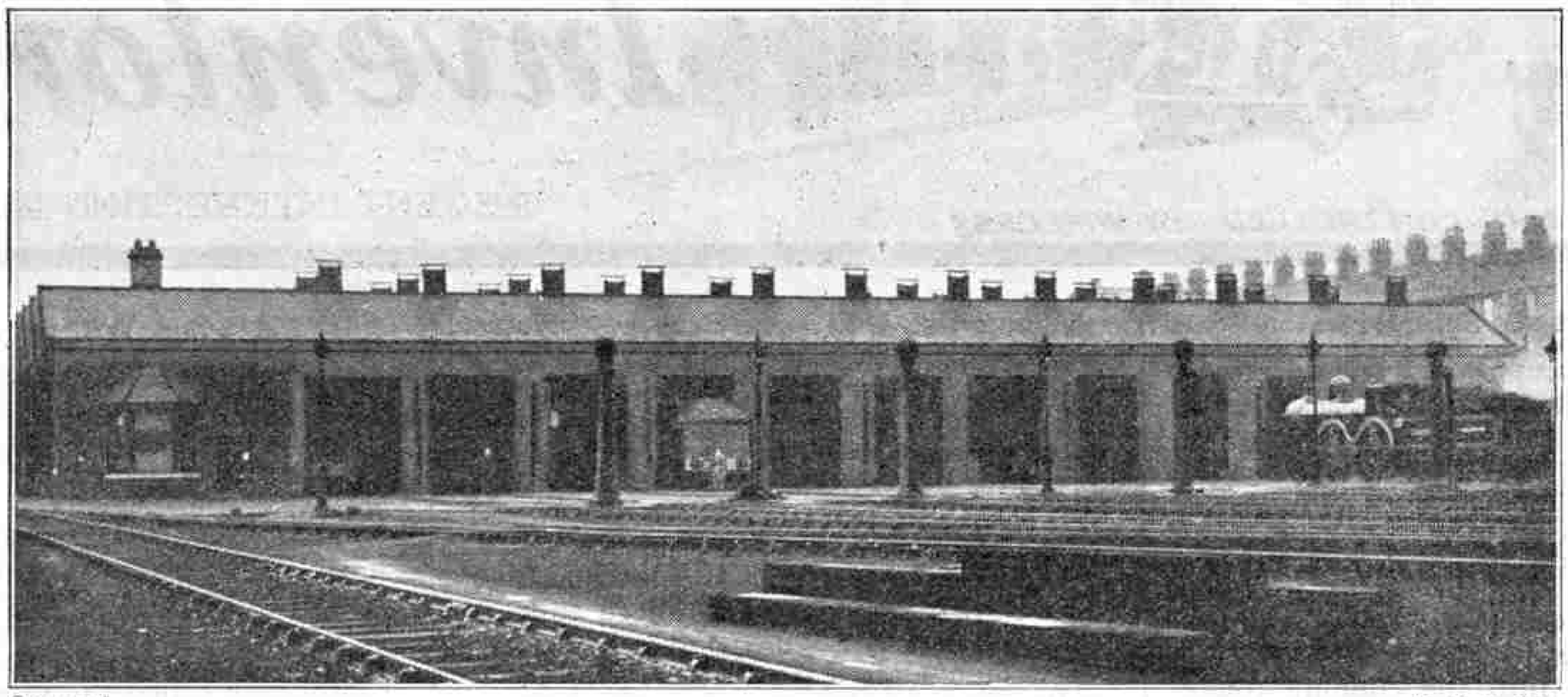
Details of the Depôts

The shed office staffs, besides dealing with work incidental to such a large and varied personnel, compile statistics of locomotive performance, consumption and condition. Some idea of their work may be gathered from the statement that the cost of fuel, water, lubricants and other stores is between £600 and £700 per engine per annum.

There is naturally similarity in the work dealt with at the depôts but differences in detail exist, due to variations in premises and yards, and in the allocation of locomotives.

The depôts are structurally either of the rectangular "straight" type illustrated on the next page, with one

or both ends open, or of the "round" house type, the main characteristic being a central turntable. Such sheds are convenient and comfortable, and although occupying relatively large sites in proportion to the number of engines stabled, they do not require such spacious yards as are necessary with the other type of shed; in fact, the cost of shed-yard layout, and the constant work of marshalling the locomotives for stabling in proper order, constitutes the most serious objection to the "straight" shed.



Courtesy] [L.M.S. Rly.

Straight-type Engine Shed and Yard

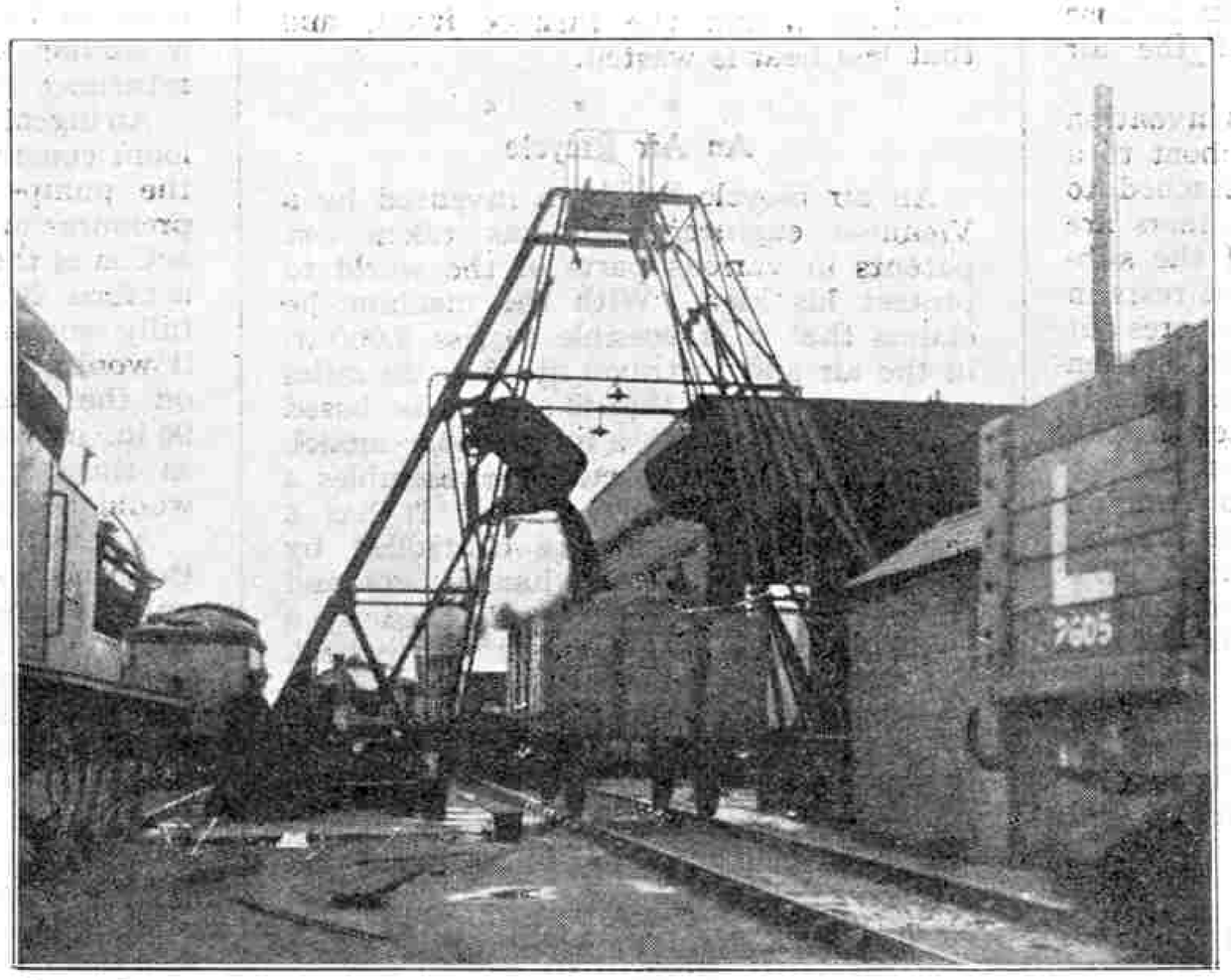
Excellent examples of well-equipped round sheds are to be found on the Midland Division, whilst the other type is common to the Western Division.

A glimpse inside the Motive Power Section may be obtained if we follow, say, an express engine from its arrival at the terminal station, to its departure from the depôt on its next trip.

Assuming the engine workings are completed, the enginemen take the engine to the depôt where she is brought to a stand over an engine-pit. This enables the driver to pass underneath the engine for the purpose of making a thorough examination of the brake gear, valve gear, axle-boxes, bearing springs and the other parts, which cannot be examined from ground level or above.

The examination is completed by a systematic observation of all other external parts of the engine, and occasionally, a special test of slide valves and pistons under steam.

Defects observed are recorded upon a repair card, which the driver hands in along with his job-card and journal, before signing off duty.



Courtesy] [L.M.S. Rly.

Ash loading Plant

Recording Defects

Meanwhile the fireman has been busily occupied with his own duties, and after the firebox, ashpan and smokebox have been emptied, the engine is taken by the shed enginemen to the coaling plant or stage, where coal suitable in kind and quantity for the next trip is placed on the tender, the watertanks are filled, and the engine having still sufficient steam, is stabled in the shed.

During the period of stabling, the defects recorded by the driver receive attention from the repair staff. These are commonly of a minor character, such as renewal of valve spindle or piston rod packing, re-riveting leaky firebox stays, or re-expanding smoke-tubes.

If the engine is scheduled for boiler washing, it will have been stabled on the washing-out pit, and the process includes emptying the boiler, removal of numerous plugs, and the thorough sluicing by a high-pressure stream of water, of every part of the interior surface of firebox, boiler head and barrel, accompanied by dislodgment of adhering scale with suitably pointed flexible steel rods, until the whole surface of the copper and steel plates are meticulously cleaned, and the water spaces cleared.

The boiler washing is arranged at fixed periods (governed by the character of the usual feed water supply). The precipitation of solids in the water-spaces varies in amount, but even with the best water supply, the necessity for scrupulous internal cleanliness is so imperative that the washing-out schedule is rigorously adhered to. However little the exterior of a locomotive may receive the attention of the engine cleaners, the interior cannot be suffered to become dirty. The penalty is too severe, and is expressed in overheated plates, broken stays, collapsed tubes and worse.

The systems of boiler washing vary, the best being that in which hot water is used. This prolongs the life of the boiler, and shortens the time the engine is out of traffic.

A further detail of the toilet of the locomotive is the cleaning of the boiler smoke-tubes, which are swept out either by a jet of compressed air, or by a mop attached to the end of a long steel rod, which is passed from end to end of each tube. The good old "Rocket" won the prize of £500 in the Liverpool and Manchester Railway competition because George Stephenson provided it with a boiler fitted with 25 smoke-tubes, which made it a better "steam-raiser" than its competitors, but to-day some locomotive boilers have upwards of 200 smoke-tubes.

The boiler is the most costly and (Continued on page 974)

Lifeboats for Submarines

The difficulties of providing any means of escape for the crew of a submarine unable to rise to the surface are enormous, the pressure of the water outside precluding any possibility of escape except in some portion of the submarine that can be readily detached. As described in the August "*M.M.*" in "*The Wonders of Salvage*," two officers attempted to escape from the K.13 when it failed to rise, by pumping air into the conning tower until its pressure was equal to that of the water outside and then opening the hatch. This was a measure of desperation that resulted in the death of one of them, however, and it is not easy to arrange a safe method without weakening the hull of the boat in some way.

An Italian inventor has suggested the use of a method of attachment that avoids all risk of this kind. In order to explain it we may recall the famous experiment of Otto Von Guericke, of Magdeburg, who fitted two copper hemispheres together and pumped out the air contained between them. It was then found that 30 horses pulling each hemisphere in opposite directions were unable to separate them because of the tremendous pressure of the air outside.

A similar method is used in this invention to attach a small cylindrical lifeboat to a submarine. A hemisphere is attached to each end of the boat and two others are fixed in a recess in the hull of the submarine, so that when the lifeboat rests in its correct position the hemispheres fit together. The air between them is then pumped out. In this case the outside pressure is provided by the water instead of air and is considerably greater.

When it becomes necessary to abandon the submarine the crew enter the lifeboat through a connecting man-hole. The water-tight doors of this connection are then closed and a valve is opened that admits water inside the spheres. The pressure is thus equalised and the cylinder is released, to float to the surface by reason of its buoyancy. The crew then emerge through the hatchway and are able to attract attention.

* * * *

An Improvement in Tyre Inflation

The only improvements made until recently upon the methods used in the early days of the pneumatic tyre have been almost entirely in the size and efficiency of the air pumps used. It is now possible to inflate two tyres at once by the aid of a simple fitting consisting of a rubber tube with ends that can be fitted to the valves of the inner tubes of the two rear or the two front wheels. At the centre of this tube is attached another tube for connection with the pump so that both tyres are inflated at the same time with air at the same pressure. A car with tyres on the front wheels inflated to different pressures is more difficult to steer than one with the pressures balanced. The use of this invention ensures equal pressures and thus satisfies an important point for safety.

In order to complete the usefulness of this device an additional short tube is provided in the middle of the connection to accommodate a pressure gauge. There is therefore no difficulty in making certain that the pressures used are those recommended by the makers as best adapted to ensure long life to the tyres.

* * * *

Rotary Flame Boiler

An invention to improve a performance of Lancashire boilers has just been patented by the Ljungström Company. Boilers of this type cannot be forced to greater output and in the belief that this is due to insufficient room in the furnace a spiral jet is fixed to the boiler front in order to produce a rotary current of air above the fire. The flame follows this rotary current with the result that a longer flame is obtained within the furnace itself, and that less heat is wasted.

* * * *

An Air Bicycle

An air bicycle has been invented by a Viennese engineer who has taken out patents in various parts of the world to protect his idea. With the machine he claims that it is possible to rise 3,000 ft. in the air and to travel at 40 to 50 miles per hour, a claim that is said to be based on experiments with a quarter size model.

In appearance the machine resembles a bicycle with a double frame. It has a series of planes that are controlled by means of levers on the handle-bars and at the rear has a propeller worked by a chain from the hub of the rear wheel. The machine can be used as an ordinary bicycle, for the propeller is clear of the ground under these circumstances. When in full working order the total weight of the air bicycle is a little less than 1 cwt., and its price is expected to be about £60.

* * * *

To Fight Forest Fires

Fire fighting in the forests of Western America will be rendered much easier by the use of a huge tractor plough recently invented. The plough itself is triangular and when drawn by a powerful tractor or "caterpillar" cuts a swathe through the undergrowth that is sufficiently wide to stop small fires. If the fire is too large to be checked in this manner the clearing is used as a base for a "backfire" to make a still wider gap.

A Loom Without a Shuttle

A revolutionary weaving device has been invented by a Lancashireman who migrated to America 45 years ago. This abolishes the shuttle, a feature of looms that has survived since the days of the earliest hand looms. In an old Egyptian type of hand loom, for instance, the long threads of the warp were hung vertically, and periodically a certain number of them were moved sideways to leave an open space, now called the warp shed, through which was thrown the shuttle carrying the cross threads or weft. In the modern loom the shuttle flies backwards and forwards with great speed and makes a considerable amount of noise in the process. Now it is proposed to replace it by an air blast.

The weft thread is fed to the device from paper cones and passes first through a mechanism that stops the loom automatically if the thread breaks. It is then passed on by gearing into a metal tube, the end of which just projects into the warp shed. At the right moment the weft thread from the feeding mechanism falls slack and an air blast blows it through the shed to the opposite end of the fabric, a similar mechanism on the other side returning it.

An ingenious feature of the demonstration loom constructed by the inventor is that the pumps producing the necessary air pressure are actuated by the weaving action of the loom itself. On this machine a fabric 20 in. in width has been successfully woven but the inventor believes that it would be quite easy to construct looms on the same principle to weave fabrics 90 in. in width. For a machine as large as this separate air compression pumps would be used.

A great advantage of the machine is that the warp shed is smaller as it need only be large enough to accommodate the weft itself, and in consequence the strain on the warp threads is lessened. It will also be possible to reclaim a considerable amount of waste by weaving it at low cost into wiping cloths. The machine is said to be well adapted to weaving wiping cloths, rough towelling and samples.

This loom without a shuttle is undoubtedly an epoch-making invention especially if, as its inventor claims, it will do away with nine-tenths of the work required in the ordinary weaving processes, while it represents the first real improvement in principle for over 2,000 years. The inventor has been working on it for many years with great perseverance, and when funds ran short he returned to the mill to earn more to enable him to make further experiments. The possibilities of development of this machine now appear to be very bright.

Directional Signal that Defies Fog

A short time ago a boy of 13, completely blindfolded, successfully steered a boat into Newhaven Harbour. The boat was never more than a yard or two out of its course, and the "steersboy" did not once show the slightest hesitation. This appears almost incredible, but as a matter of fact the boy was not a prodigy but was making use of a remarkable directional signal that promises to be of great use in fog and at night.

The inventor of this device is Mr. Henry M. Fellowes, a shipbuilder of Gt. Yarmouth. The idea is simplicity itself, but great skill and care were required in order to make it practicable.

Two horns are set up on shore on each side of the straight channel running north that forms the entrance to the harbour. The horn on the east side is made to give two short blasts with a half-second interval between them, while that on the west side gives a longer blast lasting half a second. The two horns are placed at exactly equal distances from the centre line of the true channel, and are timed electrically so that the longer blast from the horn on the west shore fits in exactly to the half-second interval between the two short blasts from the other horn.

To the steersman of a ship in the true channel the sound thus will appear continuous. If the ship deviates to the east, however, the two short blasts will come into greater prominence and the longer blasts will lag behind slightly, owing to the fact that the ship is no longer equidistant from the two horns. On the other hand, if the long blast is the more noticeable and the short blasts are somewhat late, this indicates that the ship has deviated to the west of the true course.

For convenience, the instructions necessary for the steersman are summed up in the following rhyme:—

"Dots first and best veer west;
Dots last and least veer east;
When all are one nor'ard you run."

The simplicity of the system is at once apparent, for no apparatus whatever is required on the vessel. At the same time there appears to be little doubt of its efficiency, for boats have been steered successfully into Newhaven Harbour by blindfolded men on many occasions. It will be interesting to see whether the principle will work successfully in the sinuous channels that vessels have to follow between sandbanks and mud flats in the estuaries of some of our larger rivers.

* * * *

Concrete Made with Ice

A method of producing a very light concrete for building purposes has been invented in Finland. The concrete is made of sand and cement in the ordinary way, but the method of mixing employed makes it extraordinarily light and porous owing to the presence in it of millions of tiny holes. In spite of its porosity the concrete gives adequate protection from the weather and is now being largely used in cold countries such as Finland and Sweden.

In order to make the concrete, cement and sand are mixed in a machine with snow or crushed ice instead of water, and the product is cast into blocks. The excess of moisture is removed by heat, and it is then found that the block is evenly honeycombed by tiny pores. By varying the proportion of the ice or snow used it is possible to make blocks of different densities, and mixtures containing 50 to 80 per cent. of ice have been used.

Another Attempt to Harness the Tides

The tide mills that once were fairly common along our coasts disappeared on account of their low efficiency and the short periods during which they could be operated. More recently the possibility of storing up power in electrical form has renewed interest in the problem of harnessing the tides, but none of the methods tried so far appears to have produced results of practical importance.

The Directional Fog Signal, an apparatus by which a blindfolded boy steered a ship into harbour

The latest scheme for this purpose has been devised by an engineer who has spent 30 years in studying the problem. He has built a floating platform to accommodate his machinery and has moored it in the fairway leading to a disused harbour at Pagham Beach near Bognor.

He uses a vertical shaft that acts as the axle of a drum with a series of vanes attached to it. The drum is in the water and as the tide flows it is turned round by the pressure of the water on the vanes. In this manner the drum is kept moving for four hours on the incoming tide, and reversing gear enables it to be kept working for a similar period on the ebb tide. A dynamo is driven from the shaft and the electrical energy produced is stored in accumulators in the usual manner.

The most remarkable feature of devices used for tidal power schemes is usually the enormous amount of power which, according to the inventors' calculations, should be available. In the present case the inventor states that the utilisation of the whole area of the harbour at Pagham Beach would enable him to produce 1,152,000 h.p. daily! If only a fraction of this power can be made available economically in any form then the efforts of the inventor will be amply rewarded. It is probable that the best results will be obtained by building embankments across estuaries to check the ebb of the tide and using the head of water thus formed as in the schemes now in operation on the Niagara and other rivers.

Ladders and Lifts for Salmon

The construction of huge concrete dams across many rivers of the United States in the course of water power developments at one time threatened to put an end to salmon fishing by placing an impassable barrier in the path of fish proceeding upstream to their spawning ground. As this matter concerned an important food supply, as well as the financial interests of the canning industry, it became necessary to find some means of allowing the salmon to pass upstream.

At first salmon "ladders" were provided. These consisted of a series of steps 2 ft. in height leading from the water level below the dam to that above it. On the steps were pools of sufficient depth to maintain the fish and water was allowed to flow down the ladders during the period of the year when the fish ascended the stream. The salmon found their way up the ladders by a series of 2 ft. leaps and rows of curved rods were provided to prevent the tired fish from being carried down again by the rush of water.

The greatest height to which salmon will go in this manner was found to be about 50 ft. and additional assistance has been found necessary when the artificial barriers exceed this height. In the case of dams 200 ft. in height, like that across the Baker River in the State of Washington on the Pacific Coast, a ladder 50 ft. in height is provided, at the top of which the fish are carried along into a tank. When a sufficient number have entered the tank the doors are closed and an electric motor hauls the tank bodily up an incline to the level of the water above the dam. There the fish are emptied out.

The down-stream progress of the young salmon is more spectacular, for they simply go over the top of the dam! A thin cushion of water on which to fall is provided on the concrete surface below the dam by opening slightly some of the gates, and the loss of life among the young salmon in their stupendous dive is quite negligible.

* * * *

Casting Blocks of Stone

A method of producing blocks of stone by casting has recently been brought into use on a considerable scale. The process consists of mixing thoroughly with water ground marble or granite and about one-third of its weight of cement. The product is then poured into moulds made from wood patterns, the procedure being on similar lines to making castings in an iron foundry. In order to produce uniform castings it is necessary to keep the mixture in agitation while pouring. The excess of water in the materials percolates through the sand used for the moulds and the remaining mixture becomes sufficiently hard to be removed in from 48 to 72 hours. It is then left for a fortnight or so to "cure" or harden properly, after which it undergoes various mechanical operations such as dressing and polishing.

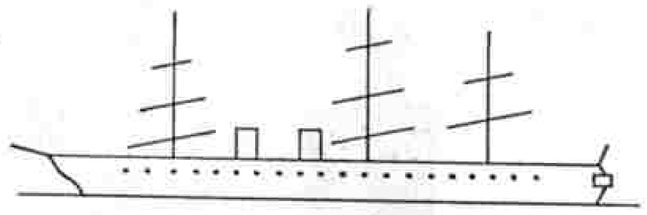
Blocks of stone produced in this manner resemble natural stone very closely and they have a high compression strength. It is not practicable to use such blocks for ordinary work on account of the high cost of making them, but they are exceedingly useful for ornamentation purposes as they can readily be cast to any shape required. Very large casts may be made hollow in order to reduce their weight and steel reinforcement may be employed exactly as in the case of concrete.

Development of the British Battleship

Progress in Ironclads in 66 Years

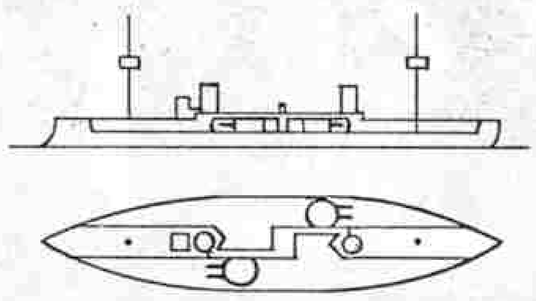
By E. A. Beet, B.Sc.

TWO new British battleships, the "*Rodney*" and the "*Nelson*," have recently been commissioned for trials, and this event once more brings to public notice the subject of the development of the ironclad. Over ten years have passed since such an event took place, and this is a time when thoughts are directed towards disarmament rather than to more battleships. Nevertheless the progress in the 66 years behind the design of H.M.S. "*Nelson*" forms an interesting story.

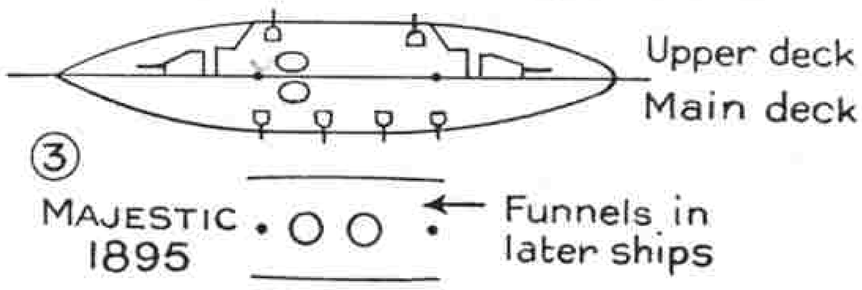


① WARRIOR 1861

The first British ironclad was built in 1861, the "*Warrior*." It was a steamship of 15 knots speed, but had auxiliary sail power, and its 38 guns were arranged on one deck on the broadsides in the same manner as in the old frigates. For the greater part of its length it was protected by heavy iron plating In the next few years several ships generally similar were built, but the tendency was to concentrate the guns into a short length amidships. Thus came the central battery ships, of which the "*Alexandra*" of 1875 is the best example. This ship of 9,470 tons had a length of about 350 ft., a steam speed of 14 knots and mounted twelve 25-ton guns. The battery was concentrated amidships, the guns being arranged on two decks, and the hull recessed to give, in addition to a broadside fire of six pieces, an ahead fire of four and astern fire of two.

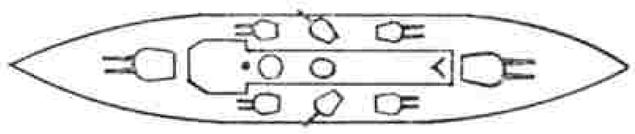


② INFLEXIBLE 1881



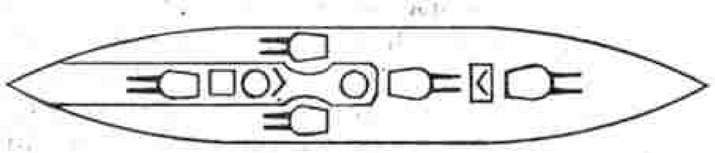
③ MAJESTIC 1895

Meanwhile, another type of line of battleship was developing. The principle of mounting the guns in revolving turrets was introduced into the British Navy in 1864, when an old three-decker, the "*Royal Sovereign*," was cut down, plated and provided with four turrets. The idea was further tried in the ill-fated "*Captain*," which capsized in 1870, but the loss of which did not prevent the continuation of the system, a number of turret ships being built soon afterwards. Notable examples of turret ships are the "*Devastation*" and the "*Thunderer*" of 1872, ships of 9,500 tons, 12 knots, and carrying four 35-ton guns in two turrets. These ships were of very low freeboard, a defect that was partially remedied in their somewhat similar but considerably better successor, the "*Dreadnought*."



④ LORD NELSON 1908

The largest of the pure turret ships was built in 1881, the "*Inflexible*." This ship was of 11,800 tons, had a speed of 12½ knots and was a kind of floating fort. One-third of its length above water was a massive iron citadel 2 ft. in thickness, upon which were mounted en echelon, that is diagonally, two huge turrets each containing two 80-ton, 16¼ in. muzzle-loading guns.

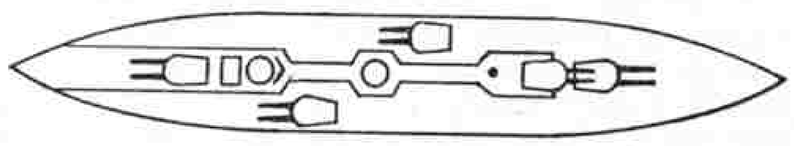


⑤ DREADNOUGHT 1906

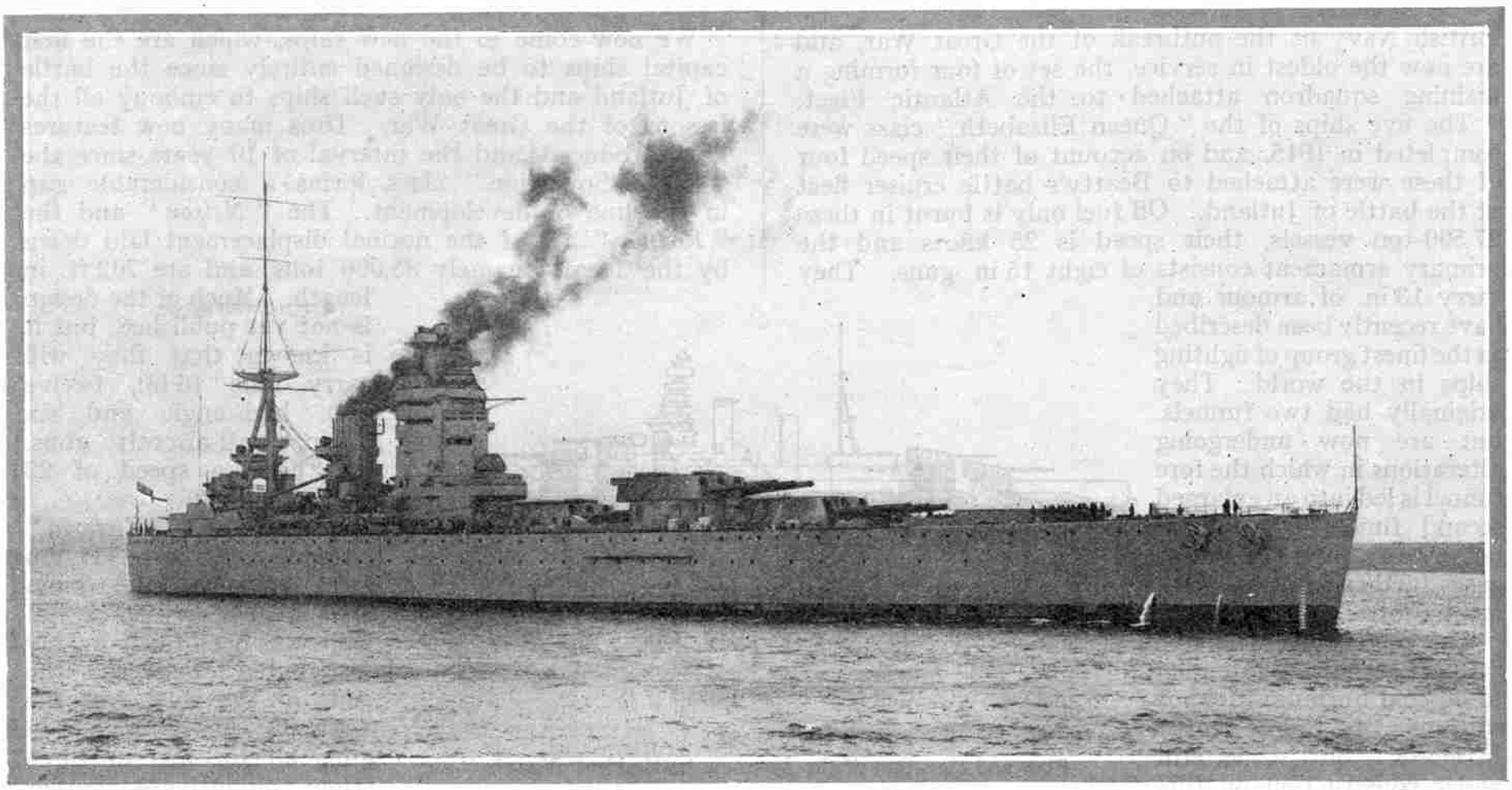
The "Admiral" class, 1886, combined the principle of the central battery with that of the turret ship, carrying four 67-ton guns in two turrets, and six 6 in. guns in a central battery. A new feature, barbettes, was introduced in most of these ships. A barbette was originally a steel breastwork over which the guns, on revolving mountings, were directed, the breech being depressed into the barbette for loading. The revolving hooded barbettes with roofs came in the early 'nineties and in an improved form have persisted ever since. A notable ship of the period was the "*Victoria*," which, however, carried her two 111-ton, 16¼ in. breech-loading guns in one turret forward. This ship displaced 10,470 tons, had a speed of 17½ knots and the remaining armament was a 10 in. stem gun and a broadside battery of twelve 6 in. guns. The "*Victoria*" was lost in the Mediterranean, being rammed by the "*Camperdown*" during fleet exercises.

From 1892 to 1900 two series of ships were built, one set being slightly smaller but a knot faster. The "Royal Sovereign" class of 14,150 tons and 17½ knots, and the "Centurion" of 10,500 tons and 18½ knots were the first. The former carried four 13.5 in. and the latter four 10 in. guns as primary armament, both series having a secondary armament of ten 6 in. guns. Their successors, the "Majestic" and the "Canopus" classes respectively, all carried four 12 in. and twelve 6 in. guns, as did the various classes that followed up to 1900. These ships were all very similar, although the later ones carried the funnels fore and aft, instead of abreast as in the "Royal Sovereign," "Centurion" and "Majestic" classes. These ships had steel armour belts six to nine inches in thickness amidships.

With the increasing power of the big gun it became evident that engagements between ships of the line no longer would be fought at short range, and the 6-inch gun was becoming useless against an armoured battleship. In the "King Edward VII" class, built in 1903-5, and somewhat similar to their predecessors, but of 16,350 tons,

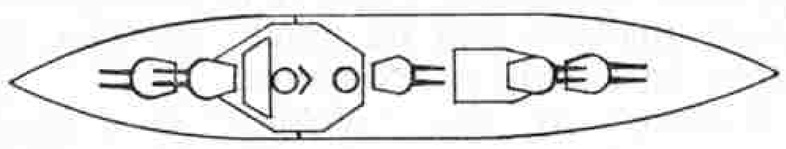


⑥ COLOSSUS 1911



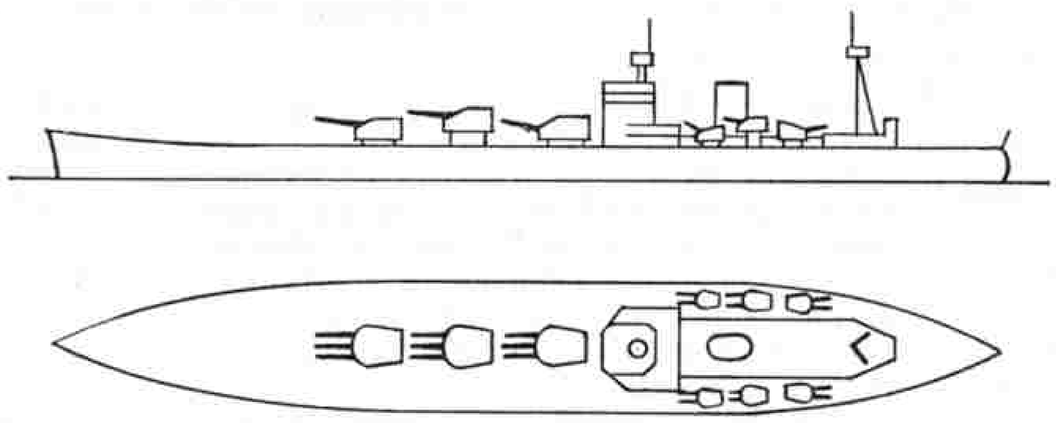
H.M.S. "*Nelson*," the latest development of the British battleship

a beginning was made towards strengthening the secondary armament. These vessels carried only ten 6 in. guns, but had four 9.2 in. guns in addition, mounted in revolving gun houses on the upper deck at the corners of the superstructure. The "*Lord Nelson*" and the "*Agamemnon*," which followed, went a step further, abolishing the 6 in. gun altogether. On a displacement only slightly greater than the "*King Edward*" they carried four 12 in. and ten 9.2 in. guns, and were protected by an armour belt that reached a maximum thickness of 12 in.



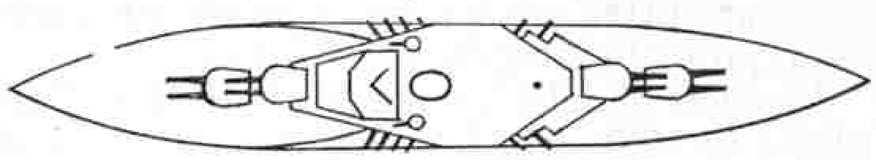
⑦ ORION 1912

While these ships were building, 1905-8, the "*Dreadnought*" was built in record time and put to sea in 1906. This, the first all-big-gun ship, rendered obsolete all the existing battleships in the world. The "*Dreadnought*" was a little over 500 ft. in length, displaced 17,900 tons, and carried ten 12 in. guns in five revolving hooded barbettes. As an anti-torpedo armament she carried 27 quick-firing guns of 12 pounder and smaller sizes, and the armour belt was 11 in. in thickness amidships. Turbine engines, installed in a battleship for the first time, gave her the unprecedented speed of 21 knots.



⑨ NELSON 1927

The "*Dreadnought*" was followed by the "Bellerophon" and "St. Vincent" classes, each of three rather similar but slightly larger ships, the notable improvement being the replacement of the 12 pounder gun by a 4 in. weapon for the anti-torpedo armament. In the "Colossus" class of 1911 an attempt was made to obtain a broadside fire from the whole of the big guns. The two amidships barbettes were mounted *en echelon*, and the quarter deck guns were supermounted, the fourth turret, a word used henceforward for convenience, being placed on a higher level than the fifth, permitting an astern fire from both.



⑧ ROYAL SOVEREIGN 1916

Two great advances were made in the four ships of the "Orion" class, completed in 1912. These were the introduction of the 13.5 in. gun and the mounting of all five turrets on the centre line. This arrangement gives a fire of four guns ahead or astern, and 10 over a wide arc on either broadside. The "*Orion*" was of 22,500 tons, 21 knots speed, and carried ten 13.5 in. and sixteen 4 in. guns, while the armour had a thickness of 12 in.

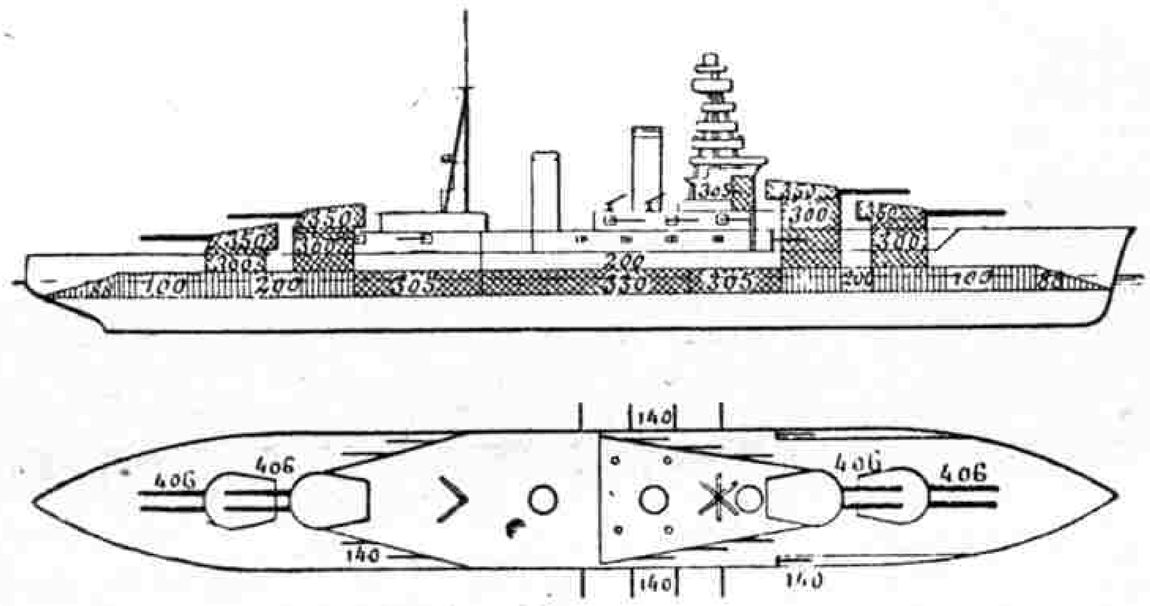
The chief improvement in the "King George V" class that followed was the use of a more powerful 13.5 in. weapon, throwing a shell of 1,400 lb. compared with the 1,250 lb. missile of the "*Orion*." The increasing speed of destroyers and the ever-lengthening range of the torpedo required a larger gun to cope with this danger, and so the "Iron Duke" class carried a battery of 6 in. guns in place of the 4 in. of the earlier ships. Nearly all battleships, of course, carry submerged torpedo tubes of their own, but these are a relatively unimportant feature of their equipment. The "Iron Dukes" were the newest battleships in the

British Navy at the outbreak of the Great War, and are now the oldest in service, the set of four forming a training squadron attached to the Atlantic Fleet.

The five ships of the "Queen Elizabeth" class were completed in 1915, and on account of their speed four of these were attached to Beatty's battle cruiser fleet at the battle of Jutland. Oil fuel only is burnt in these 27,500-ton vessels, their speed is 25 knots and the primary armament consists of eight 15 in. guns. They carry 13 in. of armour and have recently been described as the finest group of fighting ships in the world. They originally had two funnels, but are now undergoing alterations in which the fore funnel is led into an enlarged second funnel, the object being to remove the funnel gases further from the foremost control station.

The next class, the five "Revenges," were intended to be coal burning, 21 knot editions of the "*Queen Elizabeth*," but while still under construction oil fuel was decided upon and the speed raised to about 22½ knots. In armour and armament they are very similar to the earlier class, but carry their battery of 6 in. guns further astern than the "*Queen Elizabeth's*," which were very liable to be flooded out in rough weather. The displacement is 25,750 tons, and having fewer boilers there is only one funnel. Below water these ships are fitted with a bulge or blister outside the hull as a protection against torpedoes.

Mention should be made of H.M.S. "*Hood*," completed in 1921, which, being classed as a battle cruiser, is not actually within the limits of the subject under consideration. As it is the largest and fastest capital ship in the world, however, it can scarcely be left out. This immense ship of 41,200 tons is 860 ft. in length, carries the guns and armour of a first-class battleship, and her 144,000 h.p. geared turbines give her a speed of 32 knots. As her displacement is above the limit laid down in the Washington Treaty, no further ship of such size may be built, and as her characteristics could not be achieved in a smaller ship she is likely to retain her supremacy for some time to come.



Plan and elevation of the Japanese battleship "*Nagato*"

We now come to the new ships, which are the first capital ships to be designed entirely since the battle of Jutland and the only such ships to embody all the lessons of the Great War. Thus many new features are introduced, and the interval of 10 years since the "Royal Sovereign" class forms a considerable gap in the line of development. The "*Nelson*" and the "*Rodney*" are of the normal displacement laid down by the Treaty, namely 35,000 tons, and are 702 ft. in length. Much of the design is not yet published, but it is known that they will carry nine 16 in., twelve 6 in. high-angle and six 4.7 in. anti-aircraft guns, and have a speed of 23 knots.

Since the "*Victoria*" carried her two 111-ton guns forward, the main armament of British capital ships has been fairly evenly distributed between the ends of the ship, but the "*Nelson*" has her nine 16 in. guns all forward in three triple mountings—another innovation. The bridges and tripod mast support for the fire control station, introduced in the "Lord Nelson" class and continued ever since, have given place to a huge control tower, although there is a tripod mast aft of the single funnel. The 6 in. guns are mounted in six twin turrets and are available for both anti-torpedo and anti-aircraft duties. The result of all this is a very unusual and ungainly appearance, but it is anticipated that their fighting qualities will be much superior to those of any other battleship in existence.

From the "*Warrior*" to the "*Nelson*" is a long record of engineering achievement and, with the possible exception of the period 1916-23, Britain has led the world in battleship design. Some say the "*Nelson*" and the "*Rodney*" are the last of the capital ships. Time will show if this is the case, but for the present no further ships of this type may be laid down before 1931, and there will again be a period of several years before the development of the British battleship makes another advance. In the meantime the merits or otherwise of the two latest battleships will provide an interesting subject for discussion among naval experts.

Motive Power on the L.M.S.—

(*Continued from page* 969)

vital part of a modern locomotive, and supreme care has to be exercised in its design, manufacture, and maintenance. If readers wish to realise the awe-inspiring energy stored up in a locomotive boiler under steam, let them draw on a piece of paper a 1 in. square, imagine a weight of 175 lb. upon it, and calculate the number of similar squares of surface, bearing that pressure, that are withstanding the force of the pent-up steam in a standard locomotive boiler.

The responsibility for the maintenance in good condition of the boilers of the company's locomotives is shared by the repair staff of the Motive Power Section and that of the Chief Mechanical Engineer, to whom is supplied a complete history of each boiler covering the period the engine is out of the works.

Similar records are kept of the detailed examinations and repairs of all other parts of the engine—cylinders, pistons, valves, valve-gear, axles, axleboxes, brasses, springs, links, pins, each and all are regularly and systematically examined and the results tabulated.

Repairs executed are recorded and classified in suitable form, and ultimately summarised for final tabulation in the periodical statistics required by the Minister of Transport.

From the day when the design was completed and the working drawings distributed to the builders, to the day when the engine is stripped and scrapped, every detail of it is under constant and expert observation.

But to return to our particular engine, after boiler-washing is completed, and the boiler has been refilled, the firelighter gets busy, and a few hours afterwards, with steam pressure rising, the engine is prepared for another job. The enginemen have a standard time allowance for the preparation of the engine, during which oil-trimmings and lubrication are attended to, brakes tested, and promptly "on time" the work is completed, the fire well laid, and the engine is taken to the shed outlet signal ready to work "as booked."

It is interesting to know that similar work to what has been described above has gone on without interruption in some of the depôts, day and night, for over three quarters of a century.

* * * *

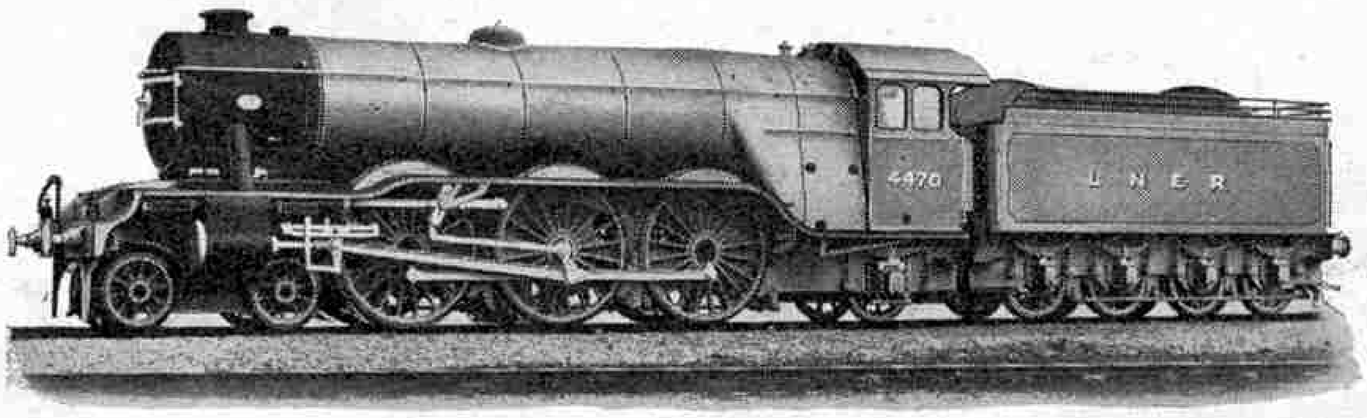
For this "peep behind the scenes" in the activities of the Motive Power Section we are indebted to the Editor of the "L.M.S. Magazine" by whose permission the article is printed here.

The Naming of Locomotives:

A British Practice that is on the Increase

By G. W. Spink

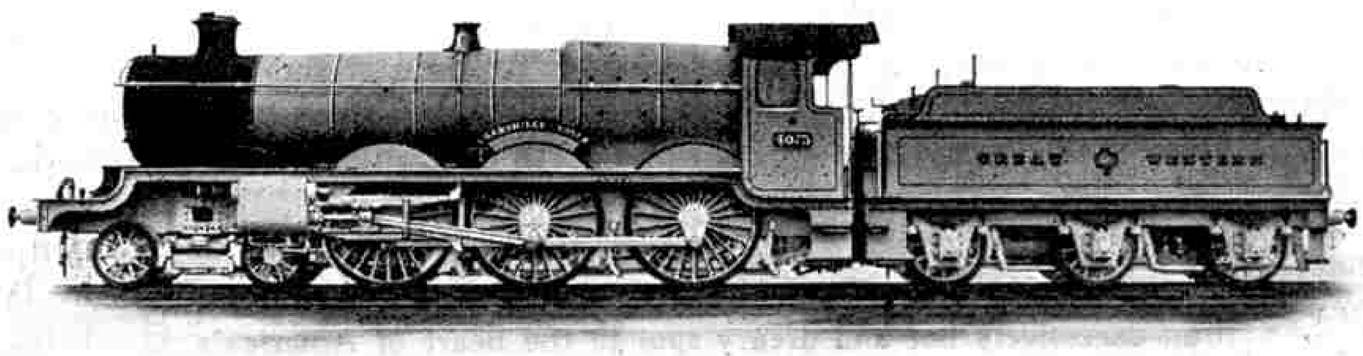
MOST of us have a liking for locos that have a name of their own as distinct from the impersonal coldness of a number, and it is interesting to find that since the grouping scheme came into operation the practice of naming locos has increased on British railways. It is true that locos are no longer being named on the L.M.S.R., but even in that group all locos that already possess names will keep them, as for example, the fine "Castle," "Ben" and "Clan" series on the Highland section.



A Famous British Locomotive: "The Great Northern" (4-6-2)

On the other hand, the Southern Railway are naming locos that formerly possessed only numbers. Some of these locos will be named after famous rivers, for example, the "*River Frome*"; others after certain geographical landmarks, "*Portland Bill*," for instance; while yet others complete the famous "King Arthur" series and bear such romantic names as "*Sir Galahad*," "*Merlin*" and "*Camelot*." A new class recently introduced on the Southern Railway is known as the "Nelson" class, and the locos constituting it will be named after famous sea-kings such as "*Lord Nelson*," "*Lord Rodney*," "*Sir Francis Drake*" and "*Sir Richard Grenville*."

The G.W.R. name their locos systematically and range over a wide area for their names, as for instance those of the "County," "Abbey," "Flower," "Court" and "Star" classes. The largest loco of the "Star" class was brought out in 1908 and on account of its size was named "*The Great Bear*." This was the first loco of the "Pacific" type to run in this country. It has since been reconstructed into one of the famous "Castle" type locos which, though rather smaller than "*The Great Bear*," are actually more powerful. There are thirty-six "Castle" locos in service and these bear names such as "*Launceston Castle*," "*Caerphilly Castle*" and "*Pendennis Castle*."



A Famous British Locomotive: The "Caerphilly Castle" (4-6-0)

The L.N.E.R., noted for their mammoth "Pacifics," have given names to many of their express locos. Five "Pacifics" are named after five cities of the late North Eastern system, these being the cities of "*Newcastle*," "*Hull*," "*York*," "*Durham*" and "*Ripon*." Other locos are named after directors of the company, while many locos in service in Scotland have characteristically Scottish names such as "*Baron Bradwardine*," "*Evan Dhu*," "*Bonnie Dundee*," "*Auld Reekie*" and "*Dominie Sampson*." Many other "Pacifics," principally those operating on the Great Northern section and in the North Eastern area, are named after famous racehorses, "*Lemberg*," "*Persimmon*," "*Ormonde*," "*Flying Fox*" and "*Bayardo*." The company have also certain locos named after well-known public men such as "*Lloyd George*" and "*Earl Haig*."

Most railways have locos whose names originated in the Great War. The Southern Railway, for instance, have one named "*Remembrance*," and the L.N.E.R. one called "*Valour*." The L.M.S.R. named several of their locos after men in their employ who gained the Victoria Cross, for example, "*Private E. Sykes, V.C.*" and "*Private W. Wood, V.C.*"

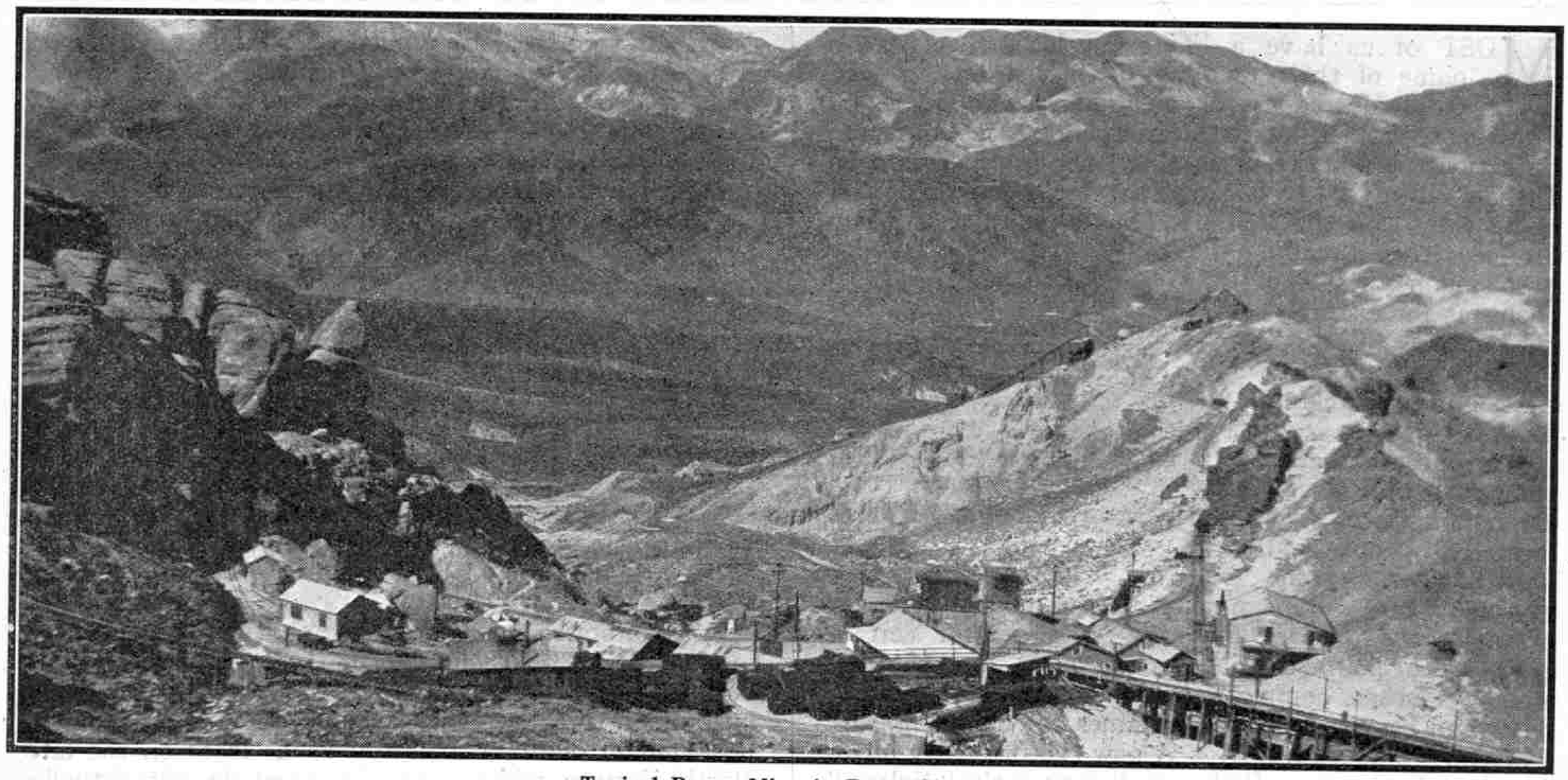
It is interesting to note that on the North British section of the L.N.E.R. two or three goods locos have been named. The naming of goods locos is a very uncommon practice, but an approach to this is to be found in one or two heavy goods locos on the late North Eastern which, although they do not actually bear names, carry "chevrons" commemorative of the part they played overseas in the Great War.

Most of the British lines make a practice of naming one or two of their most famous trains. Thus on the G.W.R. there are the "*Cornish Riviera*" and the "*Torbay Limited*," which run from Paddington into Devonshire and Cornwall. The Southern Railways' eleven o'clock express from Waterloo to the West of England is known as the "*Atlantic Coast Express*," while on the L.M.S. there are the "*Sunny South Special*" which was introduced to popularise the health resorts on the south coast among the public of the northern counties, and the "*Wild Irishman*," the latter being better known perhaps as the "*Irish Mail*." On the L.N.E.R. there is, of course, the famous "*Flying Scotsman*."

The practice of giving coaches special names is becoming increasingly popular and it will be found that almost every Pullman car possesses its own name. Thus, the "Irene" forms part of the "Harrogate Pullman," while the "Maid of Morven" is an observation Pullman car used on the L.M.S. Oban-Glasgow service. On the Southern Railway such names as "Barbara" and "Camilla" have been adopted. This form of railway "christening" is by no means new. Old pictures of travel on the Liverpool and Manchester Railway depict coaches bearing names such as "Treasurer" and "Times."

The Taming of Death Valley

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



Typical Borax Mine in Death Valley

THE conquest of Death Valley is deserving of special mention among the great achievements of modern times. It not only calls attention to this extraordinary region, but to the romance of its unique history. To-day its precious borax is being obtained by the latest scientific methods, and the great difficulty of transporting the product from the mines over the hot, alkali plains to the outside world has been overcome by the erection of an ingenious railway. To house its toilers a great modern community building, which probably has no parallel anywhere, has been reared on the very brink of the Valley in the heart of the most desolate region in the whole world.

Death Valley is an arid, sunken plain in California, so named after a party of immigrants who lost their lives there in 1849. It is approximately 150 miles in length and from 10 to 35 miles in width, and lies some 300 ft. below sea level. The approach to the hills that enclose it is across terrible desert country, and the Valley itself is one of the most treacherous and malignant spots on the globe.

How the terrible climatic conditions of Death Valley, California, an excessively hot and dreary spot in the heart of America's greatest desert, from whence come large supplies of borax, have been surmounted by the daring, skill, and organising abilities of miners and engineers

The Hottest Place on Earth

It is often referred to as the hottest spot on earth. The temperature is certainly furnace-like, and its maximum of 160° Fahrenheit has never been equalled elsewhere. In summer, 140° is common, and at midnight the mercury hovers at 120°. So hot does the earth become in August that a rock or a bit of iron scorches the naked hand like a live coal.

Furthermore, it is sunk like a huge pit far below the level of the sea. It is scurfed and scabbed like a leper with blotches of alkali; it is at once a desert and a swamp; it is a region where beds of lakes are to be found on the pointed peaks of mountains. It is swept by sandstorms that no one can face for long, and it is sown with the bones of men it has slain.

Although deposits of borax were discovered in the deserts of California and Nevada as far back as 1865, it was not till 1880 that the commodity was first located in Death Valley. It is certainly a romantic story. In a valley known as Ash Meadows, just east of Death Valley, was a tule-thatched stone cabin of a single room, the home of one Aaron Winters and his wife, Rosie—a home 200 long desert miles from the nearest settlement. Winters was a desert Arab—one of those strange men whose impulse seems to be to get as far from human habitation as possible. A little bunch-grass supported a few head of cattle, while about the stone cabin was a patch of garden and an artificial pond fed by a spring.

The only visitors were stray Piute Indians or an occasional wandering prospector, and it was one of the latter, stopping overnight at the little cabin, who talked about borax. He told Winters that borax could be identified by mixing it with certain chemicals and

igniting, when it would burn with a bluish flame, a test that could be made quite easily.

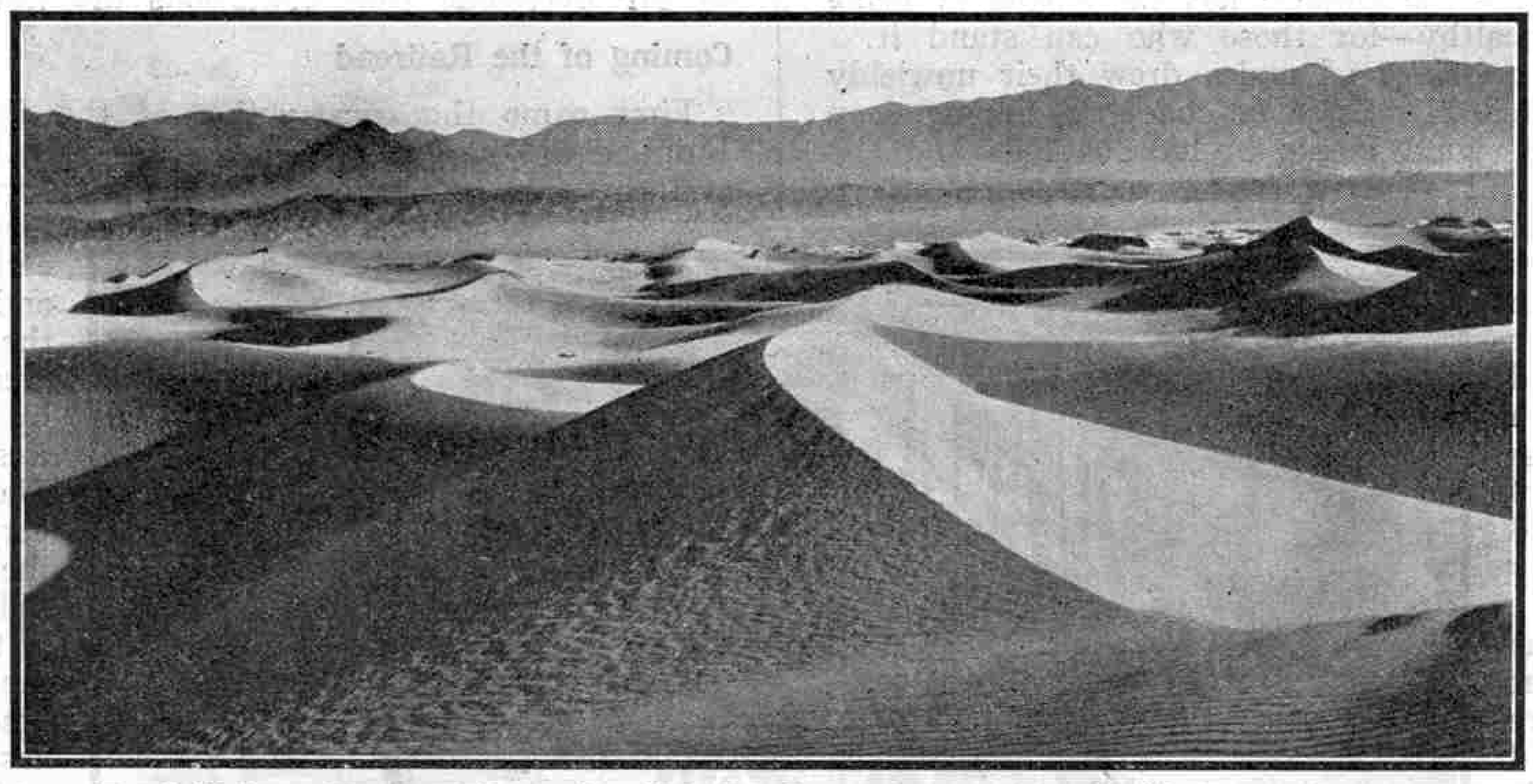
Winters had never imagined that there could be anything of value in such a place, but now he remembered some strange whitish deposits he had seen in that death-pit to the west. At length, taking his wife with him, he made the 400 mile trip necessary to obtain the chemicals about which the prospector had told him, and then the pair went over into the Valley. As the story runs, it was late at night when they reached the spot. Hastily gathering some of the substance that formed a deposit on the ground, Winters with trembling fingers poured on his chemicals and lit a match. An instant later the coyotes were startled by his shout :—

"She burns blue—by Heaven, she burns blue!"

Less than a month later Winters was awed by a payment of £5,000 for his claim, and shortly afterwards borax works were established in Death Valley.

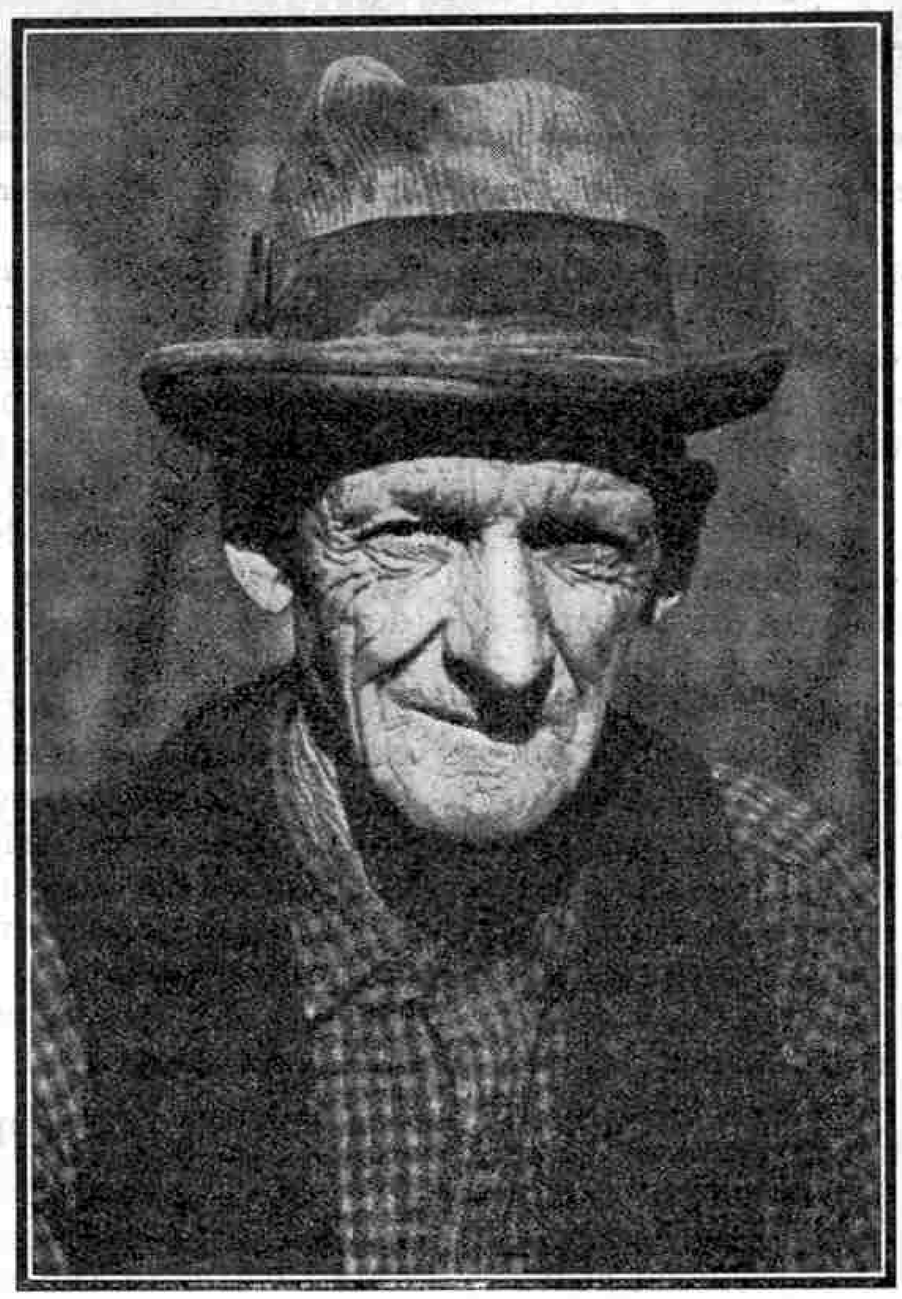
The news that borax was being worked successfully in Death Valley quickly spread. Prospectors hurried to the place, and since that time men have wrested vast fortunes from that inhospitable region where death continually stares one in the face. To-day the sides of the valley are scarred with timber erections—shafts and shanties denoting the presence of a borax mill or mine. The two principal mines are the Amargosa Borax Deposit and the Mone Blance Mine, which are said to be capable of supplying the whole world with borax for an incalculably long period.

As may be imagined from the description already given, the miners found that life in the valley was by no means easy. There was water to be had at Furnace Creek and a small oasis was formed there, but all round was a blazing white nightmare. Imagine a place where, in order to escape from the fearful heat, men habitually slept in the running water with their heads resting on stones! Few men could stand such conditions for more than a month or two. Some died from the heat while merely lying in their beds in the bunkhouse; many went mad and many more were killed in fights brought about by the condition of "nerves" engendered by the heat. A strongly made writing desk curled, split and fell to pieces in a few days; meat killed at night and cooked immediately afterward was spoiled by nine o'clock next morning; a handkerchief dipped in water and then held up to the sun dried completely in less than a minute!



Death Valley. The Sand Dunes in which lost Prospectors went mad with Heat and Thirst

Until quite recently the nearest railway station was at Mohave, 165 miles away, and this meant a journey of several days' duration. For many years this journey, which presented enormous difficulties, was performed by mule or horse teams. The wagons employed were of unusually large size and cost £200 each. They were hauled by teams of from 16 to 20 animals or even more, and these teams brought fame to themselves and to the mysterious desert pit.



R. J. ("Dad") Fairbanks, who has hunted lost persons in Death Valley more than a quarter of a century and saved hundreds from terrible deaths. He never asks nor accepts a reward. The vast region of desolation, about ten thousand square miles, is to him an open book

Romance of the Mule Caravans

The full story of the romance and tragedy that attended these indomitable caravans can never be written. Swirling sands blotted them out from day to day, but these simple carriers made good. But the hardships and the downright misery suffered by animals and drivers alike is beyond the comprehension of fortunate dwellers in places of brooks and streams, shade and tempered breezes.

In the early days there were often fierce hand-to-hand fights with Indians or robbers, and many men died of thirst or went insane for lack of water. A large proportion of the teamsters, however, once inured to the life, jogged back and forth through the blinding white dust year after year, and for most of them it became a shroud after the race was run. The majority found that

to live in the weird silence, grey and sombre, between the Funeral Range and the Panamints, is to die there. The "desert rat" stays simply because he cannot be content elsewhere. A few of the old-time drivers still survive, for the climate has the virtue of being exceedingly healthy—for those who can stand it.

The tugging strings of mules drew their unwieldy loads on wretched trails, ever changing, among deep gashes cut by cloud bursts in hideous hills and the rough wash and the treacherous salt marsh where bottom is an uncertainty. In one place an eight-mile stretch of road 6 ft. in width was built across a solid ridge of salt and graded exclusively with sledge hammers. The action of heat and moisture from below had forced up salt pinnacles as hard as rock, two or three feet in height and countless, and these had to be hammered down. This road is unlike any other; it facilitated hauling but it was cruel to hoofs. Sloping down to this salt artery are several wide fields of crude borax—borate of soda. The main and better deposits are higher up, which was a factor of consequence to the four-legged "locomotives," the only ones at first available.

The old style transport. A 20-mule team hauling Borax, with water_tank behind

"Fire-devil" Replaces Mules

When progress demanded more expeditious service, mules were superseded by steam, a slow but sure tractor of the upright type drawing laden trailers to railhead. The Piute Indians called this contrivance "fire-devil," and for months they would not venture within a hundred yards of the smoking, hissing monster. In the more torrid season the crews suffered terribly, and a man on one of the wagons died with a canteen of water in his hand.

A cold-water tank was ingeniously anchored on the tractor in front of the boiler, but the water in it was never cold for long. In a few hours it would become so heated by the sun's rays that it had to be uncovered, and frequently it was pumped into the boiler practically at the steam-producing stage. Here, probably, is the one spot on the globe where it would be possible to instal a steam-power plant and operate it without artificial heat.

Such were the conditions under which the teamsters and miners toiled until the Pacific Coast Borax Company and other subsidiary concerns decided that it was time, in view of the ever-increasing demand for the precious product and the necessity of attracting skilled workers, for practical steps to be taken to counteract the terrible climatic conditions of the region. Here it may be added that Borax Consolidated is the parent company controlling these enterprises, so that it can be said in truth that it is largely due to British foresight and initiative that the terrors of Death Valley have been so far overcome that conditions are now tolerable.

Coming of the Railroad

First came the construction of the Death Valley Railroad linking the principal mines with Los Angeles and the outside world. Its conception was a daring piece of engineering work, and called for the spanning of great openings by elaborate trestle work. Then, on the very brink of the dreaded Valley, right in the heart of the desolate desert, there has arisen a wonderful civic centre known as Death Valley Junction. Here the narrow-gauge borax line from the sink connects with the main railway, and calcining works have been established at which the ore as it comes from the mines is roasted and concentrated before it is despatched to the refineries at Los Angeles.

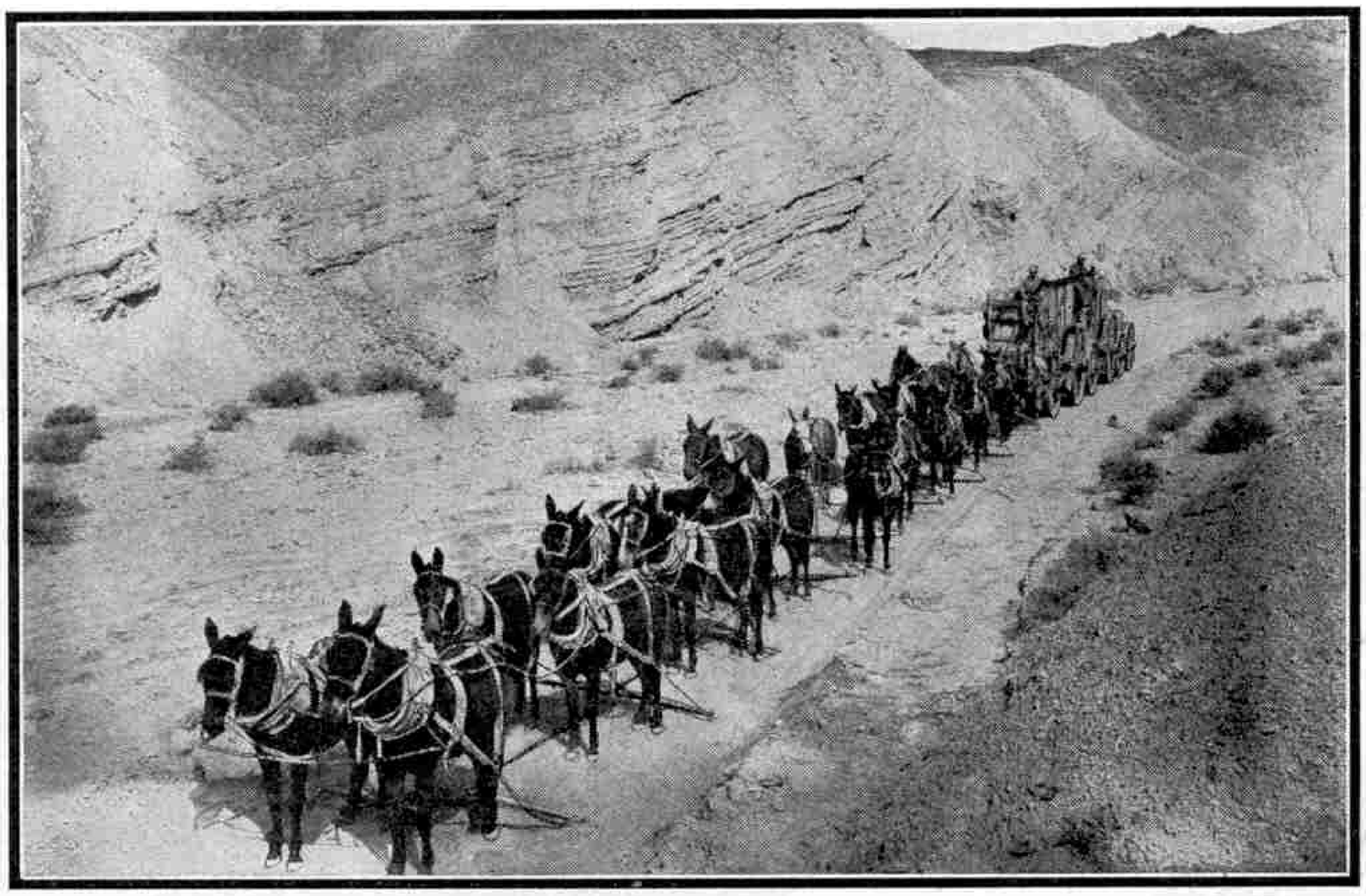
The community of this novel camp in the desert numbers about 250, and the elaborate and costly arrangements that have been made to accommodate them in the heart of a terrible desert are deserving of the highest praise. There is an adobe structure of Indian-Spanish design built in the form of a hollow square with a two-acre court, covering some 70,000 sq. ft. of space. The great building is 816 ft. in length and boasts of two wings each 198 ft. in length. There are over 200 bedrooms fitted with every modern convenience, lavatories, bathrooms and a gymnasium; there is a dining-hall capable of seating 200, a billiard hall, library, lunch-counter, and an ice-parlour. There is also a hospital with surgeon and nurses always in attendance, a theatre named after Mr. Corkhill, the popular general manager of the mines, a general store, and a post office.

The Only Water Supply in the Valley

The meat supplied at this camp comes from the farm at Furnace Creek, the only spot where the early prospectors found water in the whole of this dreary region. Here were quartered the mules that drew the borax wagons across the alkali plains, before the coming of the railway. The spring of cold water has a uniform temperature of 74°F. At present it is irrigating a tract of 50 acres, from which about 200 tons of alfalfa are obtained annually and fed to a herd of high-grade beef cattle that are slaughtered to supply the tables at the civic centre.

The tillable area can be readily increased to 100 acres, and this is to be devoted to the cultivation of the date palm. Some young trees were planted a few years ago, more to provide shade than anything else, but they thrived so well that an expert has been called in and dates are to be grown at the ranch on a commercial scale. As a result, this isolated and strange ranch in the desert, with its waving palm trees, has all the appearance of an Eastern oasis.

A school for the children of the Indian toilers on the ranch has also been opened. It can claim the distinction of being the lowest in the world, being 178 ft. below sea level, while it is located at one of the hottest places in the whole Valley. The mercury has an official record of climbing to 137° in the shade at Furnace Creek, and hovering for days and nights, sometimes weeks, above 100°. The governess, Miss Nell Henderson, is a capable and busy American lady who loves her work. She has made a special study of the desert Indians, who call her "*The Angel of Death Valley.*"



Mule transport has now been replaced by railway haulage, narrow gauge lines connecting the borax mines with the main line

The great hero of Death Valley is undoubtedly Mr. R. J. Fairbanks, or "*Dad*" as he is affectionately called. He makes it his business to search for lost prospectors and miners who have been caught in the merciless clutches of this wilderness. He lives at the small trading post of Shoshone, on the Californian border of the Valley, and he knows every trail, water hole, canyon, and mountain in this appalling sunken plain.

Tragedies of Heat and Thirst

He has seen men and beasts, and even native birds, try to cross Death Valley, only to fall, gasp, and die—the life scorched out of them by the fiercely-beating rays that apparently come from the heavens at white heat. He has rescued men who had stripped themselves naked and were going in circles, their swollen tongues protruding and the blazing sun literally burning off their skins. He is familiar with the wonderful mirages that make dreams of water such realities to thirst-crazed sufferers that they believe they are wading in its depths, and hold their clothing above their heads to keep it dry. Sometimes these unfortunates warn him to be careful of the high waves and clutch him about the neck, as would a drowning person. One afternoon he came upon a young man intently sifting sand between his fingers and laughing hilariously. In response to a query the youth said he was straining the "pollywogs" out of the water so that he could drink it. In another hour he would have been dead.

For the past 26 years, this hero of the desert has responded to the appeals of relatives and friends in nearly all parts of the world to search for their loved ones. Out he goes after these vanished men, often spending weary days in the search and covering great distances, yet he has never asked nor accepted a reward, though offered many, and declares he never will. When death wins the cruel race, as not infrequently must be the case, he always gives a proper burial and sends in no bill to any one. His 26 years' experience is proof that the climate is healthy for those who can stand it.

The crude yellowish-grey material found in the valley contains proportions of borax ranging from 10 to 90 per cent. mixed with sand and volcanic ash. Occasionally large crystals are found in beds 2 ft. in thickness in which is a liquid containing as much as one pound of borax to the gallon. In order to obtain the borax the surface of the marsh is simply shovelled off to a depth of 18 inches and carted away to wrought iron pans in which it is boiled with water. After stirring and dissolving, the mixture is allowed to settle for 10 hours, when the clear liquid is drawn off into tanks and allowed to crystallise by attaching itself to steel rods and hooks, looking for all the world like great sticks of rock candy.

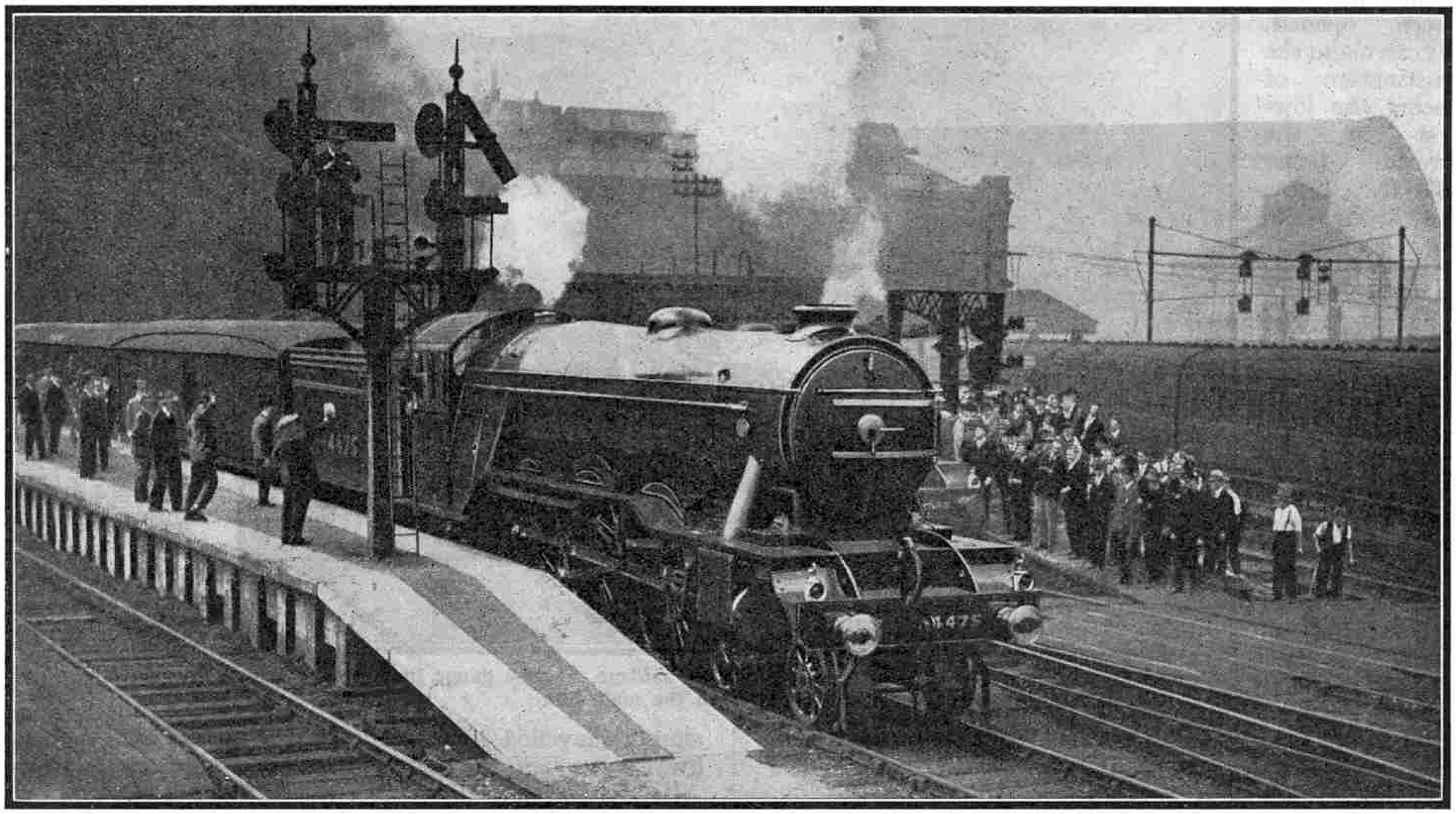
Regular mining operations are carried out to extract the hard borate of lime that occurs in strata. The lumps are thoroughly ground to powder and digested with steam under pressure in closed iron pans, with the addition of soda. In this operation the borate of lime is transformed into sodium borate, or borax, and the solution of the latter is then run off and allowed to crystallise as before. The well-known substance boric acid is readily obtained from a concentrated solution of borax in water by the addition of hydrochloric acid in the form of a crystalline precipitate, as it is not very soluble in cold water. The output of the Death Valley mines at present is about 3,000,000 lb. weight of borax annually.

Both borax and boric acid find an amazing variety of uses and between them play an important part in at least 20 well-known industries. Enamel coatings for wire and steel-work and glazes such as "biscuit ware" on pottery and on bricks and tiles are produced with the aid of borax, and it also finds large application in the glass industry, in the laundry, and in the kitchen. It is a convenient water softener, and is sometimes used in starches designed to give a high glaze. It is used as a sizing for book-paper and playing-cards, and finds extensive application in the (*Continued on page* 985)

London-Newcastle Non-Stop:

On the Footplate of the "*Flying Fox*"

By Hamish Maclaren



The photograph on this page shows the famous "*Flying Fox*," L.N.E.R. No. 4475 leaving King's Cross on the 11th July last. This was the first non-stop run to Newcastle, a distance of 268 miles, and was the longest booked non-stop run in the world

EVEN Ruskin, who did not like railways and referred to them as "the loathsomest form of devilry now extant," would have admitted, I think, that our green monster, with her long streamline body and polished brasswork, was a very beautiful piece of workmanship, and as such a thing quite outside the scope of his bitter indictment

As we pulled easily out of King's Cross Station with 400 tons of hotel behind us and began to gather speed along the track which was to lead us—one hoped without check—to Newcastle, 268 miles away, it seemed to me, at any rate, as though this great engine responded like a living thing, like a ship, indeed, under her captain's hand, and all my early enthusiasm for "railway trains" (big, squat-funnelled locomotives especially, painted green or blue) returned in undiminished force.

There were four of us on the footplate of the "*Flying Fox*": the driver (Mr. Pibworth, who has driven this engine since she was built in 1923), the fireman, an additional driver (Mr. Ferguson), with a life-long experience of the difficult, many-signalled road between York and Newcastle, and myself, but there is plenty of room in these huge "Pacific" engines, and a little seat had been rigged up for me beside the left-hand driving lever—in which position, as I found, I was scorched up to the waist by the heat of the furnace, but left cool on top—so that I could see the track ahead.

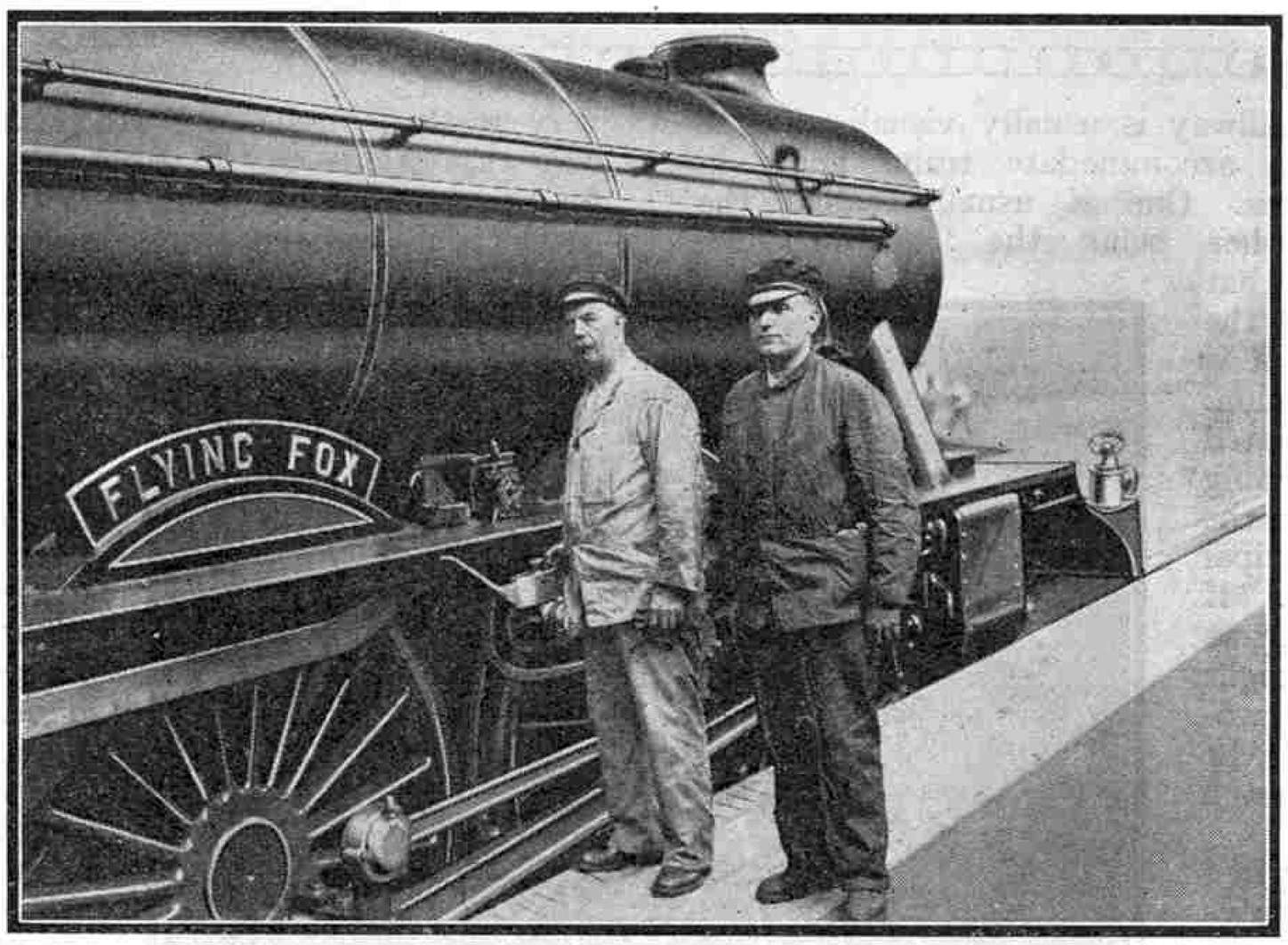
"I don't envy you," a railway official had remarked: "by the time you get to Newcastle you'll be shaken to pieces, dead beat, and as black as a nigger." Although I certainly did finish with a "playin' on de ole banjo" look about me, my adviser was scarcely doing justice to 'The Fox's' gentle soporific rhythm, her sway and lilt and seemingly effortless progress as we raced along.

"To us," said Mr. Mutton, the fireman, "it's like sitting in an armchair in the country." As he said this he called my attention to a wayside grass-patch alight with cornflowers, then carried on with his business of feeding five tons of coal into the engine's hungry, white-hot mouth. I felt that the discomfort of the footplate was over-rated, if one was a passenger, but I did not envy the fireman his armchair. Somewhere near Wood Green Tunnel the non-stop stopped (how ignominious, and so early, too) for an adverse signal, and we lost five minutes. That meant making up time, running down the winged minutes that flew

before us. And that meant *shovelling*.

"You'll see her go now!" the fireman shouted at me. And I certainly did.

We crashed through Hitchin exactly as though we were the animated and deliberate earthquake of which Ruskin so savagely wrote, and by the time Huntingdon was reached at least three of the minutes had been overtaken. The sun sparkled on the metals ahead, the country began to open out on either side, with ripening cornfields and the splashed purple of foxglove and willow herb, the air rushed past in a continuous flood of coolness, and presently I began to experience an unfamiliar intoxication in our headlong journey to the North. Speed for speed's sake has never particularly thrilled me, but this thunderous flight as it were on a purposeful cloud of steam was something odd and almost dream-like in its unreality.



Our photograph shows Driver A. Pibworth and Fireman Mutton standing by the side of "*Flying Fox*" at King's Cross. Driver Pibworth is giving the final touches with the oilcan before the famous train starts on its long run

One seemed to be detached, in an entirely different world both from that through which one was passing, and from that of the people in the coaches behind. I have always enjoyed looking out of a train window, for one of the advantages of the railway over the motor-road, which its early critics could not have foreseen, is that birds and animals have grown contemptuous of the train, and realize that, however much it may bark, it has no bite provided they leave it alone.

An express going at 80 miles an hour flushes all sorts of creatures from the immediate vicinity of the line, and in the engine one has an opportunity of watching their initial behaviour. Rooks delight in sitting on the metals up till the last possible moment. Rabbits sit up and take notice on the first apprehension of the passing whirlwind, but are soon feeding again. Pheasants don't worry, and foxes—I saw one in the woods beyond Sandy, "the Roman station"—simply merge brownly into the undergrowth and are hidden from view by the time the coaches are abreast of them. These birds and animals know that we cannot stay to harm them. We are not of their country; we on the footplate are riding a fiery horse that has no grazing in these quiet meadows. And even the little station gardens with their mignonette and marigolds, or the girls in scarlet and blue scarves cutting rushes on the river-bank—that was the Trent: we saw those girls, waved to them, and then were busy about picking up 3,000 gallons of water off the track in five seconds—seem somehow to belong to a less substantial England than the one we know.

Such imaginings as these, however, should not really be in the picture. To quote Fireman Mutton again, "With three medical and four technical examinations to pass before you become a driver, you don't want to have anything wrong with you on *this* job."

A mind that wanders is perhaps the most dangerous form of ailments conceivable in the circumstances. Yet for all that, there was not much that the "*Flying Fox's*" crew did not know about the country through which we were passing, and both had time to notice that I had been fool enough to come without anything to eat. I was at once provided with an excellent cheese-roll, and we had lunch, the driver never taking his eyes from the track as we rocked along northward at 80 miles an hour. That pace, rising to 85, was kept going till we had a check from a "distant" signal (a yellow fish-tail signal giving warning that the line may not be cleared ahead) which, however, fell before we had to pull up altogether.

So on through Doncaster, where speed was temporarily reduced because this is a junction and we were not taking any risks, to Selby on the Ouse, to York. We crept through that long station like a slow-worm, gathered speed, and ran the rest of the way to Newcastle mainly—so it seemed—at 85, through a cold driving rain that turned the coal-dust to a black mist and made one thankful for the furnace fire. There had been no speedometer in the engine cab, and no official time, but we were not late in by a second, and we were not early. We were on time.

"The first time we did this trip," said Fireman Mutton a little dolefully, looking at the solitary policeman who had come (or had he?) to congratulate the "*Flying Fox's*" crew on having achieved the longest non-stop run in the world for the second time, "the first time we did this trip the whole of that platform was black with people who had come to see how we were getting on."

Then he uncoupled "*The Fox*" while Driver Pibworth told him that what he wanted, no doubt, was a nice gold shovel with which to do his armchair work. As the great engine began to move slowly out unattached, I jumped off the footplate and patted her smooth green side. "Good old girl," I thought, "so you've done it again."

There was nothing particularly startling, perhaps, in what she had done—when it comes to the mere setting-up of "records" the famous London-Aberdeen races of 1895, with their little 70-ton expresses and relieving trains to pick up belated travellers, were far more sensational—but one cannot travel 268 miles on the footplate of an engine (*Continued on page* 985)

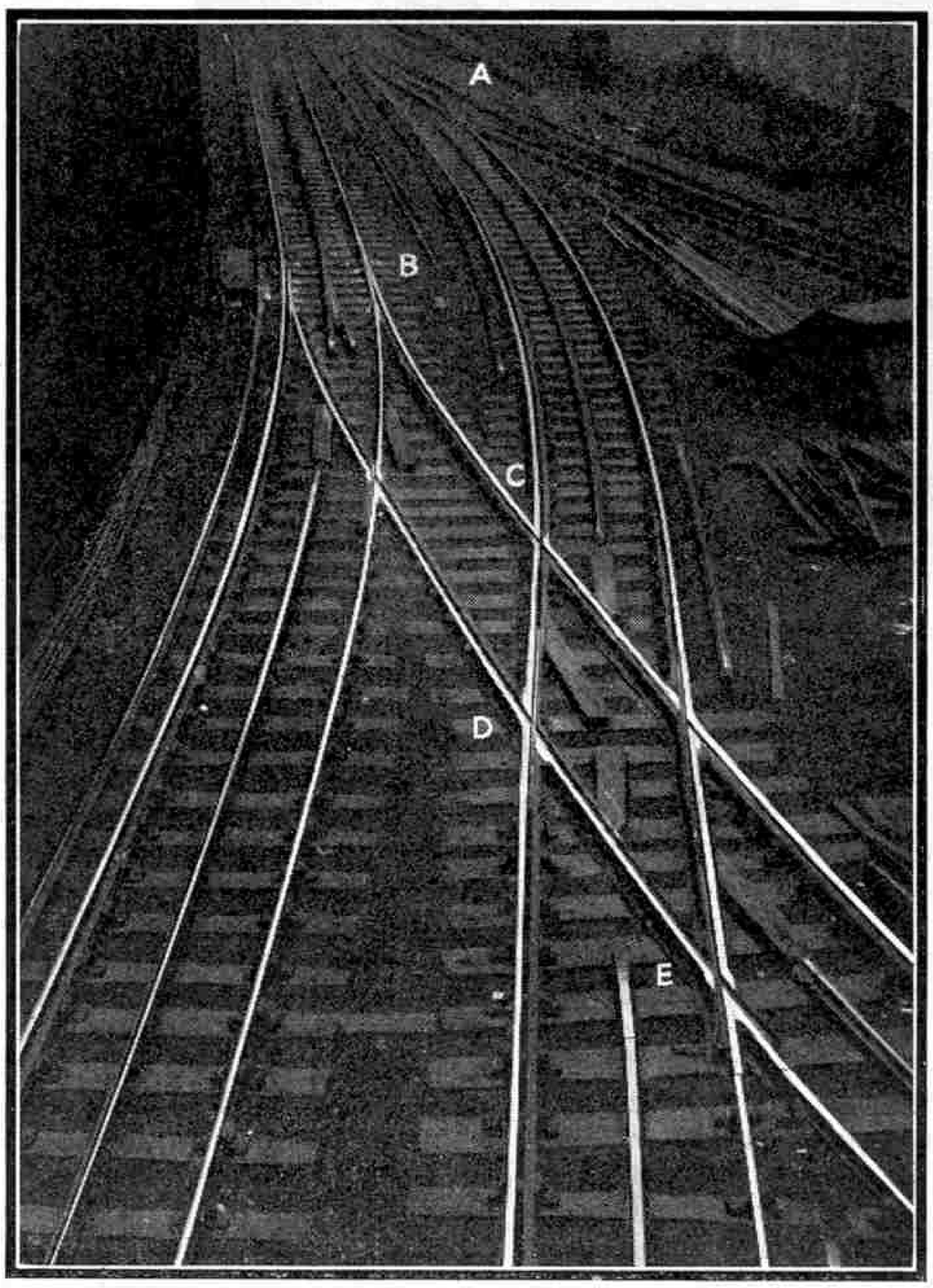
Some Notes on Permanent Way

II.—Double Junctions

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

IN this country a railway is usually visualised as a pair of tracks to accommodate trains going in opposite directions. One is usually called the "up" line, the other being the "down" line, and the convention is that it is an "up" line if the train travelling upon it is going towards London. Sometimes on isolated railways or on lines running east and west "up" is the direction of the principal town on the railway. If such a pair of tracks throws off a branch to left or right consisting of another two-track road we get the arrangement known as a "double junction."

The accompanying photograph shows a double junction on one of the London Underground Railways and the electrical equipment of the junction is very clearly seen. It will be noted that the lines branching off to the right seem to be a long way apart. The reason for this is that there is a station immediately to the right and the two middle lines of the four that pass through the station are terminal roads. The buffer stop at the end of one of these roads can just be seen on the right of the picture. The through lines therefore are at opposite sides of the station. In most double junctions the points are opposite to one another so that the points shown at B would then be at the top of the picture.



A Double Junction

At A we have an ordinary turnout as described. At B we have another single turnout followed by the arrangement lying between C and E which is known to the railwayman as a "diamond" crossing. The crossings at C and E are ordinary crossings like that at A but the two crossings at D are known as "K" crossings, "obtuse" crossings or sometimes as "diamond" crossings, although the last named is not strictly correct because a diamond crossing is made up of four crossings.

All the curves shown in the photograph are fairly sharp, that is of small radius; so that check rails are provided for the inside rail of each track. They are very neatly jointed—or "fished" to use the permanent way expression—to the wing rails of the crossings, and for this purpose the wing rails are not splayed out, or turned out, as were those shown on page 735 of the August "*M.M.*" Through the diamond the rails are actually straight, the advantage of this being that all the crossings have the same angle, whereas if one of the tracks was curved or if both were curved all the crossings would be different. The check rails are provided through the diamond because it is just as easy to do this as to turn out the ends of eight wing rails, and in addition it improves the running.

If crossings C and E are examined carefully it will be seen that they are of entirely different construction. The one at C is built up of ordinary rails while that at E is a casting in manganese steel. The obtuse crossings opposite D are also manganese steel castings. Crossing C must have lasted longer than the crossings that preceded those at D and E but when it was renewed it also probably would be replaced by a manganese steel crossing.

The advantage of manganese steel is that it is much harder and tougher than ordinary rail steel and hence lasts much longer. On the other hand it costs at least eight times as much. A railway engineer has to balance up these things, making allowance for the cost of carrying out the renewals before deciding whether or not to adopt manganese steel crossings. Generally speaking, on main lines worked by steam the installation of manganese steel crossings is not justified except in a few localities where the traffic is very dense. Our photograph shows castings, but crossings built up of manganese steel are obtainable and in fact are usually preferred because they keep the permanent way more uniform and "fish up" better to the ordinary rails. It should be noted that the castings do not rest in chairs but are fastened down to the timber through holes in their bottom flanges.

The wooden box arrangement to the left of the picture opposite B is a cover over the mechanism that works the points—in this case a compressed air motor. The air is at a pressure of about 60 lb. per sq. in. and the valves of the motor are controlled electrically from the signal cabin, the position of a certain lever in which determines the "lie" of the points.

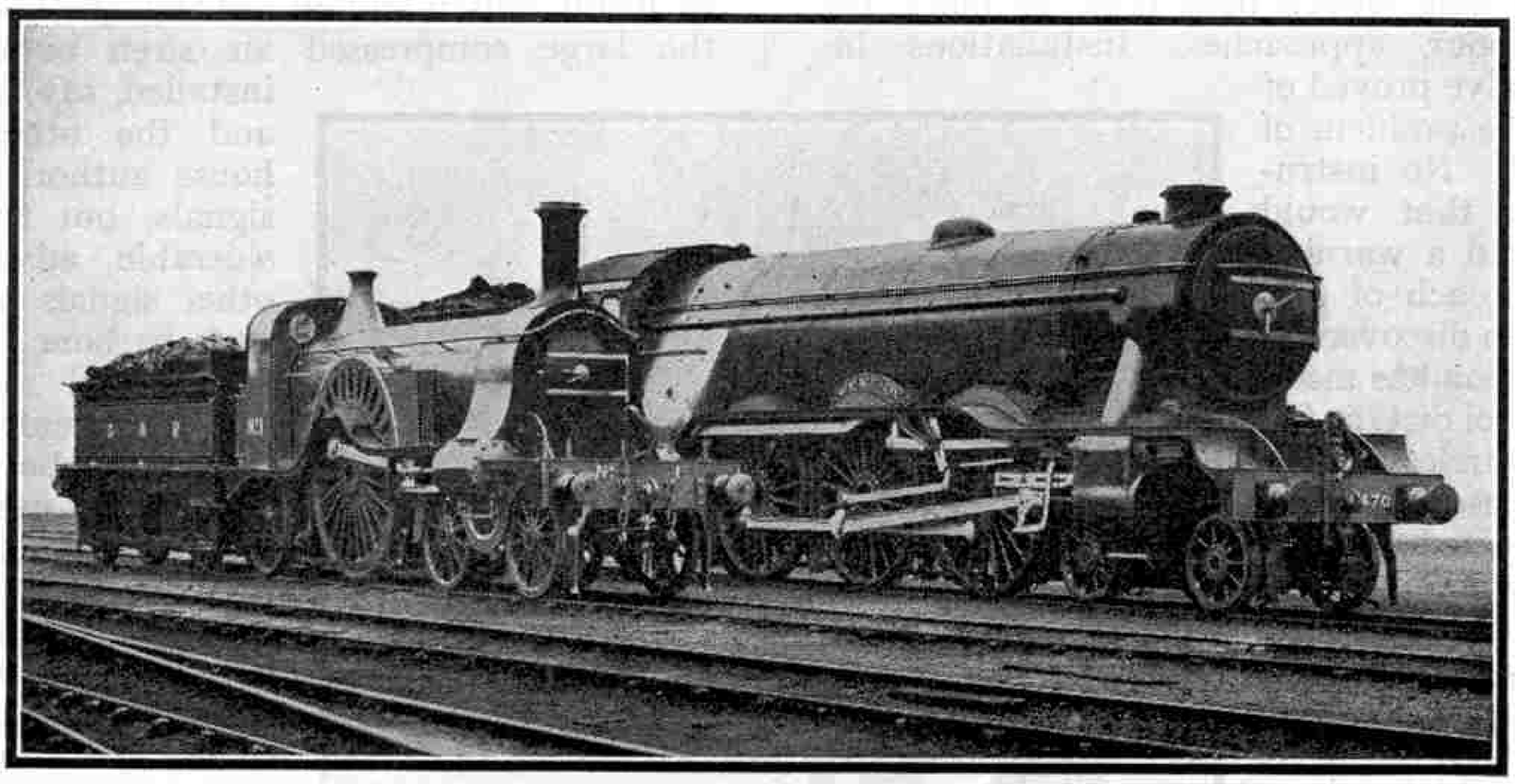
We come now to the electrical equipment. The "positive" rails are outside the running track while the "negative" rails are in the middle of it. The electrical pressure in the positive rail is about 600 volts while in the negative it probably is not more than about 40 volts. The current flows from the electric sub-station to the positive rail thence through the train motors to the negative rail and so back to the sub-station. The insulation of the positive rail therefore is much more important than that of the negative rail. The normal height of the positive rail above the running rail is 3 in. while the negative rail is only 1½ in. above the running rail.

The train collects current by means of cast iron shoes hanging from a shoe beam and returns it by similar shoes. Care has to be taken to prevent the current from passing into the running rails as this would cause an "earth" or short circuit. The current rails therefore are stopped off when they get within a short distance of a running rail. The ends are formed by "ramps," special cast portions, the tops of which gradually slope down so that the shoes do not leave or engage the rail too suddenly. This prevents "arcing" or sparking and also saves shock to the shoe. The negative shoe hangs much lower than the positive and at junctions is liable to touch a running rail. Wooden ramps or inclines are therefore provided as shown in the photograph to raise them up clear of the running rail. Near B will be noticed a special splicing arrangement in the current rails, known as "splays." The idea is to give a smooth passage to the shoe no matter which way the train may be running.

The current rails are not of the same material or section as the running rails. They are softer, as this gives better conductivity and they have a flat base to give a good bearing on the top of the insulators. Where gaps occur in the conductor rails a "jumper" cable connects the two ends. A short length of current rail will be seen on the right of the photograph opposite C. A cable comes out of it and appears to dive into the ground. Actually it enters a wooden trough called "trunking" and this may be followed in the picture until it disappears at the edge. The cable would be brought up and joined to the current rail at the extreme edge of the picture opposite E. The trunking protects the cable and also marks its position so that plate-layers are not so liable to strike it with pick or shovel.

There is just one little detail that some readers may be keen-eyed enough to spot and that is a short piece of check rail in front of the point at B. This is not put there for safety so much as to help to reduce the wear on the planed side of the left-hand switch, by keeping the wheels well over to the left and counteracting their natural tendency to bear hard to the right. This is a refinement and not at all a standard feature in ordinary junction work.

Then—and Now! A Contrast in loco design



The famous Single-Wheeler No. 1, designed by Mr. Patrick Stirling, alongside L.N.E.R. No. 4470 "Great Northern." This latter was the first "Pacific" to be used on the East Coast Route. There are now about 60 "Pacifics" in use on the L.N.E.R.

Exploring the Arctic—(*continued from page* 950)

besides a dog-sledge and driver, the loads being so adjusted that each man pulled 200 lb. and each dog 100 lb. The total weight of the sledges to be dragged by the members of each party was 1,400 lb. and of this 930 lb. consisted of provisions, mainly pemmican, biscuits and tea, with a little boiled pork, rum and tobacco. As was usual with sledging parties, depots of the provisions were to be formed at intervals for use on the return journey.

The southern parties proceeded together at first. The Eskimos met with near the magnetic pole seven weeks earlier were again found and further relics were obtained from them. The astonishing fact was also learned that the Eskimos of King William Land had actually seen the second ship of the Franklin expedition, which was reported to have been forced on shore!

It became clear that the Eskimos of Boothia knew of this, and knew also that it was from this ship that the articles purchased by M'Clintock had been obtained, as well as their supply of wood. Their reasons for denying all knowledge of a second ship in reply to M'Clintock's previous questions remained somewhat obscure, but this incident illustrates the difficulty experienced in obtaining accurate information from these people. They seemed to tire easily when questioned and it was always necessary to carry out an investigation in instalments.

Hobson's course now took him to the west, while M'Clintock held on to the south, and the two parties did not meet again until each had completed its intended journey and the greater part of the mystery of the lost expedition had at last been solved. How the dramatic story was revealed will be told next month.

Controlling Fog Signals by Wireless

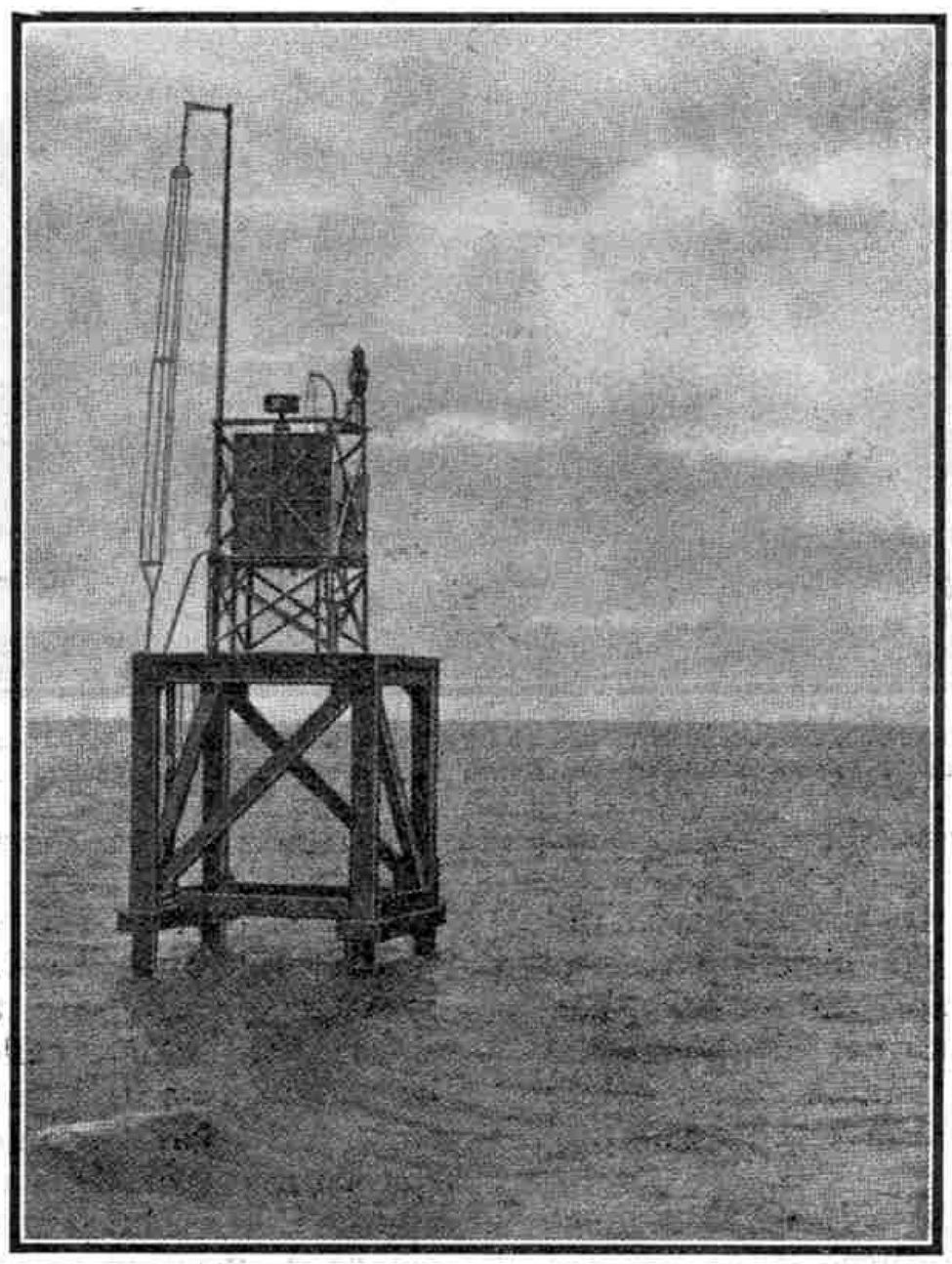
A Recent Invention in Operation on the Clyde

IN the "*M.M.*" for November, 1926, page 671, we gave a description of the "Chance" light valve, which automatically turns on and off the supply of gas, usually acetylene, for the burners of unattended lighthouses or the flashing buoys now used to mark the fairways of harbour approaches. Installations incorporating this valve proved of great value but the problem of fog still remained. No instrument was known that would automatically sound a warning signal on the approach of fog, nor has one yet been discovered; but a recent invention has made it possible to control distant fog signal stations by wireless waves.

The apparatus used for this purpose was perfected by the Marconi Company and an unattended fog signal controlled by means of it was placed on Rosneath Patch in the Firth of Clyde for experimental purposes early this year. Trials since carried out under actual working conditions have been so successful that a prolongation of the trial period is now considered unnecessary, and mariners have been officially notified of the permanent establishment of the installation.

Thus it is now possible to erect unattended lighthouses and fog signals at many difficult or dangerous situations where it is at present too expensive to provide light-keepers for a light or fog signal, or where it is impracticable, on account of rocky bottom, strong tides, rough seas or even ships' anchors, to maintain a submarine cable connection for an unattended light or fog signal, or to build a lighthouse tower. A further advantage is that the cost of light-keepers at present in attendance at many places may be saved.

The Clyde installation, the general layout of which is indicated on the map on the next page, is interesting for several reasons. Rosneath Patch is a sandbank in mid-channel at the entrance to the Clyde between Gourock and the opposite Argyllshire shore. A reinforced concrete lighted beacon marks the Patch, and fog signals have been installed by the Clyde Lighthouses Trustees both at the head of the pier at Fort Matilda, the site of the torpedo factory, and on Rosneath Beacon. These signals are automatic in action and give an explosive signal, the explosion being obtained from a mixture of air and acetylene gas. Once started, the guns continue to give an explosion until they are switched off or until the acetylene gas is exhausted.



The Fog Gun at Rosneath Patch in the Clyde Estuary

Guns of this type are largely used as fog signals in Scotland and in other countries. They are the only automatic fog signals in use at present, and they have advantages over other fog signals in being inexpensive to instal and maintain. They are not so powerful as the large compressed air siren or diaphone signals installed, say, by Trinity House and the other British lighthouse authorities, as coast fog signals, but they have a considerable advantage over all other signals in narrow waters and harbour entrances where a powerful signal is not the sole requirement, in that the signal can be repeated as frequently as every ten seconds.

At Rosneath and Fort Matilda the guns get their supply of acetylene gas from a carbide to water plant, but cylinders of acetylene gas dissolved in acetone are used elsewhere. No electrical or other apparatus beyond the acetylene supply is required to operate the guns themselves, which can be left firing for so long as the gas supply lasts.

The two guns on the Clyde have a system of wireless receiving apparatus fitted to them and a transmitting set is installed at Gourock Pier, 1¼ miles from Rosneath Beacon. When fog is observed, the transmitting installation is put into operation and the impulses sent out are received by the apparatus attached to the fog signals and thereby bring the gun into action. When the fog lifts and the guns have to be stopped, other impulses having a different period are sent out by the transmitting station, and these have the effect of putting the guns out of action.

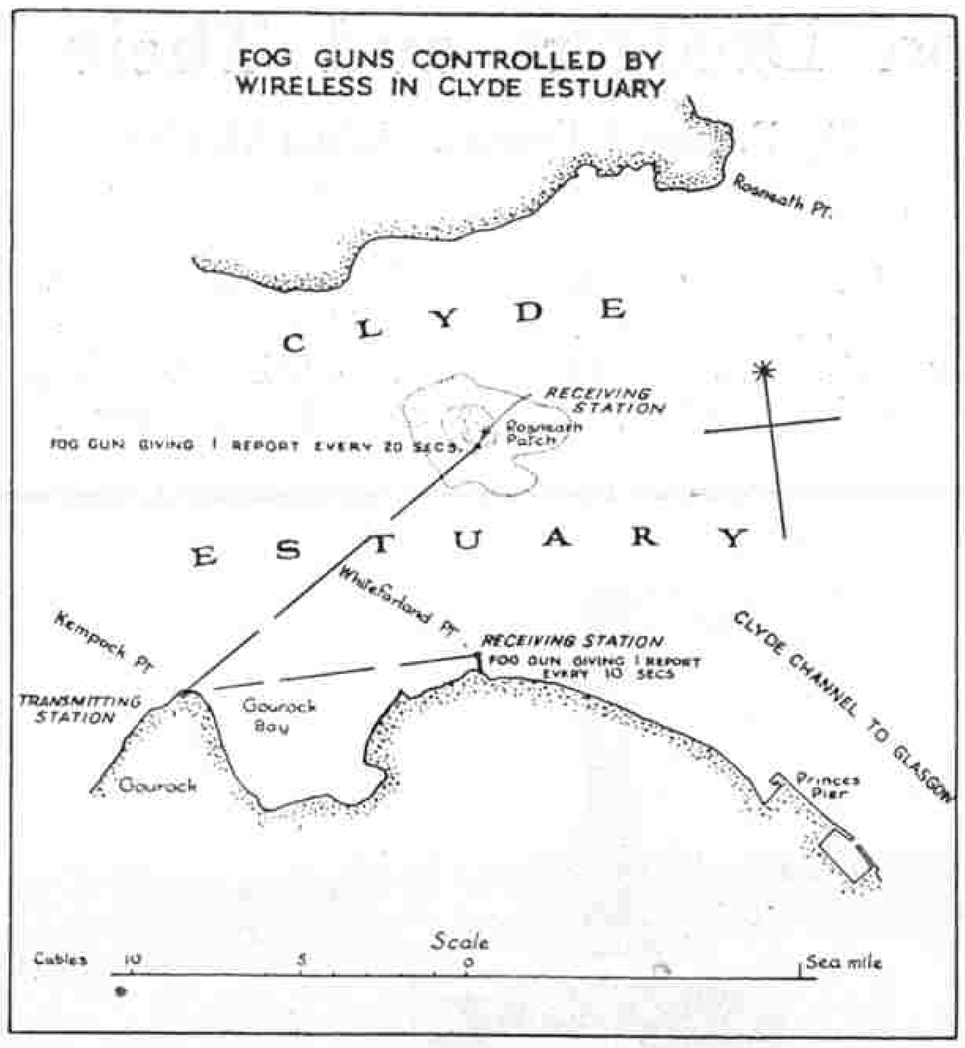
Interference from atmospherics or from other wireless waves is prevented by carefully synchronising the transmitters and the receivers, and continuous operation of the signals, resulting in annoyance to the neighbourhood and an expense of gas, is thus avoided. Rosneath signal is arranged to give one explosion every 20 seconds and Fort Matilda every 10 seconds. In each case sufficient energy is obtained from small storage batteries.

The essential features of the transmitter are a pendulum and a mercury break, a spark coil and a quenched spark transmitter. In starting the gun the pendulum is allowed to swing freely, causing a small contact on its side to dip into a mercury cup a predetermined number of times per minute. The contact closes the circuit containing the spark coil, and consequently trains of

waves are radiated at the fixed rate per minute. After a specific number of these trains have been transmitted, the gas valve of the gun is opened by the action of the receiving apparatus and the gun will commence to fire.

For the purpose of stopping the gun the transmitter has been arranged to send out trains of waves at a different frequency. These are sent in exactly the same manner as the starting signal, and after the pendulum has made the necessary number of swings the gas valve of the gun is closed.

The most interesting part of the apparatus is the receiver, which starts or stops the gun in obedience to the incoming wireless signals. It comprises a two-valve unit for operating a moving coil relay. The valves used are special Marconi dull emitter valves of constant emission with a consumption of .06 amperes per filament. These valves are lighted permanently so that a signal may be received at any time, and they are changed every three months. The first is a detector, the second a low frequency amplifier, and the third and fourth valves perform a special duty in connection with the moving coil relay, which controls a local battery circuit through two balance wheels.



Wireless Fog Gun Positions in Clyde Estuary

The signals from the transmitter cause the relay contacts to open and close once for each swing of the pendulum. This swings one of the balance wheels with a continually increasing amplitude until contact is made and the local circuit closed. The battery then sends a current through another relay, which opens the gas valve. In order to close the gas valve, the other, or closing balance wheel, is similarly energised at the appropriate number of impulses per minute by a train of waves of different wavelength.

The receiver is completely self-contained and needs attention only once in three months for battery charging and valve replacements.

This invention is still another example of the value of wireless waves. With their aid ships may always be in communication with the shore, chronometers may be checked daily, and direction finding apparatus enables ships to find their exact position when in the neighbourhood of dangerous rocks and reefs. Wireless beacons will further increase safety at sea and their warnings will no doubt be welcomed by many a vessel caught in a sudden fog.

Locomotives that have Made History—

(*Continued from page* 951)

custom of the times.

Several of the East Coast veterans are still in service hauling light express trains, and have lost none of their high speed qualities when lightly loaded. It is now stated, however, that they are to be withdrawn for breaking up, so that the accompanying photograph should be of unusual interest to locomotive lovers everywhere.

One of the class, possibly No. 1463, is to be set aside for preservation as a relic, probably at the L.N.E.R. Railway Museum at York, where it will be seen together with another "flyer" of the past—the celebrated Brighton locomotive "*Gladstone*," built by the late William Stroudley. "*Gladstone*" was the pioneer of a class of 0–4–2 express engines that made the name of their designer famous throughout the engineering world, and eventually a last resting place is to be found for it in the South Kensington Science Museum. The old Brighton engine is to be repainted in the distinctive yellow and maroon livery of its halcyon days, and in every other respect will be restored to the condition in which it started its 44 years' service, in the course of which it covered over 1,350,000 miles.

The principal features of "*Gladstone*" were its four driving wheels, each 6 ft. 6 in. in diameter, and its cylinders, which had a diameter of 18¼ in. and a 26 in. stroke. In 1882 these cylinders were considered exceptionally big, and being made in one casting were almost a revolutionary departure from current practice at that period. In actual fact this locomotive was the pioneer of many mechanical details that were not generally adopted by railway engineers until a much later date.

William Stroudley died 30 years ago but will go down in railway history as one of the greatest locomotive designers of the first century of railway operation. At the time of the Darlington Railway Centenary Celebration in 1925 more engines of his design were running than of any other designer of his period.

Another Brighton locomotive that made history was the "*Grosvenor*," a single-driver express engine built at Brighton Works in 1874. It was a splendid specimen of workmanship and was sent north to participate in the jubilee celebrations of the Stockton and Darlington Railway in 1925, and aroused much interest and admiration. With driving wheels 6 ft. 9 in. in diameter, and cylinders 17 in. by 24 in., "*Grosvenor*" made the first non-stop run between London and Portsmouth, 87 miles, in 110 minutes.

The "*Grosvenor*" was ill-fated in its later days, however. When the era of the single-wheeler had passed it was sold to the Italian State Railways, and is said to have been swallowed up in the great earthquake at Messina.

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Taming of Death Valley—

(*cont. from page* 979)

hat trade as a solvent for shellac. In tanning, both borax and boric acid are used for cleaning hides and dressing the leather. In the textile industry borax assists in dyeing, and in some parts of the world boric acid is still employed in the preservation of foods, although its use in Great Britain will soon be entirely prohibited on account of its bad effect on the heart.

Boric acid is an antiseptic and is employed for external washes, and it finds a place also in cosmetics. It is used as a larvicide and it is recommended for the destruction of fly larvæ in manures, for it destroys the larvæ without affecting the bacteria that increase the fertilising value of the manure. Finally, borax is a well-known flux used in metal working.

London-Newcastle Non-stop—

(*cont. from p.* 981)

such as the "*Flying Fox*" and not feel that, like a ship, she is alive.

And I should like to add, despite Fireman Mutton's repeated assertion: "There's nothing in it; it's only a matter of use," that one cannot travel with the men who run and control these great expresses of modern times without admiring their steadiness of nerve, their broadmindedness, and their fine, untroubled acceptance of responsibility—beyond mere words.

* * * *

This very interesting account of a ride on the "*Flying Fox*" is reprinted from "*The Spectator*" by special permission of the Editor. The photographs are published by courtesy of the L. & N.E.R.

Keeping the World's Harbours Clear

Suction Dredgers and Their Work

By E. Lloyd Francis, A.M.I.Mech.E.

THE majority of readers will be familiar with that clumsy and unwieldy-looking craft, the "bucket" or "ladder" dredger, but probably few are well acquainted with the less familiar "suction dredger," or "hydraulic dredger" as it is called in the United States. Apart from the fact that some types of suction dredgers are, when viewed from a distance, almost identical with tramp steamers, these dredgers are not used to the same extent around the coasts of the British Isles as are bucket dredgers. In the East, many suction dredgers are in constant operation, particularly where land reclamation is to be carried out.

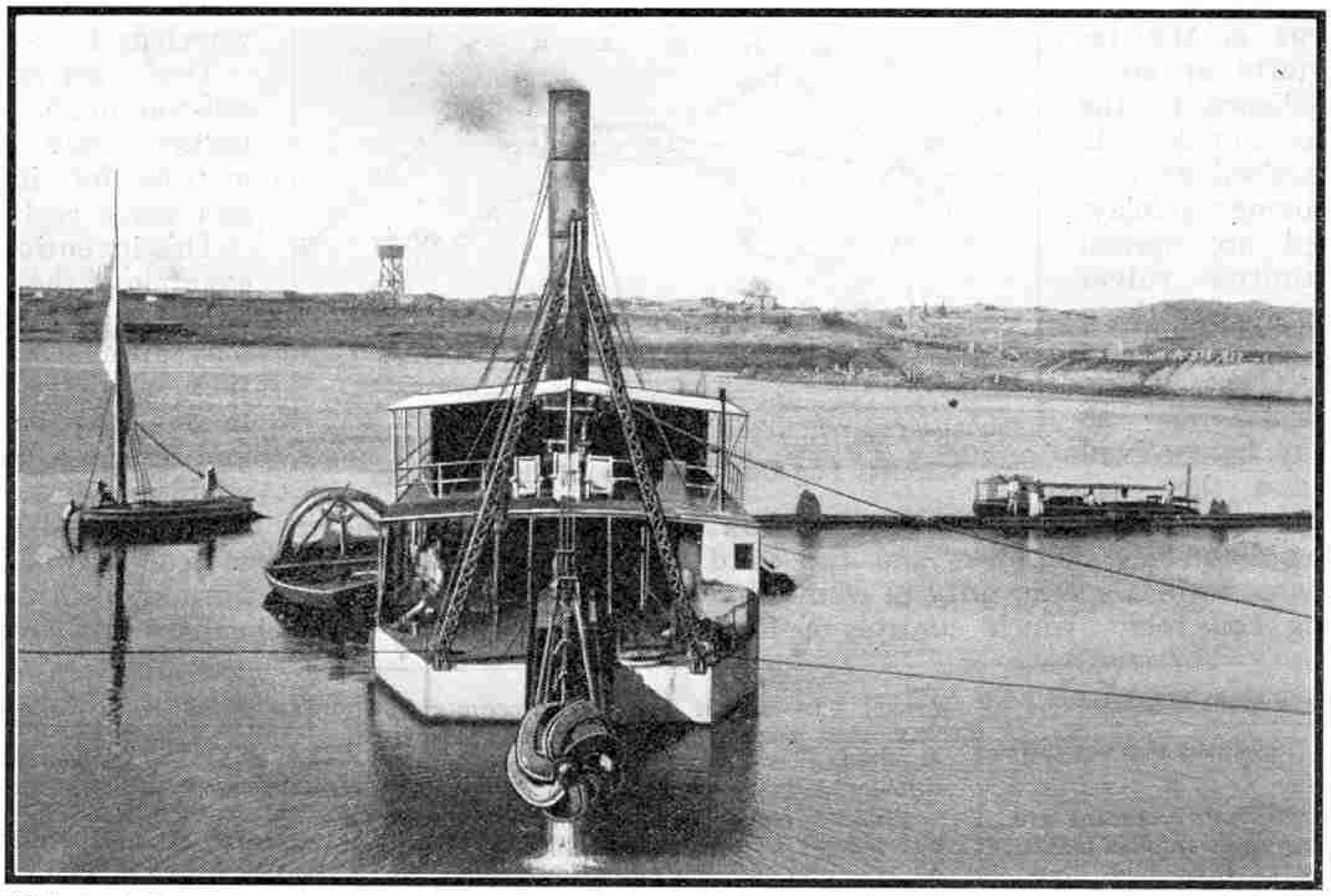


Photo courtesy] [*Lobnitz & Co. Ltd.*

A cutter suction dredger built for the Sudan Government. Note the floating pipe line in the background ; this is 18 in. in bore and 1,000 ft. in length

As its name suggests, a suction dredger is dependent for its operation on a pump. Indeed, such a dredger may be said to consist simply of a floating hull carrying a large centrifugal pump. The action of this pump is to suck up the required material from the bottom of a river, dock or harbour through a suction pipe, and discharge it through a discharge pipe into hoppers on the vessel itself, on to the adjoining land, or into independent hoppers or barges. To the uninitiated it may appear almost incredible that an ordinary centrifugal pump can form the basis of operation of a dredger, and yet it has long been proved that this pump is able to deal extremely efficiently with the dredging of sand, gravel and stones.

The centrifugal pump is so well known in connection with one or other of its many uses that a detailed description of the type commonly employed on a suction dredger is not necessary. The pump of a dredger simply comprises the usual volute casing, within which operates a disc or impeller having a number of curved, radial blades and an "eye" or opening at its centre into which the material, sucked up by the aid of the rotating disc, enters from a suction pipe, the material being drawn into the volute and led away through a discharge pipe.

A dredger that is arranged to discharge the dredged material, or "spoil," through a floating pipe-line, is illustrated diagrammatically in Fig. 1. Such a dredger is sometimes known as a "cutter suction dredger," because the work of the pump in dredging is assisted by means of a rotary cutter A, which breaks up the material before it is subsequently drawn into the suction pipe. The centrifugal pump, which is shown at B, is driven by an engine C, to which it is directly coupled. A propelling engine D is also arranged at the after end of the vessel.

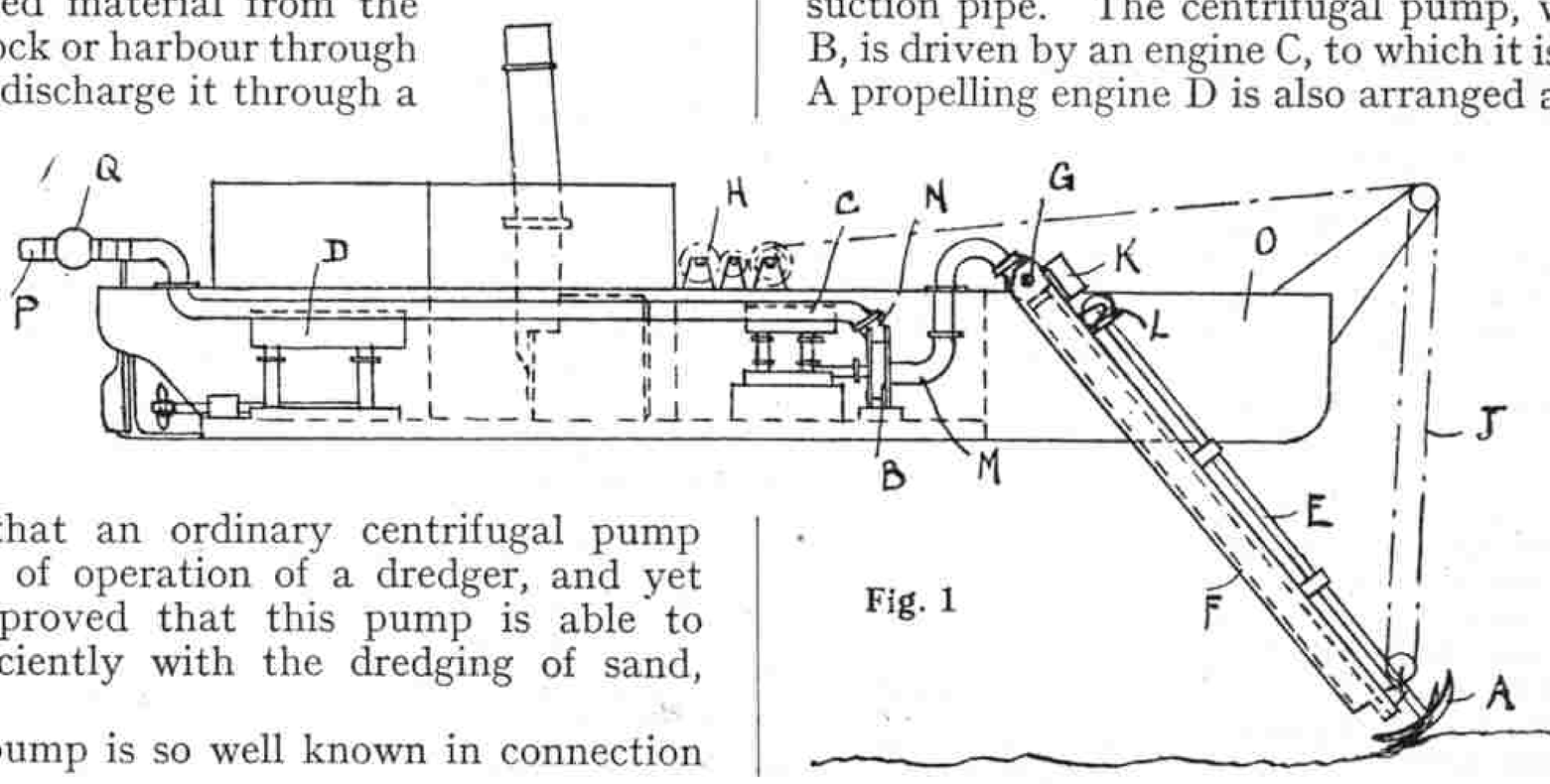


Fig. 1

The shaft E, on which the cutter A is arranged, is rotably mounted in a number of bearings carried by the cutter-frame F. The latter is built up in girder fashion and disposed in a well O formed in the bows of the vessel

and extending from the deck to the keel. If the vessel is looked at from above, the forward end is seen to take the form of two forwardly projecting parts or arms separated by the well.

As the cutter A is required to work at different depths, according to the depth of the bed being dredged, it will be obvious that means must be provided for raising and lowering the cutter frame and with it the cutter. This is done by hinging the cutter frame at G and employing a hauling winch H, which is connected to the cutter frame through the block and tackle gear J.

Means must be provided also for driving the cutter shaft E no matter what may be its inclination. In the dredger illustrated in Fig. 1, these means are seen to consist of a cutter-driving engine K, which is mounted on the cutter frame and drives the shaft E through the bevel gears L. In other forms of dredgers the driving engine is mounted on the deck, and suitable gearing, of the sun-and-planet type, is provided for connecting the driving engine to the cutter shaft, so that the latter can still be rotated in spite of its varied inclination.

Returning again to the centrifugal pump B, we see that it is provided with the usual suction pipe M leading to the centre or eye of the disc, and also with a discharge pipe N. The suction pipe is carried upward through the deck and is connected by means of a ball and socket joint G to a continuation that extends from the inboard to the outboard end of the cutter frame, and terminates in close proximity to the cutter A. In some cases, however, the suction pipe M is led from the pump through the hull at one side of the well O, and is there connected to a stuffing box within which the pipe supported in the cutter frame is turnably arranged.

The discharge pipe N is led aft almost the length of the dredger and, after being led upward through the deck, is connected by a ball-joint Q to another pipe P, which is connected in turn to the floating pipe-line. As the last-named forms such a very important feature in many dredging operations, a short description of a typical construction will not be out of place.

A floating pipe-line is used when it is desired to discharge the spoil some distance from the dredger, either on land or in the sea. The construction of the pipe-line is quite simple, as it consists merely of a number of pipes, each of which is bouyantly supported by a pontoon. One form of pontoon is shown in Fig. 2, and consists of a pair of cylindrical, metallic buoys A, arranged one on each side of the discharge pipe D, and connected together by wooden sponsons B and through bolts C. It will be understood that, owing to the movement of the dredger itself and to the roughness of the water, some form of connection must be arranged between the pipes D whereby each pipe may move relatively to the adjacent pipes. When the pipes are small in diameter, they may be connected by lengths of leather, rubber or canvas hose, but for larger pipes this method of jointing is unsatisfactory and metal joints have to be provided.

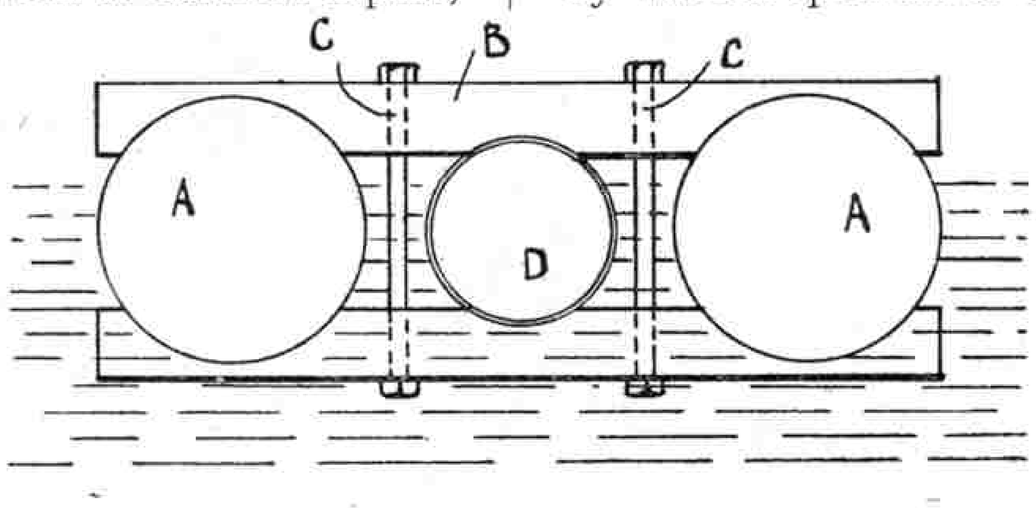


Fig. 2

Such a joint is illustrated in Fig. 3, where it will be seen to consist of a ball-joint having an inner part A, which is connected to the pipe B, and an outer part C-D connected to the adjacent pipe E. The two parts A and C-D can thus move relatively to each other. Suitable buffers are arranged at both ends of each cylindrical buoy, and two adjacent sets of buoys and pipes (Fig. 2) are connected together by means of a hinge, which allows horizontal turning movements of the sets relatively to each other and also a slight amount of relative vertical movement.

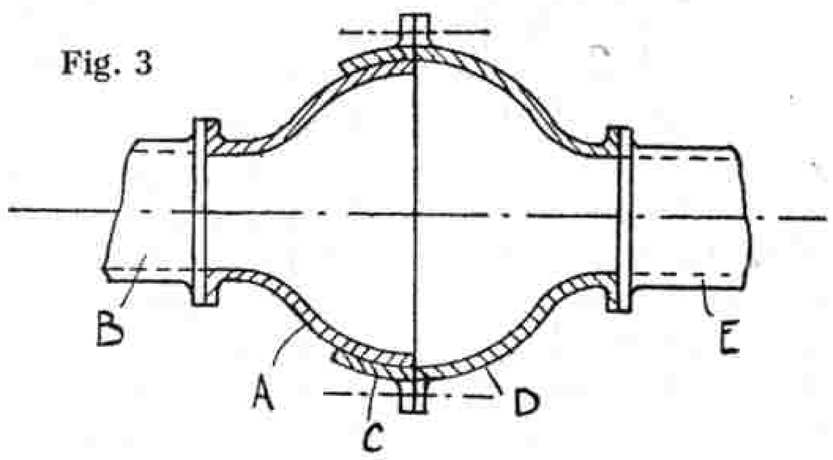


Fig. 3

In some cases the floating pipe-line is not used, and the dredger not only includes the propelling and dredging machinery, but also means wherein the spoil may be deposited in readiness for its removal to some place remote from the scene of the dredging operation, where it can then be discharged. A dredger of this type is called a "hopper dredger" or "transporter dredger."

Fig. 4 illustrates part of the hopper and the forward end of a hopper dredger. The centrifugal pump A of this dredger is provided with a discharge pipe B, which runs longitudinally over the top of the hopper C. On the underside of this pipe are provided a number of pivoted valves or gates D, which, when opened, permit the spoil pumped into the discharge pipe to be discharged into the hopper.

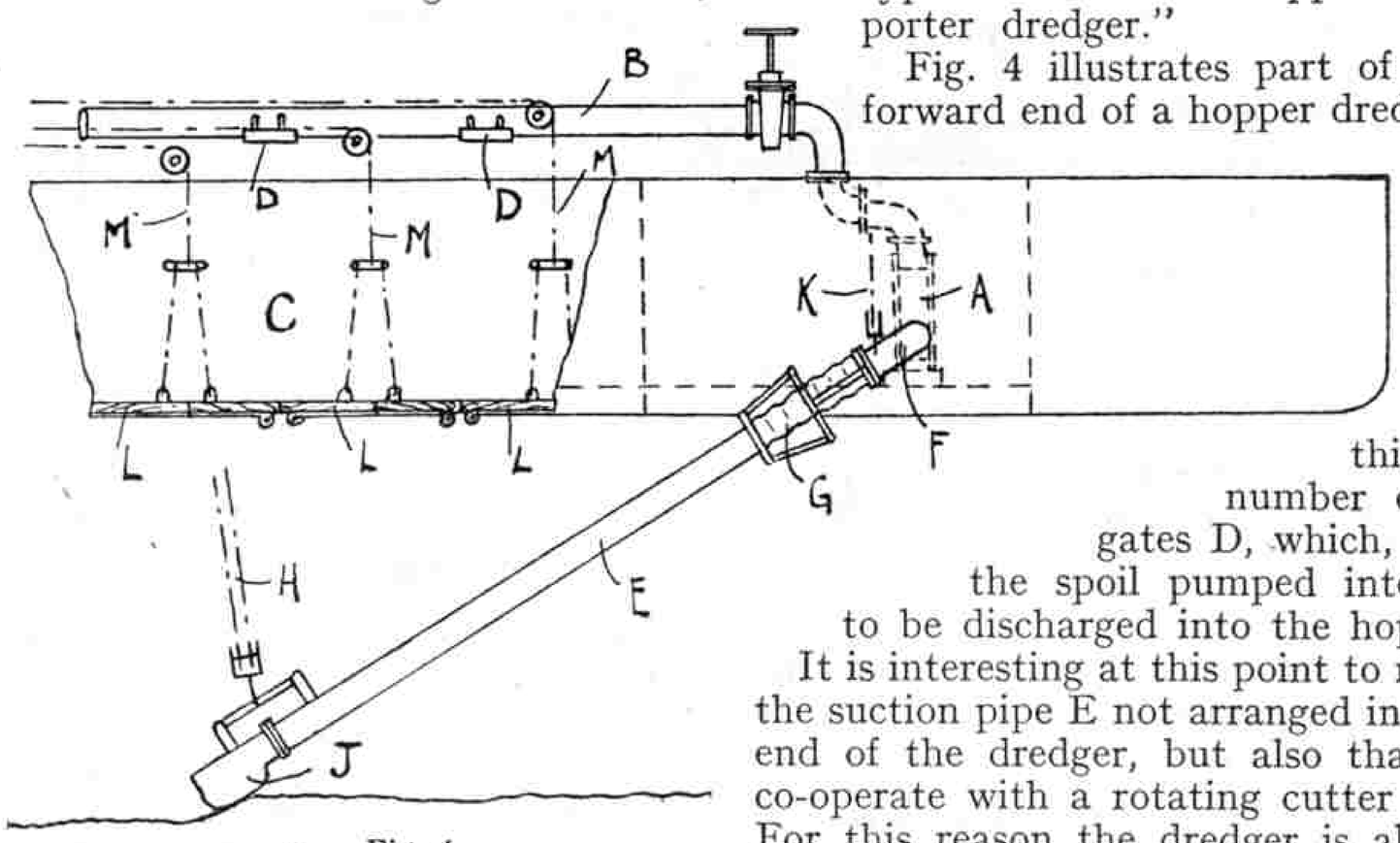


Fig. 4

It is interesting at this point to notice that not only is the suction pipe E not arranged in a well at the forward end of the dredger, but also that this pipe does not co-operate with a rotating cutter such as A in Fig. 1. For this reason the dredger is also called a "trailing suction dredger."

The suction pipe leading from the pump is connected to a steel bend F, the inner flange of which is slidably guided in a pair of vertical T-shaped guides secured to the exterior of the hull. The bottom end of the guide is semi-circular, so that while the steel bend can turn on

its axis, it cannot move away from the side of the ship. A length of strong rubber and canvas hose G connects the outer end of the steel bend to the upper end of the suction pipe E and allows movement of the latter toward and away from the side of the dredger. The steel bend F can be moved vertically in its T-shaped guides, which are extended right up to the deck, so that the bend and the suction pipe E can be hauled inboard if necessary. Hoisting gear H is provided for varying the depth at which the mouthpiece J, fixed to the outer end of the suction pipe, is to work, and other hoisting gear K serves for raising and lowering the steel bend F.

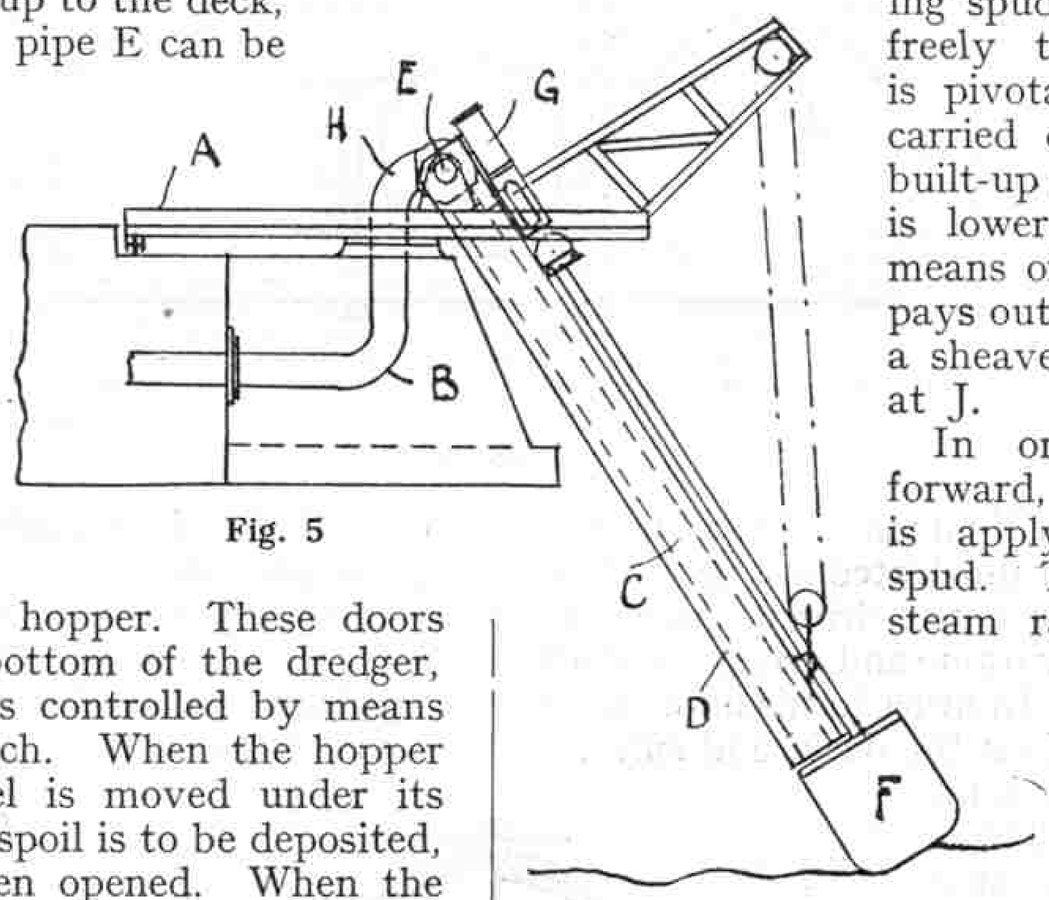


Fig. 5

Referring again to the hopper C, it will be observed that a number of hinged doors L are arranged at the bottom of the hopper. These doors open outward away from the bottom of the dredger, and their opening and closing is controlled by means of chains M connected to a winch. When the hopper is sufficiently loaded, the vessel is moved under its own steam to the spot where the spoil is to be deposited, and the hopper doors L are then opened. When the hopper is empty, the doors are again closed and the vessel returns to the place of operation.

A trailing suction dredger is used when the material to be removed is not of a particularly heavy nature. It may be mentioned in passing that hinged doors are not always used on hoppers. In some cases, large cylindrical valves are fitted to the bottom of the hopper and are opened and closed by hydraulic rams.

We have now dealt with dredgers that are arranged to pump the spoil through a floating pipe-line and with those that discharge the spoil into their own hoppers. In both cases, however, the discharge pipes may be arranged so that the spoil can be discharged into attendant hopper barges, which are self-propelled and are used solely for carrying the spoil away.

An interesting arrangement of the suction pipe of a dredger is illustrated diagrammatically in Fig. 5. A turntable A is turnably mounted at the forward end of the dredger, and the inboard suction pipe B is led upward at the centre of the turntable through the deck, and connected to a pipe H in such a manner that the latter can turn relatively to the pipe B. The outboard suction pipe C is shown supported by the suction frame D, which is pivoted at E. The turntable is swung about its axis by a wire rope which is passed around the turntable, crossed and connected to diametrically opposite sides of the barrel of a winch arranged on the deck. The cutter F is driven by an engine G mounted on the cutter frame. A dredger of this kind is particularly useful for cutting a channel as it is propelled slowly forward, the turntable being swung from side to side by the winch.

An interesting method of propelling a smaller type of dredger is shown in Fig. 6. At the after end of the dredger is formed a tunnel or well A, through which is passed a long bar B of strong wood known as a "walking spud." The latter is also passed freely through a socket C, which is pivotally mounted on a frame D carried on wheels E that run on a built-up support F. The walking spud is lowered on to the river bed by means of a winch (not shown), which pays out a wire rope G passing around a sheave H on the spud and secured at J.

In order to move the dredger forward, all that needs to be done is apply pressure to the walking spud. This is done by means of the steam ram K, whose piston rod L is connected to the after end of the frame D. Thus, when steam is admitted to the ram cylinder, the frame D is moved forward and the walking spud is forced back against the forward wall of the well A, because of the engagement of the spud in the socket C. The forward movement of the frame D is stopped by its contact with a stop M, and the spud, now inclined, is hauled upward through the well by means of the spud-hoisting winch referred to.

Space does not permit of a detailed description of the many refinements and improvements that have been incorporated in modern suction dredgers, but it may be mentioned that the dredging master is provided with an indicator by means of which he can tell at a glance at what depth the cutter or the suction head is working. In some dredgers, too, he is also able to control the whole dredging operation himself by means of a system of controls grouped almost within arm's reach.

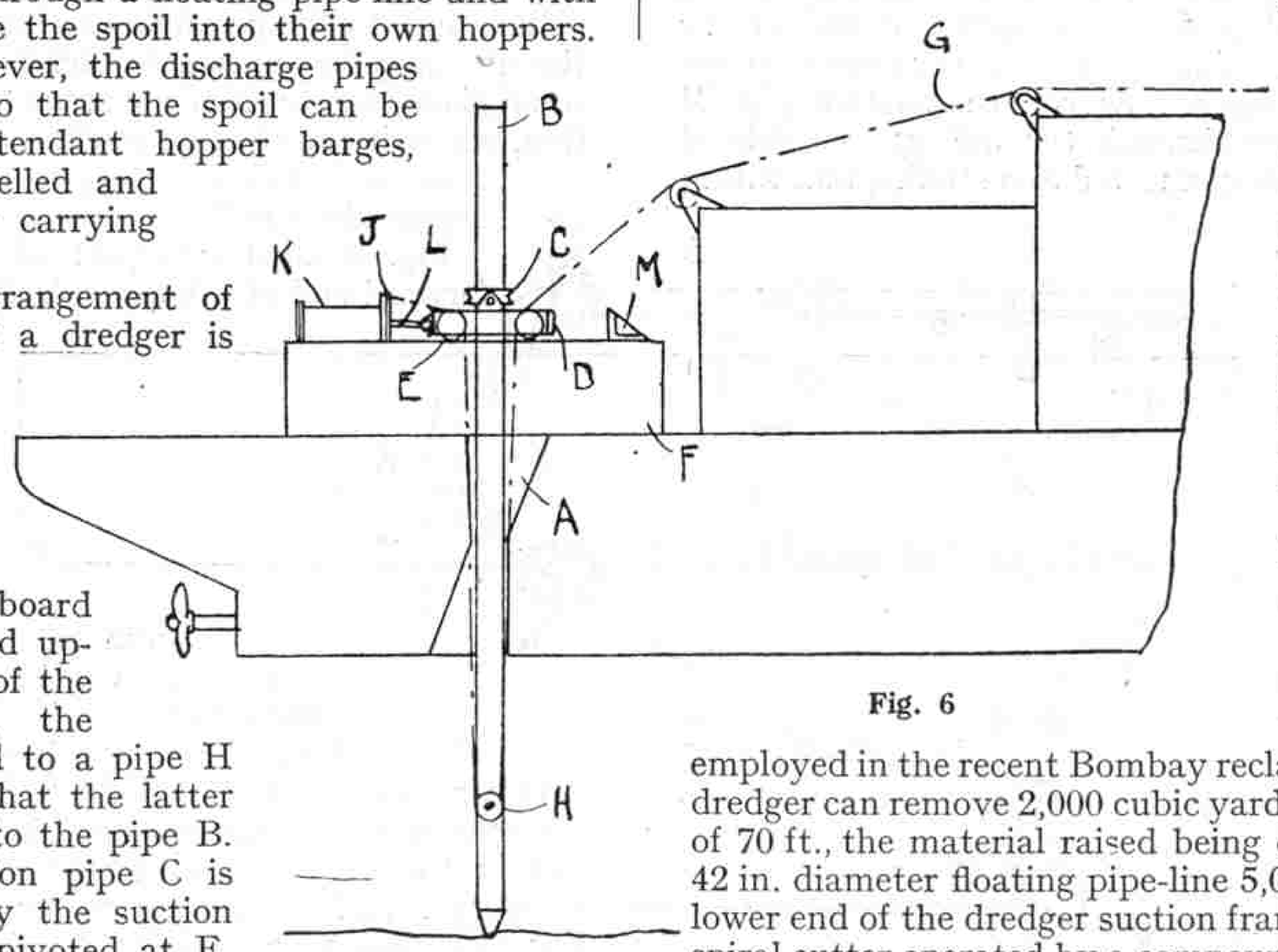


Fig. 6

One of the largest cutter suction dredgers ever built was employed in the recent Bombay reclamation scheme. This dredger can remove 2,000 cubic yards per hour at a depth of 70 ft., the material raised being discharged through a 42 in. diameter floating pipe-line 5,000 ft. in length. The lower end of the dredger suction frame is equipped with a spiral cutter operated by a compound engine at the head, while a triple expansion steam set drives the centrifugal suction and discharge pump.

In the Federated Malay States cutter suction dredgers are used in tin mining. The cutter effectively breaks up the ore-bearing gravel, which is then pumped up and passed to sluice boxes, where the ore is retained.

THE LAST STRAW

The parish visitor found the small boy, who had always worn his father's old suits cut down, crying bitterly.

" What's the matter, my boy ? " she asked.

" Father's been and shaved his face," the boy sobbed in reply, " and I don't want to wear red whiskers."

* * * *

" One of my ancestors won a battle during the Crusades by his skill in handling his artillery," said the baron.

" But my dear baron ! " said his friend, " At the time of the Crusades, gunpowder had not yet been discovered."

" I know that as well as you do, and so did my ancestor."

" How did he win the battle, then ? "

" He brought his artillery to bear on the Saracens, and the stupid fools, seeing the guns, supposed that powder had at last been discovered, and fled in dismay ! "

* * * *

Tom and Jack were late for school and were being called to account for it.

" What made you late, Tom ? " asked the teacher.

" Please sir, I was dreaming that I was going to Margate, and I thought the school bell was for the steamer that I was going by."

" You did, eh ? " said the teacher, " and now," turning to Jack, " what have you to say for yourself ? "

" Please, sir—I was waiting to see Tom go off."

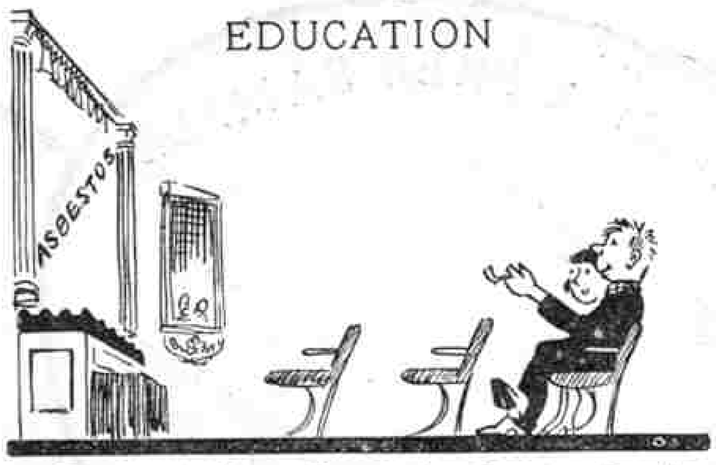
* * * *

Mistress : " What are the principal exports of Iceland ? "

Bright Child : " Please, teacher, depressions ! "

* * * *

EDUCATION



Pat took his wife to the theatre for the first time. They arrived rather early and she was much interested in everything about them.

Nudging Pat in the ribs, she whispered hoarsely, " Pat, what does that word ' asbestos ' mean across that curtain ? "

" Be quiet," said Pat, " and don't show your ignorance. That's Latin for ' Welcome ! ' "

YOU CANNOT ANSWER THIS !

" Dad ! "

" Well, what is it ? "

" It says here, ' A man is known by the company he keeps.' Is that so, father ? "

" Yes, my son."

" Well, father, if a good man keeps company with a bad man, is the good man bad because he keeps company with the bad man, or is the bad man good because he keeps company with the good man ? "

* * * *

Two unemployed men passed a church, outside of which was displayed a notice, " Sale of work."

" Strewth, Bill ; they're selling it now."

* * * *

IT MUST HAVE BEEN A GOOD ONE

The little daughter of a clergyman stubbed her toe and said " Darn ! "

" I'll give you sixpence," said her father, " if you'll never say that word again."

A few days afterward she came to him and said " Papa, I've got a word worth half-a-crown ! "

* * * *

The regular trombone player of a provincial orchestra recently went out on strike, and the conductor was obliged to accept the services of a brass band amateur.

After the first performance the amateur asked the conductor how he had done.

" Fairly well," replied the conductor, " you will do better to-morrow no doubt."

The other, eyeing him gratefully, answered : " You see, sir, the music was rather strange to me to-night, but just you wait until to-morrow night and I back you won't hear the fiddles at all ! "

* * * *

SOME ALARM

Conversation in the railway train turned on the merits of an alarm clock (bought 17 years ago at 3s. 3d., less divi.) which had never failed its owner.

" That's o' reet," said a Lancastrian in the corner, " but tha con stop a 'larum an' get back i' bed again. When aw wor a lad we had a deaf an' dumb knocker-up as had to be punched off doorstep before he knew whether we wor wakken or not. Tuppence a week, wet or fine."

I IS AND I AM

" I is," began Johnny, but he was immediately stopped by the schoolmaster.

" I am, if you please," he corrected. So Johnny made another start.

" I am the ninth letter of the alphabet," he said.

* * * *

New waitress : " Pine chunks and custard did you say, sir ? "

" Yes, thank you."

After about twenty minutes she came back with some custard.

" Where is the pineapple ? " demanded the diner.

" Oh ! " she said, " I've been to the timber-yard and they have no pine-wood in the place."

* * * *

Mr. Newlyrich : " What are you learning at school ? "

Son : " Well, father, I have been learning arithmetic."

Father (impatiently) : " Yes, well ? "

Son : " French, German, Algebra, Euclid."

Father (joyfully) : " Ah ! That's better ! Now, just tell me the Euclid for ' good morning.' ! "

* * * *

One day a gentleman bought his son, aged eight years, a donkey to amuse himself with. He got on all right with it at first, but one day he came in crying ; the donkey had kicked him.

" You have surely been making him angry," said the father, " what have you done ? "

" Nothing," replied sonny, " I was only trying to cut my name on his back."

* * * *

THEN THE AUDIENCE ROARED

In the play at the annual concert of the 13th Mudton-on-Slush Troop, a fugitive from justice was supposed to escape from his pursuers by concealing himself under a table. The table was small, while the fugitive was one of those lengthy Scouts. The commander of the pursuing party rushed on to the stage and fell over the legs of the fellow for whom he was searching.

Picking himself up and rubbing his shins, he exclaimed in true dramatic style : " Ha ! the villain has eluded us again ! "

There's "Force" behind that!

FOOTBALL again! Rugger, Soccer, whichever you play you'll want tons of staying power.

Eat "Force" for breakfast—it's a wonderful strength-giver. Eat it with hot milk or eat it with cold milk, you'll like it either way. "Force" is wheat—King of all Cereals. "Force" is a high-power energy food. You'll like "Force" because it is more than just a "power supply"; it's a jolly nice food.

Before wheat becomes "Force" it has to be cooked with barley malt, then flaked and toasted. If you don't know what "Force" tastes like, send in the free coupon and find out—it's worth it.

FORCE

WHOLE WHEAT FLAKES MALTED AND TOASTED

"The energy maker."

SEND THIS TO BRING A FREE SAMPLE OF "FORCE"

Your Name .....

Your Address.....

Sign your name and address now, tear out and post to "Sunny Jim," 197, Gt. Portland St., London, W.1.

Competition Page

What Advertised Products Are Represented Here?

Each of the silhouetted figures shown above has appeared frequently within recent times in the advertisement pages of newspapers and magazines, and many have been used on the poster hoardings.

Readers are asked to identify as many as possible of the products that are represented and to state the name of the advertiser who markets the article.

Prizes of Meccano products, to be chosen by the winners, to the value of £1/1/–, 15/–, 10/6 and 5/– respectively, will be awarded to the four competitors who submit the most accurate lists of solutions. In addition, there will be a number of consolation prizes. The solution must be submitted in the form of a list, each item being numbered to correspond with the silhouettes. Each competitor should see that his name and address appears on the back of his entry.

Entries must be addressed to "Silhouettes No. 2, Meccano Magazine, Binns Road, Liverpool," and must be sent to reach this office not later than 30th November. Overseas closing date, 29th February, 1928.

A Fireworks Essay

There are three great days every year in every average schoolboy's life—his birthday, Christmas Day and the Fifth of November. Bonfires, squibs, rockets, roman candles, catherine wheels—not to mention the host of newer contrivances—what visions they bring up! Every one is a boy at heart on 5th November.

Next to taking part in a bonfire celebration, there is nothing so entertaining as reading about how others spent the evening, and we want all our readers to write and tell us about their fireworks displays.

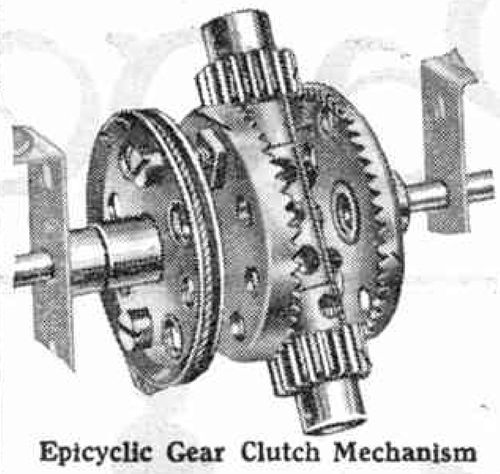
Prizes of Meccano products to the value of £1/1/– and 10/6 respectively will be awarded to the senders of the two best entries in each of the two usual sections, A for those aged 16 and over, B for those under 16.

Entries must be addressed to Fireworks Essay, c/o The Editor, and sent to reach this office not later than 30th November. Overseas closing date, 29th February, 1928.

November Painting Contest

November days are said to be grim grey days and accordingly we have chosen an appropriate subject for our painting contest this month. What could be grimmer or greyer than a British Battleship? Those readers who have not seen a battleship recently can use as a model the photograph of H.M.S. "*Nelson*," that appears in this month's "*M.M.*" The term "battleship" may be interpreted in a wide sense to include all types of warships, other than submarines.

Prizes of painting materials or Meccano products, to be chosen by the winners, to the value of £1/1/– and 10/6 respectively, will be awarded to the senders of the two best efforts in each of the usual two sections, A for those aged 16 and over, B for those under 16. Each competitor must write his name, address and age on the back of his entry, which must be addressed to "November Painting Contest, Meccano Magazine, Binns Road, Liverpool," and sent to reach this office not later than 30th November. Overseas closing date, 29th February, 1928.



Epicyclic Gear Clutch Mechanism

Suggestions Section

Edited by "Spanner"

(103)—Automatic Reversing Hoist

(M. E. G. Gheury de Bray, Eltham Park, S.E.)

WE believe many readers will welcome the device shown in Fig. 103, for it affords a means whereby a lift or similar model may be made to work for an indefinite period without attention. Such a mechanism should prove a boon in connection with demonstration models for Meccano Club exhibitions or shop window displays, etc. An important point in its favour is its simplicity, which ensures maximum reliability with a minimum amount of attention. An extremely interesting model could be made by incorporating this device, or a modification of it, in a Meccano crane, with the result that the load would be raised to a certain height, held stationary for a few seconds, then lowered and again held stationary at its lowest limit of travel for a brief period before being raised once more.

Again, combined with the intermittent rotary drive described in the August, 1927 "*M.M.*," and the automatic rotary mechanism in the June number, it should help to make a very instructive model. Under the influence of the intermittent rotary drive the crane, for example, would swivel through a certain angle in one direction while the load is operated, then pause for a brief interval, reverse, and repeat the cycle of events in the opposite direction.

The model illustrated in Fig. 103 is designed for demonstration purposes only and no attempt at elaboration has been made. It shows the mechanism adapted to a Meccano lift. The drive is taken from the Motor armature via a ½″ Pinion engaging with the 57-teeth Gear Wheel 1, and a ½″ Pinion on the opposite end of the rod carrying the Gear 1 meshes with another 57-teeth Gear Wheel on the 2″ Rod 2.

On the Rod 2 is a Worm 3 meshing with a ½″ Pinion secured to a vertical 3″ Rod 4 that is journalled in bearings consisting of a 2½″ Strip bolted across the base Girders and a 1½″ × ½″ Double Angle Strip secured between the Motor side plates. The Rod 4 carries at its upper extremity a second Worm meshing with a ½″ Pinion on the 3½″ Rod 5.

This Rod 5 is journalled in Flat Trunnions, as shown, and carries at one extremity the device whereby the automatic reversing hoist motion is obtained. It will be seen that this consists essentially of a rotating arm 6, built up from 5½″ Strips secured rigidly to the Rod 5 by means of Bush Wheels, and a system of 1″ loose Pulleys 7 and 7a. The Pulleys 7 are free to run on a 2″ Rod journalled in the arm 6 and the Pulleys 7a are mounted on a 4½″ Rod attached to the Motor. A Washer is placed between each pair of Pulleys to allow freedom of movement.

The spindle of the Pulleys 7 follows the circular path traced out by the end of the arm 6, while the spindle of the Pulleys 7a is fixed. The cord 9, which is attached to the lift, passes over the Pulleys at the top of the lift shaft. It is then led down and over one of the 1″ loose Pulleys 7a round one of the Pulleys 7, back to the remaining Pulley 7a and thence to the second 1″ Pulley 7. After passing round the latter, it is secured to the Flat Bracket 8.

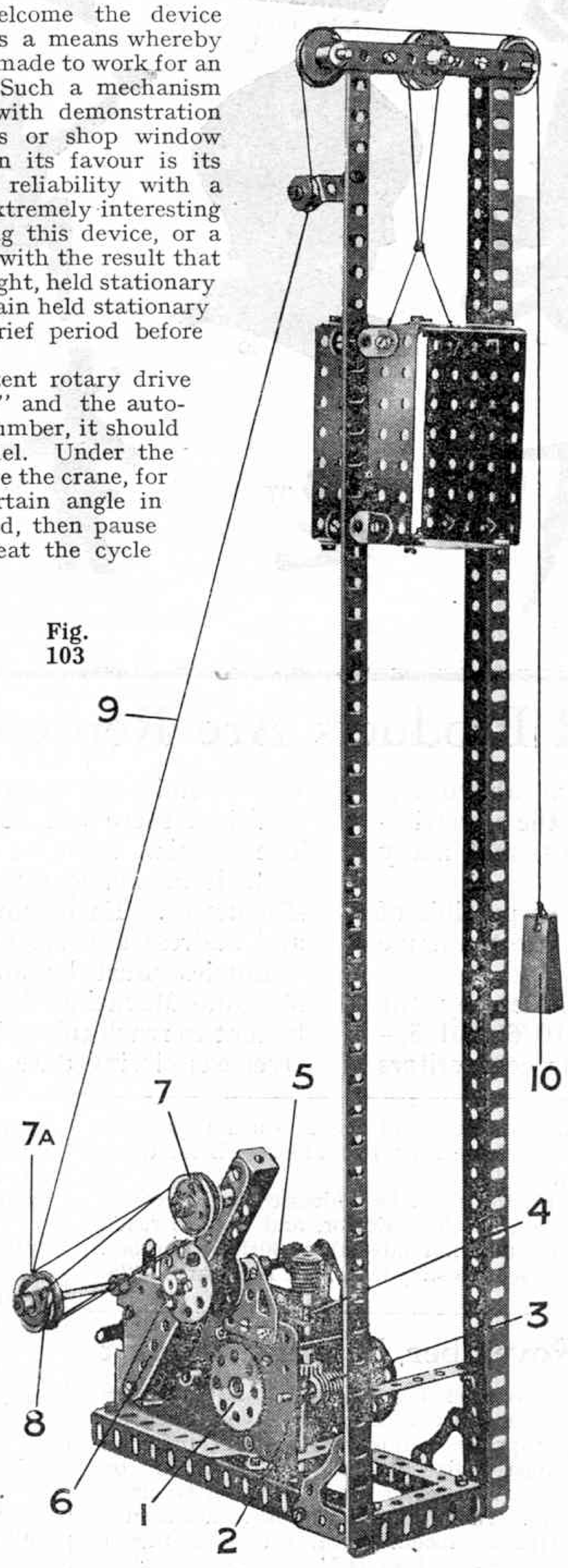


Fig. 103

On referring to the Section on Pulleys in the Standard Mechanisms Manual, readers will find that the system above described is similar in effect to a two-sheave pulley block, in which the free end of the cord, where the power is applied, moves 4 in. for every inch the load is raised. In the model under consideration, the load is attached to the cord at a point corresponding to the free end of the cord in the S.M. example, and the power is applied to the movable pulley block. Consequently the effects of the pulley blocks are reversed, and the lift cage moves through 4 in. for every 1 in. traversed by the Pulleys 7.

When the 1″ loose Pulleys 7 are directly in line with the Pulleys 7a, there is no relative motion between the two sets, and therefore the lift cage remains stationary for quite an appreciable time.

It will be apparent that with this arrangement, the weight of the cage has a considerable effect on the Motor, owing to the multiplying effect of the Pulley system. Consequently, the drive from the Motor must be geared down considerably, which explains the use of the double Worm drive. All set-screws must be secured tightly, and the weight of the lift cage counterbalanced as far as possible. For this purpose a 50 gramme weight 10 should be attached to a cord that is led over the 1″ Pulleys at the lift shaft head and secured to the top of the cage.

The extent of the travel of the cage may be considerably varied by altering the distance between the Rod carrying the 1″ loose Pulleys 7 and the Rod 5, adding to it to increase the travel of the lift cage and vice versa. This method of adjusting the movement of the driven object is equally applicable, of course, when the device is used to operate a crane, transporter bridge, telpher line, or any other suitable model.

The following is the list of parts required to build the automatic mechanism and the demonstration frame as shown in the accompanying illustration :—

2 of No. 2	2 of No. 17	1 of No. 48
2 „ „ 2A	1 „ „ 18A	1 „ „ 48A
5 „ „ 5	2 „ „ 18B	2 „ „ 53
2 „ „ 7	2 „ „ 22	14 „ „ 59
2 „ „ 8B	6 „ „ 22A	1 „ „ 66
1 „ „ 9D	1 „ „ 23	2 „ „ 108
1 „ „ 10	2 „ „ 24	1 „ „ 111c
4 „ „ 11	4 „ „ 26	1 „ „ 125
8 „ „ 12	2 „ „ 27A	2 „ „ 126A
1 „ „ 15A	2 „ „ 32	
2 „ „ 16	51 „ „ 37	Electric Motor
1 „ „ 16A	2 „ „ 37A	

Results of the "Magic Box" Competition

The interest aroused by the "Magic Box" Competition emphasizes the popularity of the "problem" competitions that are announced from time to time in the "Suggestions Section." We shall endeavour to include several new problems of a similar nature in future issues of the "*M.M.*," for their solution affords many hours of real entertainment and we believe they form a valuable means by which our readers' inventive ability may be tested.

The "Magic Box" was illustrated in the June "Suggestions Section," but all that could be seen in that issue of its inner mechanism was the ends of two Rods protruding from different sides of the box. The box itself consists of four $3\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plates forming the sides, with a $2\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plate at the top and bottom. Two cords were shown protruding from the box, cord A from the top plate and cord B from the bottom plate, and in the competition announcement it was explained that if these were held vertically in line, a slight pull applied to both cords simultaneously would hold the box stationary in mid-air. If the strain on the cords was increased, however, the box would climb up the cord A, and if decreased the box would descend. Competitors were asked to explain the mechanism by which these results may be obtained.

The competition was divided into two Sections, Section A for readers residing in the British Isles and Section B for readers residing overseas. The results in Section A appear below, together with a description of the mechanism by which the "Magic Box" is operated. The closing date for the Overseas Section will have elapsed by the time this issue of the "*M.M.*" is published, and the results in that Section will be made known as early as possible.

As is usual in these "problem" competitions, very many interesting entries were received. While the problem of the "Magic Box" did not require quite so much thought as the mysterious reversing gear about which the previous "problem" contest centred, it was by no means so easy to solve as might at first be imagined by one who holds the key to it. All the competitors mentioned below decided that the box was controlled by a mechanism based upon the familiar "wheel and axle" principle, and in this they were quite correct, of course. Nevertheless, although based upon the correct principle, several of the entries were needlessly complicated, and in making the awards preference was given to the simplest solutions.

A prize to the value of 10/6 was originally offered for the best solution, but as it was impossible to select the winner from the following four competitors, each will be entitled to Meccano or Hornby products to that value. These four readers all submitted entries very similar to our own solution, which is illustrated on this page.

Cyril E. Wrayford, Teigngrace, near Newton Abbot; D. W. A. Minette, Leicester; Geoffrey Thomas, Purley, Surrey; and Philip L. Waddington, Wigan.

The following entries closely approached prize-winning standard and the competitors concerned will each receive a Meccano Certificate of Merit and a complimentary copy of the Standard Mechanisms Manual:—

F. V. Fowler, Newport, Mon.; R. S. Wilson, Grimsby; P. Short, Wallington; H. A. Davies, Gwytherin, Abergele; C. J. Lyon, Barry; F. H. Case, Felbridge, East Grinstead; A. D. Smalley, London, W.2.

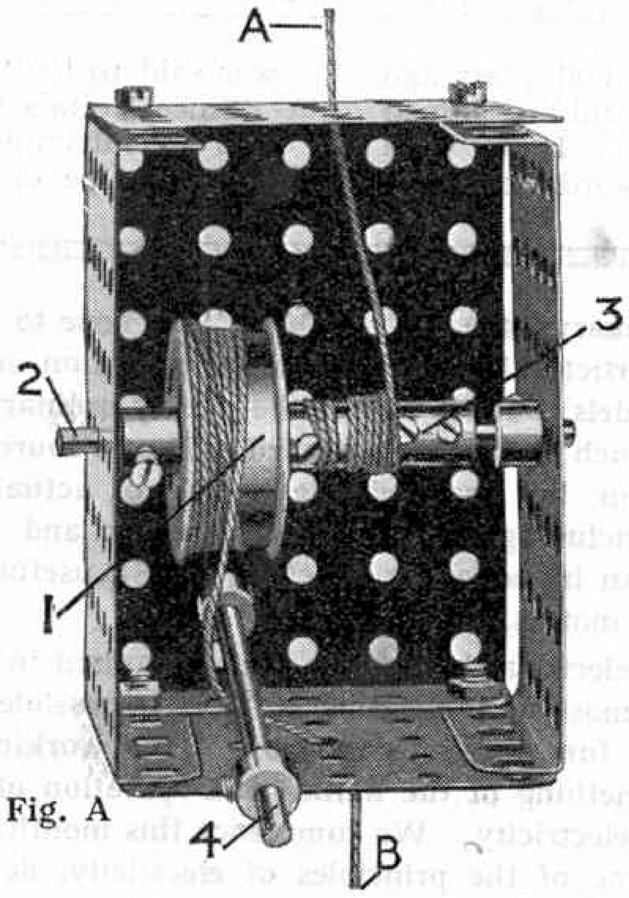


Fig. A

The following readers will also receive Certificates of Merit:—

Cyril Ash, Short Heath, near Wolverhampton; H. F. Barnard, Shepherd's Hill; J. Willis, Kings Heath, Birmingham; G. Roberts, London, W.13; G. Richardson, Weston-super-Mare; R. W. White, Glasgow; R. Russell, Birmingham; G. S. Marsh, Blackpool.

Fig. A shows the interior of the box, one of the side Flanged Plates having been removed. When replaced, this Flanged Plate may be secured in position by a $4\frac{1}{2}''$ Threaded Rod passed through holes in the edges of the top and bottom plates, with a nut screwed tightly against each. Two Flanged Wheels 1 secured on the 3" Rod 2 form a drum on which is wound the cord B, and a Coupling 3 on the same Rod performs a similar function for the cord A. The latter cord is threaded through the centre hole of the top plate of the box, and cord B, after passing round the 3" Rod 4, which forms a guide to keep the cord in line with the drum 1, passes through the central hole in the bottom of the box.

If the cords A and B are held vertically in line, and a slight pull imparted to each, the box will remain stationary in mid-air. As a matter of fact, in order to hold it in such a position unequal pulls must be applied to the cords, although this is scarcely perceptible. If the pull on cord B is increased the Flanged Wheels 1 and Rod 2 will be rotated, thus causing the Coupling 3 to wind in the cord A, and if the upper end of the latter is held immovable the box will rise vertically. Of course, when this happens a greater amount of cord must be paid out by the drum 1 than is wound up by the Coupling 3, the difference being equal to the difference in their diameters. If the pull on cord B is slackened the box will fall and the cord will be wound on to the drum 1, which is set in motion by the Coupling 3 as it pays out the cord A.

(104)—A Walking Kangaroo

(*Y. M. Bhave, Baramati, Poona, India*)

The very ingenious model shown in Fig. 104 is most amusing to watch when in action, and every Meccano enthusiast will find its construction well worth while. If placed upon an incline the "kangaroo," as it is described by our contributor, will commence to "walk" with a quaint action, and will continue to do so as long as it remains on the downward slope. The construction of the body is the all-important consideration, of course, but provided the model is built exactly as shown in the illustration it should perform without any hesitation.

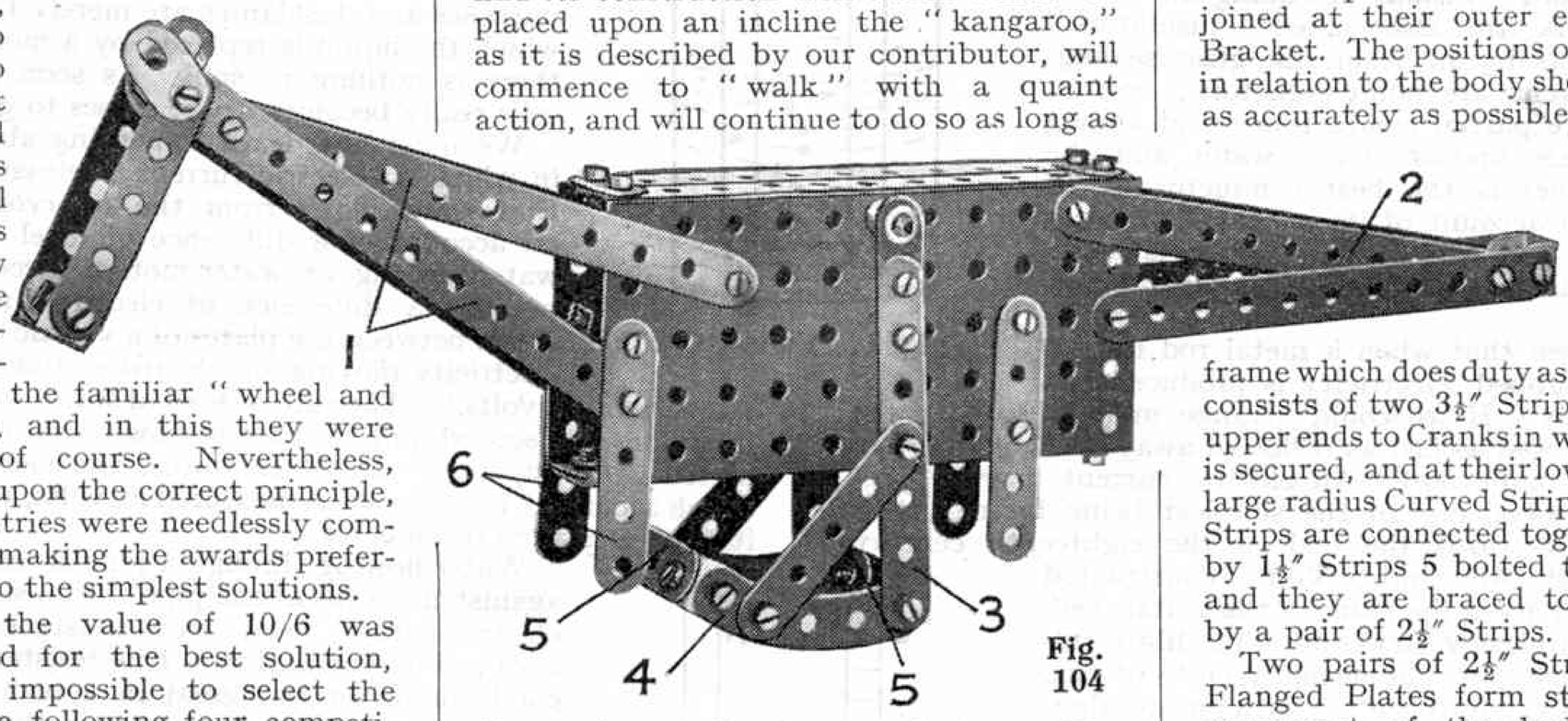


Fig. 104

The body of the "kangaroo" consists of two $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plates connected together by four Flat Brackets, and its neck is constructed from four $5\frac{1}{2}''$ Strips bolted to the Plates as shown. The head is composed of $2\frac{1}{2}''$ Strips spaced at their lower end only by a Double Bracket. Two Flat Brackets represent the ears. The tail is built up from four further $5\frac{1}{2}''$ Strips 2 joined at their outer ends by a Double Bracket. The positions of the various strips in relation to the body should be reproduced as accurately as possible, for the successful working of the model depends upon them.

The body of the animal rocks about a short Rod secured between the rocker-frame which does duty as "legs." This frame consists of two $3\frac{1}{2}''$ Strips 3 bolted at their upper ends to Cranks in which the short Rod is secured, and at their lower ends to two $2\frac{1}{2}''$ large radius Curved Strips 4. These Curved Strips are connected together at their ends by $1\frac{1}{2}''$ Strips 5 bolted to Angle Brackets, and they are braced to the $3\frac{1}{2}''$ Strips 3 by a pair of $2\frac{1}{2}''$ Strips.

Two pairs of $2\frac{1}{2}''$ Strips bolted to the Flanged Plates form stops to limit the movement of the body. When placed upon a slope the "kangaroo" swings forward between the Strips 3 and tilts on its front "legs" 6, thereby allowing the rocker-frame to swing directly under the model again, when the action is repeated.

Parts required:

8 of No. 2	6 of No. 10	2 of No. 52
2 ,, ,, 3	2 ,, ,, 11	2 ,, ,, 62
8 ,, ,, 5	4 ,, ,, 12	2 ,, ,, 90
2 ,, ,, 6a	48 ,, ,, 37	

Electricity Applied to Meccano

I.—The Primary Cell and the Accumulator

In the January issue of the "*M.M.*" we hope to commence a series of articles dealing with the construction of electrical Meccano models. These will not be merely ordinary Meccano models to which electricity is applied only as a source of power to drive them, but they will be models of actual electrical apparatus, including the Morse key, tapper and buzzer for telegraphy, an induction or shocking coil, a useful switch, a coil winder, motors, etc.

Although electrical knowledge is not required in the actual building of most of these models, it is impossible to obtain the greatest fun and interest from their working without knowing something of the nature and operation of the force that we call electricity. We commence this month, therefore, a brief outline of the principles of electricity, dealing with the subject in simple and non-technical language.

THE first electrical discovery was made over 2,000 years ago by the Greeks, who found that amber when rubbed gained the power of attracting light substances. It is from "*electron*," the Greek name for amber, that our word electricity is derived. Other materials such as glass, ebonite or sealing-wax behave similarly to amber. For instance, if we hold a stick of sealing-wax in the hand and rub it briskly with a dry cloth it becomes electrified and will then attract small pieces of paper.

If we try the same experiment with a rod of metal, however, we get no result at all. This is not because the rod does not become electrified, but because the electricity leaks away as fast as it is produced. The explanation is that such substances as glass, sealing-wax and amber are non-conductors of electricity—in other words they do not allow electricity to pass along them. When therefore we produce electricity by rubbing, the electricity must stay there, being unable to travel along and disappear. Metals, on the other hand, allow electricity to pass easily and therefore are known as good conductors. Electricity is produced when a metal rod is rubbed, but instantly it spreads over the whole rod and escapes by way of the hand.

If we wish our metal rod to retain its charge we must cut off this means of escape, and this may be done quite easily by providing the rod with a handle of glass or some other non-conducting material. When a conducting substance is guarded in this manner by a non-conducting substance so that its electricity cannot escape it is said to be "insulated" from the Latin word "*insula*," meaning an island, and non-conductors are also called "insulators."

Substances such as dry air, resin, silk, glass, sealing-wax and gutta-percha are non-conductors; cotton, linen and paper are partial conductors; and among good conductors are metals, acids, water and the human body. Silver is the best conductor of all the metals, but on account of its expense it cannot be used for cables and wires and its place is taken by copper, which is only slightly inferior in its conducting qualities.

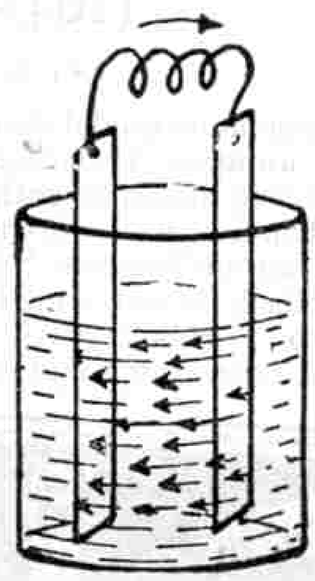


Fig. 1. Voltaic Cell

We have just seen that when a metal rod is held in the hand and rubbed, electricity is produced but escapes immediately. If we could arrange matters so that the electricity was renewed as fast as it flowed away we should obtain a continuous flow or current. An electric current may be produced in various ways, one of the simplest being by means of chemical action. Towards the end of the eighteenth century an Italian scientist, Alessandro Volta, constructed what has since been given the name of the voltaic cell. This consisted of a glass vessel containing dilute sulphuric acid in which were immersed a plate of zinc and a plate of copper, not in contact with one another. If these plates were connected by means of wire outside the cell an electric current immediately began to flow. The direction of the current was from the copper plate to the zinc plate outside the glass vessel and from zinc to copper through the liquid inside it.

This simple cell had the great defect of choking itself, as it were, after being in action for a short time. What actually happened was that bubbles of hydrogen were formed and collected on the copper plate, forming a layer sufficient to hinder and ultimately stop the flow of current. When in this condition the cell was said to be "polarized."

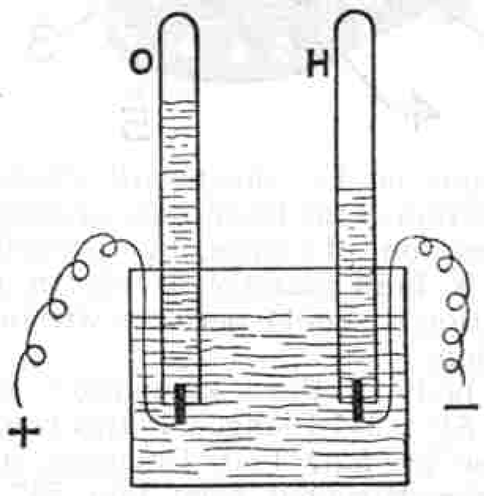


Fig. 2. Electrolysis of Water

Since Volta's time many cells have been devised to overcome this difficulty and thus to produce a constant current over a long period. One of the most successful of these is known as the Daniell cell, which consists of an outer vessel of copper, which takes the place of a copper plate, and an inner porous pot containing a zinc rod. Dilute sulphuric acid is placed in the porous pot and a strong solution of copper sulphate in the outer jar. When this cell is in action hydrogen is liberated by the action of the zinc on the acid, just as in Volta's cell, but in this case the hydrogen passes through the porous pot and splits up the copper sulphate into copper and sulphuric acid. Thus, instead of hydrogen, pure copper is deposited on the inside of the copper vessel and the action of the cell is not interrupted.

An even more familiar source of current is the "Leclanché" cell used for ringing domestic electric bells. This consists of an inner porous pot containing a carbon plate packed round tightly with a mixture of crushed carbon and manganese dioxide, placed in a glass jar containing a zinc rod and a solution of salammoniac. In this case polarization is prevented by the oxygen in the manganese dioxide, which seizes the hydrogen as it collects on the carbon plate and renders it harmless by combining with it. If this cell is used continuously for more than a very minute current, hydrogen is produced faster than the oxygen can deal with it. The cell then becomes polarized, but it soon recovers after a short rest.

The so-called "dry" cells so much used for wireless purposes and flashlamps are merely Leclanché cells in which the liquid is replaced by a moist paste so that there is nothing to spill. As soon as one of these cells really becomes dry it ceases to give any current.

We must now learn something about the manner in which an electric current is measured. We know that water flows from the reservoir to our house on account of a difference of level that produces a water-moving or water-motive force. In a similar manner a difference of electric pressure, such as exists between the plates of a voltaic cell, produces an electricity-moving or electro-motive force, which is measured in "volts." The rate of flow of water in a pipe is stated in gallons per second and the rate of flow of an electric current is stated in "amperes." In other words, the electric pressure at which a current is produced is measured in volts, while the current itself is measured in amperes.

Water flowing through a pipe is resisted by friction against the walls of the pipe. In a similar manner an electric current meets with resistance, although this is of a different nature. This resistance is small in a good conductor but great in a bad one; it is also greater in a thin wire than in a thick one and in a long wire than in a short one. Resistance is measured in "ohms." The resistance of a circuit must be overcome by the electro-motive force before a current can flow, and the definition of a volt is *that electro-motive force which will cause a current of one ampere to flow through a conductor having a resistance of one ohm.*

These three units of measurement are named respectively after the three famous scientists, Alessandro Volta, André Marie Ampère, and Georg Simon Ohm.

A single voltaic cell gives us an electro-motive force of from one to two volts, according to its type. A Daniell cell, for instance, gives about one volt, and a Leclanché or dry cell about one-and-a-half volts. People often speak of a single voltaic cell as a "battery," but this is wrong, for a battery consists of several cells coupled together. Different methods of coupling produce different results.

If we connect together all the positive poles and all the negative poles of several Daniell cells—that is copper to copper and zinc to zinc—we get much more current but no more electro-motive force than from one cell. In other words we get more amperes but no more volts. This method is called connecting in "parallel." On the other hand, if we connect the positive pole of one cell to the negative pole of the next—or copper to zinc throughout—we add together the electro-motive forces of all the cells, but the amount of current is no greater than that of one cell. In this case, therefore, we get more volts but no more amperes. This is known as connecting in "series."

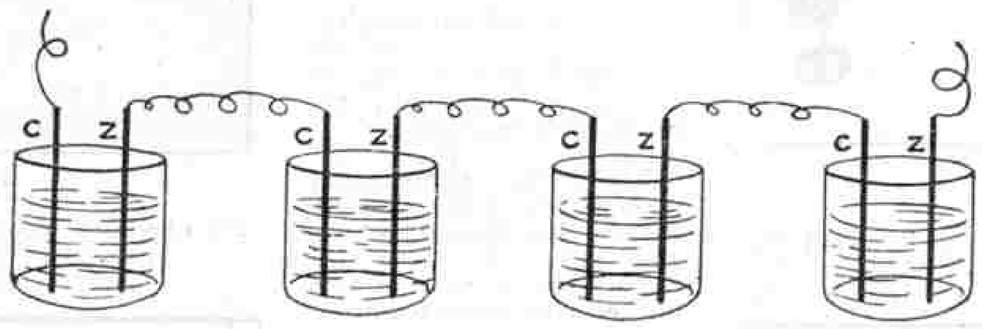


Fig. 3. Connecting in Series

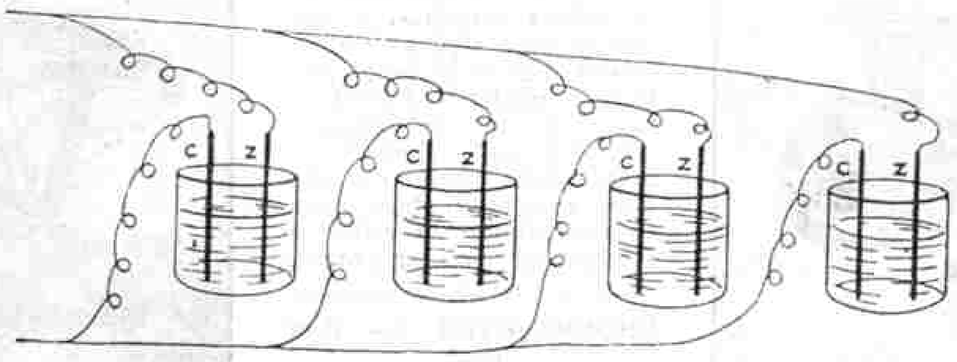


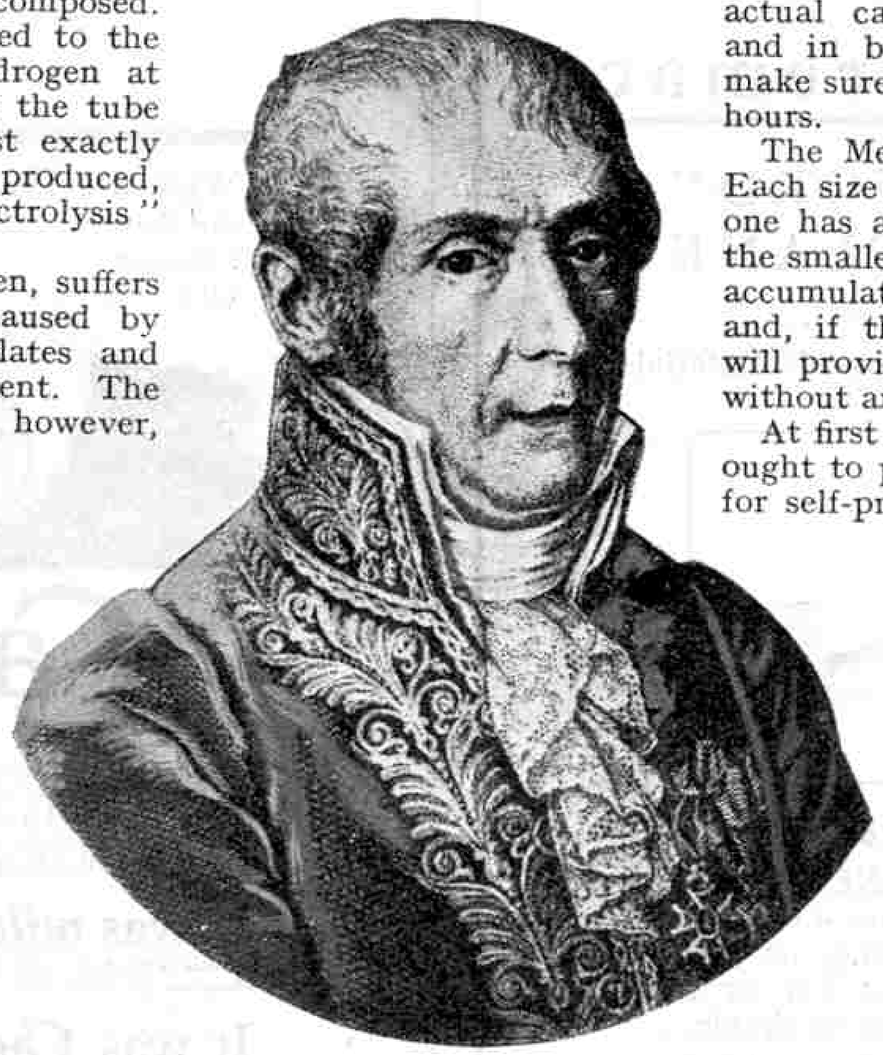
Fig. 4. Connecting in Parallel

It is possible also to increase both volts and amperes by a combination of the two methods of connecting.

The cells we have already described are called "primary" cells, and are quite different from "secondary" cells, or accumulators. Accumulators do not produce a current on their own account, but act as storage tanks from which we may draw a supply of current whenever we want it.

If we pass a current through water to which has been added a little sulphuric acid to increase its conducting power, the water is split up into the two gases of which it is composed—hydrogen and oxygen. An apparatus for demonstrating this consists of a glass vessel having two strips of platinum, called "electrodes," which are connected to a battery of Daniell cells. Two tubes, closed at one end, are filled with the acidulated water and inverted over the platinum strips. When the current flows, the water is decomposed. Oxygen is formed at the strip connected to the positive pole of the battery, and hydrogen at the other strip, and each gas rises into the tube above it, displacing the water. Almost exactly twice as much hydrogen as oxygen is produced, and the process is called the "electrolysis" of water.

A voltaic cell, as we have already seen, suffers from the defect called polarization, caused by hydrogen collecting on one of the plates and thus obstructing the flow of the current. The layer of hydrogen does more than this, however, for it causes further trouble by setting up a "back" or opposing electro-motive force tending to produce a current in the opposite direction. In the electrolysis of water a similar opposing electro-motive force is set up, and when the battery current is stopped and the platinum strips are connected, a current begins to flow in the reverse direction, and continues to flow until the two gases have recombined and the strips are once more in their original state. In this way the apparatus acts as an accumulator, for an electric current is supplied to it and it gives back another current.



Alessandro Volta

It is important to understand that this apparatus—as is the case with allother accumulators—does not actually store up electricity, but energy. We may say that the electrical energy supplied to it is converted into chemical energy, and that this chemical energy is then converted back again into electrical energy. For practical purposes, however, this apparatus is not of much service.

The first really useful accumulator was made in 1878 by Gaston Planté. The electrodes consisted of two strips of sheet lead made into a roll, but not touching each other, and placed in dilute sulphuric acid. A current was passed through, first in one direction and then in the other, and after several reversals of current one lead plate was found to be changed into a spongy condition, and the other was coated with peroxide of lead. This process is called "forming." When the process was complete, the accumulator was ready to be charged and used.

In present-day accumulators the lead rolls are replaced by lead grids coated with a paste of red lead oxide and sulphuric acid. The effect of passing the charging current through a cell with plates of this kind is to take oxygen away from the red lead oxide of one plate, leaving spongy lead, and to add this oxygen to the red lead oxide of the other plate, thus forming the brown peroxide. During discharge, that is while the accumulator is being used to supply a current, this oxygen goes back to its original place and the current continues until the surfaces of both lead plates become chemically negative. The accumulator, of course, may be charged and discharged over and over again.

All modern accumulators, except the very smallest, have several pairs of plates, all the positive plates being connected together, and all the negative plates together. This has the same effect as connecting voltaic cells in "parallel," that is more current is produced.

The electro-motive force of a single accumulator cell is about two volts, and in order to get a higher voltage several cells are connected in "series."

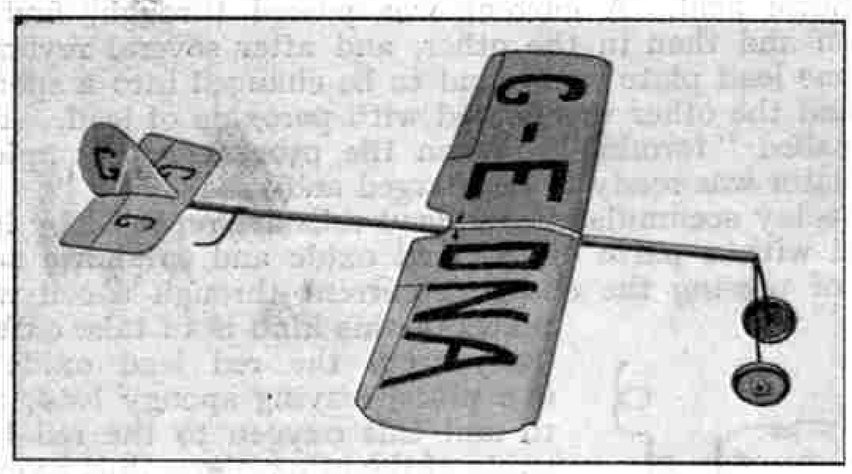
Accumulators are rated as regards their current-giving capacity in "ampere-hours." For example, an accumulator that will give a current of six amperes for one hour, or of three amperes for two hours, is said to have a capacity of six ampere-hours. Sometimes accumulators are rated by their "ignition" capacity, that is their capacity when used to supply current for ignition purposes in petrol motors. The ignition capacity of an accumulator is about twice as great as its actual capacity for supplying a steady current, and in buying an accumulator it is necessary to make sure that the capacity stated is actual ampere-hours.

The Meccano accumulator is made in two sizes. Each size gives a current of four volts, but the larger one has a capacity of 20 actual ampere hours and the smaller one of eight actual ampere hours. These accumulators are well designed and strongly made and, if the simple instructions are followed, they will provide a thoroughly reliable source of current without any trouble.

At first sight it appears as though the accumulator ought to provide an ideal means of supplying power for self-propelled vehicles of all kinds. In practice, however, there are great drawbacks. The weight of a battery of accumulators large enough to run a car with a heavy load is tremendous, and this is, of course, so much dead weight. Further, the sudden and heavy demand for current when such a vehicle is started on a steep up-gradient not only necessitates frequent recharging but is ruinous to the accumulator.

More success has been achieved with accumulator-driven locomotives. They are not in general use, but have proved satisfactory in special cases. Locomotives of this kind are largely used, for instance, in mines and factories where pollution of the atmosphere by smoke must be avoided.

More recently an electric locomotive has been built in America that derives its power from a storage battery of 120 cells weighing more than 39 tons. The locomotive is capable of hauling a train weighing 3,000 tons. The provision for recharging in this case is of interest, a gas engine on the locomotive itself being connected to a generator. By the use of this method the locomotive may be kept continually running for 24 hours.



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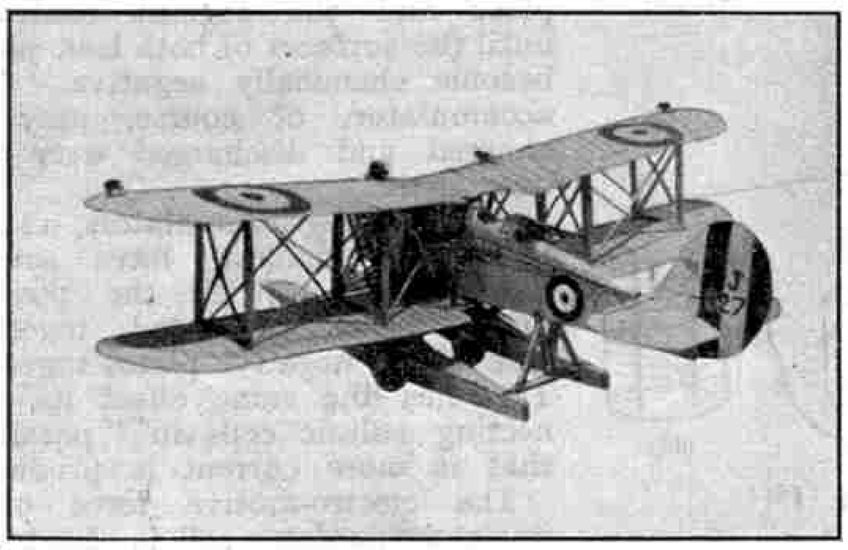

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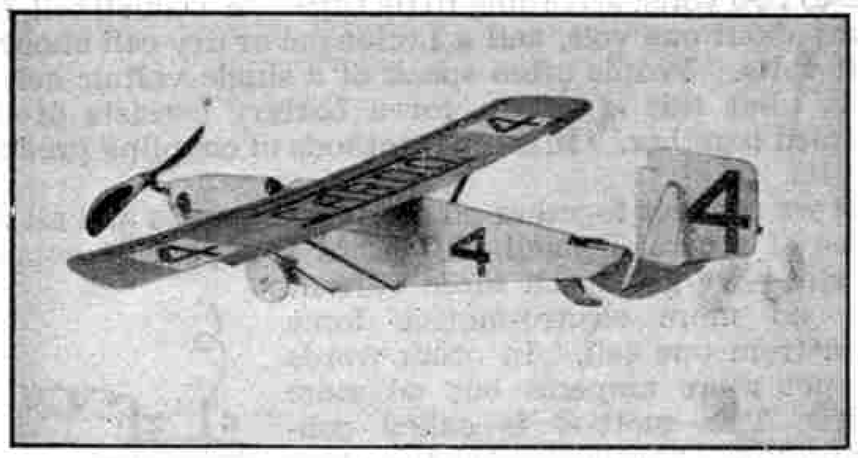

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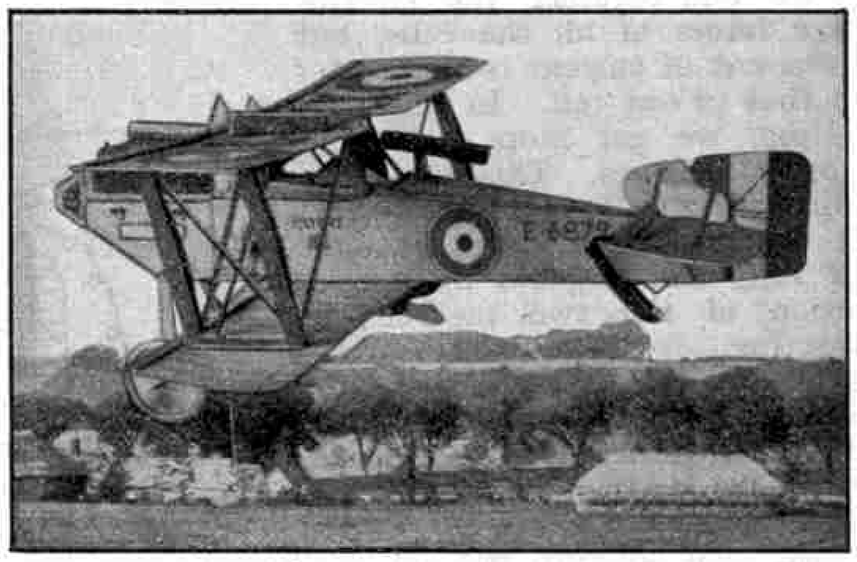

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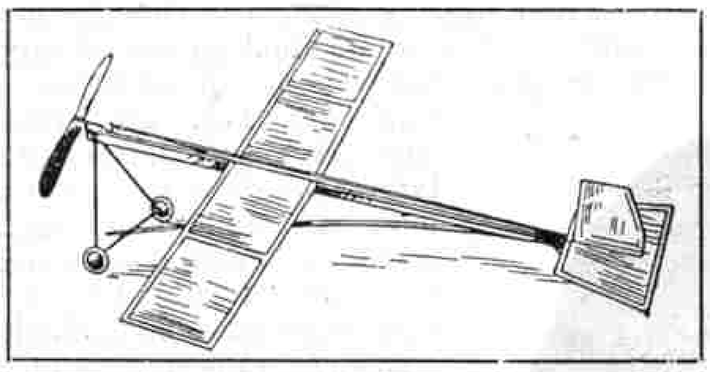

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The No. 0 "PUSHER" MONOPLANE selling at 5/6, can be adjusted for all manner of flights, i.e., Elevator can be flattened out for long distance flying, or adjusted for sharp rising, or again for turning left or right. This Machine is practically unbreakable.

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When watching Football or Cricket
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When on the River
When Shopping
When at Theatres, Cinemas or Concerts
When Sight-seeing, Visiting Galleries or Museums
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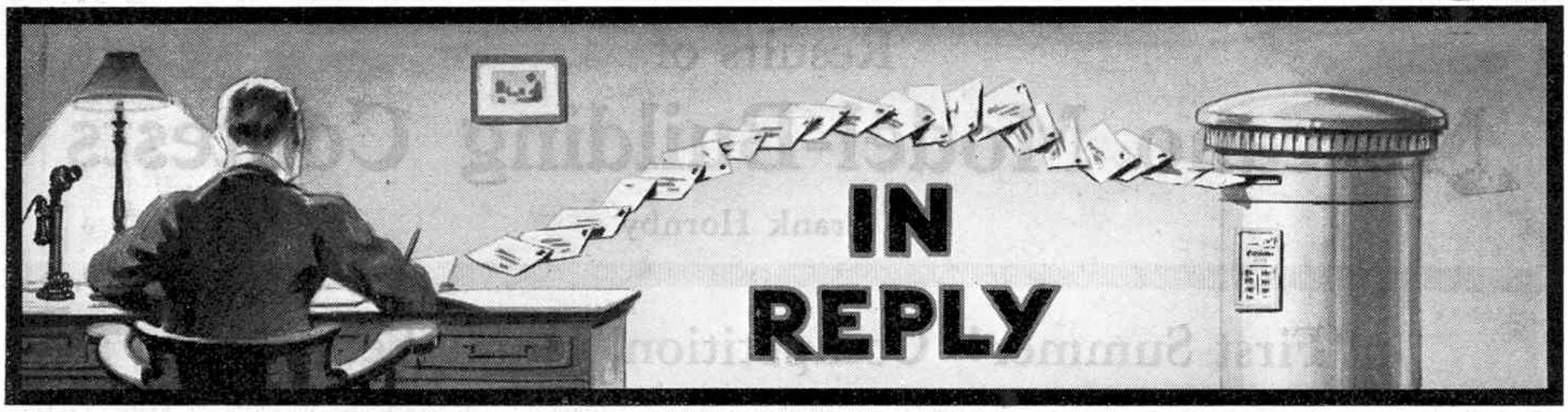


In these columns we reply to suggestions regarding improvements or additions to the Meccano and Hornby Train systems. We receive many hundreds of such suggestions every week, and consequently we are able to publish only ideas that show particular interest or ingenuity. Suggestions submitted for consideration 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. Envelopes should be addressed to "Suggestions," Meccano Ltd., Binns Road, Liverpool.

Suggested New Meccano Parts

T-PIECE.—Your proposed T-piece, resembling two Couplings joined together at right angles, would prove an expensive and difficult part to manufacture. Moreover, we cannot think of any uses for the part that are not covered already by the existing Coupling. Perhaps you will let us have further information on this point. (*Reply to H. Collinge, Birmingham*).

NEW FLANGED PLATE.—We have already taken steps with a view to introducing plates provided with flanges on all sides. We believe these will form valuable additions to many models. (*Reply to G. Birdhill, and others*).

DOUBLE-THROW CRANKSHAFT.—We fear that your suggested double-throw crankshaft would not prove sufficiently adaptable to warrant its addition to the Meccano system. A part of this kind may easily be contrived from existing pieces, such as Couplings or Cranks. See Standard Mechanism No. 274. (*Reply to R. Mayes, Ringwood*).

CONE CLUTCH.—We are interested in your suggestion regarding a cone clutch, but we fear that for the present we cannot consider the manufacture of such a part as there appears to be little demand for it. The whole question of devising an efficient Meccano clutch receives our constant attention, however. Of course, by using a rubber ring, etc., it is an easy matter to construct a very efficient working clutch with the aid of the existing parts, and we hope to describe a clutch of this type in connection with the New Meccano Motor Chassis, instructions for which will be available shortly. (*Reply to J. Wray, Auckland, N.Z.*)

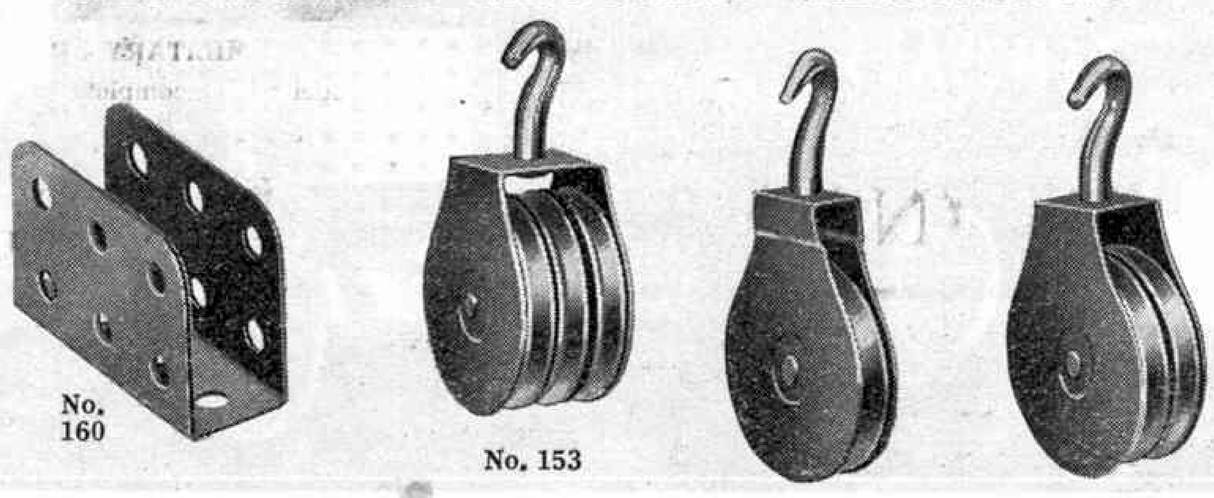
SHORTER WORM. — We cannot think of any advantages of your proposed small worm gear over the existing part No. 32. If you will let us have some definite instances of the use of your suggested accessory, however, we will go further into the matter. (*Reply to K. Chirgwin, London, S.W.*16).

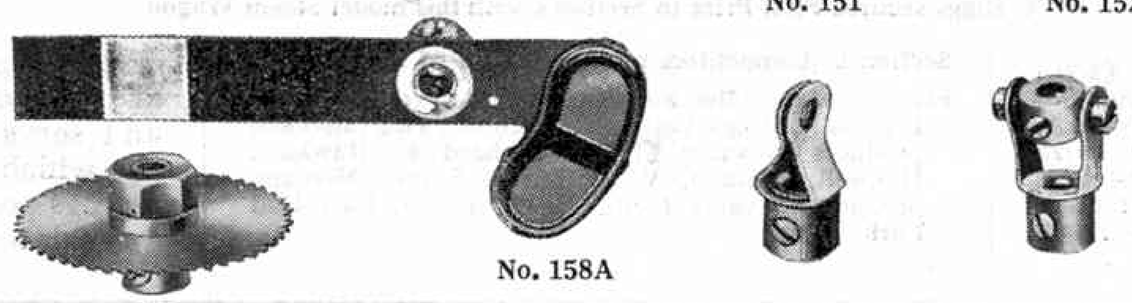
3½″×2½″ FLAT PLATE.—We note your suggestion regarding a new style flat plate, but we do not think there would be much demand for such a part, for it would be very similar to the existing 4½″×2½″ Flat Plate (Part No. 53a). We will bear your idea in mind, however. (*Reply to P. Slade, London, S.E.*5).

MECCANO BELL.—We doubt whether the type of bell you propose would be of much use, on account of its small size. Moreover, an accessory of this kind could be employed in very few models. (*Reply to E. Parker, London, N.W.*8).

NEW EYE PIECE.—Your proposed double-length Eye Piece is scarcely necessary, for the ordinary Eye Piece, if rigidly bolted, should be suitable for all purposes. If you desire exceptional rigidity, you might use two Eye Pieces secured side by side or bolted a short distance from each other. One of the disadvantages of your proposed eye piece would be its size, which, in many cases, would prohibit its use in a confined space. (*Reply to P. Gough, Birmingham, and S. T. Temple, Streatham Hill, S.W.*)

IMPORTANT MECCANO ADDITIONS





We illustrate a number of useful Meccano parts that have just been introduced. The names and particulars of these parts are as follows:—

Pulley Blocks: No. 151, single sheave, price 6d.; No. 152, two sheaves, price 9d.; No. 153, three sheaves, price 1/–. These new accessories are more compact than built-up pulley blocks and they may be used with advantage in model cranes, derricks, boat davits, etc. Finish: blocks green, sheaves nickel, hooks brass.

No. 158a, Signal Arm, "Home," and No. 158b, Signal Arm, "Distant," price 3d. each. The Signal Arms are similar to those used in the Hornby Train system, but each is fitted with a collar and grub screw so that it may be used in Meccano signal gantries, etc. Models so equipped may be used in conjunction with all kinds of model railways.

No. 159, Circular Saw, price 1/–. This consists of specially fine steel and the teeth are tempered and ground. When driven at a high speed it will cut thin pieces of wood, etc., and may be used in all types of Meccano sawing machinery.

No. 160, Channel Bearing, Price 2d. This part is designed primarily to form rigid bearings for Axle Rods, etc., where space is restricted. It may be bolted to the side of a Meccano Motor, for example, and used to form bearings for part of the reduction gearing. Finish: enamelled red.

No. 165, Swivel Bearing, Price 6d. This is intended for coupling two rods together end to end, so that one may move radially about the end of the other.

No. 166, End Bearing, Price 3d. This part may be used as an end bearing for a connecting rod, or as a method of pivotally coupling a Rod and a Strip end to end.

NEW UNIVERSAL JOINT.—We were very interested in your proposed new flexible joint, resembling a spring with a collar attached at each end but we think the existing Universal Coupling answers the purpose better, for it is more positive in action and greater torque may be transmitted by means of it. In addition, it may be employed for many other purposes beyond that for which it is primarily designed. (*Reply to J. Burton, Ludlow*).

COMPRESSION SPRINGS.—As previously announced, the small compression springs contained in the Spring Buffers may now be purchased separately, under part No. 120b, price 3d. each. (*Reply to E. A. Rawlings, Westmount, Quebec, B. Collins, Frinton-on-Sea, and others*).

LARGER DOUBLE BENT STRIPS.—We doubt whether it would be worth while to introduce Double Bent Strips in 2½″, 3½″, and 5½″ lengths, for such parts may be substituted very easily by existing accessories. Angle Brackets bolted to Double Angle Strips of suitable lengths will form excellent substitutes, for example, or, alternatively, Reversed Angle Brackets secured to the ends of ordinary strips. (*Reply to E. Parker, London, N.W.*8).

IMPROVED WHEEL BOSSES.—As previously indicated, we are taking steps to provide the bosses of the various gears, etc., with a threaded bore drilled right through two sides. As you point out, this will increase the available grip on the rods, and the extra rigidity so obtained will be a great advantage in many cases. *Reply to M. Melville, Coventry*).

OIL CANS.—We were very interested in your suggestion regarding the introduction of miniature oil cans for lubricating Meccano models. It is certainly quite a good idea, and if it proves sufficiently popular, we will give it further consideration, although we expect most Meccano boys already possess a suitable oil can. (*Reply to G. Webb, Leatherhead*).

NEW SLOTTED STRIP.—We assume that you refer to a new style of slotted strip; if so, we think the present Slotted Strip would serve your purpose as well. If you will send us some examples of the uses to which your proposed part could be put, we would be able better to consider your suggestion. (*Reply to J. Quick, Letchworth*).

MECCANO STEAM ENGINES.—We are interested in your suggestion re the propulsion of Meccano models by steam, but we do not consider this method nearly so good as electricity. A small steam engine would not be so powerful or reliable as the Meccano Electric Motor, and the cost of manufacture would be very great. (*Reply to V. Dunn, Reigate; R. Sewell, St. Ives; and J. Good, Troon*).

NEW PULLEYS AND CAR LAMPS.—We find there is very little demand for loose pulleys of a larger diameter than the existing ones. The manufacture of special electric lamps for cars is a matter we are not prepared to undertake at present. For the purpose you have in mind, could not you use the existing Meccano bulbs and lamp holders? (*Reply to W. Ballard, Rugby*).

FLAT SECTOR PLATES.—We are interested in your suggestion regarding flangeless Sector Plates. This will receive consideration later. (*Reply to W. L. Holcroft, East London, South Africa*).

NEW CIRCULAR PLATE.—We do not think that much advantage would accrue from the manufacture of a Circular Plate with a centre boss. The existing part No. 146 can easily be used in place of the proposed accessory by bolting a Bush Wheel or similar part to its centre. (*Reply to W. Bollan, Rugby*).

Results of
Meccano Model-Building Contests

By Frank Hornby

"First Summer" Competition, Home Sections

IT will be remembered that in the "First Summer" Model-building Competition we reverted to the type of contest in which any kind of model or any number of parts may be used, and the tremendous response to the competition indicates that this is the most popular type of all. The reason for its popularity probably lies in the fact that it allows the competitor a perfectly free rein to develop his own ideas and methods of construction. Many fine models were received and it was only after a process of rigorous elimination that the judges were able finally to decide on the prize-winners.

The names of the successful competitors in the "home" Sections are given below. The results in the Overseas Section, which closes for entries on 30th November next, will be published as early as possible after that date.

Section A (Competitors over 14 years of age).

FIRST PRIZE (Meccano products to value of £2-2s.) Reginald J. Webb, Wallasey, Cheshire. SECOND PRIZE (Meccano products to value £1-1s.) Hywel A. Davies, Gwytherin, Llanrwst. ADDITIONAL PRIZE (Meccano products to value £1-1s.) J. K. Wheatley, Claygate, Surrey. (Special consideration). THIRD PRIZE (Meccano products to value 10/6), Henry C. Thompson, Scotstoun, Glasgow.

SIX PRIZES, each of Meccano products to value 5/-. Philip Lyth, Newcastle, Staffs.; P. B. Lucas, Highgate, London, N.6; J. M. Baldry, St. Leonards-on-Sea; Norman C. Dunn, Kingston-on-Thames, Surrey; L. W. Gray, East Ham, London, E.6.

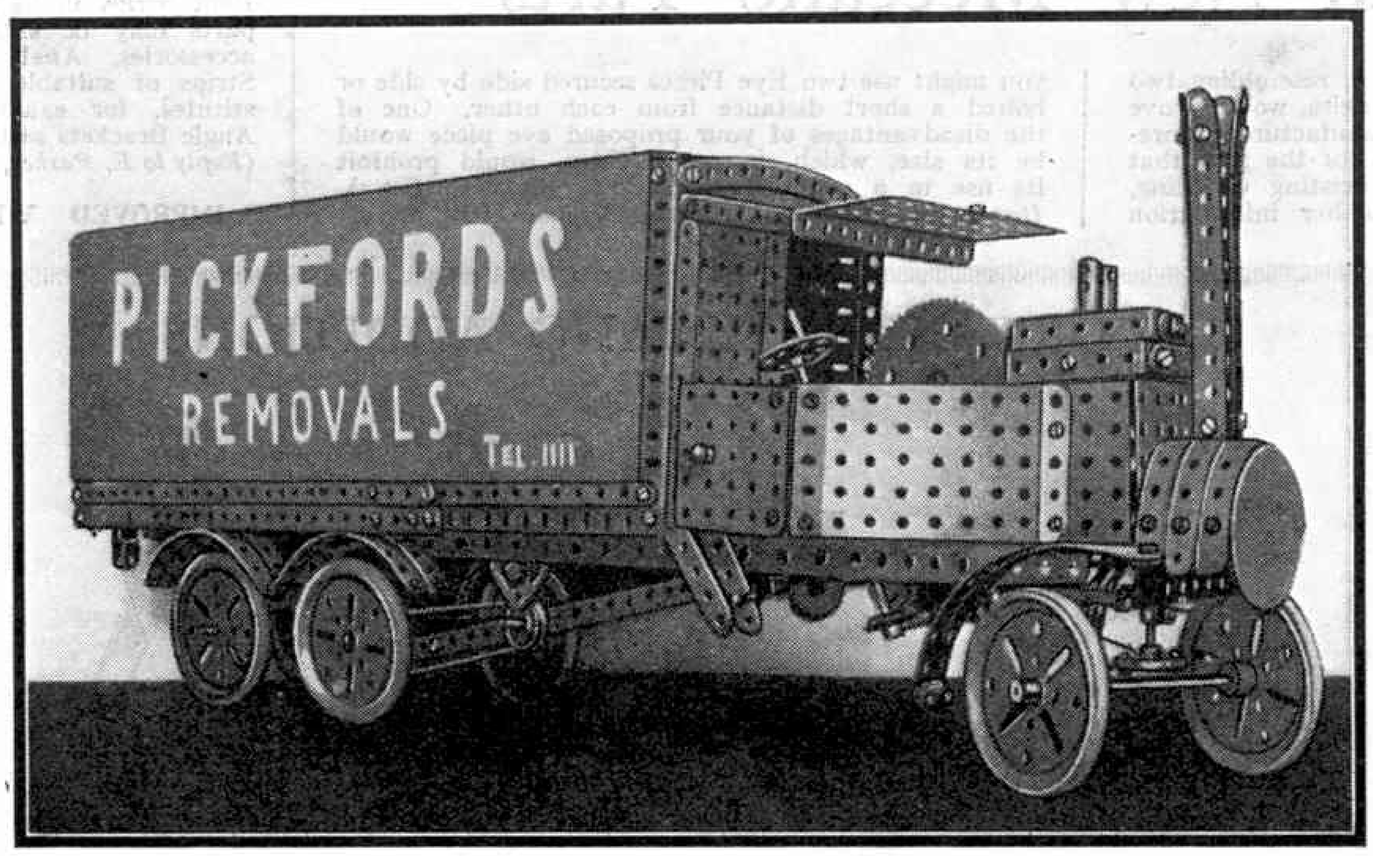
SPECIALLY COMMENDED (Certificates of Merit): J. R. Plenderleith, East Sheen, London, S.W.4; W. R. H. Temple, Shanklin, Isle of Wight; Raymond Mitchell, Keighley; V. S. Smith, Dublin; Graene Bryson, Sefton Park, Liverpool; Donald Jackson, Alexandria, Dunbartonshire; Edward W. Baker, Frinton-on-Sea, Essex; W. E. Weatherley, Hexham; William Luter, South Tottenham, N.15.

Section B (Competitors over 12 and under 14).

FIRST PRIZE (Meccano products to value £2-2s.) Michael Mackirdy, Malmesbury, Wilts. SECOND PRIZE (Meccano products to value £1-1s.) E. L. Hutchings, Southend-on-Sea, Essex. THIRD PRIZE (Meccano products to value of 10/6). A. Philp, Peverell, Plymouth.

SIX PRIZES, each consisting of Meccano products to value of 5/-. John Hady, Ilford, Essex; H. C. Stevens, Halliwell, Bolton; Ben Selby, St. Agnes, Bristol; W. J. Cozens, Edinburgh; Ralph Ganderson, London, N.W.3; G. N. Keightley, Ipswich.

SPECIALLY COMMENDED (Certificates of Merit): Bertram Francis, Heathfield, Sussex; J. Freeman, Radford, Coventry; Leslie D. Smart, Kingston-on-Thames, Surrey; C. Walker, Nottingham; Jack H. Owen, Radford, Coventry; Gordon Tucker, North Heaton, Newcastle-on-Tyne; J. Burdon, Whitby; Lawrence Thomas, Holywell; Alex Smith, Haddington; L. G. Morgan, Purley; Basil Fearnley, E. Molesey, Surrey.



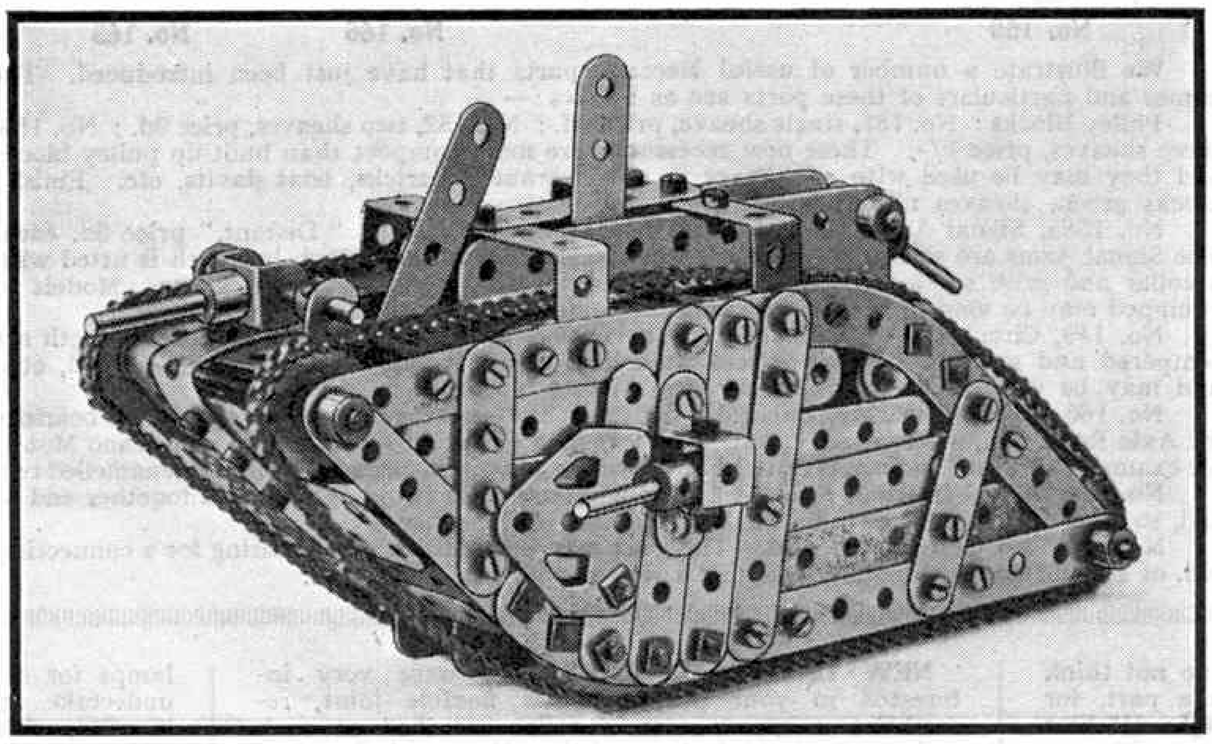
F. R. Higgs secured First Prize in Section C with this model Steam Wagon

Section C (Competitors under 12 years of age).

FIRST PRIZE (Meccano products to value £2-2s.) Francis R. Higgs, Leicester. SECOND PRIZE (Meccano products to value £1-1s.) Richard R. Rawkins, Hanwell, London, W.7. THIRD PRIZE (Meccano products to value 10/6). R. Berriman, East End Park, Leeds.

SIX PRIZES, each consisting of Meccano products to value of 5/-. G. Crowther, Golcar, Huddersfield, Yorks.; Alan B. Horn, London, N.10; Vincent Base, Egremont; Kenneth White, Purley, Surrey; L. A. Frayn, Devonport, Plymouth; Jack Peach, Glasgow, N.W.

SPECIALLY COMMENDED (Certificates of Merit): G. Summerfield, Woodbury, Nr. Exeter; Lawrence Barr, Folkestone, Kent; A. Sheldrick, Tottenham, N.17; J. Cecil Hudson, Leighton, Nr. Neston, Ches.; Stan Seymour, N. Heaton, Newcastle-on-Tyne; Roy Livsey, Erith, Kent; William Drake, Southsea, Hants.; Harold Shaw, Dyserth, Flintshire; Andrew Fell, Ulverston, Lancs.; Frank Croft, Rossall Beach, Nr. Fleetwood.



A Meccano Army Tank, by E. L. Hutchings (Second Prize, Section B)

A Locomotive-Crane

The First Prize in Section A goes to R. J. Webb, who sent in an excellent model of a combined locomotive and crane. A mobile crane of this type is used sometimes in place of the more familiar kind of railway breakdown crane, which is quite separate from the locomotive. It is employed also to a large extent in factories and engineering works of all descriptions.

The Meccano model is well-proportioned and comprises a six-coupled saddle-tank locomotive having its main frames extended rearward over a four-wheeled bogie to support the weight of the crane. The saddle-tank of the engine is built up from 12½" Strips at the sides and Flat Plates at the top, and serves to conceal the Electric Motor by which the model is propelled. The fittings of the engine cab comprise a "regulator," by means of which the Motor is controlled, a vacuum brake injector handle, fire-hole door, and reversing wheel.

The crane is mounted on roller bearings of similar design to those described under Suggestion No. 84 in the May 1927 "*M.M.*," and its several movements (i.e., hoisting, luffing, and swivelling) are operated by a second Electric Motor carried in the swivelling structure. All the crane operations are brought in or out of gear by means of two levers and a hand wheel situated on the foot plate at the rear of the crane. When not in use the jib is lowered on to a cradle mounted on the top of the engine tank.

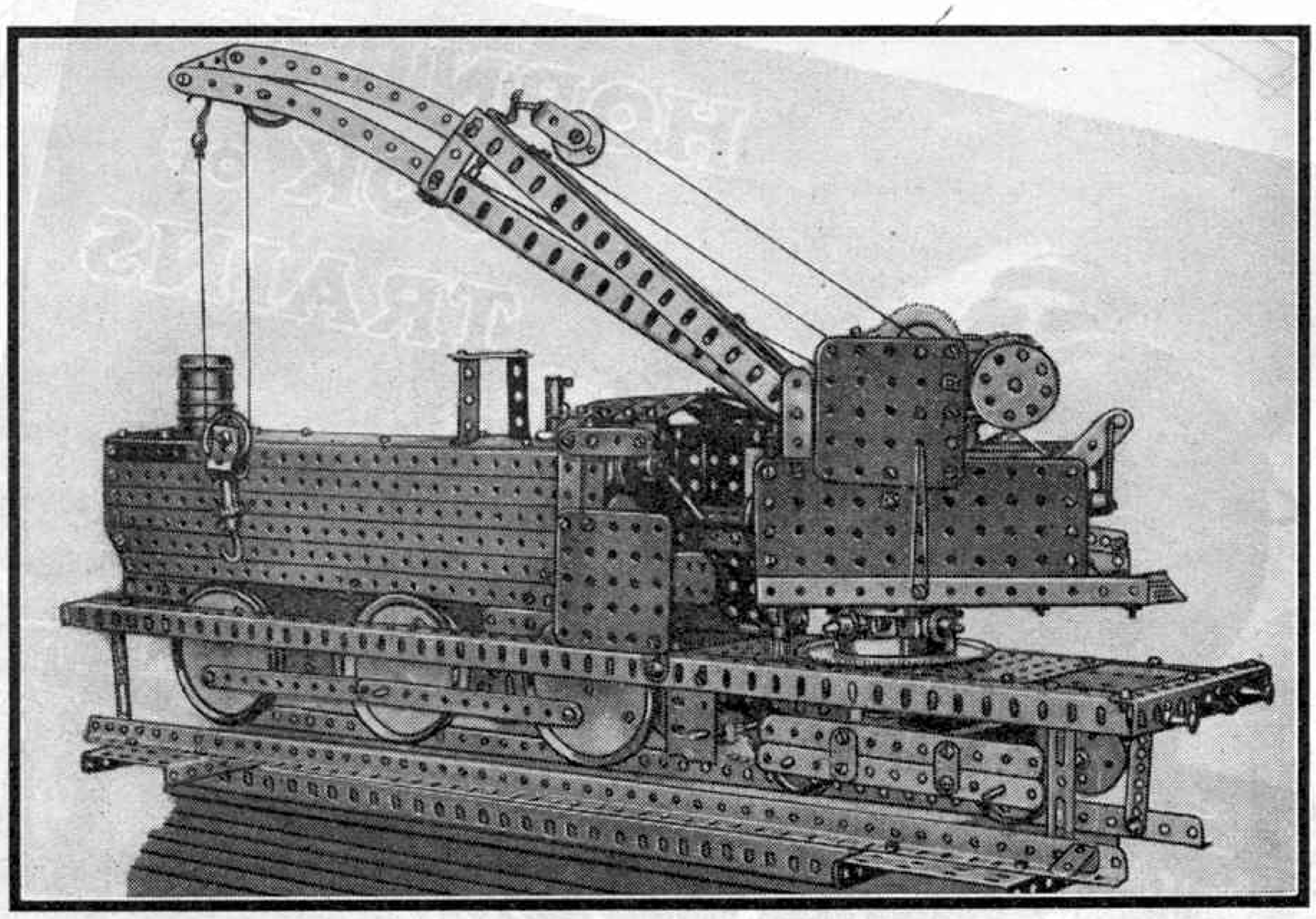
H. Davies obtained Second Prize with a very ingenious model of a double-acting reciprocating electro-magnetic engine. This consists, briefly, of a lever constructed in the form of an inverted "T" and pivoted at the point of intersection of the two limbs of the "T." Each end of the horizontal limb is fitted with an

electro-magnet, and beneath these further magnets are secured to the fixed base of the machine. By means of an ingenious make-and-brake contact mechanism actuated by the rotation of the crankshaft, the polarity of the magnets is affected in such a manner that each pair of magnets alternately repel and attract one another, thus imparting a see-saw motion to the "T" lever. This movement is caused to rotate the crankshaft by means of a horizontal connecting rod pivotally attached to the top of the vertical limb of the "T" lever. When in motion the model presents a most attractive spectacle.

A fine model of a Priestman Universal Excavator obtained Third Prize for H. Thompson. As in the prototype, the model may be adapted for use either as a dragline or as a bucket excavator, but its greatest interest lies in the fact that it is mounted on "pedrails" or caterpillars, which enable it to travel over the roughest surfaces without difficulty. The model is driven by a Clockwork Motor that supplies the necessary power for all the several motions. The caterpillars are attached to a travelling base, to the centre of which is pivoted the superstructure carrying the boom and the operating mechanism. The swivelling gear and the roller bearings on which the superstructure rests are designed according to Standard Mechanism No. 106. The frames in which the caterpillars work are connected to the main frame by means of flexible joints, which allow for movement in every direction when negotiating obstacles.

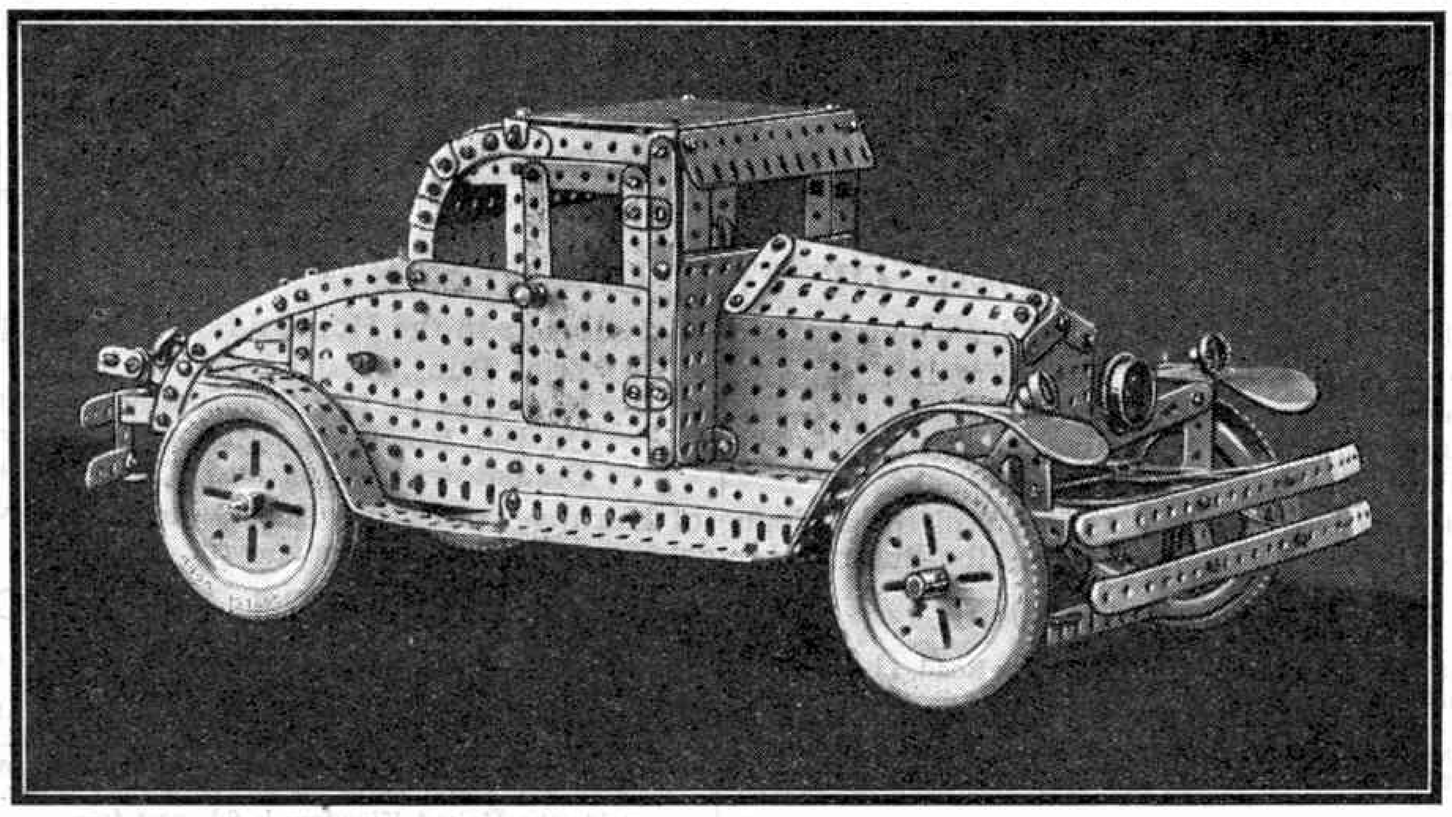
In addition to the "pedrails," the model is supported on a pair of trailing wheels secured to a fixed axle that is capable of moving about a central pivot. The movement of the fixed axle is controlled by a hand wheel mounted in the superstructure, but it may be turned only when the superstructure is locked in a fore and aft direction. Henry Thompson has figured prominently in prize-winning lists in several previous competitions, and this model is undoubtedly one of the best that he has yet submitted.

Titan block-setting cranes form a favourite subject for Meccano models, and we receive from time to time some very fine examples of this branch of engineering The model submitted by J. K. Wheatley is one of the best of these cranes that I have seen recently, and it was decided to award him a special prize consisting of Meccano products to the value of one guinea. All the movements in the model, i.e., hoisting, traversing movement of the crane trolley, swivelling, and travelling, are driven from a single Clockwork Motor, the drive being transmitted through a well-designed gear box. The Motor operates the different drives in a very satisfactory manner. J. K. Wheatley is building up an enviable reputation for himself in the Meccano world, for I remember examining several models with which he obtained prizes in previous contests.



A fine Locomotive Crane, by R. J. Webb (First Prize, Section A)

J. Baldry's prize-winning model is reproduced on this page and, as will be seen, it represents a saloon coupé motor car. The exterior work is very well done and is finished off by such details as lamps, spring bumpers, luggage grid, and hinged door. The mechanism leaves room for certain improvements, however, such as Ackermann steering gear in place of the present cord-operated mechanism. Also, providing sufficient parts are available, the transmission gear might be improved and made more realistic.



Saloon Coupé, by J. M. Baldry (awarded prize in Section A)

An extremely well-proportioned model of a cable ship gained a prize for Mr. L. W. Grey. The vessel is complete with cable and cable rollers, anchors, handrails, derricks rigged to the foremast, winches, mast head light, port and starboard lights, bridge with ladders to deck, six life boats on davits, skylights, and a single raked funnel with steam pipe and whistle, etc. I can safely say that this is one of the best model ships I have seen for a long time.

Another very pleasing model that I noticed in Section A represents a 4-4-0 Southern Railway locomotive, by N. S. Dunn. It is equipped with an enlarged cab, of the type that has been adopted recently by the S.R. on certain of its engines, and a six-wheeled tender of the Ashford type. The general lines of the model are very clean and "business-like."

Entries in Section B

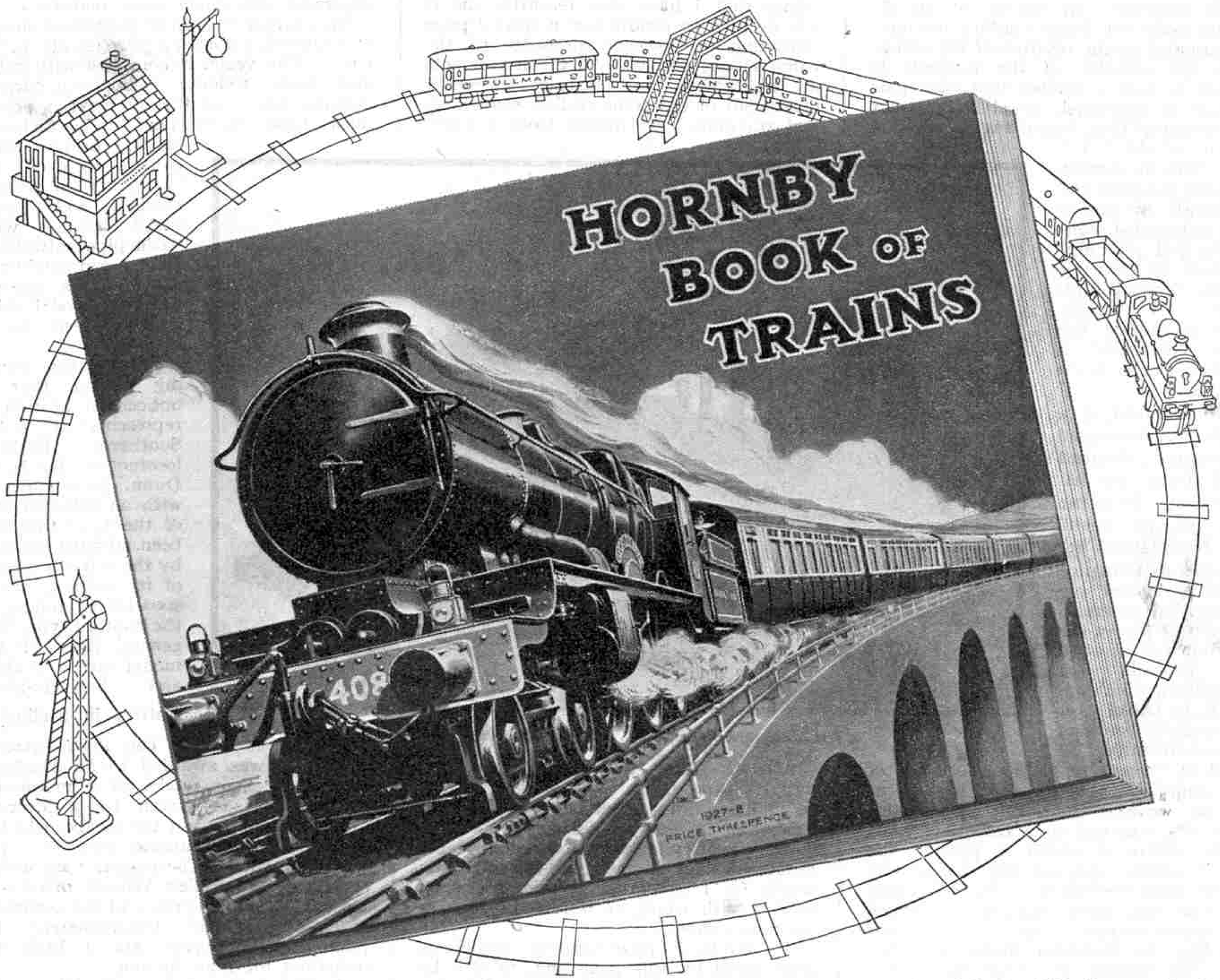
The First Prize in Section B was awarded to M. Mackirdy for an excellent model of a motor fire escape. This is driven by a Meccano Clockwork Motor and the escape, which is mounted on a turntable, measures 2¼ ft. when extended. The chassis road wheels consist of 3" Pulley Wheels fitted with Meccano Dunlop Tyres, and the bodywork is most realistic. Unfortunately, the photographs received are a little too indistinct for reproduction.

A. Philp's prize-winning model is in the form of a windmill pump. Although the actual pump is not made from Meccano parts, it works exceptionally well and adds considerably to the interest of the model. Apart from the pump, excellent use is made of the Meccano parts in the design of the windmill, and the various working parts are driven by a Meccano 4-volt Electric Motor.

E. L. Hutchins carried off the Third Prize with the very neat little model of an army "tank" shown in the accompanying illustration. The "caterpillars" of the tank are represented by lengths of Sprocket Chains passing over sets of 1" Sprocket Wheels. The latter are actuated by a Clockwork Motor, as will be seen, and when in motion the tank is carried along on the Sprocket Chains in a very realistic manner.

(*Continued on page* 1024, *second column*)

GET THE 1927 HORNBY BOOK OF TRAINS



THE 1927-8 Hornby Book of Trains is better even than last year's edition. It deals with the Life Story of a Locomotive. The preparation of the plans in the drawing office, the various stages in the erection of the engine, its trials, its career on the road, and its final withdrawal in favour of a later type—all this is described in detail and illustrated by a series of splendid photographic reproductions. The book will prove invaluable to every railway enthusiast, and, together with the earlier "Hornby Books of Trains," will form a unique work of reference on the history and operation of railways.

There is sure to be a great demand for the book, but a definite number only will be printed. Therefore, to make quite certain of getting your copy, send along your order *now*. The book will be ready by 14th November and all orders on hand will be executed, in strict rotation, as soon after that date as possible.

SOME OF THE CONTENTS

The following are the sections under which the principal subjects in the Hornby Book are grouped :—

Members of the Locomotive Family.
Drawing Office and Pattern Shops.
Foundry, Fitting, and Machine Shops.
Boiler and Erecting Shops.
Trial Runs, Testing and Painting.
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Address your orders to "Hornby Book," Meccano Limited, Binns Road, Liverpool, and please write your name and address clearly.

The price of the book is 3d. (post free), and a remittance in stamps for this amount should be sent. There is no reduction if more than one copy is ordered. Orders will not be acknowledged.

We hope to have the Hornby Book of Trains ready for delivery on or about the 14th November. All orders will be carefully filed and as soon as the book is ready they will be executed in the rotation received.

ORDERS FROM OVERSEAS

There is a special edition of "The Hornby Book of Trains" for Overseas readers, and copies have already been despatched to fill orders received from Overseas. Readers in Australia, New Zealand, or South Africa who require copies should address their orders to our agencies as detailed below. Readers living in countries other than those mentioned should order from Meccano Ltd., Binns Road, Liverpool, and send a postal order for 6d. with their order. The price for all orders from outside the United Kingdom is 6d. post free.

AUSTRALIA. E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W. P.O. Box 1832.
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Another New Meccano Model-Building Contest

TO TEST MECCANO BOYS' INGENUITY

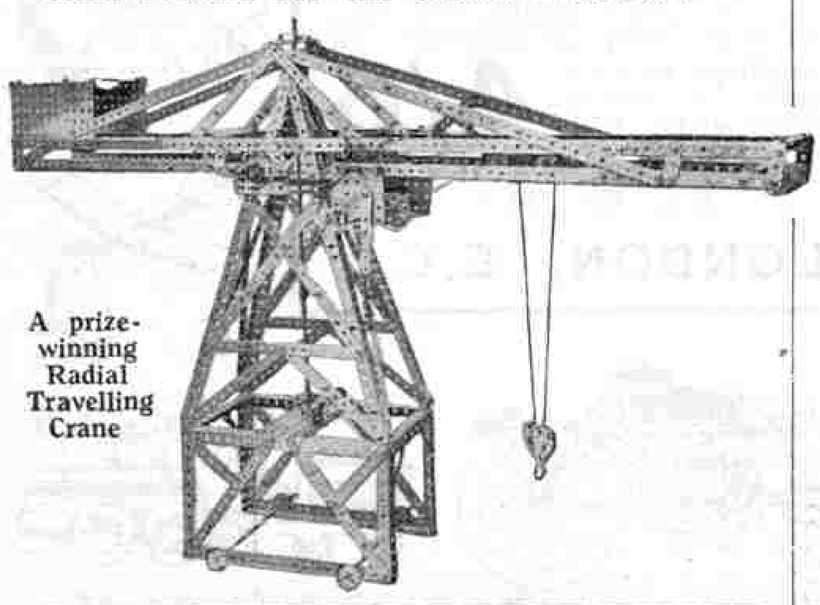
NO real Meccano boy ever grumbles at the inclemency of the English climate. The wettest day leaves him just as happy as the sunniest. True, he can try out his model motor lorry down the garden path when the sun is shining, or he can span the "vegetable patch" with a telpher line, but there are still more wonderful things to be done indoors when the weather is bad.

Simple models like this No. 0 Outfit Tower Wagon stand a good chance of winning prizes

During the long winter evenings Meccano becomes even more exciting and Meccano boys settle down to work in real earnest, secure in the knowledge that they cannot be called away next minute to "play with little Bobbie on the lawn" or to "go and cut the grass because Dad's too busy!" Everywhere they are looking round for "new worlds to conquer" and that is why we expect a bumper entry in this month's special Model-building Competition.

What you have to do

Every "*M.M.*" reader ought to enter the competition, because everybody has an equal chance of winning a prize, and we hope that the work submitted this time will be even better than usual. If they are suitable, many of the prize-winning models will be included in forthcoming Instruction Manuals and other Meccano publications that we have in mind, so that your competition model may be rebuilt again and again by Meccano boys of all nationalities. This in itself will be regarded by most Meccano boys as a sufficient reward for the labour involved.



A prize-winning Radial Travelling Crane

You have at least seven or eight weeks in which to construct your model, no matter whether you live in England or Australia, but it is not necessarily the amount of time you spend in building it that will qualify you for a prize. It is originality of ideas and novelty of construction that will determine the winning models. It will greatly assist the Competition Judges in the work of tabulation, etc., if you will send along your entry as soon as it is ready instead of waiting for the closing date.

LIST OF PRIZES

The Prizes to be awarded in Sections A and C are as follows:—

First Prize; Cheque for three guineas.

Second Prize; Cheque for two guineas.

Third Prize; Cheque for one guinea.

Six prizes, each consisting of Meccano products to the value of 10/6.

Twelve prizes, each consisting of Meccano products to value 5/–.

A limited number of Certificates of Merit and complimentary copies of "Meccano Standard Mechanisms" Manuals.

The Prizes in Section B are as follows:—

First Prize, Meccano products to value two guineas.

Second Prize, Meccano products to value one guinea.

Third prize, Meccano products to value 10/6.

Six Prizes, each consisting of Meccano products to value 5/–.

Of course, no Meccano boy ever enters a competition solely for the purpose of getting a prize. He works because he just loves building fine models and he knows that there are few better ways of gaining practical model-building experience than entering competitions of this kind. The prizes offered act merely as incentives to start work.

No Forms or Fees

It is a perfectly simple matter to participate in the Meccano Model-building Contests, for no entrance forms or fees are required. Any model you wish to submit must be your own unaided work as regards design and construction. There are no restrictions laid down as to the number of parts used or to the subject chosen for the model.

The ages of all competitors will be taken into consideration. To make the judges' task easier, the entries will be divided into three separate Sections, as follows: Section A, for competitors residing in the British Isles and over 14 years of age. Section B, for competitors residing in the British Isles and under 14 years of age. Section C, for competitors residing overseas, of all ages.

Important Instructions

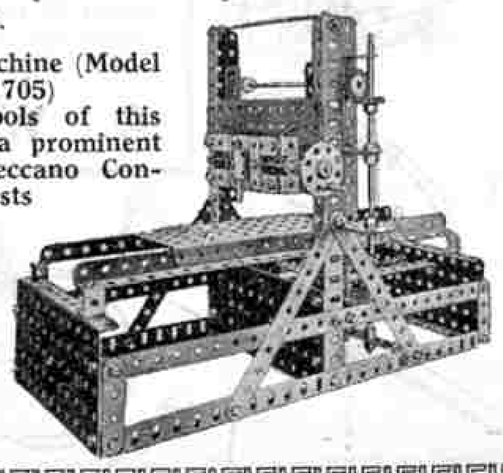
Actual models should not be sent. A clear photograph or good drawing is all that is necessary. Photographs or drawings of unsuccessful entries will be returned if a stamped addressed envelope of the necessary size is enclosed with the entry. It should be noted, however, that photographs of prize-winning models become the property of Meccano Ltd. Competitors should send in any explanations that may be necessary with the photographs or drawings of their models.

The following instructions must be followed closely:—The competitor's name and address must appear on the back of each photograph or sheet of paper used, together with his age, name of the competition ("November" Model-building Competition) and the Section in which the model is entered. Envelopes should be addressed "November" Model-building Competition, Meccano Ltd., Binns Road, Liverpool.

Closing Dates

Entries for Section A and B must be received not later than 31st December, 1927. Closing date for Section C: 31st March, 1928.

Correspondence relating to any subject not connected with the competition must not be enclosed in the same envelope as a competition entry. Entries will not be acknowledged, but all prize-winners will be advised by post as soon after the closing date as possible. Competitors entitled to prizes consisting of Meccano products will have the opportunity of choosing any items they like from current price lists.



Planing Machine (Model No. 705) Machine tools of this kind play a prominent part in Meccano Contests

Father Christmas' Circus is coming!

GOOD NEWS FOR MECCANO BOYS!

GAMAGES

CHRISTMAS BAZAAR

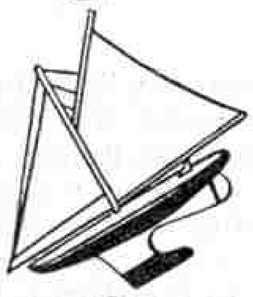
is always the Red Letter Day of the Meccano Boy's Year.
This year it is to be

BIGGER AND BETTER THAN EVER

Thousands of Wonder Novelties are arriving and the Big

XMAS CATALOGUE

is a Feast of Colour and Good Things. In order to secure a copy send 1/- at once.
An exchange voucher for this amount is sent with each Catalogue. Published early November.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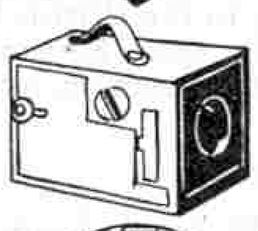
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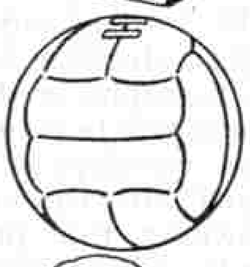
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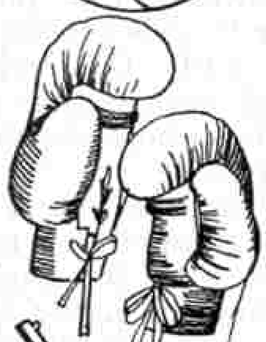
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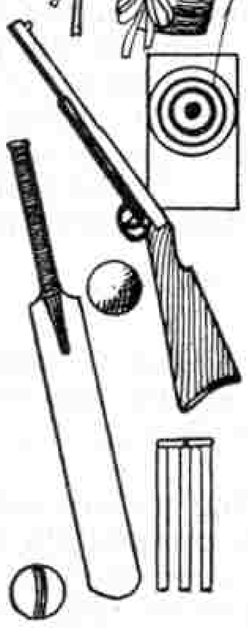
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Bat 5/-
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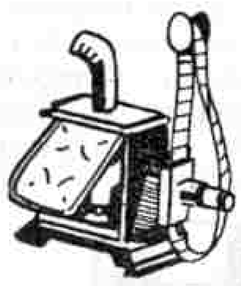
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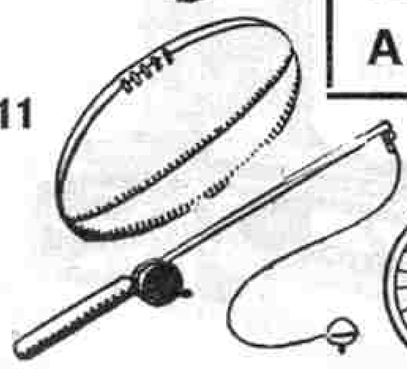
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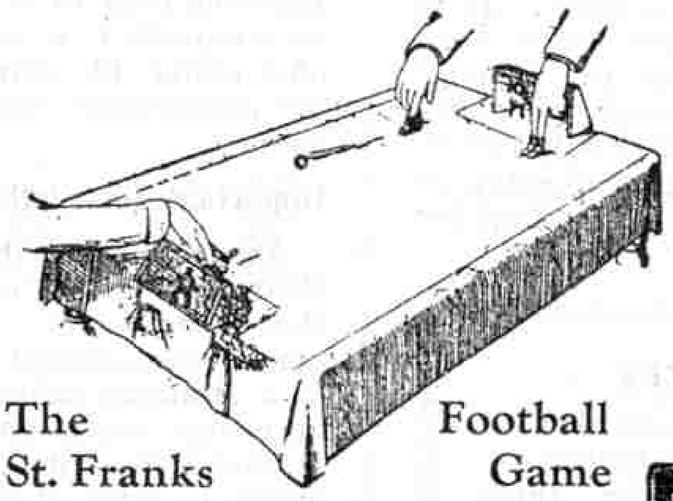
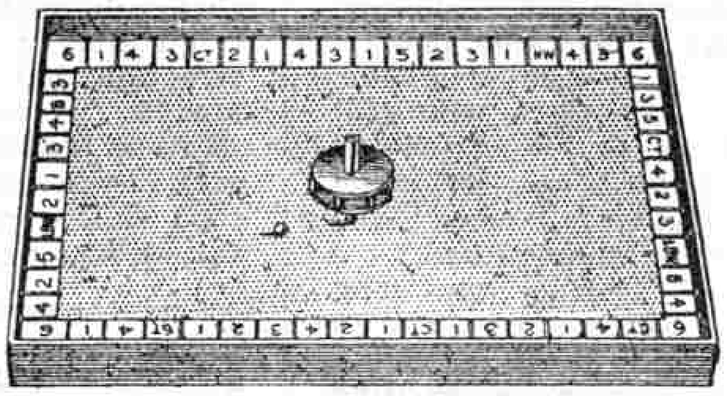


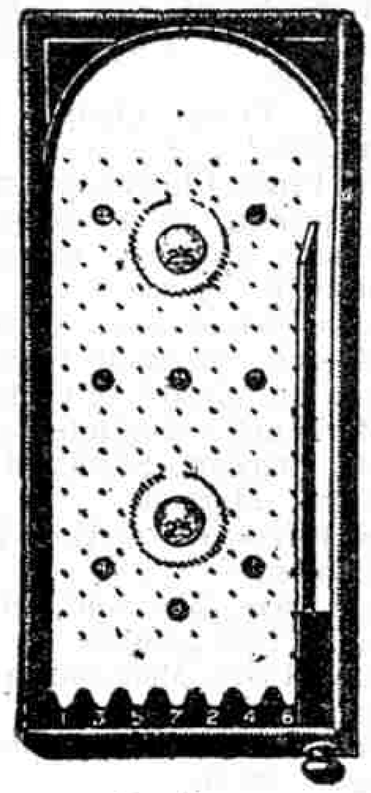
The St. Franks Football Game

Splendid amusement for the long evenings, it is a most realistic game of Football, the ball actually kicked about the field of play by a small device which fits on to the end of the fingers. Price **3/6** and **7/-**
Post 4d. and 6d.



Googley Cricket

A well-constructed game, as illustration; the Batting Top is set going in the centre of board into which the Bowler drops the Ball, this is thrown out of the top into one of the separated divisions around the board, which is marked with the score to be counted. Price **7/6**
Post 6d.



Spring Tivoli Boards

Mahogany finish, Stained and Polished, Green lined, with Numbered Cups and Bells.

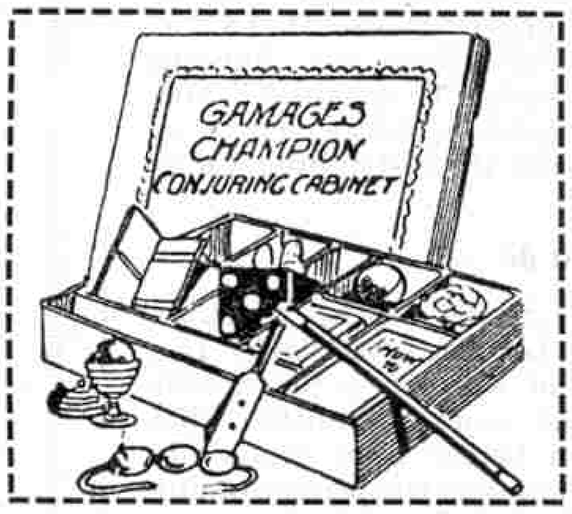
Size	Price
2 ft. 3 in. × 1 ft.	**8/11**
2 ft. 6 in. × 1 ft. 2 in. ...	**11/6**
Superior do., Baize lined.	
2 ft. 6 in. × 1 ft. 2 in. ...	**13/6**
2 ft. 9 in. × 1 ft. 2 in. ...	**17/6**
3 ft. × 1 ft. 4 in., Two Bells	**25/-**
4 ft. × 1 ft. 6 in., Four Bells	**32/6**

Carriage extra.

For the Young Student

Chemical Outfits

A fine Hobby for the long winter evenings and one of which you will not quickly tire. It is amusing, interesting, and very educational. The modern schoolboy will find it extremely useful for improving his knowledge. You have a choice of a large range of outfits if you come to GAMAGES. **5/6**
Other Sets **3/3, 14/6, 32/6, 52/-**



Conjuring Outfits for the Amateur

Jolly good fun and ever so easy if you get your tricks from the right place, and don't forget to practice. The fellow who can conjure gets a wonderful time. Not only does he get the fun of the conjuring but also invitations to parties, fetes, etc., that he would never get otherwise. All the apparatus and instructions for several mystifying tricks. Post 4d. **4/6**
Other Sets **3/-, 7/9, 10/9, 15/9, 22/6, 35/-, 42/-, 63/-**

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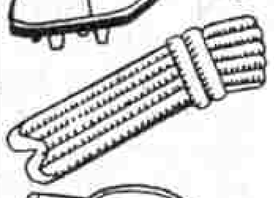
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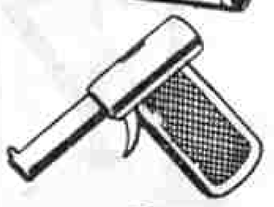
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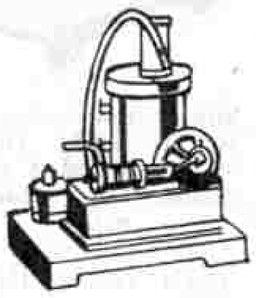
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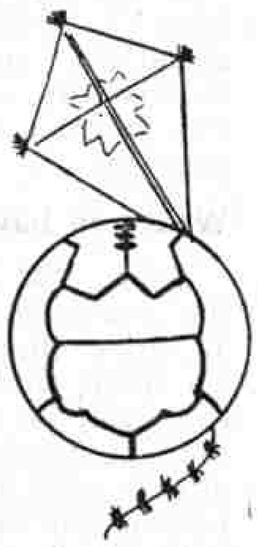
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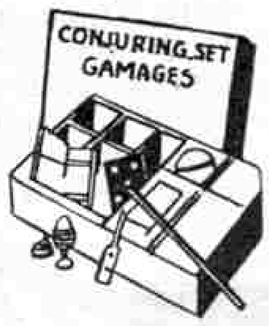

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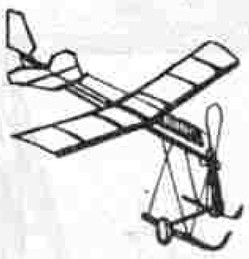
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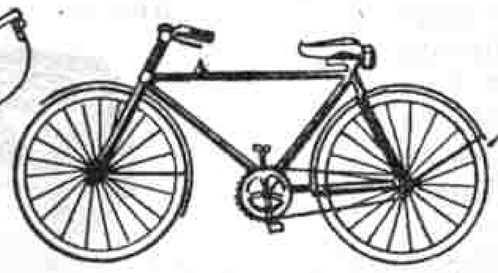
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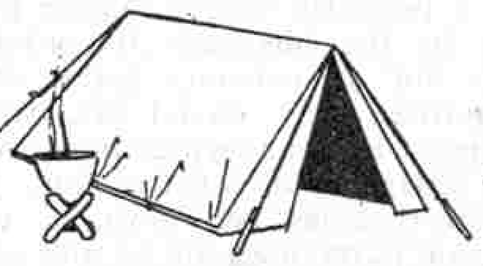
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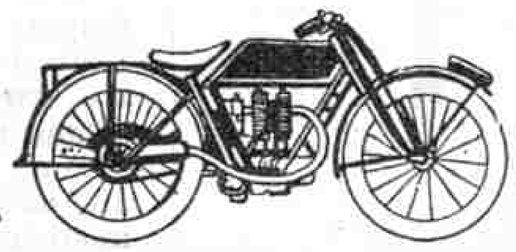
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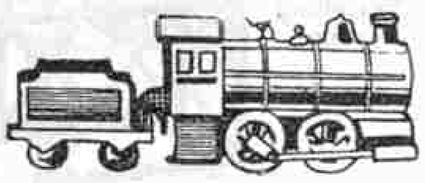
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With the Secretary

L'Entente Cordiale

The Guild Correspondence Club, in addition to placing many thousands of Meccano boys in communication with kindred spirits, has brought about many interesting meetings. An example of this occurred recently at Birmingham. M. Lacroix, secretary of the Strasbourg Meccano Club, while on a visit to Birmingham sought out A. L. Noke, secretary of the King Edward's Grammar School Meccano Club, and the two secretaries spent an exceedingly pleasant time together. The meeting took place at the home of the Birmingham club's secretary, and Mr. W. Bryan Chivers, B.A., Leader of the club, was also present. As may be imagined, a large part of the conversation consisted of interesting comparisons between the organisation and methods of the two clubs.

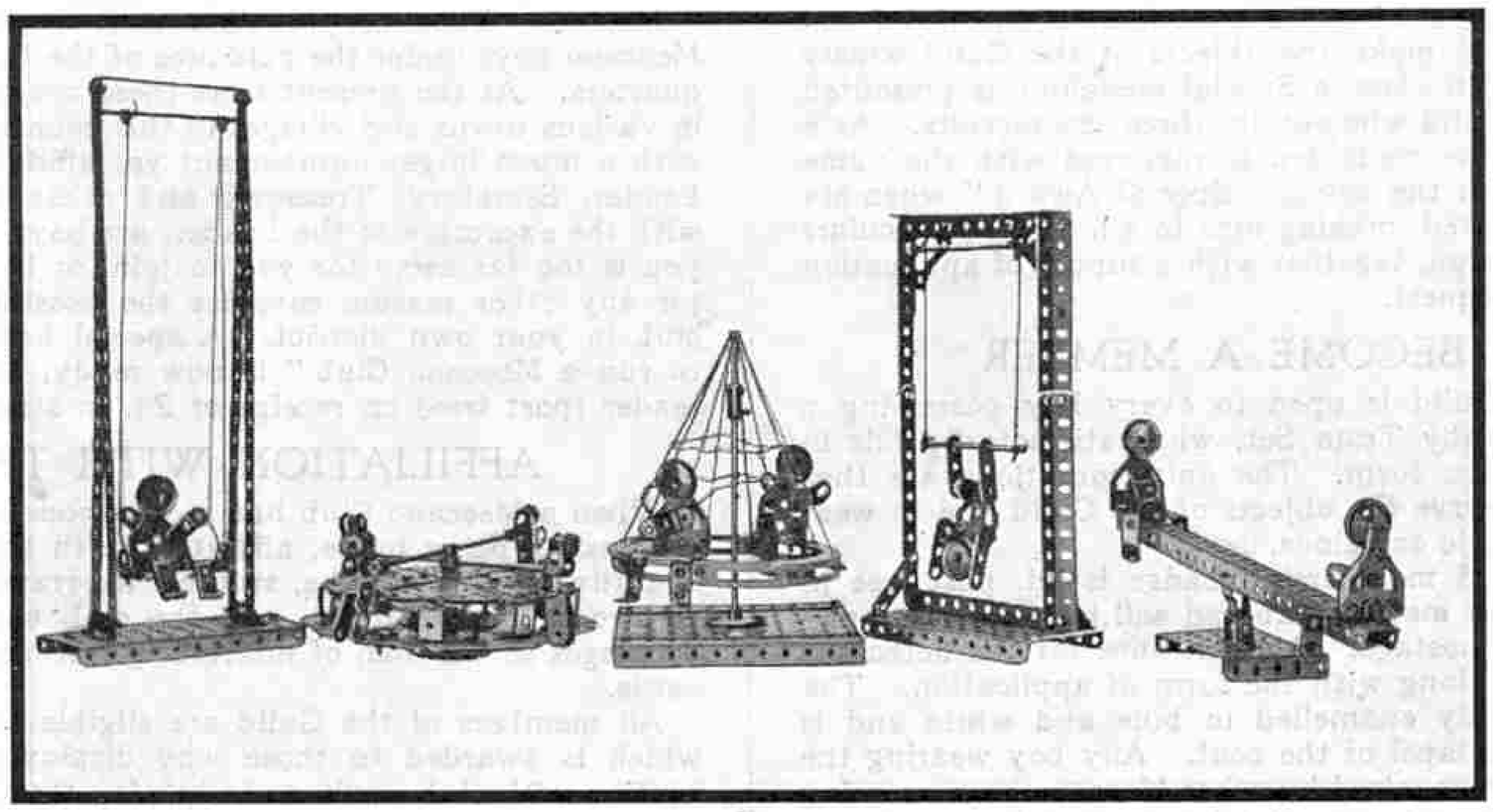
The Strasbourg M.C. came into being early this year and has made excellent progress. From the beginning the main feature of its work has been the construction of large models, which have been exhibited and studied at club meetings. Lectures also have not been neglected and many interesting subjects have been dealt with. The organisation of this club is planned on thoroughly sound lines. The object of the club is defined as that of endeavouring to provide pleasant hours for its members by means of recreation and instruction obtained in the building in common of models; by meetings and discussions, and by visits to works in the neighbourhood. The club consists of active members, honorary members, and "*membres d'honneur*," the last-named being persons who have rendered outstanding service to the club. In order to become an active member it is necessary for a boy to be proposed by at least one active or honorary member and to make his application to the committee in writing. The application is then considered.

The rule regarding attendance at meetings is very strict. Any active member who is unable to be present at a meeting of which he has had notice is required to inform the committee of the fact as soon as possible and to explain the reason of his non-attendance. The committee is the sole judge of the validity or otherwise of the excuse put forward, and after three consecutive absences for which the excuses have not been accepted the delinquent is brought before the committee and is dealt with as may be decided after consideration.

Planning an Exhibition

It is interesting to note that the practice of concluding each of the winter sessions with an Exhibition continues to grow, for an Exhibition forms one of the best possible means of making the club well-known in the district. In addition to publicity an Exhibition provides a definite object towards which every member of the club can aim and it provides an incentive to both individual and collective work. Many clubs find it advisable to hold their first winter session exhibition not later than the second week in December so that its success is not interfered with in any way by other Christmas activities. The question of date is, however, one that can only be settled by each club individually.

I have emphasised on many previous occasions the importance of including among the exhibits at least one or two large models built by the combined efforts of a number of members. For all-round attractiveness it is probable that nothing can beat a large model of a bridge—say of the Forth Bridge type—with a Hornby train running over it. A model of this kind is not really difficult to build and the labour spent upon it is invariably repaid by the amount of interest it arouses, especially among visitors who have not previously realised the possibilities of Meccano. By way of contrast to such a model a small exhibit may be arranged of quaint figures such as those described and illustrated in the new booklet "*Adventures in Meccanoland*," a copy of which will be sent to any reader on receipt of 2d. postage. These tiny inhabitants of Meccanoland never fail to create intense amusement and the construction of a number of them is well worth consideration. The illustration on this page affords a good example of what may be done in this respect.



A Playground in Meccanoland ! A quaint corner in the Exhibition of the Napier (N.Z.) Meccano Club

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 :—

AGRA CITY (India).—Mr. S. Raza Ahmad Jaffri, Imdad House, Agra City, India.

ALDERSHOT.—D. MacLeod, "Brook House," Ash Road, Aldershot.

BENARES CITY (India).—Mr. B. N. Ghosh, 121, Ramapura, Benares City, India.

BRISTOL.—R. A. Barnwell, 36, Downleaze, Sneyd Park, Clifton, Bristol.

CONGLETON.—William Hoyle, 23, High Lowe Avenue, Buglawton, Congleton.

GLASGOW.—William Gilchrist, 6, Pollok Road, Shawlands, Glasgow, S.1.

LIVERPOOL.—Fred Stockley, 20, Hawkins Street, Kensington, Liverpool.

LONDON.—F. Tay, 55, Shakespeare Avenue, Harlesden, N.W.10.

The Meccano Guild

A Great Fellowship of Boys

President: Mr. Frank Hornby —Inventor of Meccano

What the Guild Means

The Meccano Guild is an organisation for boys, started at the request of boys, and conducted as far as possible by boys. In joining the Guild a Meccano boy becomes a member of a great brotherhood of world-wide extent, every member of which has promised to observe its three great objects; wherever he happens to be—even in strange countries—he will know he has met a friend whenever he sees the little triangular badge. The Meccano Guild is bringing together Meccano boys all over the world, and is helping them to get the very best out of life.

How it Commenced

More than a million boys in Great Britain derive their greatest indoor pleasure from Meccano. Before the Guild was formed, hundreds of these Meccano boys wrote to us every week. They told us how they wished they could be put into communication with other Meccano boys and how they longed to be able to meet them. They asked if arrangements could be made so that their wishes might become an accomplished fact. We responded to their repeated and increasingly numerous appeals, and as a result the Meccano Guild came into being.

Why You Should Join

Every Meccano boy should be a member of the Meccano Guild. All who have studied its objects must agree that the Guild cannot fail to have a profound effect for good on the lives of its members. It is ready to be of service to each individual member—to help or give advice whenever requested. At the head—guiding and controlling, and taking a personal interest in this great movement—is the President, Mr. Frank Hornby, Inventor of Meccano and Managing Director of Meccano Limited.

The Headquarters of the Meccano Guild are at the Head Offices of Meccano Ltd., Binns Road, Liverpool.

THE GUILD RECRUITING CAMPAIGN

Every Meccano boy should become a member of the Guild and do his utmost to help to make the objects of the Guild widely known. With this end in view, a Special Medallion is presented to each member of the Guild who obtains three new recruits. As a mark of further merit the medallion is engraved with the name of the recipient and with the words "Special Award" when six more members are recruited, making nine in all. Full particulars of the Recruiting Campaign, together with a supply of application forms, will be sent on request.

HOW TO BECOME A MEMBER

Membership of the Guild is open to every boy possessing a Meccano Outfit, or Hornby Train Set, who satisfactorily fills in the prescribed application form. The only conditions are that members promise to observe the objects of the Guild and to wear their badges on all possible occasions.

The price of the Guild membership badge is 7d. post free in the United Kingdom, but members abroad will be required to pay 5d. extra for registered postage. A remittance for the necessary amount should be sent along with the form of application. The Guild badge is beautifully enamelled in blue and white and is made for wearing in the lapel of the coat. Any boy wearing the Guild Badge is at once recognised by other Meccano boys as being a member of the Guild and one who has undertaken to live a clean, truthful and upright life.

In addition to the badge, each member receives a membership certificate, measuring 7″ × 9½″. This certificate is printed in orange and sepia and is a smaller edition of the large club certificate.

Write to the Secretary of the Meccano Guild, Binns Road, Liverpool, asking for an application form and full particulars. Then fill in the form and return it to Headquarters, when you will be enrolled and your badge and certificate will be sent to you. Write to-day, and put M.N. after your name for reference.

The Secretary receives hundreds of letters every week from members all over the world and he hopes that new members will also write to him as often as possible.

MECCANO CLUBS

Meccano Clubs are founded and established by enthusiastic Meccano boys under the guidance of the Guild Secretary at Headquarters. At the present time there are over 100 affiliated clubs in various towns and villages in this country and abroad, together with a much larger number not yet affiliated. Each club has its Leader, Secretary, Treasurer and other Officials, all of whom, with the exception of the Leader, are boys. If the nearest club to you is too far away for you to join, or if you are unable to join for any other reason, consider the possibility of forming a new club in your own district. A special booklet explaining "How to run a Meccano Club" is now ready, and will be sent to any reader (post free) on receipt of 2d. in stamps.

AFFILIATION WITH THE GUILD

When a Meccano Club has been successfully launched and good progress is being made, affiliation with the Guild is granted. A beautiful club certificate, suitable for framing and hanging in the club-room, is presented, and the club becomes entitled to such privileges as the loan of interesting lectures and club membership cards.

All members of the Guild are eligible for the Merit Medallion, which is awarded to those who display special ability in connection with club work, or in helping the Guild.

THE CORRESPONDENCE CLUB

Members of the Guild are able to join the Correspondence Club, by which they are placed in communication with other Guild members in some other part of the country or abroad. To those boys who are interested in foreign languages the Correspondence Club presents a splendid opportunity of obtaining a correspondent in the particular country in the language of which they are interested. They are able to write to a Meccano boy in his native language, and as he would probably reply in English, the correspondence will be of mutual benefit. Stamp collectors also find the Club of value, as they are enabled to exchange stamps with their correspondents. Full particulars and enrolment form will be sent on application.

THE THREE GREAT OBJECTS OF THE GUILD

THE MECCANO GUILD

BADGE OF MEMBERSHIP

(1) **To make every boy's life brighter and happier.**

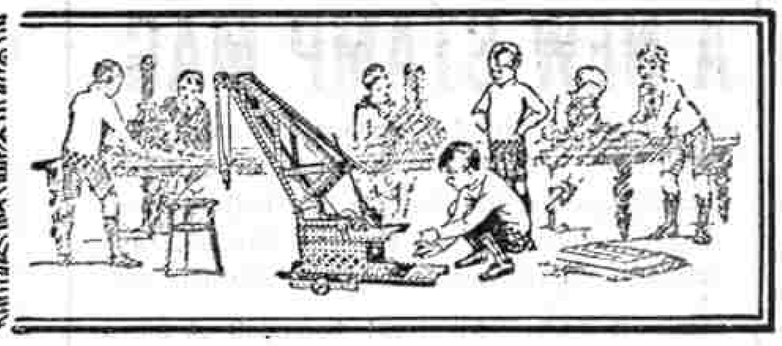
(2) **To foster clean-mindedness, truthfulness, ambition, and initiative in boys.**

(3) **To encourage boys in the pursuit of their studies and hobbies, and especially in the development of their knowledge of mechanical and engineering principles.**

THE MECCANO GUILD

BADGE OF MEMBERSHIP

CLUB NOTES



St. Helens M.C.—Since its affiliation excellent progress has been made. Mr. Brooks has been elected President and he is helping the boys in many ways. A very interesting paper on "*The Progress of Railways*" was recently read to the club by the secretary and was well received. An exhibition has been arranged and a Derricking Crane is being sent from Headquarters for the occasion. Mr. Brooks is presenting the club with a Wormar steam engine and is also loaning a model for the Exhibition. Club roll: 15. *Secretary*: Frank Ripley, 214, Greenfield Road, St. Helens.

Nuneaton Grammar School M.C.—Is making good progress and the new session has started well. The first meeting of the new session took the form of a "Sales and Exchange Evening," and this aroused great interest in addition to providing a good deal of amusement. A visit is to be paid to the Pooley Hall Colliery in the near future. *Secretary*: Grahame Clarke, 45, Seymour Road, Nuneaton.

Barrow-in-Furness M.C.—The first meeting of the session proved a great success, 22 members being present. A vote of thanks was extended to Mr. and Mrs. Sansom for the use of a large room as a club-room. The club Magazine is to be started again and First Aid lessons are to be given by the Leader. A Swimming Section has been formed and the members hope to pay weekly visits to the Public Baths. An exhibition is being organised and a model is to be loaned from Headquarters. A very enjoyable evening was spent recently with a cinematograph loaned to the club. A "Blindfold Model-building Contest" has been arranged. Club roll: 30. *Secretary*: Len Martin, 147, Greengate Street, Barrow-in-Furness.

Hastings Central M.C.—Good progress is being made and various good friends have promised the club a quantity of Meccano and Hornby parts. Practices are now in full swing for a Concert that is to be held shortly. New members are being enrolled at each meeting but there is still room for many more. An effort is being made to secure a Wireless Set for use at meetings. *Secretary*: W. V. Veness, 9, Earl Street, Hastings.

St. Michaels (Teignmouth) M.C.—Model-building is a popular feature, and a cardboard Model Railway is being made for the younger members. An interesting visit was paid to Newton Abbot Railway Sheds and was greatly enjoyed. Games Nights are popular and meetings are well attended. New members will be welcomed by the Leader: the Rev. J. R. Hopwood, 2, Thornhill, Teignmouth, Devon.

Albert Village M.C.—Six members have been obliged to leave the club and therefore there is room for more. A good Football team has been formed and several matches have been arranged. It is hoped to hold a Social shortly. *Secretary*: L. C. Adey, 239, Occupation Road, Woodville, Burton-on-Trent.

St. Albans M.C.—Efforts are on foot to increase the membership and it is hoped that the club roll will soon show a decided increase. The syllabus for the new session includes Model-building, Lectures, Mock Trials, Draughts, and Visitor's Evenings. A visit is to be paid to the Electric Generating Station some time during the session. A new feature of the syllabus is a "Puzzles" evening, on which occasion the puzzles are to be taken from the "*Meccano Magazine*" and solved. Draughts and Table Tennis Tournaments are to be held. Club roll: 22. *Secretary*: Herbert M. Upward, 19a, Worley Road, St. Albans.

Stoke and Newcastle M.C.—Excellent progress is reported and meetings are held fortnightly on Monday evenings at 7-25. New members are always welcome and full particulars may be obtained from the secretary. Model-building is popular and Hornby Trains are always running on club evenings. Club roll: 11. *Secretary*: P. L. Taylor, 6, Poolfield Avenue, Newcastle, Staffs.

Merelands M.C.—A large railway track laid in the club room has been in operation for some time, the complete outfit being kindly loaned by one of the members. A patron of the club has generously loaned a first-class Microscope and two interesting meetings have been devoted to the study of minute creatures. Club roll: 7. *Secretary*: Eric Stroud, The Vicarage, Lindsey, Hadleigh, Suffolk.

Watford M.C.—One of the members, L. Horwood, has had an accident and therefore has been unable to attend meetings. As a token of sympathy his fellow members have presented him with a book. A club supper has been arranged. An application is to be sent to the L.M.S. Railway Company for permission to visit the Engine Sheds at Watford Junction. New members will be very welcome. Club roll: 12. *Secretary*: Sydney Page, 211, Leavesden Road, Watford, Herts.

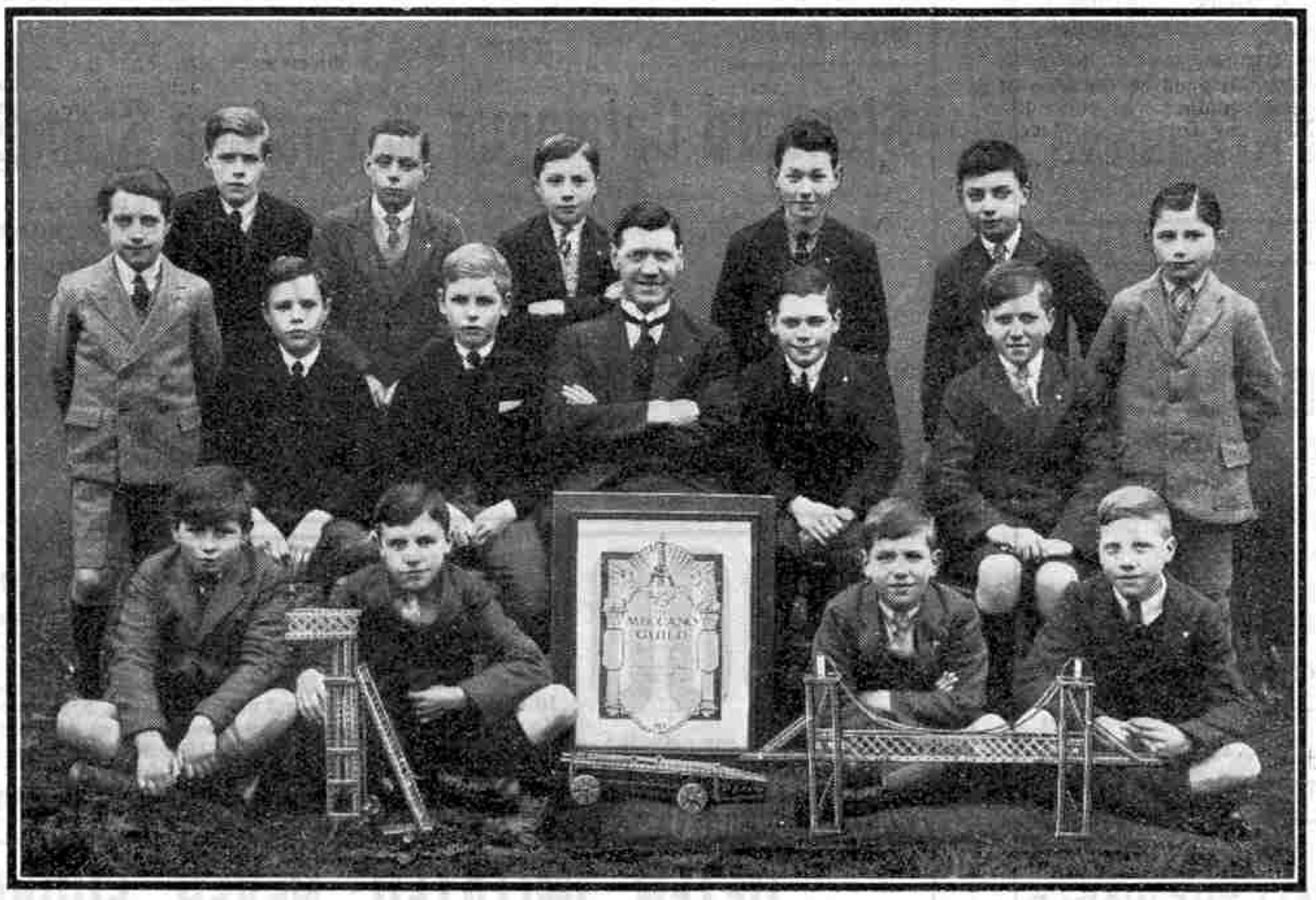
Willingham M.C.—Games Evenings have been very popular and Boxing is a favourite sport. It is hoped that this session will be the best on record. Special sections are to be introduced for Philately and Fretwork. Club roll: 16. *Secretary*: R. W. Huckell, Short Lane, Willingham.

Haslingden Secondary School M.C.—Good progress is reported and new members are being enrolled. It is under consideration to divide the club into two sections, one for the juniors and one for the seniors. In this way the senior section will be able to do advanced work and something simpler will be arranged for the juniors. *Secretary*: Kenneth G. Tupling, 16, Alexandra Terrace, Haslingden, Rossendale, Lancs.

Cranham M.C.—This club is passing through a very difficult period. Owing to certain local difficulties that have occurred the membership has decreased seriously. The Leader is doing everything in his power to hold the club together and the remaining members are backing him up splendidly. New members are urgently needed and it is hoped that all Meccano boys in the locality will do their best to assist the club. *Secretary*: J. G. Cheshire, Post Office, Cranham, Essex.

Holy Trinity (Barnsbury) M.C.—The new session commenced in September and excellent progress is reported. An interesting syllabus has been drawn up, including Model-building, Competitions of various kinds, Parents' Night, Lectures, and Socials. The members are all very enthusiastic and the attendance on club evenings is highly satisfactory. The ninth Annual Exhibition was held during the past month and many ingenious models were on view. It is hoped to give an account of this in the December "*M.M.*" when a full report has been received from the club. Club roll: 44. *Secretary*: Frederick W. Johnson, 23, Market Street, Edgware Road, Paddington, W.2.

Sparkhill Meccano Club



This enthusiastic and enterprising club was affiliated with the Guild in May 1926 under the Leadership of Mr. T. W. Stewart, who is shown in the centre of the group. The most popular features of the syllabus are model-building during the winter and cricket and rambles in summer. The club also issues an attractive Magazine.

Australia

Hampton (Victoria) M.C.—Is making excellent progress. A silver medal has been purchased to be presented to the member having the highest marks and whose attendance has been good. It is hoped to introduce Flags for the various sections, but nothing definite has yet been decided. Games Nights are held frequently and Hornby Nights are popular. The secretary is very desirous of increasing the membership of the club, and will be pleased to give full particulars to any boy wishing to join. Club roll: 17. *Secretary*: F. Wallis, 9, Kerford Street, Hampton, Victoria, Australia.

Yeronga (Brisbane) M.C.—Has had a most successful session both in work and play and financially is in a good position. The club is divided into five sections, each having its own Leader. Two outings were arranged during the session and were well attended. Competitions have been held for Model-building and for Drawing. A local firm very kindly gave a donation of 10/- for prizes in a competition and this was greatly appreciated. Club roll: 30. *Secretary*: Jack Hooker, Grosvenor Street, Yerongpilly, Brisbane, Queensland, Australia.

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CANADA'S DIAMOND JUBILEE

ON Friday, 1st July last, there were rejoicings throughout Canada, from the Atlantic in the East to the Pacific in the West, from the Southern boundaries to the farthest ice-bound regions of the North. The occasion was the celebration of the Diamond Jubilee of the Confederation of the Canadian Province. The occasion was more than that. It was a halt in the trail of Canadian history. A halt to permit minds and memories to hark back to those strangely near far-off "sixties," when Canada received its charter.

In the map of British North America, as the territory was then known, there were only five provinces, on the Eastern edge of the continent. The population was thinly distributed along the River St. Lawrence in Lower Canada (Quebec) and about the shores of Lakes Ontario and Erie in Upper Canada (Ontario). A few miles north of each province there lay vast uninhabited, unexplored tracts. The peoples of Upper and Lower Canada, of Prince Edward Island, Nova Scotia and New Brunswick, were strangers one to another. Intercourse between the existing provinces, either by trade or travel, was strangely limited for such a comparatively recent period. Isolated areas they were, largely self-dependent and of necessity equally self-reliant. The Canadian, whether of 1767 or 1867, has always been that. The railway was a new thing, with scarcely more than 2,000 miles of track in all Canada; the steamers that crossed the Atlantic would dwindle into river craft when measured by a stately ocean liner of the present.

Such was the Canada of 1867. To-day, Canada is a nation, taking its share in the transforming and building up of the British Empire. Well spoken were the words of Lord Carnarvon who, introducing the Canadian Federation Bill into the House of Lords in 1867, declared: "We are laying the foundation of a great state—perhaps one which at a future day may even overshadow this country, but, come what may, we shall rejoice that we have shown neither indifference to their wishes nor jealousy of their aspirations, but that we honestly and sincerely, to the utmost of our power and knowledge, fostered their growth, recognising in it the conditions of our own greatness."

The story of this sixty years' progress had been indelibly inscribed in philatelic history by the issue of a special Confederative issue.

The Confederation issue proper contains six stamps, 1c., 2c., 3c., 5c., 12c. and 20c., but advantage was taken of the occasion of the Jubilee to issue also a new historical series, bearing portraits of five of Canada's most famous men. This series, consisting of three values, 5c., 12c. and 20c., actually was ready for issue in the early part of this year, but was held back to make its appearance simultaneously with the Commemoration stamps. The Commemorative issue is distinguishable from the historical series by the word "Confederation" that appears across the head of each stamp of the series.

Dealing first with the Confederation issue, we find the portrait on the 1c. stamp to be that of Sir John A. MacDonald, the first Prime Minister of the Dominion. MacDonald was a man of great ability and personal charm. It was largely due to him that the bitter racial controversies that kept the provinces apart at the earlier conferences on this same question of unity were overcome in the early "sixties," and through him the provinces of New Brunswick, Nova Scotia, Ontario and Quebec became the Dominion of Canada, inspired by one great national ideal. The federal system was largely framed by MacDonald. He noted the vital defects in the United States system, and avoided their pitfalls. As a result, all power not specifically delegated to the individual Provinces rests with the Dominion or Federal government. Only strictly local affairs are left with the provinces. Trade, commerce, justice, lands, agriculture, labour, marriage laws, waterways, harbours, railways, are specifically placed under Federal Control. The speedy entrance of Manitoba (1870), Prince Edward Island (1873) and British Columbia (1871) into the Confederation must be accepted as a great tribute to the statesmanship of MacDonald.

The turning point in the negotiations with British Columbia was the promise of the great trans-continental railway that would link up the West with the East. Without this link with the new Dominion there could be no community of interest and it would have been merely a matter of time before British Columbia—indeed the whole of Western Canada—became joined with the United States. No secret of its aspirations was made by the United States Government—British Columbia was to be "annexed." Only Sir John MacDonald's foresight in facilitating the construction of the Canadian Pacific Railway saved Western Canada for the British Empire.

The 2c. stamp is a representation of Robert Harris's famous painting of the "Fathers of Confederation" assembled in conference at Quebec in the autumn of 1864. Representatives from each province attended and, small though the reproduction is, it is possible to recognise Sir John MacDonald standing in the centre of the picture. This stamp is coloured green and in common with the remainder of the series is perforated 12 all round. As a permanent reminder of the work of the Fathers of Confederation, the Association of Canadian Clubs has presented a copy of the original picture to every school throughout Canada.

The recently completed Federal Houses of Parliament at Ottawa form the subject of the 3c. stamp which, by the way, is carmine in colour. The Victory Memorial Tower, the dominating feature of the building, possesses a carillon of 53 bells, the finest peal in the world. The opening of the Jubilee celebrations was heralded by the chimes of these bells, set in operation by H.M. King George, who flashed a signal to Ottawa from London.

Ottawa, the capital of the Dominion, naturally was the centre of celebrations, but Montreal, Toronto, Winnipeg and Vancouver, arranged their own programmes. Throughout the Dominion there were presented historical pageants depicting various scenes illustrating Canada's evolution.

(Continued on page 1009)

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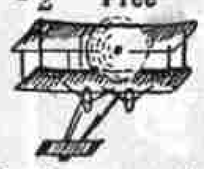

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For further Stamp Advertisements see also page 1024

Famous Trains—(*continued from page* 957)

Aynho Junction—where it is our down line that makes the "fly-over" to join the old main line—but down this the speed is usually moderated somewhat. The second set of water-troughs is here.

Five minutes later we dash through Banbury "on time"—67½ miles in 72 minutes—where we shed a couple more coaches and the load thus shrinks to the nicely-manageable figure of 285 tons all told. There is a gentle rise of seven miles from here to a point midway between Cropredy and Fenny Compton, after which all is plain sailing to Leamington. The first four miles of the descent from Fenny Compton Station are not steeper than 1 in 240, but they are quite sufficient to produce a maximum of 75 an hour, if the driver be so minded. Then from Southam Road follow four miles at 1 in 187, which is a useful "recovery" stretch, if the train from any cause is a little behind time. It was here that my maximum of 91.8 miles an hour was recorded, but we need not expect any such colossal speed on any ordinary evening, and probably we shall not get up to more than 75 an hour at most. For all that, we roll round the long curve into Leamington platform, stopping dead, probably, at a shade before 7.40 p.m. Ninety minutes for a journey of 87¼ miles over such a road and with such a train—wonderful work!

At 7.44 p.m. we get away again. With Hatton Bank ahead, the engine is well opened out, and aided by a brief ¾-mile down at 1 in 101, we accelerate with great rapidity, passing Warwick—although only two miles from the start—at a round 50 miles an hour or more. Striking the 1 in 104 of Hatton at about 55 an hour, our rate of deceleration up the bank will depend a good deal on the individual driver, and the minimum will vary between 40 and 47 or 48 miles an hour. After that we accelerate sharply to Lapworth troughs—where a third replenishment of the tender tank takes place—and hurry up the rising grades to Solihull, which include three miles at about 1 in 200, at very little under the mile-a-minute rate. The summit of the rise is turned at well over 60; another lightning acceleration follows to between 70 and 75 over the junctions at Tyseley and, with a final thrilling dash through the underground approach to Snow Hill, we draw up in that magnificent station at 8.9 p.m., with a minute in hand.

It would be more or less of an anti-climax to describe the remainder of the journey, as there is little further opportunity for anything in the way of speed achievement and the thrills are at an end. Twenty minutes are allowed for the 12½ miles' traverse of the "Black Country" to Wolverhampton, where our hard-worked steed comes off the train, taking with her the leading coach and the restaurant car set. On to the remaining five coaches is backed a two-cylinder 4–6–0 or a 4–4–0 "County," or, quite probably, one of the handy 2–6–0 "Moguls," and this works the train over the next stage of 72 miles to Chester, calling at Wellington, Shrewsbury, Gobowen and Wrexham.

In the General Station at Chester the train reverses its direction, and with—singularly enough—a North Western tender or tank engine of the L.M.S. (for the final stage is over joint L.M.S. and G.W. metals), completes its journey of 210½ miles from Paddington to the Woodside Station at Birkenhead exactly five hours after leaving London.

Stamp Collecting—(*continued from page* 1007)

The portrait on the 5c. violet stamp is of Sir Wilfrid Laurier, the first Canadian of French descent to become premier of the Dominion. He held office from 1896 to 1910. His work was distinguished for his zealous defence of Canadian self-government and his constant striving to maintain perfect harmony between the French and English-speaking Canadians. The part played by the French-Canadians in building up the Dominion is happily recognised in the Confederation stamp issue. A close examination shows that each stamp bears the word "post" both in English and French. The 20c. special delivery stamp, with which we will deal later, also signalises the union in wording appropriate to the stamp's function.

The 12c. and 20c. stamps, coloured blue and orange respectively, illustrate in striking fashion the progress made in Canada since 1867. The 12c. stamp shows a map of the Dominion. The heavily shaded portion to the east is that part of the country included in the original union of 1867. Since then comparative settlement has spread itself across the continent; the population has increased from three to 10 millions; the wheat crop has grown from 10 to 400 million bushels, and the acreage under cultivation from 10 to 60 millions! These marvellous increases are bound up in the story of Canada's means of transportation, a story that is excellently displayed in pictorial form on the 20c. special delivery stamp. In tableau form are arranged first the pony express rider, then the dog team, the trans-continental railroad, a C.P.R. liner and finally, the aeroplane. Each has played its part in the development of Canada's great interior.

The Hon. Thomas D'Arcy McGee, Irishman, poet and orator, in some ways the most picturesque of all the Fathers of Confederation, whose portrait appears on the violet 5c. stamp of the historical series, played a remarkable part in the early negotiations for Confederation. Originally a bitter enemy of Britain and all things British, he became an ardent supporter of British-Canadian association. He gave his life to the cause, for in 1868 he was foully murdered by a band of Irish irreconcilables.

The remaining stamps of the historical series bear the portraits of Laurier and MacDonald (12c.), Baldwin and Lafontaine (20c.) No story of Canadian history is complete without reference to the work of these latter two men, who were called upon to form the first responsible Government in Canada in 1848. The abuses arising from the old system of government in the Canadian provinces under the domination of Downing Street had led Lafontaine to declare in 1837: "Everyone in the colony (Lower Canada) is dissatisfied; we have demanded reforms and have not obtained them; it is time to be up and doing."

Baldwin had for years urged responsible government so strongly that he became known as "the man of one idea." He was thoroughly loyal, and had the wisdom to see that Canada could rise to greatness only when the English and French understood each other. It is pleasant to know that both he and Lafontaine lived to see a better day in Canada.

Lafontaine sympathised with the rebels in 1837 and was imprisoned in the following year, but later perceived that Lower Canada must join with the English to bring about the much-needed reform.

We take this opportunity of making acknowledgment to Stanley Gibbons Ltd., for their courtesy in loaning the stamps from which the illustrations used with this article have been prepared.

Stamp Gossip

NEW ZEALAND'S PENNY STAMP

15th November 1926 was an important date for stamp collectors; a new penny stamp made its appearance in New Zealand. It is bright carmine in colour and the design consists of a portrait of H.M. the King in the uniform of a Field Marshal. This is unusual for our "little islands near Australia." The side tablets show Maori drawings, the stamp value being prominently displayed in the centre of each. In the lower corners of each tablet, stars represent the Southern Cross. The upper corners bear the Imperial Crown flanking the inscription "postage and revenue." The wording "Dominion of" which was in the "Universal," is now deleted, and the words New Zealand alone appear at the foot of the stamp.

The new 2/– and 3/– stamps are of similar design but are considered a very poor likeness.

The die is by Waterlow & Sons, and the printing plate by Perkins, Bacon & Co., both of London. The printing was carried out at the Government Printing Office, Wellington, on Cowan paper, which was found to be the most suitable. Each stamp is watermarked with a five pointed star and the letters N.Z. The perforation is 14 × 15.

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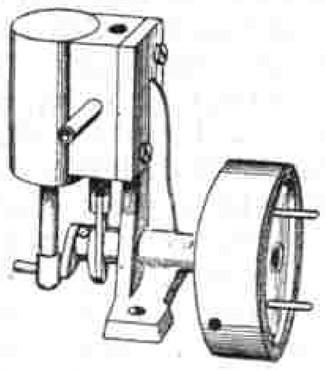

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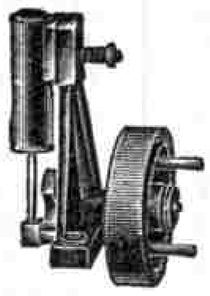

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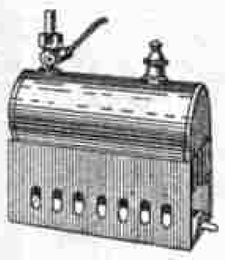

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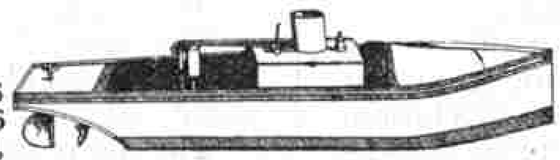

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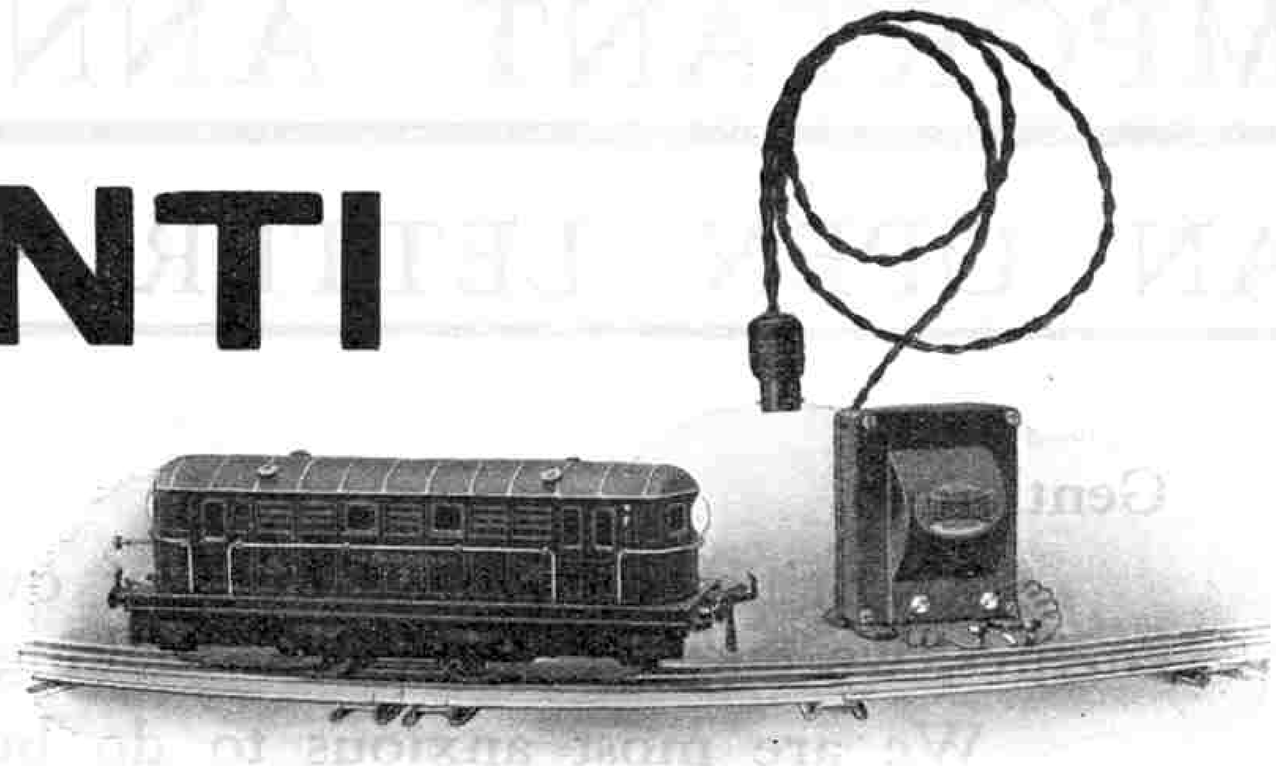

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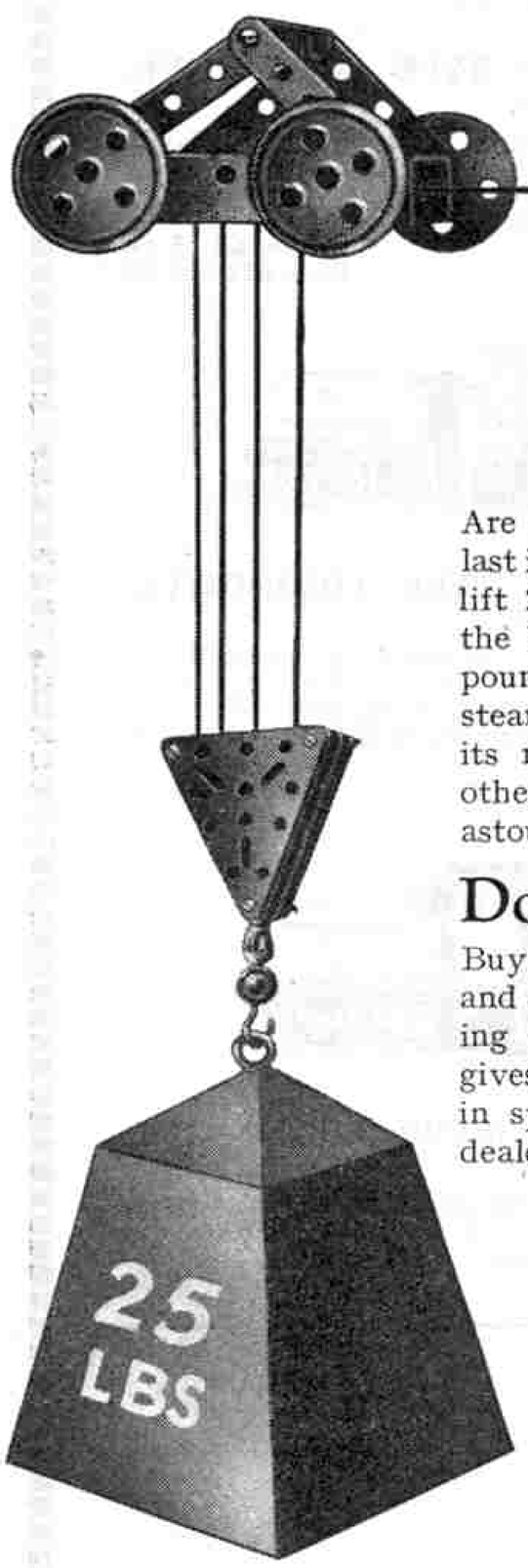

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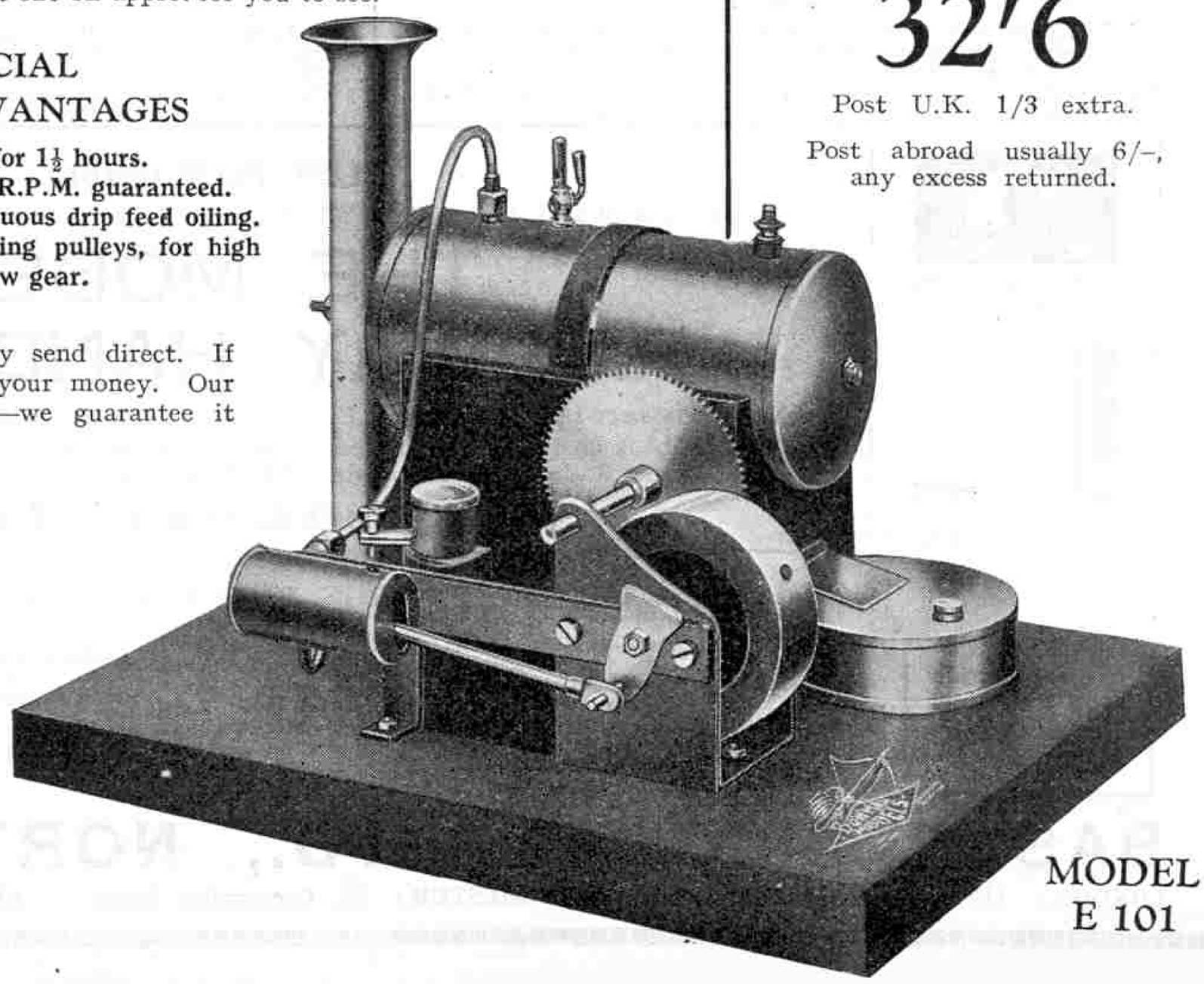

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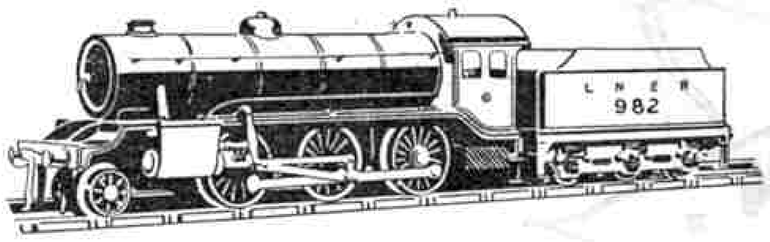

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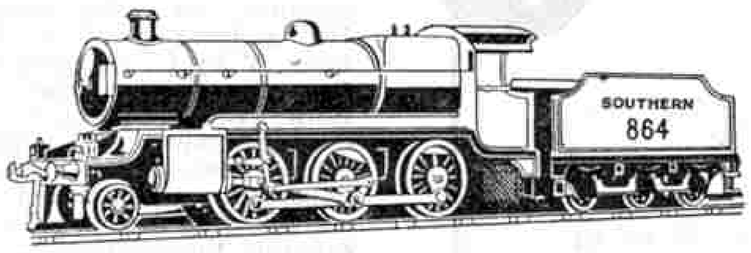

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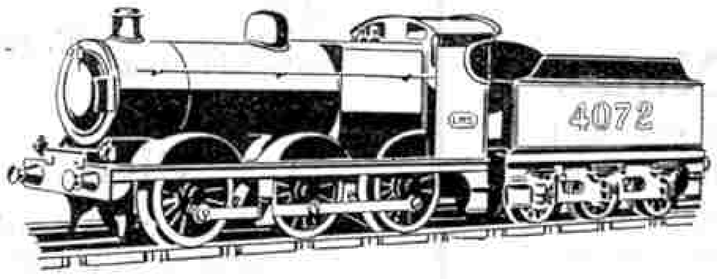

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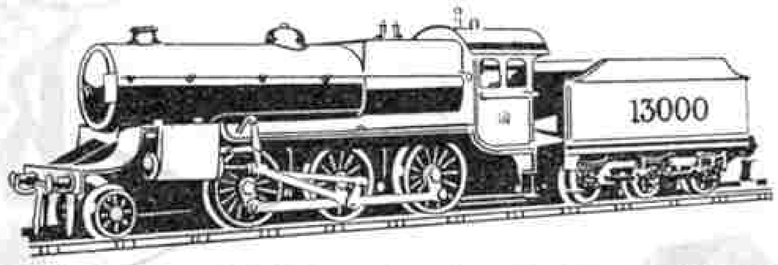

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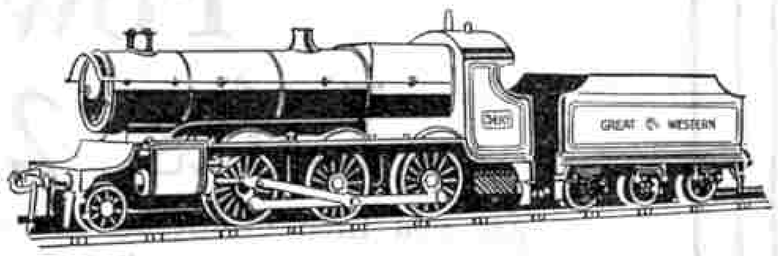

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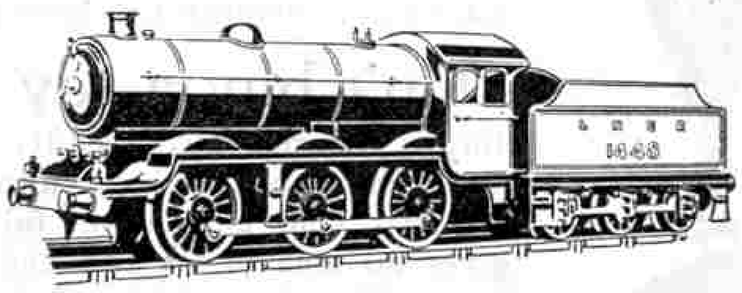

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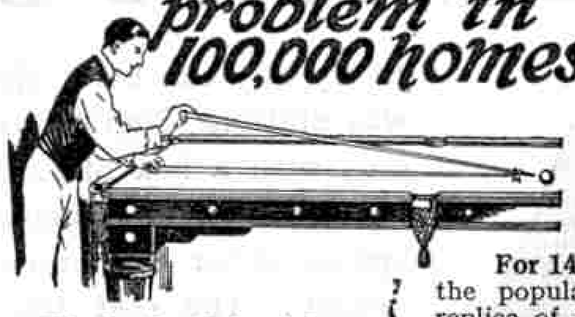

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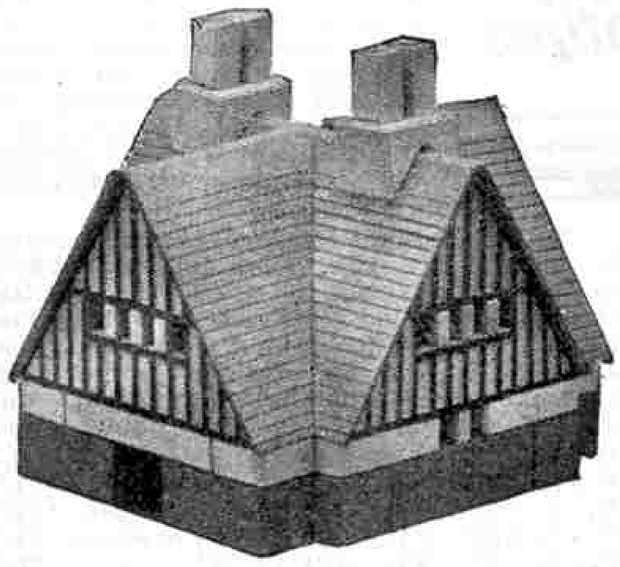

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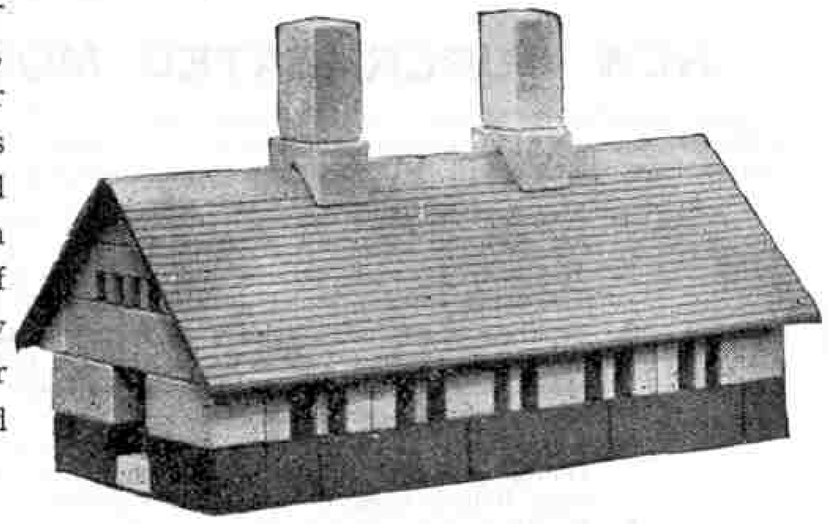

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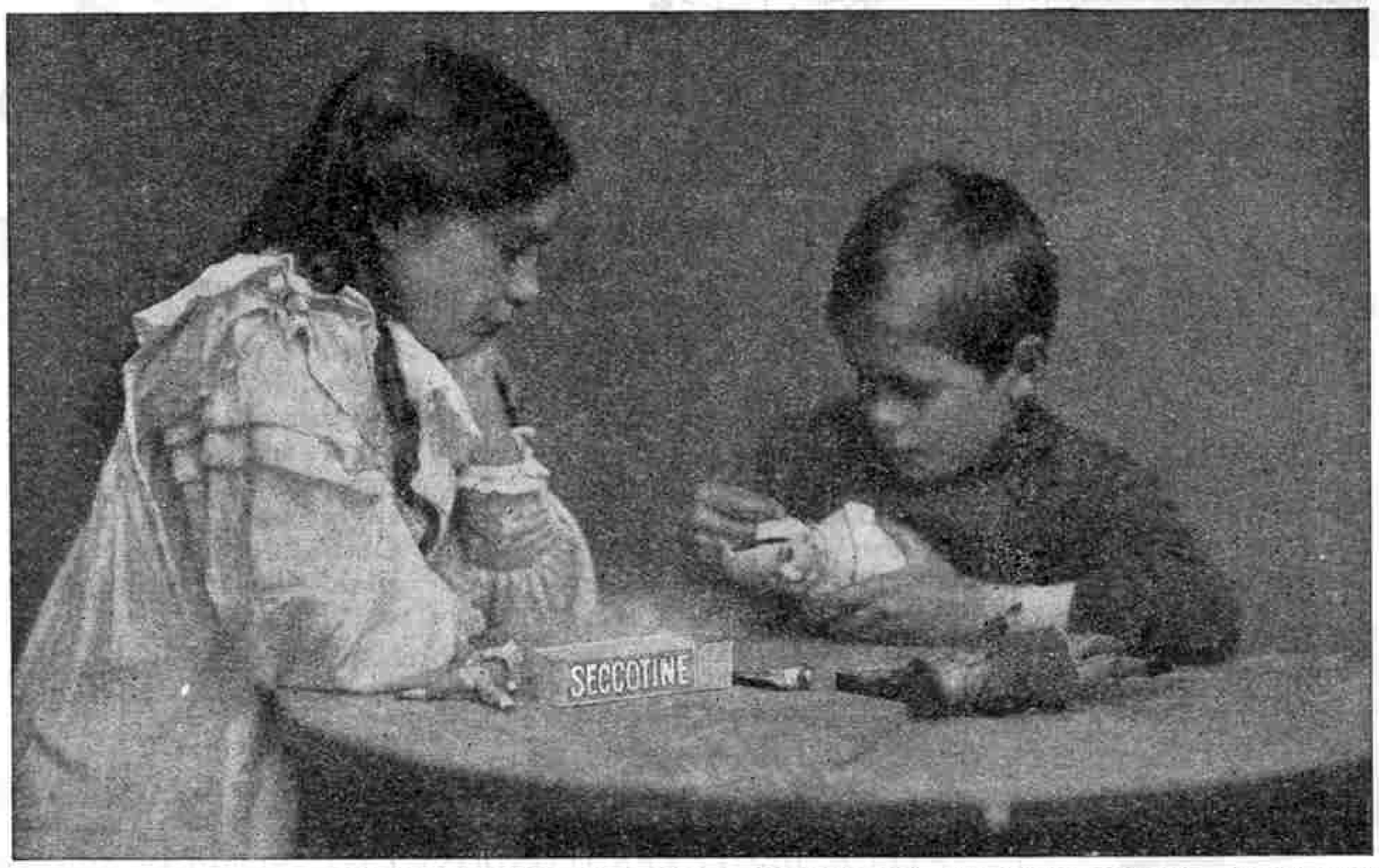

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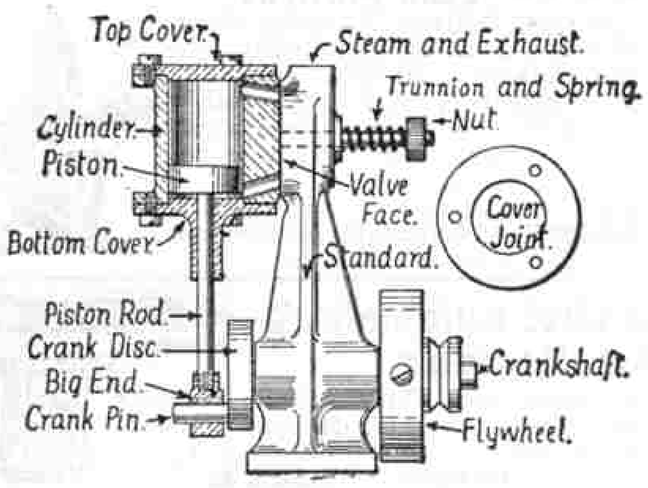

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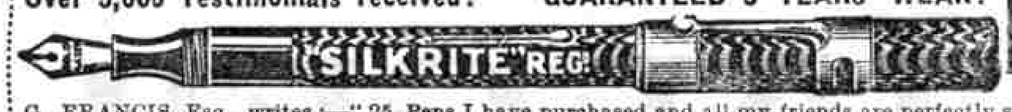

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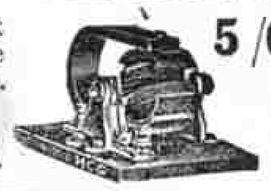

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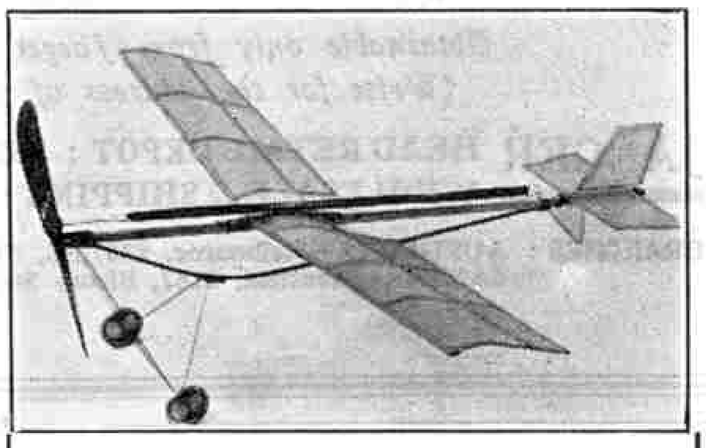

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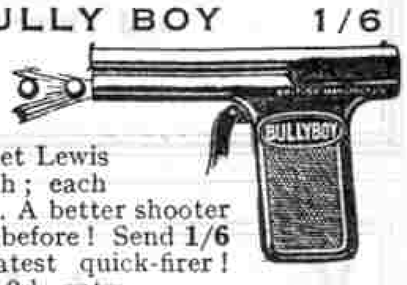

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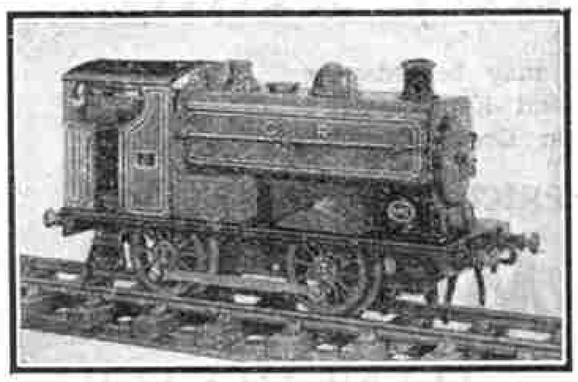

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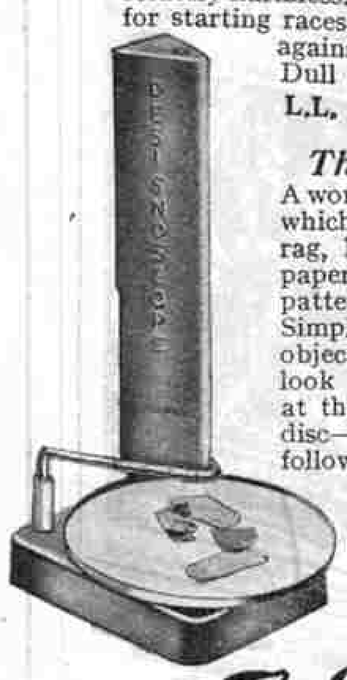

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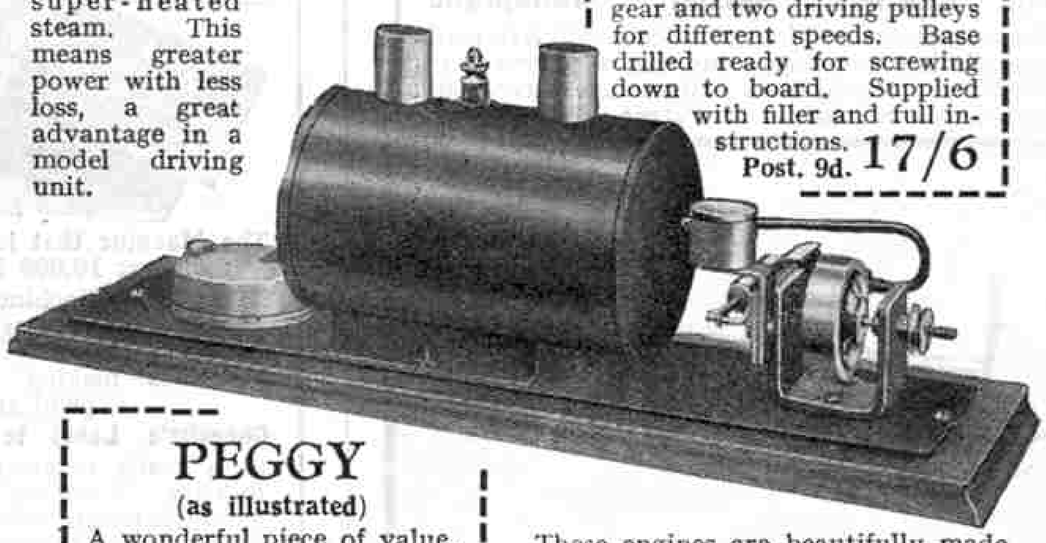

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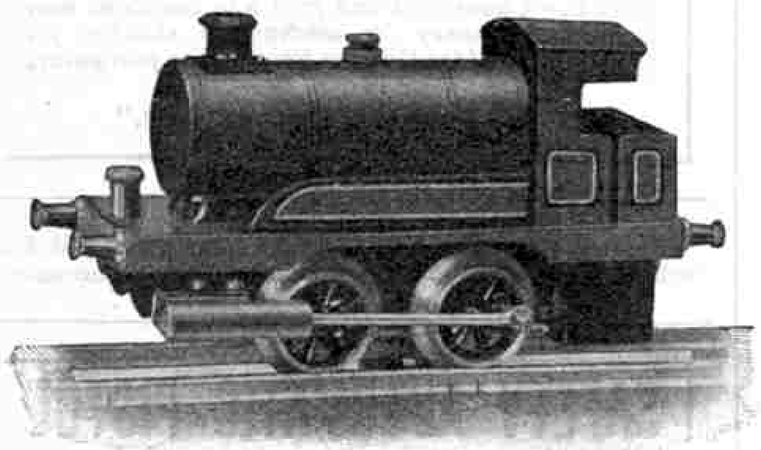

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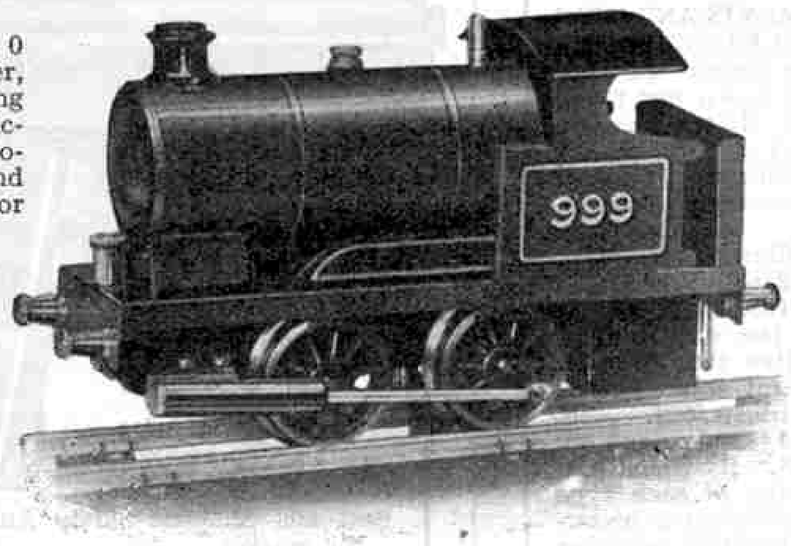

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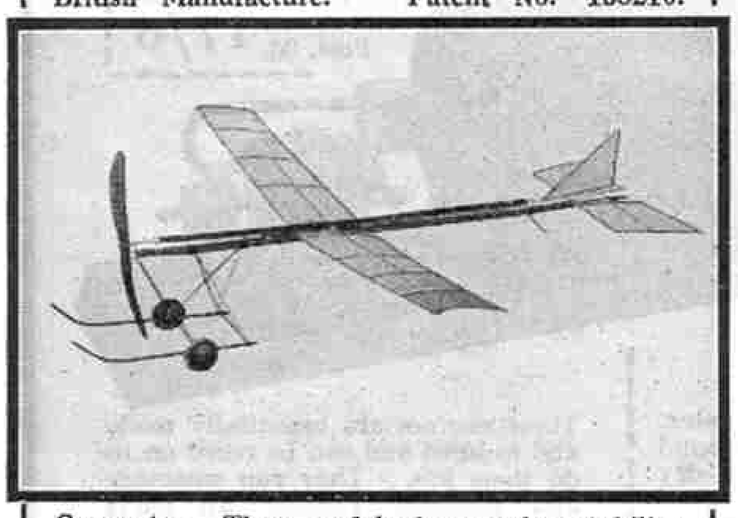
THE SIGN OF QUALITY & EFFICIENCY

The Famous "Skisail" Monoplane

The soaring demand for our models, with letters of appreciation from happy purchasers, proves that our Patent Monoplanes still stand unrivalled. **British Manufacture. Patent No. 138210.**



Guarantee. These models show perfect stability in flight, will rise from ground, and fly **from 150 to 450 yards, according to size, in straight or circular course.**

Specification. Silver Spruce fuselage, Silk-covered Planes, Aluminium Wheels. Nos. 0, 1, 2 and 3 fitted with our **Famous Patent Safety Chassis** with **Bamboo Runners.**

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„ 1	„ 14/6	„ 4	„ 6/6
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Postage 6d. Two sent carriage paid.

Wing Span of our 4/6 Model 21in., 18/6 model 33 in. span.

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The model has flown well and I have recommended to a friend.—J.S.

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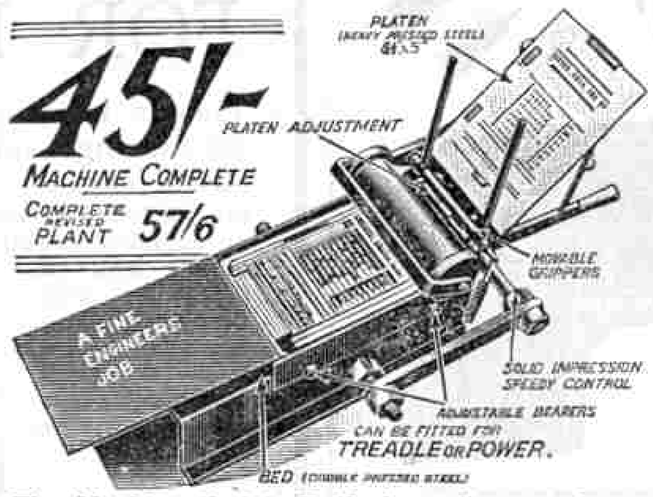

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This model is designed for commercial use in all large and small printing establishments.

Machines can be shipped abroad C.O.D. cash against documents in London. Goods F.O.R. Twickenham.

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is a complete organization for the supply of Printing Office Equipment of every description for the small working Printer and Business House Printing Dept. Controlled by most highly skilled and long experienced men of the Printing world, having expert technical knowledge of every part of Letterpress Printing. **(Dept. MM/0), 17, Church Street, Twickenham.**

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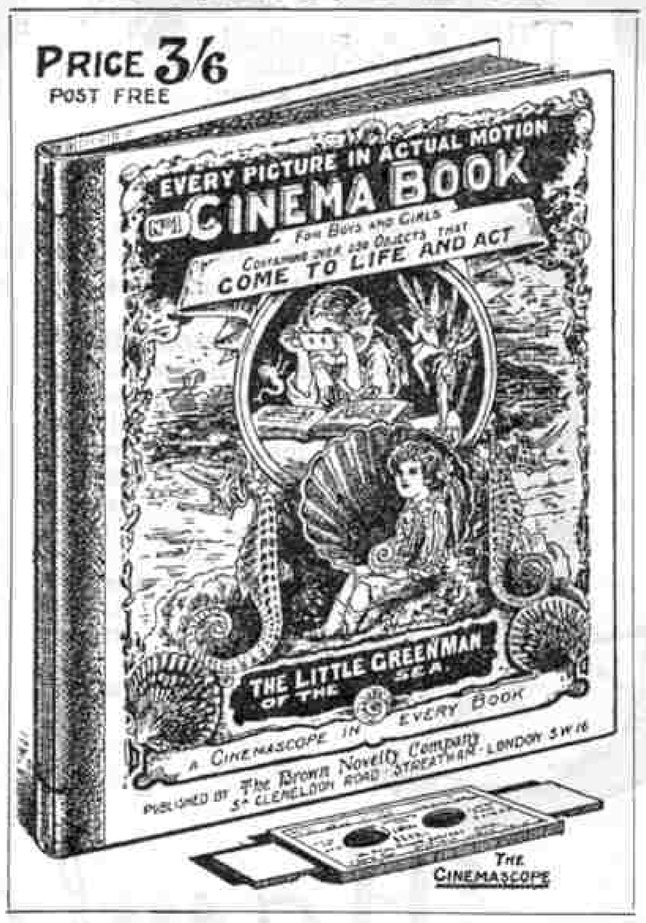

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No License Required

Best and Simplest Safety Automatic Pistol on the market.
In appearance replica of real Automatic Pistol.
In Blue Steel.
Magazine takes six blank cartridges and after the sixth is discharged is automatically ejected for re-filling.
Useful for sports and theatricals, also great protection against burglars and foot pads.
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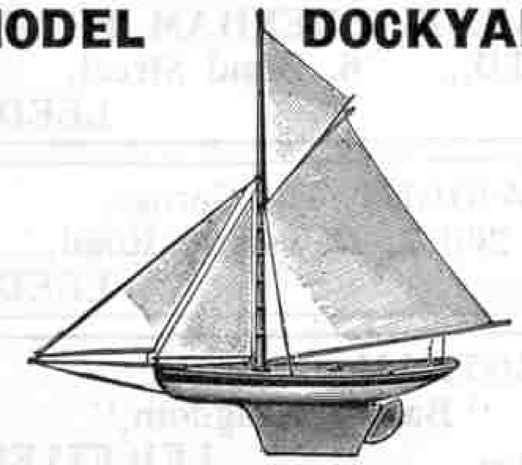

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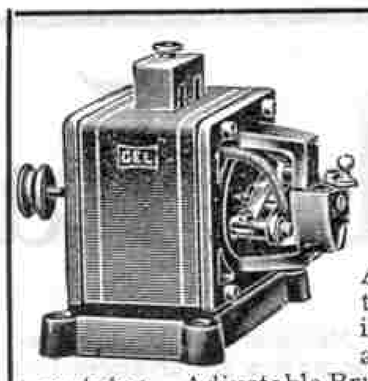

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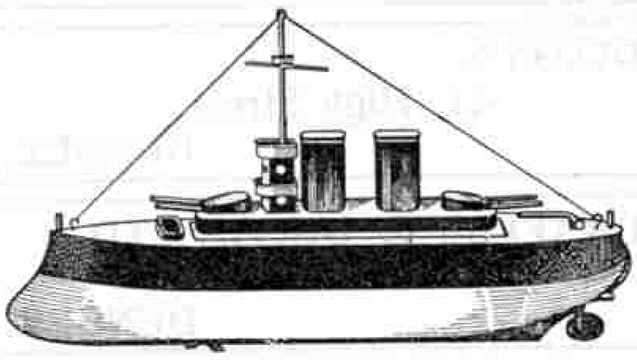

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NO CLOCKWORK. NO ELECTRICITY.

A mysterious and most ingenious principle of propulsion is employed which will drive the boat at a nice speed up to 2 hours at a stretch.

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A complete stock of all Hornby Train Accessories and Meccano Parts

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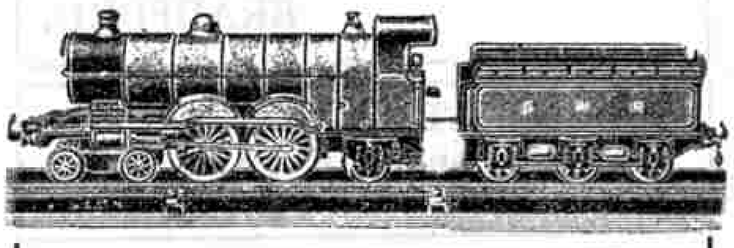

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We specialise in Wireless, Model Railways, Steam Engines, Yachts, Motor Boats, Ships' Fittings, Kites, Aeroplanes, Cinemas, Films, and other Hobbies.

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Goods over 5/- Carr. Paid (few exceptions).

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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.

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'Phone : B'head 621 BIRKENHEAD.

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SELLEN'S BAZAAR,
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SALANSON LTD.,
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Silver Street,
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HAROLD HUNT,
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R. H. JEPSON,
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COVENTRY.

PURSEY & MOCKRIDGE,
The Sports Outfitters,
Tel. Dartford 173 DARTFORD.

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DARWEN.

RATCLIFFES TOYERIES,
19, Osmaston Road,
DERBY.

C. E. MELLER,
"Dolls' Hospital,"
55, Hall Gate, 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,
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WRIGHT'S DOLLS' HOSPITAL,
14, High Street,
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ROBERT BALLANTINE,
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GLASGOW.

C. BELL (The Children's House),
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GLASGOW, W.2.

CLYDE MODEL DOCKYARD,
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Model Makers to the Admiralty, the Railway Coys., etc.

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The MARVEL MART (Wm. Ross & Co.)
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Grand Building, RAWTENSTALL.

GAMLEYS,
The Hove Hornby Train Store,
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HAMMOND'S LTD.,
Paragon Square,
HULL.

W. J. S. CARPENTER,
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The ARUNDEL CYCLE & SPORTS STORE, 52, Church Road,
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Meccano & Hornby Train Supplies

The twenty-nine 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.

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Tel. Mus. 1656 LONDON, W.C.

HOBBIES LTD.,
147, Bishopsgate,
Tel. London Wall 7350 LONDON, E.C.

HOBBIES LTD.,
79, Walworth Road,
Tel. Central 2457 LONDON, S.E.

W. HUMPHRYS & SON,
269/271, Rye Lane,
Estab. in 1840 PECKHAM, S.E.15.

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.

BARRS, Children's Paradise,
49, Deansgate,
Telephone 165 City. MANCHESTER.

A. FRANKS LTD.,
95 & 97, Deansgate, MANCHESTER.
90, Bradshawgate, BOLTON.

HENRY'S Toy & Game Stores,
22, King Street,
Tel. 3004 Central MANCHESTER.

HOBBIES LTD.,
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MANCHESTER.

A. INMAN, MANCHESTER.
105, Lapwing Lane, Didsbury. Tel. 1518.
179, Dickenson Rd., Rusholme. Tel. 2241.

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 LTD.,
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 LTD.,
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.

SPORTS HOUSE WOKING & WEYBRIDGE.

The 1927-8 Hornby Book of Trains will be ready on the 14th November. See the announcement on p. 1000 of this issue

"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.

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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.

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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, etc.

Make your riding doubly interesting. Its accuracy has been endorsed by all the best authorities and the experience of your fathers for 30 years.

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LONDON, E.C. 1.

£10 FOR £6

THE WORLD'S GREATEST 3-SPEED CYCLE OFFER

Read the specification and be fully convinced.

B.S.A. 3-SPEED GEAR
DUNLOP Roadster Cord Tyres
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MIDDLEMORE'S
Three Coil Spring Saddle
Frame enamelled and lined. Lady's or Gent's Model same price. Carriage Paid. Terms: 8/- now, & 8/- monthly. Full Approval
Write for Catalogue Post Free.
J. G. GRAVES Ltd. Sheffield

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"Meccano Engineer" Nos. 1, 6, 7, 8, 9, and "Stamp Collector's Monthly" Nos. 2, 3, 4, edited and published 1921/2 by H. Lansley. In perfect condition, separate copies 3d. each post free, or 8 copies (one of each) 1/3 post free. "Beautifully produced and every page well thought out."—Editor, "*M.M.*" "Enterprise stamped on every page."—Westminster Gazette. Box 1101.

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Sale. Gauge 0 Clockwork Loco and Rolling Stock, also Cinematograph. Stamp for particulars.—Young, 1, Oakhill Road, Netheredge, Sheffield.

Cigarette Cards, 50 assorted for 6d. Sets 25 5d. 50 9d.—Walker, 61, Cromwell Road, Stretford, Lancs.

Exchange Stamps. Your Country for Mine.—W. E. Broadbridge, Taipeh, Formosa.

Sale. Gauge 1 Model Railway in parts or one lot, 40/-. Gauge 00 Table Railway, 7/6. Stevenson's Stationary Engine, with boiler, excellent condition, 25/-. Collection Birds' Eggs, 7/6. Write—Duncan 8, Hill Close, Hampstead Way, London, N.W.

Splendid Offer. Clean Cigarette Cards, 1,200, Sets, 15/-; 3,200, Mixed, 25/-; 430, Pinnace, 5/-; sell separate, extra cheap, what offers?—A. Brown, 38, Wellington Avenue, Lower Edmonton.

Model Yacht, Home Cinema Goods. Write—Higgins, 11, Scolton Villas, Haverfordwest, Pem.

Wanted. "Meccano Magazine" for January, 1926. Give sixpence and postage.—Cavanagh, Retreat House, Glashill, King's Co., Ireland.

Wanted. Gauge 0 Train Set. Good condition. Full particulars to—Wotherspoon, 263, Padiham Road, Burnley.

Wanted. Model Railway Track, Gauge 0, Points, Crossings, etc. Carriage will be paid.—Anton, Bredinsweg, 68, Bussum, Holland.

Gauge 1. 2-4-0 Tender Loco, Reverse, very powerful. Nearly new. Offers.—P. Le Rossignol, 7, St. John's Road, Harrow.

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Sale. Hobbies Steam Launch, 15/-. Model Yacht, length overall 24 inches, 20/-. Both good condition.—Roston, 5, Hurstwood Road, Golder's Green.

Cinematograph for Sale, cheap. Accept 30/-. Films optional.—Lewis, 30, Richmond Road, Wolverhampton.

Hobbies Steam Launch, nearly new. Cost 12/6. What offers?—Wilson, 10, Bellbanks, Hailsham, Sussex.

Stamps exchanged, any country.—Leslie Hope, "Patia," Frenchay Road, Weston-super-Mare.

For Sale. Gilbert Conjuring Outfit, cost 22/6. Equal to new. Sell 10/-. Apply—G. N. Rhodes, 11, Knowles Street, Preston, Lancs.

Sale. "Scouts," Nos. 870-1011. Also "Boy's Own Paper," April 1926-July 1927. Clean. What offers?—Grimwade, Woodland Avenue, Wolstanton, Staffs.

Sale. Album containing over 500 Stamps catalogued £1/12/-. £1 post free.—D. Thornton, Trowell Avenue, Ilkeston.

Exchange. Phonograph and 70 Records for Powerful Engine and Boiler.—Lane, 157, Osborne Road, Brighton.

Exchange Stamps, "Meccano Magazines," Cigarette Cards for Sale. Apply—Clarke, Faughart Terrace, Dundalk, Ireland.

Sale. 1,000 Different Foreign Stamps. Average Condition. Catalogued over £5. Accept £4/10/- or nearest.—Parr, 7, Second Street, Alexandria, Dumbartonshire.

STAMP ADVERTS.

(*Continued from page* 1008)

150 DIFFERENT COLONIALS, 1/6. English 1d. Plate Nos. 50 Different 7d.—Jones, Fincairn, Cheltenham.

THESSALY OCTAGON FREE with my ½d. Approvals.—S. R. Catt, 20, Brunswick Road, Ipswich.

1,000 DIFF. STAMPS (all perfect), 3/6 post free. —F. Gibbins, 6, Montpellier Rd., Exmouth, Devon.

BONUS to all Applicants for my Cheap Approvals.—(M) Taylor, Trent Valley Road, Lichfield.

30 DIFFERENT STAMPS FREE. Send for 1d. and ½d. Approvs.—Miss Williamson, 18, Victoria Pk., Dover.

5 Montenegro Free. Request approvals. Generous discount. Enclose postage. — Allnutt, Kilmeston, Alvesford, Hants.

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"First Summer" Competition—

(*Continued from page* 999)

F. Higgs won First Prize in Section C with a model of a six-wheeled steam wagon. This also is illustrated, and some idea of its effective appearance will be gathered from the photograph. A 3" Sprocket Wheel secured to the crankshaft represents the flywheel, and the drive is led to the back wheels by means of Sprocket Chains. The steering gear is operated by a Worm-driven shaft winding up a length of Sprocket Chain, as in the alternative steering method mentioned under Standard Mechanism No. 118. A feed pump works off the crankshaft.

R. R. Rawkins qualified for Second Prize with a model of a combined windmill, pump, and circular saw. He suggests that the model could be adapted for demonstration purposes in shop windows, etc., and I agree that it would be most effective if so used, for the rotation of a single Crank Handle (which could be replaced by a Motor if desired) sets all the various parts in motion.

R. Berriman's prize-winning entry is a most ingenious representation of a tin-labelling machine. The model was built entirely from memory after its builder had seen the prototype working in a cocoa factory. Briefly, the action of the model is as follows: A ram pushes the tin to be labelled under a pivoted arm, which picks up a label from a drum that receives its supply of labels from a convenient box. The pivoted arm, which is controlled by a crank and connecting-rod mechanism, presses the label on the tin. The ram then brings forward the next tin to be labelled, and in doing so pushes the first tin on to a belt conveyor constructed from a piece of stout brown paper.

MECCANO WRITING PADS

These Writing Pads are just the thing to use when writing to your friends, for the special notepaper shows at once that you are a Meccano boy.

The pads are supplied in two sizes, each consisting of 50 printed sheets of tinted bank paper with cover. Prices—Large, 1/- each (post free); Small, 6d. each (post free), from Meccano Ltd., Binns Road, Liverpool.

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.

CUT THIS OUT

"MECCANO" PEN COUPON, VALUE 3d. Send 5 of these coupons with only **2/9** (and 2d. stamp) direct to the **FLEET PEN CO., 119, Fleet Street, E.C.4.** By return you will receive a handsome lever self-filling **FLEET S.F. PEN** with solid gold nib (fine, medium or broad), usually 10/6. Fleet price **4/-**, or with five coupons only **2/9.** De Luxe Model 2/- extra.

1927 MECCANO

A new thrill for boys— and a new free book!

This year Meccano is more than ever real engineering in miniature! All the Girders, Plates, Strips and large Wheels are coloured in real engineering colours—green and red. It's wonderfully fascinating to see how much the colours add to the realism of the hundreds of models that can be built with Meccano parts—Towers, Cranes, Motor Cars, Drills, Looms, Machine Tools, etc., in endless variety. Have a look at the New Meccano at your nearest dealers. Remember, you can still get Meccano parts with nickel finish if you prefer them or want them for any special model.

ALL COLOURED!

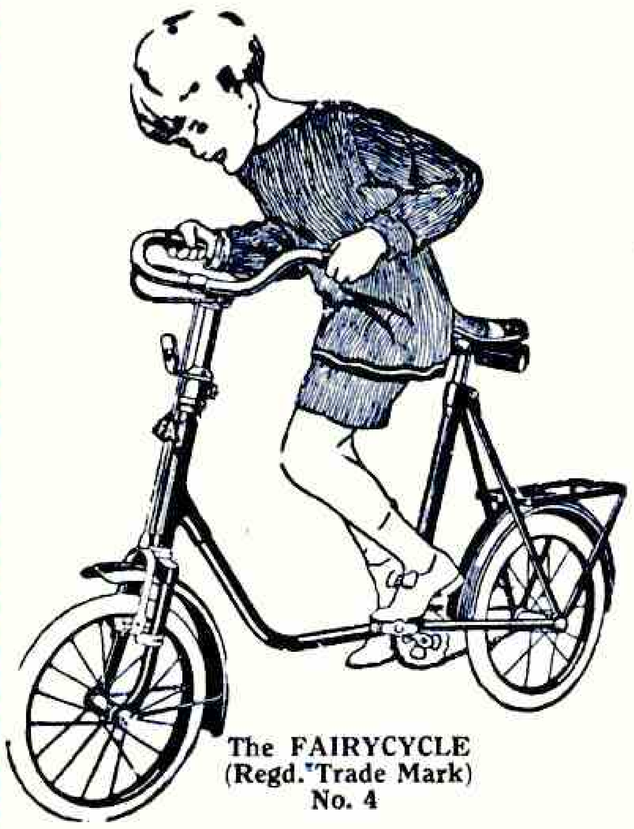
Order the New Meccano Book now—it's free!

On the 14th of November we are publishing a fine book, printed in colours, that will tell you all about the New Meccano in colours. If you would like a copy of this book, free, send a postcard to Meccano Ltd., Dept. 70, Binns Road, Liverpool, giving your own name and address and the names and addresses of three of your chums. All applications will be dealt with in strict rotation.

Prices of New Meccano Outfits from 3/6 to 370/-

MECCANO LIMITED BINNS ROAD LIVERPOOL

All models measure 21″ from saddle to pedals but saddle can be raised about 6″. No. 3 illustrated has ball bearing tangent spoke wheels with thick rubber tyres and plated rims. Stand and Carrier, spring saddle and upturned handlebars are fitted. **59/6**



The FAIRYCYCLE
(Regd. Trade Mark)
No. 4

Ball bearings throughout make this super model a joy to ride. Besides running wonderfully easily, the life of this little cycle is considerably prolonged. Plated rims, large white ribbed cushion tyres, domed mudguards, rim brake, free wheel and well plated handlebars. **65/-**

Made like a real "Bike" and finished black, red or blue with gold lines. Stand and carrier, white ribbed cushion tyres and brakes are fitted. No. 1 as illustrated. **39/6**

IF the triangle trade mark as shown below is on the toys you buy you can be sure you're getting a British Made article that will give you plenty of good fun and splendid service.

Tri-ang Toys are made by the largest wheel toy manufacturers in Europe. Low prices combined with good quality are made possible by production on a large scale.

These are toys that every out-door boy wants. There's a leaflet printed in colours that will show you crowds of them. You may have a copy free if you send us your address.

Obtainable from all good toyshops and stores.

Lines Bros. Tri-ang Toys

REGD TRADE MARK

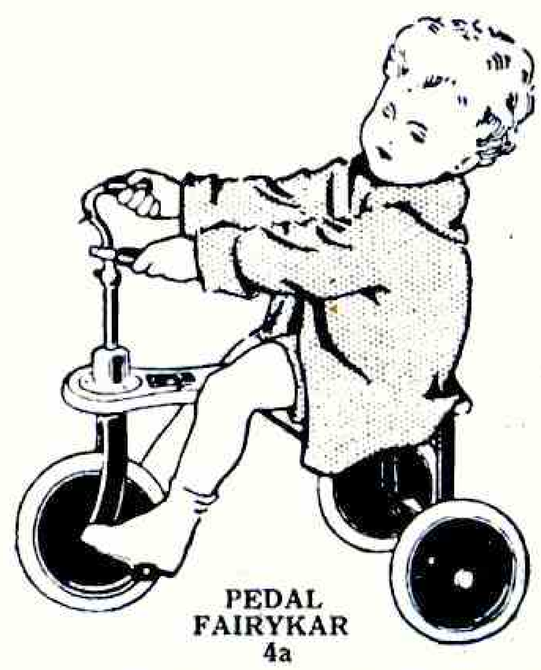
L. BROS. LTD. LONDON
BROS.
ENGLAND

Regd. Trade Mark

British Made by LINES BROS. LTD.,
TRI-ANG WORKS, MORDEN ROAD, MERTON,
LONDON, S.W.19.

Popular with fellows not old enough to ride a Fairycycle. Nicely finished bright red with latest pattern balloon disc wheels with rubber tyres. Folds up to pack in a box. **13/6**

Larger and fitted with tubular handlebars with ivorine grips. Light in weight, easy to pedal but strong. Seat measures 13″ from ground. Rubber pedals are included. **22/6**



PEDAL
FAIRYKAR
4a

Disc wheels with rubber tyres are fitted to this model. Seat is 11″ off the ground. Hard wearing cellulose paint is used on the wooden seat and disc wheels, a bright lasting finish is thus obtainable. **10/6**

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